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Energy Storage for Social Equity Roundtable Report

September 2021

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Pacific Northwest National Laboratory
Richland, Washington 99354

Summary

In support of the Office of Electricity Energy Storage program, Pacific Northwest National Laboratory (PNNL) hosted a roundtable to explore the relationship between energy equity and energy storage. Flexible and available at any scale, energy storage offers a useful framework and starting point in a larger conversation around energy equity. Through storage, we can imagine more broadly how improvements and investments in the grid can respond to social and health challenges and increase affordability, reliability, and community value in the future. The roundtable featured keynotes and conversations with people leading the charge in transitioning our energy system to a more equitable, affordable, accessible, and sustainable future. This event was presented in collaboration with Sandia National Laboratories.

The roundtable was anchored by four panels and two contextual keynotes:

- Metering Energy Justice: Centering Historically Disinvested Communities in a Warming Planet
- Building an Affordable Power Module for Remote Applications
- State Government Perspectives on Energy Equity
- Communities Through Transition
- Utility Business Practices
- Energy Storage as an Equity Asset

Several overarching themes were identified by participants, including:

- Energy storage is one component of the larger systems change. Concerns were raised about replacing the existing unjust system with a cleaner, unjust system. Energy inequity is a result of long-standing historical issues. Energy is interconnected to many other aspects of life requiring consideration of how energy intersects with community needs such as affordable housing, energy efficiency, community resilience, health, and well-being.
- Meaningful stakeholder engagement is necessary to better understand the needs of communities and stakeholders. However, outcomes from stakeholder engagement then must be integrated into pilots and programs to better address community needs and ensure the community is being heard and valued.
- Metrics of energy investment, particularly for non-energy benefits such as sustainability, resilience, and equity, are integral to measuring progress in a more meaningful way. Advancing energy storage equitably requires changing utility models to consider benefits, costs, health, and other externalities alongside traditional technological deployment requirements such as technical capacity/funding and market access.
- To do this work effectively, appropriate time and staff must be allocated, including experts on social justice and historically underserved communities to center the lived experiences of those communities. A balance between the longer-term energy transition

and immediate community needs ensures that the communities who need help now are getting the benefits of the clean energy transition.

- The role of energy storage in energy equity includes reducing emissions and improving air quality, improving resilience to disasters and power outages, promoting local economic development and job growth, accelerating greater levels of renewable energy, reducing electricity bills, and ensuring that communities have a seat at the energy table. Specific benefits for communities include energy independence, improved environmental conditions, increased property values, and wealth generation – all of which can contribute to building a place where people want to stay and live, fostering a sense of community.

Acknowledgments

This event and the associated research were initiated and sponsored by Imre Gyuk, Director of Energy Storage Research at the U.S. Department of Energy.

The authors would like to thank the presenters and panelists for sharing their invaluable expertise, including Dr. Vivek Shandas, Founder and Director of the Sustaining Urban Places Research (SUPR) Lab; Dr. Deepak Divan, Professor and Director of the Center for Distributed Energy at the Georgia Institute of Technology; Dr. Sarah Vorpahl, Senior Energy Policy Specialist at the Washington State Energy Office; Dr. Joy Wang, Public Utilities Engineer at Michigan Public Service Commission; Crystal Pruitt, Deputy Director for Clean Energy Equity at the New Jersey Board of Public Utilities; Sergio Lopez, the Energy, Climate and Transportation Coordinator at Verde Northwest; Reverend Michael Malcom, Founder and Executive Director at Alabama Interfaith Power and Light; Kevin Blaser, Business Growth/Development and Energy Specialist at the Midwest Tribal Energy Resources Association; Derrick Terry, Renewable Engineer Specialist at the Navajo Tribal Utility Authority; Uzma Siddiqi, Senior Manager of Grid Modernization at Seattle City Light; Jessica Lin, Principal Product Manager for Oracle Utilities Opower's Data Engineering Platform team; Dr. Tina Jayaweera, Power Planning Resources Manager at the Northwest Power and Conservation Council; Heather Moline, Policy Associate at NW Energy Coalition; Julia Prochnik, Executive Director at the Long Duration Energy Storage Association of California; Dr. Jeremy Richardson, Senior Energy Analyst at the Union of Concerned Scientists; Dr. Elena Krieger, Director of Research at PSE Healthy Energy; and Abbe Ramanan, Project Manager at Clean Energy States Alliance.

We are deeply grateful for additional participation from the Secretary of Energy Jennifer M. Granholm, Michael Pesin Deputy Assistant Secretary for the Advanced Grid Research and Development Division in the U.S. Department of Energy's Office of Electricity, Wahleah Johns Senior Advisor for the U.S. Department of Energy (DOE) Office of Indian Energy Policy and Programs, and U.S. Congresswoman Melanie Stansbury.

Contents

1.0 Introduction

The Energy Storage for Social Equity roundtable took place virtually on June 28th and June 29th, 2021 to explore the relationship between energy equity and energy storage. The roundtable was hosted by Pacific Northwest National Laboratory in collaboration with Sandia National Laboratories and sponsored by the Department of Energy's Office of Electricity, Energy Storage Program. The roundtable brought together specialists from academia, state government, community organizations, utilities, and energy storage experts to discuss how the energy system transition can become more equitable, affordable, accessible, and sustainable. About 450 people attended the event.

Both days began with welcome and opening remarks, followed by a 30-minute contextual keynote presentation, two hour-long panels, and concluding remarks. The focus of the contextual keynote presentations and four-panel sessions were:

- Metering Energy Justice: Centering Historically Disinvested Communities in a Warming Planet
- Building an Affordable Power Module for Remote Applications
- State Government Perspectives on Energy Equity
- Communities Through Transition
- Utility Business Practices
- Energy Storage as an Equity Asset

These discussion topics were selected to further establish the connections between energy storage and equity as well as enabling broader conversations around energy and social equity. To support the roundtable, four pre-readers were made available to participants and the final published documents can be accessed on the event web page. Pre-readers 2-4 can also be accessed in Appendices C-E, directly through the footnote link, or through the event webpage, found here: https://www.pnnl.gov/events/energy-storage-social-equity-roundtable.

1. Energy Storage as an Equity Asset:[1] A journal paper, published in Current Sustainable/Renewable Energy Reports, was developed by PNNL authors earlier in 2021 and served as an important paper that explores the four tenets of the energy justice concept—distributive, recognition, procedural, and restorative. The paper discusses how these tenets relate to power system inequities in energy poverty, energy affordability, energy insecurity, energy vulnerability, and technology availability.

2. Community Energy Storage and Energy Equity:[2] A memo that explores a variety of ownership and business models for community energy storage, and challenges to community benefits from storage deployment. See Appendix B.

[1] https://link.springer.com/article/10.1007/s40518-021-00184-6
[2] https://www.pnnl.gov/sites/default/files/media/file/Community%20Energy%20Storage%20Memo.pdf

3. Metrics for an Equitable and Just Energy System:[3] A report that explores three categories central to the equity metrics development process—target population identification, investment decision-making, and program impact assessment. See Appendix C.

4. Energy Storage for Social Equity: Capturing Benefits from Power Plant Decommissioning:[4] A case study report that provides an overview of local energy effects and non-energy benefits of energy storage. The report reviews three Peaker power plant decommissioning strategies where energy storage is used as a replacement solution—Dynegy Oakland, Centralia, and Manatee power plants. See Appendix D.

This report synthesizes the roundtable discussion and provides emerging themes and questions for the field exploring the relationship between energy equity and energy storage. Section 2 provides workshop discussion topics and outcomes organized by the four panels: State Government Perspectives on Energy Equity, Communities Through Transition, Utility Business Practices, and Energy Storage as an Equity Asset. An additional section is provided to discuss the two context presentations given on Metering Energy Justice and the Development of an Affordable Power Module for Remote Applications. Section 3 will then synthesize key outcomes across the event discussion topics and provide several next steps as the emerging relationship between energy storage and equity continues to develop and becomes more critical amid simultaneous decarbonization and equity priorities. Appendix A contains the full roundtable event agenda. Appendix B through D contain the pre-readers discussed above: Community Energy Storage Memo (Appendix B), Metrics for Energy Equity Memo (Appendix C), Energy Storage for Social Equity Case Study (Appendix D).

[3] https://www.pnnl.gov/sites/default/files/media/file/Metrics%20for%20Energy%20Equity_0.pdf

[4] https://www.pnnl.gov/sites/default/files/media/file/Energy%20Storage%20for%20Social%20Equity%20Case%20Study.pdf

2.0 Workshop Discussion Topics

The two contextual keynote presentations and four panels were chosen to provide a well-rounded understanding of the connections between energy and equity from various energy stakeholders including state government, community, and utility perspectives. Section 2.1 briefly summarizes the two contextual keynote presentations and Sections 2.2 through 2.5 summarize the four panels. Each panel began with brief presentations by the panelists followed by a moderated question and answer session that included questions received via the zoom chat. In this report, each panel section begins with an overview of panelists' presentations followed by a summary of discussion subjects.

2.1 Context Presentations

2.1.1 Metering Energy Justice: Centering Historically Disinvested Communities in a Warming Planet

Dr. Vivek Shandas is the Founder and Director of the Sustaining Urban Places Research (SUPR) Lab, broadly interested in the intersection of exposure to climate-induced events, governance processes, and planning mechanisms.[5] Dr. Shandas' presentation focused on urban heat islands—a single phenomenon at the intersection of climate change, the built environment, and development that provided generalized takeaways applicable to the energy storage field.

Dr. Shandas presented his research on urban heat islands (UHI)—areas that run hotter than the rest of the region. For example, city centers often have hotter temperatures than the outskirts. Researching temperature in cities across the U.S. involved overlaying multiple factors—spatial distribution of heat, social vulnerability, and distribution of green assets. The research found that hotter parts of the cities shared demographic characteristics such as less formal education, limited English proficiency, high racial diversity, and extreme poverty. On the other hand, self-identifying white communities tended to have greater access to cooling technologies. When trying to identify why this phenomenon existed, the research team evaluated historic redlining[6] maps. This research found that historic redlining maps were still persistent today i.e., neighborhoods that were redlined in 1933 were still seeing deep levels of economic inequality and segregation today.[7]

Dr. Shandas' work showcases not only that the built environment drastically influences heat patterns, but how the built environment intersects with community demographics and historical development processes to amplify vulnerabilities. Similarly, energy use levels consistently overlap with neighborhoods that have been historically marginalized and/or are low-income. Dr. Shandas emphasized that effective planning of energy storage to mitigate UHI should include considering how energy is distributed and utilize city block-level data to understand specific impacts and access to resources. Additionally, equitable energy storage projects must center communities that are vulnerable and suffer from underinvestment. In the context of UHI, energy

[5] To see Vivek Shandas' full biography and presentation slides see the event website: https://www.pnnl.gov/events/energy-storage-social-equity-roundtable

[6] Redlining is the denial of services, often colloquially understood to be the homeowners loan program which largely decided loans based on color of skin, immigrant status, and income level.

[7] The open-access journal article that details this work can be found here: https://www.mdpi.com/2225-1154/8/1/12/htm

storage could ensure access to cooling centers, which play an integral component in survival during extreme heat. But equitable energy decisions are driven by the community. However, as Dr. Shandas' research emphasized, policies have historically marginalized communities and inclusion may require building trust. Effective engagement strategies are a pillar in increasing community involvement in his own work, and community-based organizations may play an important role. Early and often engagement can identify solutions applicable to specific communities or households. Finally, Dr. Shandas highlighted that communities need myriad solutions. Therefore, battery storage would need to be coupled with other local interventions at a street level, tax lot, and neighborhood level.

2.1.2 Building an Affordable Power Module for Remote Applications

Dr. Deepak Divan is a Professor, John E Pippin Chair, GRA Eminent Scholar, and Director of the Center for Distributed Energy at the Georgia Institute of Technology.[8] Dr. Divan's presentation focused on a potential energy storage application (AC Cube) in research and development to improve energy access and resiliency in remote locations.

The motivation behind Dr. Divan's work is that while the price of renewable energy and energy storage is rapidly decreasing, this does not guarantee that people in remote locations will also be able to participate in a just energy transition. Distributed energy resources (DER), including energy storage such as the AC Cube, increase the ability for remote locations to participate in a just energy transition. He shared some statistics on the global lack of energy access but pointed out that communities right here in the United States, such as Native American Nations, face similar challenges.

Key success criteria of the AC Cube include flexibility, safety, and cost-effectiveness, themes that apply both to the technical and equity dimensions of storage.

- Flexibility, to support varying needs. The AC Cube includes the ability to compile multiple energy sources and operate in a networked fashion (i.e., multiple cubes working together). From an equity perspective, the ability to meet a variety of uses, based on a particular community's needs, is essential.

- Safety, so people can operate it themselves. The AC Cube minimizes the technical expertise required to make it accessible to communities through plug-and-play installation and communication, akin to an appliance. From an equity perspective, this enables a level of energy independence and reduces the cost spent on expensive energy experts.

- Cost-effective, to ensure viability. The AC Cube can export power back to the grid. If power can be sold back to the grid, the payback period may be as low as three years. From an equity perspective, a revenue-generating asset can minimize energy burden and allow the community to redistribute funds to other needs.

Additionally, a central component to the AC Cube's development has been engaging with intended users, energy-constrained communities, to understand how they would use this solution. In particular, the research team integrated the needs of the Navajo Nation ensuring

[8] To see Deepak Divan's full biography and presentation slides see the event website: https://www.pnnl.gov/events/energy-storage-social-equity-roundtable

installment, deployment, and final uses are relevant at both individual and community scales. The community perspective is critical to implementing energy storage.

2.2 State Government Perspectives on Energy Equity

The purpose of the State Government Panel presentations and the following discussions were: 1) understanding how state agencies typically work with energy equity-related issues; and 2) identifying how equity work is evolving, including existing challenges, recommendations, and programs to improve energy equity in the future. The State Government Panel consisted of speakers from three different state agencies: Dr. Sarah Vorpahl, Senior Energy Policy Specialist at the Washington State Energy Office, Dr. Joy Wang, Public Utilities Engineer at Michigan Public Service Commission, and Crystal Pruitt, Deputy Director for Clean Energy Equity at the New Jersey Board of Public Utilities.[9]

Dr. Sarah Vorpahl's presentation emphasized the important perspective state agencies bring as a connector piece for energy equity. She explained that state agencies often cover a wide range of policy topics, from infrastructure to business assistance to public safety. Although energy may be its own pillar, it is intertwined with many of the above policy topics. She, therefore, recommended state agencies widen their lens and consider how energy intersects with communities and the ways in which energy is interconnected with other aspects of life such as affordable housing, energy efficiency, community resilience, health, and well-being. In Washington, equity work has been recognized and funded by the state legislature, where the focus has been on health equity through the Healthy Environment For All (HEAL) Act. This has translated into three components of equity in Dr. Vorpahl's work for the Washington Department of Commerce: working with communities differently, internal change management, and lasting systems change. Some components of working with communities differently discussed include integrating environmental justice into strategic plans, creating robust community outreach, developing community support systems, and providing funding capital for competitive grant programs alongside pre-deployment feasibility studies to extend funding access. Dr. Vorpahl emphasized that internal change management is critical in equity work since state agencies cannot do the work well externally if they're not doing the work internally. This includes building internal capacity around racial history, other diversity, equity, and inclusion (DEI) topics, and environmental justice. Lasting systems change includes doing these things consistently and integrating them into the system.

Dr. Joy Wang's presentation identified six areas where the Michigan Public Service Commission considers energy equity: strategic plan and internal DEI initiatives, utility rate cases, integrated resource plans, workgroups, the MI Power Grid proceedings, and other State of Michigan initiatives. She identified three next steps for the Michigan Public Service Commission to continue the emphasis on energy equity: meaningful stakeholder engagement, improved utility pilots and programs, including the regulatory framework, and better data and analysis. Dr. Wang emphasized the necessity of meaningful stakeholder engagement to better understand the needs of communities and stakeholders. Outcomes from stakeholder engagement then must be integrated into pilots and programs to better address community needs. Dr. Wang highlighted that updates to the regulatory framework should also occur based on learning about the existing regulatory barriers. While pilot programs can be an effective way to learn what works and what doesn't, if data isn't collected on equity metrics, it's impossible to analyze how those pilots

[9] The state government panelists full biographies can be found here: https://www.pnnl.gov/sites/default/files/media/file/State%20Government%20Panel%20Bios.pdf

impact equity. Dr. Wang also stressed that data is an essential first step to conducting better analyses which in turn informs improved future programming.

Crystal Pruitt emphasized that her overall goal is to make sure that all the benefits of clean energy are accessible, and all New Jersey residents can partake. This goal requires ensuring that all programming considers equity in a way that centers low- and moderate-income and overburdened communities and lifts them up. Pruitt emphasized that stakeholder engagement is a critical piece to equity, including equity working groups around topics such as participation, supplier diversity, and workforce development. In her experience, stakeholder outreach should be as broad as possible, including environmental NGOs, grassroots organizations, community groups, and so forth. Pruitt identified four challenge and opportunity areas in energy equity: measuring equity, building equity, workforce development, and community energy resilience. Measuring equity first requires definitions of equity that translate into program goals with program metrics that capture both quantitative and qualitative data. Building equity requires listening to the communities and their needs and then integrating that into programs. Workforce development also includes a lens of building generational wealth and considering jobs that translate into well-paying careers. This work includes partnering with local community organizations that do job training. Finally, programs to ensure low-income and overburdened communities have access to energy, particularly against weather events, promotes community energy resilience.

Over the course of the discussion, panelists identified the significant role the internal operating environments of state agencies play. At the highest level, state agencies represent diverse mission statements with differing capabilities. For example, policy agencies may have more freedom in directing priorities than regulatory agencies. Panelists pointed out that state agencies are bureaucratic environments with conflicting timelines between policy and the programs used to serve communities. Operating in a bureaucracy requires consideration of the amount of time it takes to implement programs effectively. States must account for the necessary timelines to do equity work well, in a way that centers the community's experiences and needs. Panelists also discussed the interconnected nature of energy that also requires a multidisciplinary approach with internal stakeholder engagement. Panelists proposed that state agencies consider the intersectional nature of energy and foster collaboration among relevant state agencies such as an economic development authority, human services, labor department, and so forth. Other departments or programs need to know how their piece fits into the energy puzzle and be open to thinking outside the box to prevent perpetuating the inequality that exists in the status quo.

The discussion also emphasized that, although energy equity is an emerging priority, it is a result of long-standing historical issues. Understanding racial equity issues is critical to understanding current disparities around health and energy. One panelist noted that public power has always had a goal of increasing reliability and accessibility, which are pillars of equity. However, agencies now are reconciling what access, accessibility, and equity mean in terms of who energy has been affordable and accessible. Another panelist discussed how this reconciliation must include identification of the ways in which government agencies have caused harm and contributed to current disparities. Panelists underlined that although energy equity may be a new explicit priority for some agencies, it’s not going away anytime soon.

The discussion also emphasized the issue of metrics and quantification. All panelists discussed that there is a lack of data being collected on equity and justice metrics, making it difficult to appropriately analyze program impacts. For example, regulatory agencies have found that utilities often don’t collect ample social or economic data, which are key pieces to assembling an equity picture. However, another panelist pointed out that states and utilities are not starting from square zero with data collection. Existing information, compiled alongside the community's expertise from robust community engagement, and made accessible will illuminate what we know and knowledge gaps. Panelists offered a few existing metrics to consider health outcomes, educational performance, energy use, and energy cost. Panelists also suggested agencies strike a balance between quantitative and qualitative information. There has been a tendency to think about equity in purely mathematic terms or purely qualitative social justice terms. Both kinds of information provide invaluable insight but are most powerful when used in tandem with one another. Stakeholder engagement will identify additional burdens and non-energy benefits to the community to include in equity assessments. Panelists also discussed that energy storage offers many non-energy benefits such as sustainability, resilience, and equity. Unless there are good quantifications of these benefits, they cannot be included in the regulatory process, resulting in significantly undervalued energy projects and adversely impacting decisions about the future of the energy system.

The issue of data and metrics was further stressed in the discussion on understanding what communities to work with. While some states have legislative terminologies, such as highly impacted or vulnerable communities in Washington or overburdened communities in New Jersey, others such as Michigan do not yet have this guidance. Panelists noted that if legislative language does not exist, it is up to agencies to compile and utilize existing data to begin piecing together a picture of equity in their state or local area. Some organizations may use stakeholder engagement to identify a fuller picture of needs, burdens, and barriers to inform the selection of priority groups. Panelists also pointed to the data communities themselves have – agencies must identify ways to access it and value it – and communities may want access to data that state agencies have as well to make more informed decisions.

Panelists agreed that there is much learning and work to be done. However, one panelist pointed out that both government agencies and communities are often resource-constrained and juggling many different priorities. Another panelist underlined the importance of methods to educate the community about how energy storage is intersectional with other community concerns and provide information about different technologies so communities are informed and can make their own decisions. When possible, information must be translated into local terms so people understand how it fits within their current conditions. Within the discussion of being resource-constrained, panelists noted their responsibility as institutions to do this work without blame or resentment towards communities.

Key discussion themes:

- Energy is interconnected to many aspects of life. State agencies, who cover a wide range of policy topics, are positioned to take a widen lens and consider how energy intersects with communities in ways such as affordable housing, energy efficiency, community resilience, health, and well-being.

- Meaningful stakeholder engagement is necessary to better understand the needs of communities and stakeholders. However, outcomes from stakeholder engagement then must be integrated into pilots and programs to better address community needs and ensure the community is being heard and valued.

- Energy inequity is a result of long-standing historical issues. State agencies have contributed to current disparities and therefore have a responsibility to center equity and communities in their work to prevent perpetuating the inequality that exists in the status quo.

- Metrics of energy investment, particularly for non-energy benefits such as sustainability, resilience, and equity, are integral to measuring progress in a more meaningful way.
- States must adopt the necessary timelines to do equity work well in a way that centers communities' experiences and needs.

2.3 Communities Through Transition

The purpose of the Communities Through Transition Panel was to discuss the energy needs and priorities of traditionally energy burdened and underserved communities. Energy burden is an important concept, defined as the percentage of gross household income spent on energy costs. While the national average energy burden of non-low-income households is 3%, for low-income communities this is three times as higher at 8.6%.[10] The panelist presentations and following discussions focused on the unique perspective of community organizations and the role of energy storage to help meet existing community needs. The panel consisted of four speakers: Sergio Lopez, the Energy, Climate and Transportation Coordinator at Verde Northwest; Reverend Michael Malcom, Founder and Executive Director at Alabama Interfaith Power and Light; Kevin Blaser, Business Growth/Development and Energy Specialist at the Midwest Tribal Energy Resources Association; and Derrick Terry, Renewable Engineer Specialist at the Navajo Tribal Utility Authority.[11]

Sergio Lopez's presentation discussed the specific context of Verde Northwest and provided examples of integrating equity and energy. Verde Northwest provides services around policy-building, legislation, and grant programs in the community with a geographic focus on Northeast Portland. Lopez explained that Verde was founded in Portland's Cully neighborhood, which has high poverty rates and pollution levels and is one of the most diverse neighborhoods in Portland. Verde NW focuses on air quality work, portable energy, and zero-emission transportation, based on the community's needs. Lopez pointed out that development is impacted by and impacts factors including systemic and institutional racism, white flight, and redlining. As a result, all Verde NW programs use an anti-displacement lens so that programs do not contribute to gentrification and communities can stay where they are living. Lopez's presentation covered four examples of integrating equity and energy: 1) productive legislation, ensuring that legislation includes equity considerations. He pointed out that this has not precluded bipartisan support – Oregon's Energy Affordability Act (HB 2475) demonstrated that energy is not inherently political and bipartisan support can be achieved; 2) air quality advocacy, including more regulation on local polluters, minimizing single-occupant vehicles, and promoting public transportation; 3) re-formatting allocation funds ensuring taxes are funneled to the appropriate communities and fund the community's needs; and 4) developing grant programs to provide energy with no charge to the communities.

Reverend Michael Malcom's presentation emphasized the unique perspective of energy burden and energy poverty in southern states, explaining that despite their prevalence and negative consequences, energy burden and energy poverty are rarely talked about or addressed.

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[10] https://www.energy.gov/eere/slsc/low-income-community-energy-solutions

[11] The communities through transition panelists full biographies can be found here: https://www.pnnl.gov/sites/default/files/media/file/Communities%20Through%20Transition%20Panel%20Bios.pdf

Reverend Malcom also pointed out that no community is a monolith. That is, experiences, perspectives, and needs are variable. As a result, there is no one-size-fits-all energy or energy storage project. Reverend Malcom offered three strategies to advance equitable energy projects: leading with love, utilizing collective action, and speaking truth to power. He also highlighted a critical component: channeling the investment and benefits to the most vulnerable and those who are suffering the most. For example, most energy programs don't address renters, who might be most vulnerable, often BIPOC (Black, Indigenous, and other People of Color) communities, with a significant energy burden. Reverend Malcom also discussed that multiple scales should be considered for energy solutions: household, community, and planetary levels because solutions for the planet are also solutions for generations to come.

Kevin Blaser, in his role at the Midwest Tribal Energy Resources Association, works at the intersection of tribal sovereignty of individual member tribes and the collective strength of all member tribes. He pointed out that this is an important intersection because many energy projects rely on economies of scale – the bigger the projects, the more benefits that can be distributed among tribal communities and ancillary communities. He also discussed that energy storage can reduce the "not in my backyard" opposition because energy storage does not require as much physical space as traditional fossil energy infrastructure. His presentation noted six factors to advance energy storage that centered around knowledge barriers, building revenue sharing models, and methods for monetary improvement. Knowledge barriers exist around the economics of energy and the patchwork state regulatory framework resulting in a steep learning curve and reducing the ability for communities to participate effectively. Blaser suggested that regulatory agencies consider implementing a standardized regulatory process for states to adopt and include underserved communities in the rulemaking process. Blaser echoed Reverend Malcom's remark that communities are not monoliths and will require unique solutions but offered that a standardized foundation can reduce barriers. His presentation highlighted a couple of revenue-sharing models – the first is private partnership solutions, where community members or organizations can partner with developers to implement the projects. The second is revenue sharing models and securitization of costs. In terms of monetary improvement, Blaser discussed possible tax incentive improvements, the potential for tradeable credits, and reduced barriers to grant applications including shortening applications and clarifying opportunities.

Derrick Terry represented the most boots-on-the-ground perspective of energy storage. His work implements energy projects to provide electricity, through renewable energy, to families that don't have access or means for electricity on the Navajo Nation. Terry pointed out that energy burden is a big problem for Navajo communities, but it is not the only one. Energy burden cannot be reduced if affordable housing isn't in place. Consumer energy cost savings are a central goal to energy projects implemented by the Navajo Tribal Utility Authority (NTUA) to allow community members to be able to spend their finances on other needs. Terry also highlighted the additional barriers energy projects on the Navajo reservation face such as distance, with some families living miles from the grid, unmaintained roads, rough terrain, and so forth. These conditions can make the cost of construction significantly higher. Terry and NTUA have made it a priority to engage with students and the school system to improve engagement with electricity including internship opportunities. Terry highlighted how this experience can be particularly meaningful for students because it provides an opportunity to contribute to their own community.

A question was posed to the panel to discuss how energy storage assets create value for disadvantaged communities. One panelist began the conversation by discussing how energy storage can facilitate energy independence, or in the case of tribe's energy sovereignty, and how control over energy resources can translate into wealth generation. For example, a community that has battery storage can take advantage of peak shaving. This converts what is normally an expense into a revenue-generating asset. Another panelist highlighted that storage can be a community-building asset and, when combined with wealth building, can form the foundation for anti-displacement policies. In this way, energy storage can help foster a community where people want to stay and continue to build tangible and intangible wealth.

One panelist emphasized that energy storage is one component of the larger systems change required to ensure we do not simply replace the existing unjust system with a cleaner, unjust system. Through the lens of system change, another panelist offered the importance of building capacity in the community – whether that is through communication to empower participation in what can be intimidating rooms such as with state regulators, or in data collection to monitor the environmental conditions.

Key discussion themes:

- Community organizations provide a unique perspective because these organizations work with a people-first perspective and cater to the needs of the community.
- No community is a monolith; experiences, perspectives, and needs are variable. As a result, there is no one-size-fits-all energy or energy storage project. However, in the regulatory context, some foundational level of standardization would improve participation.
- Benefits, including return on investment, are distributed to communities in an equitable energy system.
- Energy storage creates a variety of benefits for communities–energy independence, improved environmental conditions, increased property values, wealth generation–all of which can contribute to building a place where people want to stay and live and foster a sense of community.
- Energy storage is one component of the larger systems change required to ensure we do not simply replace the existing unjust system with a cleaner, unjust system.

2.4 Utility Business Practices

The purpose of the Utility Business Practices Panel was to explore practical considerations of planning and implementing a more equitable grid with panelists discussing best practices and novel approaches to consider equity. The focus of the presentations and following discussions included developing and using metrics to improve equity consideration, including equity within grid planning, and improving procedural equity[12] in utility and regulatory processes. The panel consisted of speakers from four different utility roles: Uzma Siddiqi, Senior Manager of Grid Modernization at Seattle City Light; Jessica Lin, Principal Product Manager for Oracle Utilities Opower's Data Engineering Platform team; Dr. Tina Jayaweera, Power Planning Resources

[12] Procedural equity (also referred to as procedural justice) speaks to the fairness of process, transparency of actions, opportunity for participation, and impartial decision making.

Manager at the Northwest Power and Conservation Council; and Heather Moline, Policy Associate at NW Energy Coalition.[13]

Uzma Siddiqi's presentation focused on two components of the municipal electric utility that contribute to equity. The first component was sustainability, with Seattle having aggressive decarbonization goals including transportation electrification. The City of Seattle has been working for the last decade to eliminate radical disparities and achieve racial equality and as a result, both the city and Seattle City Light have equity and justice-focused tools or programs. Siddiqi focused on Seattle City Light's Racial Equity Toolkit, which was developed in 2012. The Toolkit is a multi-step process that involves stakeholders and community outreach with the goal of determining benefits and burdens to improve equity and minimize unintended consequences on racial equity. The impacts are tracked and reported to leadership to create a full circle project lifecycle. Additionally, each Seattle City Light department has volunteer teams to help develop innovative solutions and strategies for equity and there are two full-time advisors to help with social justice efforts. Seattle City Light is also working with environmental justice communities to implement technology that improves the grid and communities simultaneously.

Jessica Lin's presentation focused on exploring metrics and new solutions for limited-income customers. Metrics development includes analysis of how traditional metrics impact equity alongside the development of new equity-centered metrics. She explained that energy affordability, a widely utilized metric with various interpretations, has traditionally been studied from the supply side (i.e., the cost-effectiveness of investments rather than the demand side, the ability of customers to pay). However, she highlighted how energy affordability metrics often miss the communities most deeply impoverished and most in need. For example, a common assumption is that an affordable energy burden would be 6% or less, meaning that 6% or less of gross household income is spent on energy costs. However, this assumes that 30% of income is spent on housing and 20% on utilities. For low-income and renters, the percent of income spent on housing can drastically skyrocket up to 70% of their income. For these customers, an energy burden of 6% could lead to the 'heat or eat' phenomenon where people must choose between certain necessities. This challenges the common assumptions underlying energy burden and energy affordability. As a result, she is working on new ability-to-pay indices that consider additional factors influencing the ability to pay, such as rent or house tenure, rather than relying solely on poverty thresholds. Additionally, Oracle Utilities leverages computer science data and behavioral science techniques to develop new solutions for limited-income customers. This includes a savings hub that will connect customers with funding sources that can alleviate energy burden and developing hyper-personalized communication status alerts for customers to educate themselves and help manage their bills.

Dr. Tina Jayaweera's presentation focused on the unique role of the Northwest Power and Conservation Council (Council) and steps to integrate equity. The Council is responsible for future planning to ensure an adequate, efficient, economical, and reliable power system for the Northwest states. It therefore acts as a regional convenor and operates as an independent authority with reliable data and unbiased results. One of the three main tenets of the Council is to provide open access to the public, which requires stakeholder engagement from a broad range of stakeholders. She explained that this is a direct shift from historical energy development where decisions occurred behind closed doors. The Council has two main programs to improve equity considerations. Earlier in 2021, the Council held a forum to explore

[13] The utility business practice panelists full biographies can be found here: https://www.pnnl.gov/sites/default/files/media/file/Utility%20Business%20Practices%20Panel%20Bios.pdf

how to consider DEI in power planning. And the 2021 Northwest Power Plan[14] will likely include language about identifying and resolving equity data gaps through regional workshops. A draft of this Plan was released in September 2021.[15] This is key to identify data gaps and develop methodologies to measure whether equity is being achieved.

Heather Moline's presentation discussed Justice, Equity, Diversity, and Inclusion (JEDI) in the Pacific Northwest utility sector, and how legislative direction can support equity. A key point she made is that utilities constantly make decisions that impact people and society thereby making or influencing social policy and therefore they must do a better job at considering equity. JEDI applications began with an internal, more human resources look at individual staff, and then evolved to evaluating the organization, membership, and leadership, which have historically been white-led. She highlighted that capacity and training must also be built into the system so people can participate in the often-complex utility sector. This process includes a wide umbrella that reaches environmental justice organizations, community-based organizations, community action agencies, and tribal sovereigns. She also pointed out that while more diverse participation is essential, advance internal work involves evaluating the power dynamics to ensure people participating feel welcome, heard, and like they belong at the table as well. Communities have real expertise from lived experience and this cannot be replaced by other experts. Moline also explained how having legislative direction can help utilities overcome barriers because it allows for resources to be allocated and clearer mandates within a complicated topic. For example, Oregon has passed a law that allows utilities to consider burdens on low-income customers or other environmental justice factors that affect affordability. Without legislative direction, utilities may have to consider equity under existing directives rather than addressing equity directly.

Over the course of the panel discussion, data and metrics were emphasized as critical components of equity. Data may exist or data gaps may be identified and then collected, but data informs if processes or decisions are equitable or not and the extent to which programs are achieving goals and serving customers. One panelist recommended utilities think about data at a more local level across demographic categories within utility service territories since service can be variable. However, another panelist explained that different utilities have different levels of data granularity. Some utilities have collected a lot of demographic information while others have collected very little demographic information. Panelists noted that innovative analysts who can approach these topics creatively and integrate feedback from customers and other stakeholders are integral to improved programming. Panelists also discussed the development and integration of methods to account for the different value streams of energy. For example, the Northwest had a significant number of extreme weather events, highlighting the value of methods to consider valuation of resiliency. Another panelist emphasized that providing a baseline knowledge of equity will be key to ensure analysts are willing to listen and value those with lived experience and ensure program goals, such as equity, are captured.

Panelists shared that utilities have challenges in identifying limited-income customers and creating awareness of income-qualified programs. Suggestions included utilizing data-driven metrics, which may provide more insight into customers improving program design and enhancing methods of engagement with customers. This may also alleviate some utility level

[14] The plan includes an electricity demand forecast, electricity and natural gas price forecasts, an assessment of the amount of cost-effective energy efficiency that can be acquired over the term of the plan, and a least-cost generating resources portfolio. The plan informs resource decision-making to meet its customers' electricity load requirements.
[15] https://www.nwcouncil.org/2021-northwest-power-plan

barriers where low- and moderate-income programs are expensive to administer and require complex inter- and intra-departmental coordination. Additionally, the point was raised that utilities are not in full control of delivering equity and affordability outcomes. Where assistance programs may be outside of the utility's purview, utilities can help connect their customers to those programs. Panelists also recommended utilities explore opportunities to share this data with customers for transparency and personal use.

A question from the participants asked about incentives for utilities to consider equity. This raised the conversation about different utility types and a range of solutions. For example, mission statements of public power tend to center more on doing good rather than profit. Another perspective is using a strong legislative presence that includes conversations around different models for regulation. These discussions should begin by asking if a utility could be supported to be more equitable and what they would be supported to do. Answers to these questions can then be taken to inform legislative guidance.

Key discussion themes:

- The central question utilities are asking is how well do we know if equity is being achieved and if we don't know, what data would fill those gaps?
- Metrics development focusing on the customer demand side, before getting to the supply side, can ensure prioritization of health and well-being while working to develop strategies for payment.
- Energy affordability is a downstream metric and does not address why people cannot afford their bills in the first place. The upstream indicators are currently less standardized but provide important information across demographic categories within utility service territories.
- Stakeholder engagement is a key component, but advance internal work involves evaluating the power dynamics to ensure people participating feel welcome, heard, and like they belong at the table.
- To do this work effectively, appropriate time and staff must be allocated, including experts on social justice and historically underserved communities who have lived experiences.

2.5 Energy Storage as an Equity Asset

The purpose of the Energy Storage as an Equity Asset panel was to discuss how the deployment of energy storage can respond to local environmental and health concerns and community needs. The panelist presentations and following discussions focused on four key topics: the role of energy justice/energy equity in relation to the broader social equity goals, the role of energy storage in enabling a just transition, identifying the gaps or challenges in effectively measuring equity, and highlighting the opportunities to significantly advance energy equity. The Energy Storage as an Equity Asset panel consisted of four speakers with varying energy-related roles: Julia Prochnik, Executive Director at the Long Duration Energy Storage Association of California; Dr. Jeremy Richardson, Senior Energy Analyst at the Union of Concerned Scientists; Dr. Elena Krieger, Director of Research at PSE Healthy Energy; and Abbe Ramanan, Project Manager at Clean Energy States Alliance.

Julia Prochnik's presentation discussed how energy storage is a central component to addressing climate mitigation goals and equity concerns. Her presentation emphasized the role of energy storage in decreasing emissions, keeping the lights on, preparing for climate emergencies, and providing equitable community benefits such as resilience and lower costs. However, the presentation also noted that there is limited knowledge of the diversity of energy storage technologies. Prochnik highlighted the technical components of ten different energy technologies, including capacity, duration, life-cycle, ability to provide ancillary services, resource attributes, and the average deployment stage of each technology type. The presentation then offered three pillars to advance energy storage: technical capacity and funding, market access and market signals, and models to consider benefits, costs, health, and other externalities. To do these equitably, Prochnik underlined the importance of having more community representatives at the table from the very beginning and ensuring that community needs are incorporated into all new clean energy infrastructure development. The presentation also showed four maps of California—two that showed disadvantaged or low-income communities, one that showed transmission lines, and another that showed emergency room visits due to asthma. While visual interpretations can be drawn, Prochnik pointed out that there is not yet sufficient mapping capability that overlays the different infrastructure and demographic variables.

Dr. Jeremy Richardson's presentation focused on principles of stakeholder convening and the roles legislation can play in equitable energy storage development. When the Union of Concerned Scientists began working on energy storage equity in 2018, they convened stakeholders representing 30 distinct groups including environmental justice and grassroots organizations, policy experts, industry consultants, labor and consumer advocates, faith groups, and renewable energy advocates. Their energy storage equity work focused on six critical issues—reducing emissions and improving air quality, improving resilience to disasters and power outages, promoting local economic development and job growth, accelerating greater levels of renewable energy integration, reducing electricity bills, and ensuring that communities have a seat at the table. This work resulted in a report on the Principles of Equitable Policy Design for Energy Storage to guide policymakers who are considering tools, incentives, and processes to deploy energy storage by specifically considering disadvantaged communities. The Union of Concerned Scientists is also in the process of finalizing research that identifies pieces of state legislation that have addressed equitable storage deployment. The presentation covered three particular aspects of the research: replacement of peaker plants, resiliency enhancement, and the reduction of greenhouse gases and criteria air pollutants. Dr. Richardson shared that case studies in this forthcoming report will serve an essential function as a blueprint for future states to adopt including defining disadvantaged communities, conducting robust stakeholder engagement, offering best practices on regulatory guidance, and integrating labor standards.

Dr. Elena Krieger's presentation focused on four main metric dimensions and research efforts at PSE Healthy Energy. The organization focuses on supporting data-driven energy policymaking in a way that accelerates the clean energy transition to maximize co-benefits including environment and equity. The presentation also noted other essential co-benefits including workforce development and community engagement, although they were not explicitly covered. Instead, Dr. Krieger gave four frameworks to advance energy equity in the deployment of energy storage: air pollution, including the magnitude, place, and time of pollutants to account for immediate and cumulative burdens that result from these emissions; economics, identifying cost burdens, and energy access at the household level; resilience, with priority going to vulnerable groups and those at risk from natural disasters; and lifecycle considerations. Dr. Krieger discussed three projects that have begun to integrate these metrics. The first project is supporting peaker plant replacement strategies by integrating the above metrics as considerations in developing dynamic tools to provide recommendations that adjust criteria based on community priorities. The second is analyzing the potential of solar and storage in community centers. This project engages community organizations to identify what resilience means to communities and develops toolkits for outreach to ensure these programs reach vulnerable populations. The third project is focused on integrating health and equity metrics into deep decarbonization planning. This initial phase includes work in Colorado, Nevada, and New Mexico. The presentation emphasized that multiple sets of metrics can better anticipate and minimize the trade-offs or barriers to community participation.

Abbe Ramanan's presentation identified three equity challenges facing underserved communities and offered recommendations for those challenges that may be applicable regardless of the implementing institution. She highlighted that energy inequity is the result of vast structural inequalities. To get to an equitable energy system, the entire system will need to be re-shaped; individual components cannot just be replaced. The first challenge identified is that low-income populations have the highest energy burden, and critical facilities serving these populations tend to be resource-constrained, further inhibiting wealth creation. The second challenge is that vulnerable communities often must deal with both natural hazards and hazards from outdated and inefficient infrastructure. These hazards could translate into tangible and severe consequences including loss of lives. Both household- and critical facility-level energy storage can be utilized to improve healthcare and emergency preparedness, even during blue sky conditions. The third challenge is the public health consequences in vulnerable, low-income, and environmental justice communities due to pollution from fossil fuels. Ramanan emphasized that in the case of replacing fossil fuel power plants, large-scale battery storage projects can play an important role; especially if they are paired with smaller-scale projects to really have a tangible impact on the equity and resiliency dimensions.

The panel discussion began with a conversation on defining energy equity. Although energy equity is increasingly discussed, panelists pointed out the benefits of common terminology to strengthen the understanding and acceptance of what energy equity is. One panelist noted that there is a desire to understand, learn, and do better, but consistent and constant terminology use enables more coherent implementation across different developers and industries.

When connecting energy storage and equity, panelists stressed the importance of connections that extend beyond just fuel source transition and replacement of peaker plants to include economic development, workforce transition, and engagement with the workers and communities that are going to be negatively impacted by that transition. Another panelist suggested that peaker plant replacements are a ripe opportunity area because of the win-win solutions to accelerate decarbonization alongside equity.

A question was posed to the panel about timelines referring to the friction between the fossil fuel transition that requires immediate action and the longer timelines required to do work equitably. One panelist responded that a balance between the longer-term solutions and immediate impacts ensures that the communities who need help now are getting it and are seeing the benefits of the clean energy transition. The panelist provided the example of a resilience hub that can act as a cooling center – relief from the heat is an immediate need of communities, but by integrating renewable plus storage, we're facilitating that longer-term transition. Another panelist offered the perspective that many are focused on research, to maximize grid efficiency with the integration of renewables, reduce pollution, and so forth. However, research is typically accompanied by long timelines which may conflict with a community's more immediate priorities. Additionally, communities have valuable lived expertise. Panelists also highlighted that equity goals should not mean inaction for an extended amount of time; implementation needed to start yesterday.

Panelists discussed that energy storage can serve many roles, creating both benefits and challenges. With different community goals, different places, and the many storage technologies, compiling this information is a key step to effectively analyze the role energy storage can play, both in the grid and for equity. One panelist also emphasized that equity is going to be a key criterion as it can significantly add value to energy projects.

The role of legislation at various levels was discussed by panelists as an increasingly important consideration. One panelist emphasized that policymakers must be aware of some of the different equity aspects and that the information must be integrated at the policy level, particularly as policymakers are increasingly setting ambitious targets for storage deployment and implementing pilot programs. Another panelist added that, particularly at the federal level, greater coordination among agencies can better address the different aspects of what equity and a just energy transition means. For example, it’s not just reducing people's energy burdens, but rather it is ensuring they also have access to home health care. These areas must be connected to improve the outcomes in disadvantaged communities. Another panelist emphasized the importance of coordination between federal and local level efforts. The panelist pointed out that all panels had highlighted the need for community input, to address communities' needs, yet federal funding targets may not align with states or local needs.

Key discussion themes:

- Advancing energy storage requires changing utility models to consider benefits, costs, health, and other externalities alongside traditional technological deployment requirements such as technical capacity/funding and market access.

- The role of energy storage in energy equity includes reducing emissions and improving air quality, improving resilience to disasters and power outages, promoting local economic development and job growth, accelerating greater levels of renewable energy, reducing electricity bills, and ensuring that communities have a seat at the table.

- Guidance around concepts such as defining disadvantaged communities, conducting robust stakeholder engagement, deciding best practices on regulatory guidance, and integrating labor standards can improve coherence coherent across implementation by different developers and industries. Other metrics of importance include air pollution, economics, resilience, and lifecycle considerations.

- Developing connections between energy equity concerns at the household and community level, and between federal, state, and local governments, improves consideration of energy equity and outcomes.

- Establishing common terminology of energy equity strengthens understanding and acceptance of the concept.

- A balance between the longer-term transition and immediate impacts ensures that the communities who need help now are getting it and will see the benefits of the clean energy transition.

- Policymakers must be made aware of the role of energy storage to advance equity to integrate it into policy from the beginning.

3.0 Key Themes & Next Steps

While each of the two contextual keynote presentations and four panels brought a unique lens to this topic, several overarching themes were highlighted for advancing energy equity, the common barriers to doing so, and the specific role of energy storage in those efforts. The key themes from the roundtable event include:

- Energy storage is one component of the larger systems change required to ensure we do not simply replace the existing unjust system with a cleaner, unjust system. Energy equity, or the lack thereof, is a result of long-standing historical issues. Energy is interconnected to many other aspects of life, requiring consideration of how energy intersects with community needs such as affordable housing, energy efficiency, community resilience, health, and well-being.

- Meaningful stakeholder engagement is necessary to better understand the needs of communities and stakeholders. However, outcomes from stakeholder engagement then must be integrated into pilots and programs to better address community needs and ensure the community is being heard and valued.

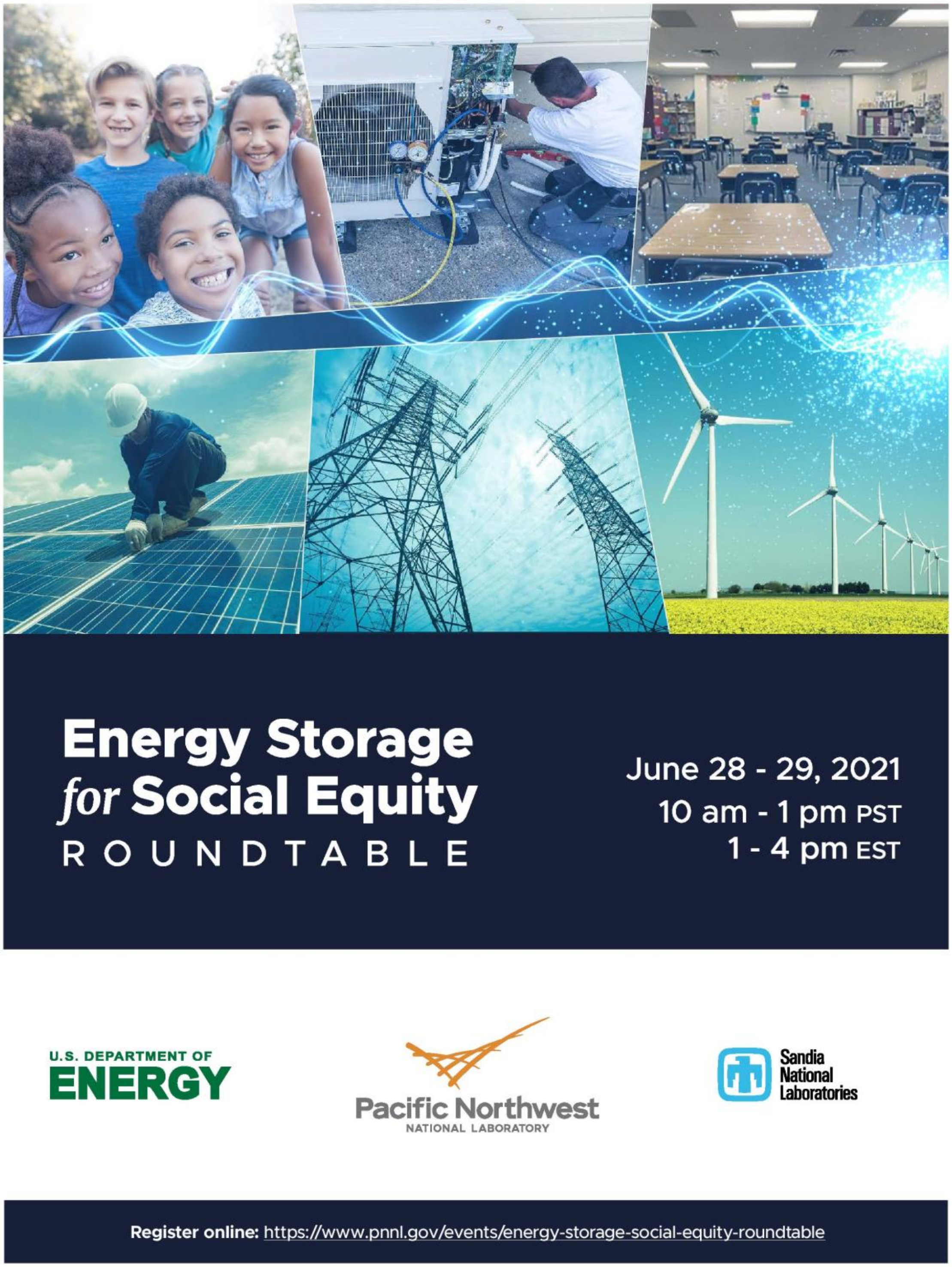
- Metrics of energy investment, particularly for non-energy benefits such as sustainability, resilience, and equity, are integral to measuring progress in a more meaningful way. For example, energy affordability is a downstream metric and does not address why people cannot afford their bills in the first place. The upstream indicators are currently less standardized but provide important information that can lead to improved programming. Advancing energy storage requires changing models to consider benefits, costs, health, and other externalities alongside traditional technological deployment requirements such as technical capacity/funding and market access.

- To do the equity work effectively, appropriate time and staff must be allocated, including experts on social justice and historically underserved communities who have lived expertise. A balance between the longer-term transition and immediate impacts ensures that the communities who need help now are getting it and will see the benefits of the clean energy transition.

- The role of energy storage in energy equity includes reducing emissions and improving air quality, improving resilience to disasters and power outages, promoting local economic development and job growth, accelerating greater levels of renewable energy, reducing electricity bills, and ensuring that communities have a seat at the table. Specific benefits for communities include energy independence, improved environmental conditions, increased property values, wealth generation – all of which can contribute to building a place where people want to stay and live and foster a sense of community.

Participants from this Roundtable offered a range of challenges and opportunities to further advance equitable energy storage. These concepts indicate that a holistic systems approach is needed to advance energy equity. While energy storage can play a critical role in meeting community needs, this requires understanding the many ways people actually experience energy. The Roundtable was an essential seedbed for ideas and to launch a new Energy Storage for Social Equity Initiative that was announced in September 2021. This Initiative responds to the themes discussed above.

Appendix A – Agenda



AGENDA

DAY 1

28 JUNE

1:00–1:10pm EST

WELCOME REMARKS

Jennifer Granholm
Secretary of Energy, U.S. Department of Energy

Michael Pesin
Deputy Assistant Secretary, Advanced Grid Research & Development, Office of Electricity

1:10–1:30pm EST

WELCOME KEYNOTE

Imre Gyuk, Director
Energy Storage Research
Office of Electricity
U.S. Department of Energy

1:30–2:00pm EST

CONTEXT PRESENTATION:

Metering Energy Justice: Centering Historically Disinvested Communities in a Warming Planet.

Vivek Shandas
Portland State University

2:00–3:00pm EST

STATE GOVERNMENT

Hear from representatives in state governments administering energy equity programs. Speakers will discuss the current procedural, structural, and regulatory environment.

Moderator: Rebecca O'Neil, PNNL
Participants:
- Crystal Pruitt, New Jersey BPU
- Sarah Vorpahl, Washington COM
- Joy Wang, Michigan PSC

3:00–4:00pm EST

COMMUNITIES THROUGH TRANSITION

Community leaders from traditionally energy-burdened communities are at the forefront of climate change and environmental justice. In this conversation, a diverse group of voices will discuss the energy needs and priorities of underserved and vulnerable populations, including capacity and data.

Discussion outcomes:
- *Community needs and benefits from technologies*
- *Benefits from grid investments and futures*
- *Needs from federal research*

Moderator: Stan Atcitty, Sandia
Participants:
- Sergio Lopez, Verde NW
- Reverend Michael Malcom, Alabama Interfaith Power and Light
- Kevin Blaser, Midwest Tribal Energy Resources Association
- Derrick Terry, NTUA

Wrap: 4:00pm EST

CONCLUDING REMARKS

Register online: https://www.pnnl.gov/events/energy-storage-social-equity-roundtable

AGENDA

DAY 2

29 JUNE

1:00–1:30pm EST

WELCOME
Wahleah Johns
Deputy Director
Office of Indian Energy

1:30–2:00pm EST

CONTEXT PRESENTATION:
Building an affordable Power Module for remote applications.

Deepak Divan
Center for Distributed Energy
Georgia Tech

2:00–3:00pm EST

UTILITY BUSINESS PRACTICES
This panel will explore practical considerations of planning and implementing a more equitable grid, discuss best practices, and present novel approaches.

Discussion outcomes:
- *Defining equity opportunities within the utility business model and operations*
- *Practical trends in utility direction*

Moderator: Bobby Jeffers, Sandia
Participants:
- Uzma Siddiqi, Seattle City Light
- Jessica Lin, Oracle Utilities Opower
- Tina Jayaweera, NW Power and Conservation Council
- Heather Moline, NWEC

3:00–4:00pm EST

ENERGY STORAGE AS AN EQUITY ASSET
This panel will discuss how deployment of energy storage can respond to local environmental and health concerns and community needs.

Discussion outcomes:
- *Energy storage as an equity asset – priorities*

Moderator: Bethel Tarekegne, PNNL
Participants:
- Julia Prochnik, LDESAC
- Jeremy Richardson, Union of Concerned Scientists
- Elena Krieger, PSE Healthy Energy
- Abbe Ramanan, CESA

Wrap: 4:00pm EST

CONCLUSION AND THANK YOU
U.S. Representative Melanie Stansbury, New Mexico, United States Congress

Register online: https://www.pnnl.gov/events/energy-storage-social-equity-roundtable

Appendix B – Community Energy Storage Memo

Pacific Northwest
NATIONAL LABORATORY

Community Energy Storage and Energy Equity

Introduction

Community ownership of assets is one way to deliver a more equitable distribution of benefits and control in the energy sector. Energy storage in particular can be adopted at the local level due to the flexible and scalable nature of the technology. As a result, with the wider adoption of community solar, interest in community energy storage (CES) is growing. However, CES projects are still uncommon and lack the comparatively clear compensation signals, policy support, and deployment experience as with community renewables. New business models are emerging to support CES, and some regulators are beginning to develop programs designed to support the framework. While early results are promising, there is more to be done to capture the full value of energy storage deployment for communities and to expand access to investing in and benefiting from these installations. Key findings and strategic highlights include:

- Community energy storage encompasses a wide variety of business models and can have differing impacts on community wealth and wellbeing.
- Disparate value streams can make CES difficult for nonutility entities unless customers have high demand charges or are maximizing the self-consumption of rooftop photovoltaics.
- An expansion of community energy storage will not necessarily lead to more equitable outcomes. Greater regulatory and financial support will be needed for these assets to be accessible to underrepresented communities.

Current Models

The “community” of community energy storage as a business model is broadly defined. As an example, the California Public Utility Commission (CPUC) defines community storage as storage connected at the distribution feeder level, associated with a cluster of customer load (California Public Utilities Commission 2013). This definition could include storage systems owned and controlled by any entity, so long as they are sited on the distribution grid and serve more than one customer. While this definition could enable several use cases, in practice most community energy storage projects feature direct utility ownership and control; they are not community owned. However, other models are emerging that tie the asset more directly to the community.

Utility Ownership

As previously mentioned, most community energy storage projects in the United States are distribution sited and utility owned. The community indirectly benefits from cost-effective investments that reduce system costs. There is also the potential for distribution sited storage systems to improve local reliability and resiliency. These are positive outcomes in cost and in grid performance, but do not offer the community a wealth-building opportunity through direct monetary payments. While some investor-owned utilities advertise their projects as community storage, these systems are more likely to labeled as CES by industry observers and academics if they are owned and operated by a municipal or cooperative utility (Flanegin 2018; Petta and McConnell 2018). In general, these utility-controlled programs are the least community oriented of the CES business models.

Storage Shared by Rooftop Solar Customers

A small but growing share of CES systems feature batteries that are installed in tandem with rooftop PV or other behind-the-meter renewables. Rather than each household separately installing a behind-the-meter battery, a communal battery is sited on the local feeder and each household purchases fractional shares. This model is most popular in Australia, where a drop in compensation for exported solar power has led many PV owners to retrofit their systems with batteries (Kurmelovs 2021). Though many households are simply adding a behind-the-meter battery, these customers have chosen to pool their resources into a communal battery. This arrangement can offer lower costs through economies of scale. In the US these programs have been more limited, though several exist. For example, the Sacramento Municipal Utility District's (SMUD) Anatolia Solar Smart Homes projects features this sort of CES system (Takata 2017).

Virtual

Virtual arrangements leverage common business models from the community solar area and apply them to storage. Virtual net energy metering (VNEM), which allows solar customers to directly offset their energy consumption with PV, even if the system is offsite, has been extended to storage systems in some areas. As an example, SMUD's StorageShares program allows commercial customers to offset their demand charges by subscribing to an offsite storage system (Howland 2020). This form of virtual CES is particularly popular in Germany, where the SonnenCommunity project has more than 10,000 subscribers (Koirala, van Oost, and van der Windt 2018).

Additionally, many traditional community solar providers have expanded their product lines to support solar plus storage. In general, these programs are more common in areas that have reduced support for net metering, as solar and storage behind the meter would be more lucrative and valuable to a customer where viable. Hawaii and Texas, for example, both have programs that offer customers virtual access to large offsite solar + storage arrays (Spector 2017a; 2017b). In Hawaii for example, time-of-use rates make it less lucrative to generate during the day. The community solar + storage project allows customers to buy electricity for a lower rate than the utility, while providing more valuable generation to the grid.

Campus and Multi-tenant Buildings

Energy storage can also be installed in campuses or multifamily buildings and shared among the tenants. In multifamily environments, where renters do not control their roofs or the building envelope but likely pay the power bill, there is a split incentive between the landlord and the tenant. Community storage offers a pathway for tenants to invest in energy systems without the ownership prerequisites. For example, a single storage system could help multiple users manage demand charges or be paired with PV to encourage self-consumption. In New York, developers have been specifically targeting public housing for solar + storage upgrades (Lillian 2019). The virtual arrangement can lower project costs on a per unit basis due to economies of scale, making it ideal for low- and moderate-income households. Furthermore, the state has offered generous grants and rebates to ensure equitable access to the technology.

Existing State Programs

Community storage is still a nascent business model, and state programs to support CES are just beginning to emerge. Regulators are looking to CES to promote access, decarbonization and improve community resilience (Koirala, van Oost, and van der Windt 2018). Likewise the goals of community energy storage are broadly in line with the principles of a just transition (Atteridge and Strambo 2020). To date, the most common step regulators have taken is an incremental one to open community solar programs to solar + storage projects. For example, New York provides technical assistance and predevelopment services to assist affordable housing providers in installing community solar + storage (NYSERDA 2020). Likewise, Oregon has expanded their rebate program for solar on multifamily housing to include solar plus storage (Oregon Department of Energy 2020).

Perhaps the most advanced policy support for CES comes from California's Self-Generation Incentive Program (CPUC 2021). This program was amended following the Camp Fire in 2018 and is designed to promote resilience in communities that are at risk of wildfires. Though much of the funding is dedicated to single-family, behind-the-meter battery systems, multi-tenant, campuses, and critical facilities are also eligible to receive the rebate for CES projects. These systems are intended to promote resilience and provide backup power in the event of a disaster or grid shut-off.

Challenges to Community Benefits from Storage Deployment

Disparate Revenue Streams Makes Community Storage Difficult

Value streams for community energy storage are more disparate than those associated with shared renewables. Except in a handful of cases (i.e. high demand charges, paired with non-net metered solar), CES will require multiple revenues in order to make financial sense. Utilities are better equipped to capture these benefits than ordinary consumers, especially in places where third-party markets for transmission and distribution deferral and ancillary services do not exist. Split ownership models between utility payments and revenues and customer payments and revenues are one path forward. Another is to quantify and compensate developers for resilience and other community benefits.

Consumer Ownership Opportunities are Limited

Many utility programs only allow consumers to benefit from storage systems indirectly. If storage can avoid system costs or improve reliability, consumers will pay lower rates. However, these programs allow few opportunities for non-utility entities to invest, reap direct benefits, and build wealth. Opening ownership models and associated revenues to nonutility ownership can promote a more equitable distribution of benefits from grid investments. They could also be more targeted to community design and interests, rather than optimal grid and system cost conditions.

Expand Community Solar Programs to Storage

Many states offer rebates, grants or have carve outs for community solar projects. Allowing solar + storage projects to access these programs would increase demand for community storage. Some states seeking to expand access to CES have already taken these steps. Likewise, community solar has benefited from the expansion of virtual net metering. Developing tariffs that pass through the benefits provided by energy storage to customers would enable more hybrid solar + storage projects.

Expand Availability to Financing

Providing financing to low- and moderate-income (LMI) households has proven difficult with community renewables and will continue to be an issue with community storage. Expanding grants and rebates will lower costs for frontline communities, and explicit financing opportunities will also be significant for technologies that have high up-front costs. PACE and on-bill financing are often cited as more equitable mechanisms to finance clean energy than traditional loans (Bird and Hernández 2012).

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Appendix C – Metrics for Energy Equity

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Metrics for an Equitable and Just Energy System

Introduction

Communities of color, those living with low to moderate income, and those on the frontlines of climate change are only some of the groups who have disproportionately felt the burden of an inequitable energy system [1]. Recent policy initiatives [2] have begun to highlight the clear need to generate energy equity and justice by providing reliable, safe, and affordable energy where the costs and benefits of such energy services are disseminated fairly. However, the ways for measuring progress towards these goals are not yet clearly defined.

Metrics, indicators, and indexes are three mechanisms available to support these efforts. While often used interchangeably in literature, each is distinct in its functionality.

- *Metrics* are a quantitative measurement for a qualitative phenomenon that can help measure a specific equity outcome. Metrics are likely to become key for tracking equity-related efforts and ensuring goals are met.
- *Indicators* are a representation of relevant equity outcomes that can be used to establish the state of equity at a given point in time [3]; indicators are useful in collecting baseline equity measurements.
- Multiple indicators can be aggregated into a single measure, known as an *index*.

Most energy justice and equity metrics are built around measuring or assessing energy inequities such as energy poverty,[1] energy burden,[2] energy insecurity,[3] and energy vulnerability.[4] However, advancing an equitable energy future would also require equity metrics that measure the justice and equity implications of current and future energy projects. To that end, the following review is structured around three categories central to the equity metrics development process: target population identification, investment decision-making, and program impact assessment. These categories have been adapted from the equity metric dimensions developed by [4] in the literature. Each of these categories are described below and metrics within each category are presented. The metrics in each category are described, data points needed to calculate each metric are listed, and potential resources through which to acquire the necessary data are shared. This information is intended to provide an overview of the prominent metrics in each category to support ongoing efforts in energy equity metrics creation.

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[1] Energy poverty refers to the lack of access to affordable and sustainable energy service.
[2] Energy burden is defined as the percentage of gross household income spent on energy costs. https://www.energy.gov/eere/slsc/low-income-community-energy-solutions#:~:text=Energy%20burden%20is%20defined%20as,which%20is%20estimated%20at%203%25.
[3] Energy insecurity refers to the hardship households face to meet basic household energy needs.
[4] Energy vulnerability indicates the propensity of a household to suffer from a lack of adequate energy services in the home.

Target Population Identification

To advance energy equity, one must start with an understanding of population distribution within a society—who is eligible for support programs, where are energy prices higher or more burdensome, who is able to make their monthly bill payments, where have energy efficiency measures been put into place, and who has better quality of life? The target population identification metrics category provides community descriptive metrics for evaluating the distribution of benefits and burdens in society, measuring distributive[5] and recognition[6] justice.

Table 1 lists metrics that can be used to identify target populations: program equity index, program accessibility, energy cost index, energy burden index, late payment index, appliance performance, and household-human development index (HDI). These metrics require data pertaining to the cost of energy bills, frequency of late payments, demographics, and the type of assistance offered through specific programs. These data can often be collected from organizations like the Energy Information Administration (EIA), utilities, and the programs they are designed to evaluate. The National Institute of Health (NIH), Environmental Protection Agency (EPA), and appliance purchase records may also be useful sources for collecting data in this category of metrics. The spectrum of metrics in this space ranges from measuring the success of programs created to help communities access energy efficient appliances to the demographics of those who participate in programs such as the Weatherization Assistance Program (WAP) and the Low-Income Home Energy Assistance Program (LIHEAP).

Table 1 Target population identification metrics

Metric and Reference	Needed Data Points	Data Sources and Description
Program equity index [5]	Energy assistance offered	Program data; distribution of program benefits across populations
Program accessibility [6]	Eligible population data, income data	Program data; distribution of program eligibility across population groups
Energy cost index [5]	Median annual energy bill	EIA, utility records; distribution of energy cost across populations
Energy burden index [5]	Median annual energy bill and annual median income	EIA, utility records, census; distribution of energy burden across populations (i.e., 6% is considered high, 10% is considered severe)
Late payment index [5]	Late energy bill payment rate	Utility records, LIHEAP; distribution of late bill payment habits across populations
Appliance performance [7]	Appliance maintenance cost (lifespan, energy profiles)	Appliance purchase records, audit template; distribution of access to energy efficiency measures
Household-human development index [8]	Health status, education level, income	NIH, EPA, EJScreen[7]; distribution of HDI scores across population subgroups

[5] Distributive justice involves identifying where energy injustices emerge in society. https://www.sciencedirect.com/science/article/pii/S2214629615300669
[6] Recognition justice emphasizes the need to understand different types of vulnerability and specific needs associated with energy services among social groups. https://www.frontiersin.org/articles/10.3389/fenrg.2019.00099/full
[7] https://www.epa.gov/ejscreen

Investment Decision-Making

Investment decision-making metrics largely use a community lens to understand the distribution of investments across populations—which communities support specific investment decisions, to what extent different communities experience health and environmental impacts, where the quality of energy service is lacking, and which communities see an increase in jobs. These metrics help in understanding effects of investments and subsequently help measure whether those investments contribute to or detract from an equitable energy system. This category evaluates procedural justice[8] by assessing the fairness of funding/grant processes, policy levers, and equity programs.

Table 2 includes metrics for investment decision-making: community acceptance rating, program funding impact, energy use impacts, energy quality, and workforce impact. Compared to the target population identification metrics, this category of metrics largely requires data around community satisfaction, the impacts of investments on health and frequency of electric outages, as well as the budget available for equity programs and the jobs generated through investment. The EIA and program-specific data are again key sources for calculating metrics in this category, and surveys from communities can also support these measurements. The metrics range from communities' acceptance of investments to the impact that investments have on local communities.

Table 2 Investment decision-making metrics

Metric and Reference	Needed Data Points	Data Sources and Description
Community acceptance rating [6, 9]	Numeric representation of community satisfaction	Surveys of community acceptance and support for investment
Program funding impact [6]	Percent budget for advancing equity	Program data; percent of investment funding supporting disadvantaged communities
Energy use impacts [9]	Health and environmental impacts due to investment	Distribution of health and environmental impacts of energy investments across populations
Energy quality [9]	Investment impact on frequency of electric outages, energy capacity	EIA; utility data
Workforce impact [6, 7]	Investment generated jobs	Department of Labor (DOL); community benefits from investment (participation from low-income groups, local business contracts)

[8] Procedural justice evaluates decision-making processes to assess whether all stakeholders have been included in a non-discriminatory way. https://www.sciencedirect.com/science/article/pii/S2214629615300669#sec0045

Program Impact Assessment Metrics

Once equity programs have been implemented, assessing the impact they have had in achieving their goals becomes necessary—have they generated wealth for targeted communities, are communities satisfied and enrolling in programs, have they generated savings in energy or costs, and have they improved the quality of life? Compared to the target population identification and investment decision-making metrics that speak to specific tenets of justice, these metrics measure the success of the decisions and programs that were designed to generate equitable outcomes.

Table 3 lists six key metrics for assessing program impact: program acceptance rate, energy savings, energy costs savings, energy burden change, and change in HDI. They require energy use and cost data, household income data, and program data such as revenue and implementation costs in addition to the portion of a population enrolled in a program. These data can be found through resources similar to those used in target population identification metrics, including the EIA, utilities, and equity programs.

Table 3 Program impact assessment metrics

Metric and Reference	Needed Data Points	Data Sources and Description
Program acceptance rate [6]	Percent of population enrolled in program	Program data; program enrollment after receiving information (i.e., information dissemination, transparency, community trust, etc.)
Energy savings (MWh) [6]	Energy use over time	EIA, utility records; Energy use savings in disadvantaged communities after program implementation
Energy cost savings ($) [6]	Energy cost over time	Energy cost savings in disadvantaged communities after program implementation
Energy burden change [8]	Household income, energy bill	EIA, utility records, census; percent reduction in energy burden after program implementation (EE, weatherization, rate design, wage changes, etc.)
Change in HDI score [8]	Household income, quality of life	EIA, NIH; wellbeing and quality of life improvement after program implementation

Conclusion

While the above metrics represent the best available options for measuring equity within the development of energy projects and programs, metrics development for energy equity is still at the ideation phase.

Including and thinking through the equity metrics identified in this review and expanding on them as new areas are identified is important for a robust measurement capability. Based on the review of metrics above [4, 10, 11, 12], opportunities for future metrics are listed below:

- Metrics to show disparate effects of past policies
- Metrics to capture community needs
- Metrics to track and measure project impact
  - Metrics to assess quality of jobs generated
  - Metrics to capture the non-cost benefits of reducing energy burden
  - Metrics to capture health and safety issues abated

PNNL and partners are working to identify and develop additional metrics for energy system planning to support utilities, state regulatory agencies, and other interested entities.

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Appendix D – Energy Storage for Social Equity Case Study

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Energy Storage for Social Equity: Capturing Benefits from Power Plant Decommissioning

Introduction

Flexible and available at any scale, energy storage offers a useful framework and starting point in a larger conversation around energy equity.[1] Through the lens of energy storage deployment, stakeholders can imagine more broadly how improvements and investments in the grid can respond to social and health challenges and increase affordability, reliability, and community value leading to a more equitable, accessible, and sustainable energy future.

The following sections provide an overview of local energy effects and non-energy benefits of energy storage, with a focus on the role of energy storage in fossil fuel plant decommissioning and replacement strategies. The paper offers a brief summary of three case studies, Dynegy Oakland, Centralia, and Manatee power plants, where storage was integrated into plant decommissioning strategies to play the dual role of enabling the reduction of fossil sources from the grid while allowing increased integration of renewable sources into the electric grid. These case studies are intended to show the essential role of storage in accelerating deep decarbonization and the possibilities of enabling a just transition from fossil fuels.

Fossil-fuel power plants generate greenhouse gas emissions and health impacting criteria pollutants with plants often disproportionately located in disadvantaged communities.[2] This has resulted in an energy system with increased health and environmental burdens on vulnerable populations.[3] The strategic integration of energy storage in plant decommissioning plans can mitigate these negative impacts while providing energy system, environmental, and societal co-benefits including resiliency, reduced outages, decreased pollution, increased property values, lower compliance costs, lower utility bill, job creation, and reduced land use (Woods and Stanton 2019). This brief report uses the three case studies as a lens into the possibilities of storage in enabling the rapid decommissioning of fossil-fuel baseload and peaker power plants across the country.

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[1] Equity, as defined in Executive Order No. 13985, "means the consistent and systematic fair, just, and impartial treatment of all individuals, including individuals who belong to underserved communities that have been denied such treatment, such as Black, Latino, and Indigenous and Native American persons, Asian Americans and Pacific Islanders and other persons of color; members of religious minorities; lesbian, gay, bisexual, transgender, and queer (LGBTQ+) persons; persons with disabilities; persons who live in rural areas; and persons otherwise adversely affected by persistent poverty or inequality" (Executive Order No. 13985 2021).

[2] Disadvantaged communities are those who most suffer from economic, health, and environmental burdens.

[3] Vulnerable populations are those who are economically disadvantaged, racial and ethnic minorities, the elderly, rural residents, those with inadequate education, and those with other socio-economic challenges.

Benefits of Energy Storage

Integrating energy storage into fossil-fuel plant decommissioning strategies offers benefits for a wide range of stakeholders in the energy system (Saha 2019). For federal, state and local governments, replacing fossil fuel power plants with storage capacity could support their decarbonization and energy transition goals. For example, New York's Climate Act[4] sets a goal of achieving 100 percent zero-emission electricity by 2040 including a 3,000 MW energy storage target by 2030. The New York Power Authority (NYPA) also released its VISION2030 plan to an emissions-free electricity by 2035 including a commitment of 450 MW of energy storage deployment (Colthorpe 2021). For utilities, storage offers the operational flexibility to provide safe, clean, and reliable energy. In addition, for fenceline[5] and frontline[6] communities, switching to storage may offer benefits by minimizing air pollution, improving property value, attracting businesses, creating jobs and stimulating local economic activity.

Storage offers energy benefits at multiple points in the electric grid similar to baseload generation assets and peaker plants, including transmission, distribution, and cost (see Figure 1) (Rohit and Rangnekar 2017). Fossil fuel plants as a baseload generation asset guarantee supply reliability and wholesale market stability, while peaker plants support variable peaks in electricity demand. Energy storage can provide these attributes along with added non-energy benefits. The non-energy of storage are the values that energy storage participants – utility companies, individuals, communities, or society – receive in addition to the benefits to the energy system (Woods and Stanton 2019). Table 1 offers a brief overview and taxonomy of the plant-scale and community-scale non-energy benefits of storage that can be included in future valuation analysis and development. The energy benefits of storage are more well documented[7] and are included here in less detail. For additional information on the energy benefits of storage, see Balducci et al. (2018).

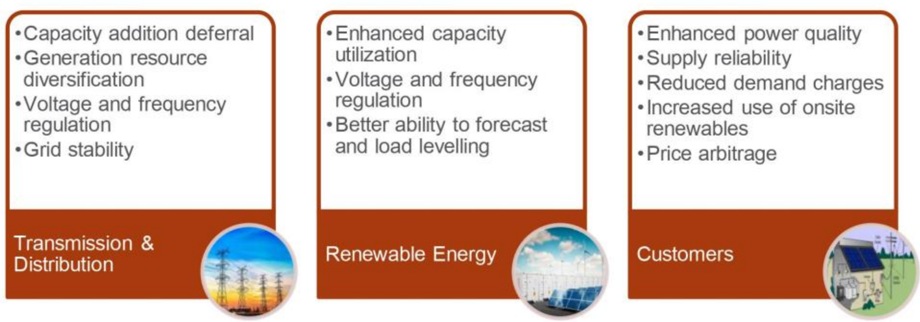

Figure 1 *Grid Benefits of Energy Storage*

[4] In 2019, Governor Andrew Cuomo signed the Clean Leadership and Community Protection Act (Climate Act) into law. The law requires New York to reduce economy-wide greenhouse gas emissions 40 percent by 2030. https://climate.ny.gov/

[5] Fenceline communities are those living in closest proximity to dangerous facilities (within one-tenth of a facility's vulnerability zone).

[6] Frontline communities are those experiencing first and worst of air pollution resulting from energy systems.

[7] Despite the additional coverage of energy benefits, benefits at the transmission or distribution levels, and customer energy management of behind-the-meter (BTM) resources are only included in a few existing models (Balducci, et al. 2018).

Table 1 Local and systemic non-energy benefits provided by energy storage

Benefit Title	***Benefit category(ies)***	***Description***
Emissions reduction	*Environmental*	The emissions reduction impact of storage installations is dependent on how and when the storage system is charged and discharged. Storage facilitates the removal of fossil fuels from the grid through decommissioning strategies and renewable energy expansion, resulting in significant emissions reduction (Arabzadeh, et al. 2019).
Energy costs	*Economic, social*	For storage that is replacing fossil-fueled systems, utilities can minimize safety-related emergency calls and avoid fines related to environmental compliance. Peak demand currently results in demand charges and time-of-use (TOU) rates. Storage creates a resource to manage peak demand. Both instances reduce the cost to provide energy and the utility can pass on saved costs to ratepayers. As energy becomes more affordable to the ratepayer, the utility also saves costs by avoiding ratepayer collections and terminations (Woods and Stanton 2019).
Equity enhancement	*Social, economic*	Storage systems, if implemented with appropriate strategies, can provide targeted benefits to underserved communities including revenue generation and energy independence to improve energy affordability and reduce energy burden (Union of Concerned Scientists 2019, Tarekegne, O'Neil and Twitchell 2021).
Increased property value	*Economic*	For ratepayers with storage installed in buildings, storage provides the capability to keep heating and cooling systems reliably operational and may decrease energy costs leading to an increased property value. A study by the Appraisal Journal found that for every $1 decrease in the annual utility bill, property value increases by approximately $20 (NREL 2008). A meta-analysis study (Brinkley and Leach 2019) of energy infrastructure impact on housing value found a consistent positive property value impact for rooftop solar, a corollary to residential storage installations.
Job creation	*Economic, Social*	Storage creates job opportunities across the asset's lifecycle, including battery manufacturing, operation, maintenance, and management. The California Energy Storage Alliance (CESA) reported that energy storage projects in California have supported approximately 20,510 jobs and they project that number might increase up to 113,190 jobs in the next ten years (Noh 2020). Job creation benefits of energy storage could support communities in revitalizing their economies. This is especially critical for regions that will be negatively impacted by the energy transition. For example, in the Centralia case study, the decision to build storage capacity

		in the plant decommissioning strategy led to research and development efforts creating jobs and work opportunities in the storage supply chain (Centralia Coal Transition Grants 2021).
Less land use	*Environmental, social*	Utilizing energy storage to manage increasing power requirements (baseload and peak demand) decreases the need to build new or maintain existing power plants. Decreasing the land required for power plants allows communities to use the now available land for alternative public-serving uses including parks, conservations, commercial and residential facilities, health centers, schools, and recreation centers (Woods and Stanton 2019).
Resilience benefits	*Social, Economic*	The main resilience benefit is avoided energy outages and the resulting avoided disruption costs (financial and otherwise). For ratepayers, the avoided disruptions are in day-to-day life activities. However, there are currently limited metrics to assess the impacts despite their significance. For example, power outages can create life-threatening risks for vulnerable customers that rely on electronic devices, such as the elderly who require refrigerated medication. Currently, the "value of lost load" (VOLL) is used to estimate the avoided outage benefits to participants (Woods and Stanton 2019). Future valuation methods need to capture the avoided outage benefits of storage in critical and community-serving facilities such as hospitals, senior housing, community centers, schools, and emergency shelters (Rutgers 2019).

Case Studies

Case Study I: Dynegy Oakland Power Plant, California (1978 – 2022)

The Dynegy Oakland Petroleum Liquid Power Plant is a 223.5 MW capacity (County Office 2021) oil-fired energy generation facility owned and operated by Dynegy Oakland (Chhabra 2018). As a peaker plant, it provides up to 40 MW of support to the grid for 10 hours/day[8] (ENEFIRST 2020). The plant has been in operation since 1978 but is set to be retired in 2022 (Chhabra 2018).

The decommissioning of the Dynegy Oakland Petroleum Liquid Power Plant and the resulting loss of capacity was flagged as a potential local transmission reliability concern during the Independent System Operator (ISO) Transmission Plan planning process[9] (ENEFIRST 2020). In response, two replacement options were discussed. The first option was to repower the retiring plant with natural gas. However, according to the California EPA, the plant's fenceline communities were already exposed to extremely high levels of toxic particulates and air pollution (Chhabra 2018). Repurposing the plant with natural gas would only have extended pollution in the area and could have generated backlash from the local community. The second option was to build a high-power transmission line through Oakland, requiring expensive

[8] This requirement is to guarantee energy reliability under the California Independent Service Operator (CAISO) Reliability-Must-Run contract (ENEFIRST 2020).
[9] The process was led by California Independent Service Operator (CAISO).

transmission and distribution (T&D) investment and additional siting impacts to communities and local businesses in a heavily populated downtown area. Considering these constraints of environmental impact, economic and social disturbances, and significant economic investment needed, the planning process focused on local clean energy resources.

The local utility, Pacific Gas & Electric (PG&E), and the region's clean energy provider, East Bay Community Energy (EBCE), collaborated to create the Oakland Clean Energy Initiative (OCEI).[10] OCEI planned to replace the plant by expanding distributed resources including clean energy generation, energy system upgrades, and energy storage (EBCE 2020, PG&E 2019, CAISO 2020). OCEI resulted in a project portfolio mix of solar, energy storage, and demand response providing local environmental benefits and a cleaner electric portfolio with a 43 MW storage capacity.[11] The storage system will draw electricity from the grid when demand is low and supply power in times of increased demand, supporting the grid in meeting demand changes and securing reliability (ACORE 2020).

Utilizing storage in decommissioning the Dynegy Oakland Power Plant will reduce toxic emissions and may lead to improved indoor air quality, health outcomes, and comfort and quality of life for frontline communities (PSE Healthy Energy 2020). This in turn may improve property values, facilitate new business attractions, and create jobs in the community. The cost-savings from storage may be passed on to ratepayers to lower the energy burden on low-income customers while reducing their service disconnection risks.

Case Study II: Centralia Power Plant, Washington (1973 – 2025)

The Centralia Power Plant is a 1,459.8 MW capacity coal-fired energy generation facility owned and operated by TransAlta in Centralia, WA (Global Energy Monitor 2021). The Centralia Power Plant is composed of two coal-fired generating units, each with a 729.9 MW capacity (Global Energy Monitor 2021). While both units came online almost together, in 1972 and 1973, Unit 1 retired in December 2020 and Unit 2 is scheduled for early decommissioning in 2025.

The early decommissioning of the power plant was spurred both by local environmental stakeholders' environmental justice advocacy and Washington State's efforts in curbing greenhouse gas emissions.[12] In 2009, environmental stakeholders (for example, Earthjustice) appealed the renewal of Centralia's air pollution permit and led the effort to close the power plant (Earthjustice 2009). In 2010, the Washington legislature introduced a bill to revoke Centralia's tax exemption, which amounted to $4 million/year (Global Energy Monitor, 2021) because the plant was no longer using locally mined coal.[13] A year later in 2011, the state passed the TransAlta Energy Transition Bill which set in place an early decommissioning timeline due to the plant's negative impact on human and environmental health (Ecology, 2020).

The state worked with TransAlta to determine the 2020 and 2025 scheduled retirement dates. This met the state's goals of an early closure for the plant, being only five years later than the

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[10] The Oakland Clean Energy Initiative (OCEI) was approved by CAISO during the 217-2018 transmission planning process. Under OCEI, PG&E focuses on utility-scale storage to meet Oakland's transmission reliability needs and EBCE focuses on local distributed energy resources.

[11] Vistra Energy and esVolta/Tierra Robles Energy Storage, LLC were chosen to develop utility battery storage systems to partially replace the capacity of the retiring plant. The facilities will have a 36.25 MW and 7 MW capacity respectively (Dohrety 2020)

[12] In 2006, the power plant emissions per MWH were approximately: CO_2 7,974,564 tons, SO_2 1668 tons, NO_x 9699 tons, and Mercury 315 lb (Global Energy Monitor, 2021; Vartan, 2018)

[13] The Centralia coal mine was closed in 2006 and The Centralia Power Plant then began sourcing coal from Rawhide Mine in Peabody and Spring Creek Mine in Navajo (Global Energy Monitor 2021)

state's original 2015 retirement proposal, while achieving significant benefits for the local community. TransAlta was also able to recoup its investment while planning to finance a $55 million Coal Transition Fund used to assist workers and communities impacted by the plant closure (TransAlta USA 2020). The Coal Transition Fund will pay $25 million for clean energy projects, $10 million in grants for energy efficiency and weatherization projects (with specific carve-out for low-to-moderate-income households), and $20 million for economic and community development. The community development payment includes an $8 million fund for payout for displaced workers and an additional $1 million for education and retraining. Displaced workers will get a lump sum payment of $44,000 and they can apply for education grants up to $15,000 (McIntosh 2020). Environmental and labor groups played a significant role in the development of the Coal Transition Fund, particularly in negotiating benefits for older workers to retain benefits. The extended plant decommissioning timeline allowed 40 percent of workers to reach retirement age before the plant closure. It also added 8 years for non-retirees in their current jobs (Centralia Coal Transition Grants 2021).

To replace the retiring plant, TransAlta is supporting a feasibility study for long-duration battery storage technology (Centralia Coal Transition Grants 2021). A grant in the amount of $350,000 has been approved from the $25 million clean energy transition fund. This work will assess the role of storage in delivering reliable renewable power while providing benefits to the community. Decommissioning fossil fuel plants requires planning that considers diverse stakeholders, particularly community members. The Centralia case also illustrates how a community-centered model for the decommissioning process can actively engage local environmental and labor groups, local policy makers, and the plant owners in planning a decommissioning and replacement strategy that results in tangible economic benefits to workers and the local community.

Case Study III: Manatee Power Plant, Florida (1970s – 2021)

The Manatee Power Plant is a 1,638 MW capacity natural gas peaker power plant owned and operated by the Florida Power & Light Company (FPL) in Parrish, FL (Proctor 2019). The plant came online in the mid-1970s and is scheduled for retirement in 2021.

FPL decided to replace Manatee's gas-fired generation with battery storage at least partly due to the utility's plan to eliminate over one million tons of carbon dioxide emissions from its portfolio and generate $100 million in savings for ratepayers (FPL 2019). This plan includes installing 30 million solar panels by 2030. Through several smaller battery installations across the state, FPL has demonstrated the cost-effectiveness of battery technology. The Manatee replacement project includes a solar plus storage plant including a 409 MW capacity energy storage facility (Manatee Energy Storage Center). The storage system will cover a 40-acre parcel of land and will be distributing 900 MWh of electricity. According to FPL, this will be the world's largest energy storage system (FPL 2019).

The storage technology will help Florida realize the full benefits of its abundant solar power and other clean energy resources. The solar plus storage integration offers a compounded benefit in saving customers money (approximately $100 million savings to ratepayers), reduced emissions (1 million tons of CO_2), improved service reliability, increased clean energy penetration, and new job creation (approximately 70 new jobs during construction) (FPL 2019).

Considerations for future research

All three case studies identified storage as the technology of choice to support the energy transition from fossil fuel plants. These case studies also highlighted the current stages of storage project development, from the initial feasibility study (Centralia) to implementing 43 MW (Dynegy Oakland) to 409 MW (Manatee) of storage. In the next decade, many fossil fuel power plants will be reaching the end of their working life, while clean energy mandates and tax incentives are increasing (Pontecorvo 2020, Balducci, et al. 2018). Storage can provide the critical services that were traditionally offered by fossil fuels in the energy system, filling a critical capacity gap, while supporting federal, state, and local decarbonization goals and community needs (Table 2 Summary of energy storage benefits in power plant decommissioningTable 2) (Deloitte 2015, Balducci, et al. 2018).

Table 2 Summary of energy storage benefits in power plant decommissioning

Benefit	Description
Reliable and affordable energy supply	• Accommodates variable renewable energy and expanded electrification advancements • Energy security during physical and cyber-security threats
Clean environment	• Increased and effective renewable energy integration • Decreases need for new baseload/ peaker power plant construction
Strong energy infrastructure	• Enhances grid flexibility • Supports efficient power plant operation, transmission, and distribution

Capturing the full capabilities and benefits of energy storage is crucial to accurately assess the value of storage systems. Without, assessments will significantly undervalue energy storage systems and investment will be stalled with repercussions on ratepayers, communities, and the energy transition. As future work continues to assess the non-energy benefits, researchers, utilities, and policymakers need to work with communities to understand past decisions and inform future decision-making tools that account for environmental, economic, and social impacts, particularly on disadvantaged and fenceline communities.

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