Pacific Northwest
NATIONAL LABORATORY

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Energy Equity and Environmental Justice Workshop Report

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1.0 Overview

On December 11, 2020, 28 PNNL staff members discussed research to advance energy equity and environmental justice at a two-hour internal workshop. The primary purposes of the workshop were to baseline existing efforts at the laboratory and brainstorm future research activities.

Outcomes of the workshop:

- **PNNL is already conducting work across the spectrum of sponsors and topics that relate to energy equity and environmental justice, but in few instances are they explicit or primary goals of the research.** PNNL staff expressed a strong desire to organize existing work, develop research with explicit goals to advance equity, and to make equity part of all research we do. Where there are programs and projects, we should gather them together and develop higher-level takeaways. For example, PNNL conducts environmental justice reviews as part of the National Environmental Policy Act (NEPA) review for nuclear siting under the Nuclear Regulatory Commission (NRC) and operates a lighting program that supports human health outcomes for the Building Technologies Office of Energy Efficiency Renewable Energy (EERE) of the U.S. Department of Energy.

- **Equity and environmental justice are complex terms that require definitional aggregation and careful considerations**. There are many types of equity: racial, economic, gender, age, geographic, and other demographic descriptors. Certain work is community-scale (Energy Transitions Initiative); other work is concerned with human-centered experience, affordability, and access.[1]

- **There is foundational work to be done**. While we can develop research questions, in many cases there are few supporting datasets or difficulty in adapting information to traditional energy modalities and analytical tools. Another critical first step is in baselining: a better understanding of our current condition, how that has changed over time, relationships and trends between demographics and energy system characteristics and investments.

- **Utilities, state, regional and national partners and sponsors recognize the importance of advancing equity as part of technology and grid futures.** Staff indicated partners across the country are looking into this topic and trying to understand the possibilities and the implications. PNNL does not have deep expertise in this area and should engage partners, including other laboratories, for highest impact.

This report covers the workshop discussion and new research areas and questions, broken into energy system topics. Appendix A lists PNNL staff in attendance and Appendix B contains a full workshop agenda.

[1] https://www.pnnl.gov/news-media/mapping-electricity-affordability

2.0 Workshop Discussion

A critical but underdeveloped component of investigating electric grid modernization and technology futures is equity. To advance equity, a high-level set of research aims might be: fair and affordable access to the electric system for all citizens; wealth from innovation investments accruing to more sectors of society; adjustments to electric system planning and technology design to increase the *value* of those investments to more communities; and environmental justice advances by reducing direct localized and systemic environmental effects.

2.1 Definitions and Purpose

The workshop attendees agreed that the terms equity and environmental justice were complex and multi-variate. There are several types of equity (not equality) that have different characteristics, with different supporting data and relationships to the motivating question, with no simple optimization solution. There are working definitions for environmental justice that are operational today (see 2.2.1 below). Diversity, equity and inclusion (DEI) is an emerging term that encompasses workforce and internal or institutional operations. Attendees discussed the basic need to develop definitions in order to pursue research.

The recent Washington Clean Energy Transformation Act offers this definition:

> The equitable distribution of energy benefits and reduction of burdens to vulnerable populations and highly impacted communities; long-term and short-term public health, economic, and environmental benefits and the reduction of costs and risks; and energy security and resiliency. [§1(6)]

2.2 Existing Work

While much equity work is ongoing at PNNL, it is not coordinated under a specific program and is distributed across many projects. The workshop offered a forum for researchers to share their ongoing efforts. A pre-identified sample was discussed in the workshop.

2.2.1 Environmental Justice Reviews

PNNL conducts environmental justice reviews for the Nuclear Regulatory Commission (NRC). These reviews stem from the definition of environmental justice in Executive Order 12898.[2] As part of a NEPA analysis, PNNL evaluates the potential for explicit impact from nuclear siting on minority populations and low-income populations. Since a definition for environmental justice already exists in this context, the analysis answers the question as to whether environmental justice can be ensured.

2.2.2 Lighting

[2] https://www.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice Executive Order 12898 -- *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (1994). "…each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations…"

PNNL's Advanced Lighting team has documented tunable lighting installations in senior care, hospital patient rooms, behavioral health units, and elementary school classrooms, with several results applicable to equity challenges:

Senior care facilities – A recent study in a senior care home specifically looked at how better control of light intensity and color can improve resident sleep quality.[3] Retrofitted lighting to enable dimming and color tuning could improve the large proportion of senior care centers that are in older, inefficient buildings.

Classroom lighting – Tunable lighting in standard and special needs classrooms gives teachers another tool for managing the environment, cueing activity changes and directing students' attention.[4]

Hospital patient rooms – Research based on surveys of hospital nurses concerning patient room lighting revealed the need for better control of light intensity and color.[5]

2.2.3 Community Resilience

Within Powering the Blue Economy, DOE is looking at how ocean sectors have new energy needs and how those spaces converge. Coastal communities aren't all big cities. They often rely on fishing and logging industries and can have high energy costs. They also are on the front lines of climate change impact, but they aren't always in favor of renewable energy development. We can consider more community-based approaches to better enable this transition. We are also thinking about ocean-based climate mitigation strategies.

As part of the Energy Transitions Initiative Partnership Program[6], PNNL is supporting the creation of a rural and island grid community cohort. This cohort will receive support from the national labs in establishing an energy vision for their community. While this work is still in its early stages, they have established five regional partners to work with in Alaska (2), Hawaii, Maine, and South Carolina.

2.2.4 Rate Affordability

As part of the Grid Modernization Laboratory Consortium, PNNL calculates affordability metrics such as affordability gap, electricity cost burden, average electricity rates, electricity cost/customer, and rate indices using monthly data from EIA's Form 861. This work helps show the economic equity of electricity costs, both spatially and temporally, through its online viewer.[7]

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[3] https://www.energy.gov/eere/ssl/downloads/measuring-light-exposure-and-its-effects-sleep-and-behavior-care-center-residents

[4] https://www.energy.gov/eere/ssl/downloads/evaluating-tunable-lighting-classrooms

[5] McCunn LJ, Safranek S, Wilkerson A, Davis RG. (2020). Lighting Control in Patient Rooms: Understanding Nurses' Perceptions of Hospital Lighting Using Qualitative Methods. HERD: Health Environments Research & Design Journal. Online Aug 12, 2020. https://doi.org/10.1177/1937586720946669 or https://www.energy.gov/sites/prod/files/2020/08/f77/ssl-mccunn-etal-2020-nurses-perceptions-hospital-lighting.pdf

[6] https://www.energy.gov/eere/about-us/energy-transitions-initiative (multi-lab partnership led by NREL)

[7] https://gmlc.pnl.gov/affordability/

2.3 Baselining and Business Models

A starting question:

What would an equitable grid look like? The electric grid of today was built to minimize financial cost, meaning that non-monetary impacts on the environment and society generally weren't considered. As equity objectives are incorporated into grid planning and operations, what will the impacts be, in terms of both finances and social welfare?

This is difficult to do without baselining, which certain partners (e.g., ACEEE) have done.[8] Some utilities have developed both implicit and explicit approaches (e.g., tariffs, cost-based rates) to addressing low-income populations. Still: can we be more systematic and go deeper than costs, and actually address inequity? Certain business models may invite equity structurally: for example, membership cooperative models that were successful in electrifying rural communities. These may lend well to community-based electricity business models, or other private business approaches.

3.0 Energy System Topics

For workshop purposes, the organizers chose broad energy topics as a starting point for research questions:

- Energy storage
- Resilient grid
- Built environment
- Transportation
- Distributed systems
- Renewable energy

The relationship between equity and these traditional energy domains is not yet clear, but it is a useful starting point to assess previous work, brainstorm high impact motivating questions, and connect them to our research activities. Over time, this organizing structure may shift as we learn more about equity and environmental justice needs and research approaches.

3.1 Energy Storage

3.1.1 Discussion

Energy storage programs at PNNL already actively work with regulatory and utility stakeholders, a strong base from which to look at questions about people, value, culture, and broad improvements in the grid. We can consider how different types of entities are structuring agreements and incentives in the energy storage space.

[8] https://www.aceee.org/white-paper/low-income-ee-baseline

There are several examples. A Vermont utility (Green Mountain Power) is partnering with customers in developing behind-the meter (BTM) storage to reduce utility and customer costs.[9] The customer can use the battery during outages, but the utility can control the assets otherwise on an aggregated basis to reduce peak needs and provide other grid services, thereby reducing expenditures on generation and transmission resources. While participating customers capture the resilience benefits and bill savings of the BTM storage systems, the reduced system costs accrue to all customers. And since the utility is leveraging the private investments of participating customers, program benefits are achieved at a reduced cost to non-participating customers.

In Oakland, CA, a peaker plant powered by jet fuel was selected for retirement. Working with the distribution utility and the community choice aggregator that served the area, the California Independent System Operator (CAISO) determined that it would be more cost effective to site energy storage and distributed energy resources in the Oakland area than to build enough additional transmission assets to deliver power to the area. The distribution utility took on the responsibility of acquiring the energy storage, while the community choice aggregator initiated a program to assist local customers in deploying distributed generation.[10] By reducing local environmental impacts from energy generation and helping the customers who have historically born those impacts directly benefit from the clean energy transition, the Oakland Clean Energy Initiative is an example of how enabling equity can present multi-faceted challenges.

3.1.2 Potential research questions

- Index of non-power benefits from storage integration with non-electric system infrastructure or systems
- Evaluation of storage solutions to resolve environmental justice challenges (physical interactions) with the power system.
- Alternatives analysis & non-power benefits for storage vs. transmission or generation solution (eg. decommissioning of thermal plants and replacement with battery storage to solve load pocket problems)
- Analysis of policy and regulatory design related to storage for enhanced equitable outcomes
- Study on potential economic benefits for rural environments – especially farming-centered and tribal communities – of storage development
- Opportunity assessment for environmental benefits associated with storage solutions – policies and programs needed to send proper price signals to achieve environmental benefits.
- Evaluating of potential business models such as pooled investment, community banks, social investment portfolio funds and sustainable corporate metrics for storage solutions
- Siting potential for storage to optimize for equity or environmental outcomes

3.2 Resilient Grid

3.2.1 Discussion

The idea of resilience on its face appears to include the community and social dimensions of the electric system, but to date the focus has been on the infrastructure and operational conditions

[9] https://greenmountainpower.com/rebates-programs/home-energy-storage/bring-your-own-device/battery-systems/
[10] https://ebce.org/ocei/

of electricity service. What would it mean to integrate equity into a resilient grid, and what competing interests exist when trying to create both an equitable and a resilient power grid?

Referencing the discussion about about recognizing the resilience challenges of coastal communities, they are also on the front lines of climate change are often economically depressed with high energy bills; however, those same communities are sometimes hesitant to adopt renewable technologies. How might that tension be reconciled to create energy transitions that communities support?

There's a need to take a broader and integrative viewpoint when valuing resilience, one that is inclusive of people and community resilience. A useful metric in the buildings space is "exposure risk," which can be applied elsewhere. When considering the impact of wildfires on indoor air quality for low-income households, for example, what is the exposure risk to particulate matter or extreme heat? The ReNCAT tool, created by Sandia, produces a "community burden" metric based on community's access to critical resources in a disaster.

Health, support services, infrastructure, and other population-centric decisions are being made by state legislatures and city councils, and the approach for program implementation should be similarly community centric. We also need to think about how we drive *speed* and *scale* in addition to taking a community perspective in order to address climate change effects. Can we develop a playbook and scale it, as a way to put tools in the hands of governments and get closer to what communities need? At the same time, we need to avoid top-down approaches and instead favor a community oriented/led approach; consider a wide-scale approach over top-down, or at least, a combination between scaling up and a wide-scale approach will be necessary to create balance.

3.2.2 Potential research questions

- Relationship between public health and reliable supply / energy security
- Relationship between wealth and reliability. Least reliable systems (reliability metrics SAIDI SAIFI) correlated with economic disadvantage or other demographic (Western rural co-op customers, due to equipment age and geographic distance, fewest customers per line)?
- Tipping points: buy rather than retrofit (mobile homes), decommission and replace rather than retrofit (thermal plants)
- Analyze methods to drive markets/investments toward more equitable outcomes (systemic fix), rather than guard against harm to vulnerable populations after the fact (defense).
- Elasticity of regulatory models for traditional "least cost" strategies and affordability; potential methods of devising and valuing equity metrics
- Pathways for legacy customers in an increasing gap in electricity service costs as large loads exit the system.
- Shifts in large populations due to climate migration and effects on electric loads
- Wildfire, public safety power shutoff, and long-term transmission and corporate liability models
- Community-scale resilience approaches (Energy Transitions Initiative)
- Baselining in order to illustrate the change – how well do we understand current conditions in a comparative format, relationships, levers, trends.

- Racial review – explicit policy review for effect of programs/policies/rate design/price design to racial groups
- Rate making as social policy – electricity as a social good, a right – the effect of price depression in driving other opportunities (e.g. no active marketing from solar PV, solarize programs, due to avoided cost rates / net metering rates)
- Smart Grid and elderly populations or folks with lower technology aptitude (studies show time of use rates do not have strong negative impacts on these communities)
- Membership cooperative business model – old and new community-based electricity models (CCAs, community solar model). Relationships to telecommunications, health, business.

3.3 The Built Environment

3.3.1 Discussion

As most of us spend the majority of our time inside buildings, ensuring equity in the built environment has significant implications for ensuring equitable distribution of energy costs, equitable benefits of new technologies, and subsequent health effects. Previous research has examined building energy codes through an equity lens and how disparities in the quality of housing can have disproportionate impacts on low-income or rural communities. There is a strong interest in metrics to quantify equity in buildings to ensure it is adequately considered in research and deployment programs.

In the residential buildings space, there is currently a focus on workforce development programs and going beyond traditional weatherization assistance measures to enable deep energy retrofits on an equitable scale in the short term.

Motivating questions: How does access to energy efficient technologies vary between socio-demographic groups in different types of buildings? To whom and to what extent does wealth accrue as a result? What type of adverse health conditions are generated from inadequate housing conditions and to whom?

3.3.2 Potential research questions

- Multi-family retrofit/re-tuning deployment programs focused on low-income housing; helping to solve the split-incentive, energy savings get passed on to tenants; partnering with organizations like NHPD, WAP, HUD, and other affordable housing advocates
- Analysis of how access to energy efficient technology varies by socio-demographics; both in single family and multi-family households, and commercial buildings (especially small commercial)
- Analysis of how energy performance of buildings varies by socio-demographics; both in single family and multi-family households and commercial buildings
- Analysis of prevalence of smart-building technology in multi-family and commercial buildings across socio-economic areas
- Analysis of access to consistent and operational HVAC climate control in affordable housing, particularly in rent-controlled buildings
- Quantifying health outcomes of building residents across different economic levels of housing. This could include things like the impact of quality lighting and control over heating/cooling and associated comfort for workers and residents.

- Understanding virus transmission through HVAC systems in multi-family housing
- Workforce training programs in diverse and low-income communities focused on installing energy efficient HVAC technology. This could be expanded to focus on contractor training around additional building systems. Analysis of market barriers that are impeding uptake of cost-effective but underutilized technologies such as low-e storm windows
- Research that leads to a better understanding of potential partnerships and deployment approaches to reach underserved communities and improve equity. For example, what community groups and nonprofits, and state and local programs could be tapped to support both equity and workforce development?

3.4 Transportation

3.4.1 Discussion

This space is slightly different than energy systems, as there are local facets of government and transportation authorities. At a federal level, there are other agencies like the Department of Transportation. Transportation may approach equity through a lens that lumps together health and access to transportation through clean cities programs. See Seattle City Light's electrification transportation plan, which considers bus range and access.[11]

Additionally, environmental justice is an issue for ports and maritime transportations and an entry point to build support for decarbonization and low emissions fuels and port electrification. We are exploring this through the Powering the Blue Economy Initiative.

This is a clear priority area for internal development.

3.5 Distributed Systems

3.5.1 Discussion

There was a Rocky Mountain Institute E-lab Accelerator related to distribution system planning with stakeholders in Oregon, in which PNNL participated.[12] The goal was trying to imagine what a human-centered approach to distribution system planning would look like to help inform guidelines; conversation focused on transparency, accountability, and communication. They noted that while a utility's goal is to provide a reliable grid, there's also a need for utilities to acknowledge that some communities and cities have energy goals; customers want a say in what their energy looks like. The E-lab Accelerator aimed to start those discussions and formalize what accountability looks like. Utility score cards were one proposed solution. The guidelines for the Oregon system distribution system planning have been released, and they include some recommendations from the E-Lab Accelerator.

Examples of equity in distribution system planning:

- Hawaii has an integrated grid planning process, which includes a stakeholder council to provide input.

[11] Seattle City Light Transportation Electrification Strategic Investment Plan: 2021-2024 – Racial Equity Analysis

[12] https://rmi.org/elab-accelerator-2020-teams-oregon-distribution-system-planning/

- California requires environmental justice assessments for new energy projects.[13]

Things are still process driven in this space. Work needs to be done to show what an equitable *outcome* would look like, or what the difference would be.

3.5.2 Potential research questions

- Analyze long-term effects of distributed approaches on equity objectives. Changing grid topology from central to distributed approaches – behind the meter and distribution-system scale generation, storage, microgrids – may result in widening gap in customer electric service based on consumer and community wealth and associated resources.
- Analyze effectiveness of new policies / funds to prioritize mid- to low-income beneficiaries (LBNL and others with initial studies). Incentive-based DG, electric vehicle, and efficiency programs do not reach low- to middle-income consumers as effectively, requiring specialized approaches ("Solar for All" or community solar).
- Comparison of co-siting or co-optimizing benefits across control schemes, with two site-specific simulated feasibility studies (water and energy, or transportation)
- Adjust or re-design transactive energy price signals to account for wealth and access inequity. Participation in specialized rates and transactive energy programs assumes the ability to accept risk and the technology and sophistication to interact with price signals. How can transactive energy price signals be adjusted or re-designed to account for wealth and access inequity? What broader impacts are generated as a result?
- Analyzing the potential for leveraging private investment in distributed resources to improve service and reduce costs for all customers.
- What are the long-term equity effects of localized programs (e.g., financial incentives available to all, LMI-only incentives, leasing, PACE, and solarize programs) across the country?

3.6 Renewable Energy

3.6.1 Discussion

In addition to resilience and distributed energy resources, the renewable energy sector introduces questions about wealth distribution and community value. Policy strategies (e.g., renewable energy credits) and tax incentives have become financially sophisticated over the last decade, resulting in a system that benefits only those who can afford large, upfront capital expenditures. Without a preference for diversity in renewable resources, certain industrial sectors will continue to grow in the clean energy transition while those who lack the financial capital or tax appetite to benefit from existing programs will languish, with geographic wealth implications.

Also of interest is moving beyond siting processes with minimum standards and avoiding harm toward adding value to local communities. Value could be in integrating and supporting other community functions and systems, contributing to community health and well-being, providing high-wage jobs and opportunities for long-term economic success, serving as a draw to the community or a point of distinguishing recognition.

[13] https://calepa.ca.gov/envjustice/

There is a shift in thinking about the value of renewable energy beyond simply providing energy or mitigating climate change. This is reflected in industry rebranding from resource specific development and associations (wind, solar) to clean power and smart power. It is also reflected in the emergence of hybrids. We can now consider organizing around challenges rather than technologies. There is an opportunity to better understand what communities need and help them reach those goals instead of strictly focusing on single technologies. The landscape is different than 10 years ago. The question used to be: do these technologies work? Now it is: how do these technologies work together?

Renewable energy research and incentive programs in the past three decades have been focused on reducing the cost of renewable energy and deploying it on the grid. Now that those goals have largely been achieved, with widescale deployment at low cost, there is an opportunity to pause. We can be more strategic in deploying these technologies to secure a wider set of societal benefits and improve equity outcomes.

3.6.2 Potential research questions

- Exploring the equity and environmental effects from technology features (e.g. tradeoffs from prioritizing certain environmental effects over others, ability to be sited within communities, level of disturbance and safety, rare earth elements required) and emphasized technology developments and mandates.
- Assess macro-economic / wealth implications of investment in different clean energy portfolios (consider diversity in resources, maritime opportunities)
- Develop and analyze far-reaching concepts (e.g. price/tariff structures from dominant, abundant, and cheap generation due to zero fuel cost resources with sufficient storage)
- Assessment of clean energy futures against equity or environmental (beyond GHG) metrics; modeling scenarios with specific equity or environmental objective functions beyond production (variable fuel) cost
- Leveraging/prioritizing renewable energy development to displace fossil resources with the most severe health/environmental impacts
- As time of use rates and other price structures emerge to facilitate renewable integration, how can we assure equal access to the technologies needed to respond to those signals and minimize energy costs
- Providing economic stabilization to communities affected by renewable energy transition
- Exploring the impact that community solar and community hydropower projects have on wealth distribution and technology access in a community.
- Assessment of the macro-economic and wealth implications of investments in different clean energy portfolios (e.g., resource diversity, maritime opportunities).
- Full life-cycle assessments of renewable projects that are built on undeveloped areas of exurban land that also include the placement of peaking generation units on cheap urban land (near fence line communities).

4.0 Key Outcomes

Several key outcomes were noted from the workshop that reflect the current equity and environmental research space, PNNL's existing efforts, and material content for consideration in research projects.

- Staff consensus that equity and environmental justice are critical, and we should find a way to do this work.
- PNNL already works in this space, but it is not fully developed or coordinated.
- Research opportunities span across all technologies and DOE office interests, as well as our state and utility partners.
- There is a clear need for baselining in this space. Graphical representations of how data can inform community-based decision making would be helpful.
- There is a spectrum of partners in this effort, many of whom know more about equity than we do.
- Equity work needs to put communities at the forefront and engage with governments to address their specific needs.
- There is a widespread shift occurring in the industry and government with respect to equity,[14] and states are already reaching out to DOE and the labs for technical assistance on this topic
- It would be useful to be identify tools, methods, and/or approaches that PNNL uses to consider equity issues.

5.0 Next Steps

At the conclusion of the workshop, significant interest was expressed in reconvening to continue discussing how PNNL can build coordinated research capabilities in energy equity and environmental justice. Specifically, workshop participants agreed to the immediate next steps:

- Think and talk – reflect on the workshop discussion and how continued coordination might take place. Build a Teams channel for internal coordination.
- Literature review – establish a more complete understanding of state of the art, available data, what work is already well covered and what is incremental in the current research environment, appropriate role for research and national laboratory.
- Capability leveling – assess expertise and tools we already have in place.
- Outreach and partnerships – start the engine of learning from others and seeking feedback on research concepts.

Longer-term, next steps could be:

- Convene partnerships and workshops in the energy, environmental, and equitable solutions space

[14] Washington state's draft energy strategy includes equity considerations. https://www.commerce.wa.gov/wp-content/uploads/2020/12/Washington-State-2021-Energy-Strategy-Second-Draft-12-02-2020.pdf

- Metrics and baselining activities
- Develop research projects and programs to respond to equity and environmental justice
- Assess data needs and methods
- Develop educational and informational tools to relay the importance and opportunity of addressing energy system inequities
- Case studies and technical assistance tools
- Community-scale solutions and value, program development
- Large-scale grid future research questions

Appendix A : Workshop Attendees

- Dave Anderson
- Chrissi Antonopoulos[15]
- Angela Becker Dippmann
- Sarah Barrows
- Juan Carlos Bedoya Ceballos
- Dhruv Bhatnagar
- Casie Davidson
- Kathleen Doty
- Sumitrra Ganguli
- Simon Geerlofs
- Sarmad Hanif
- TJ Heibel
- Juliet Homer
- Kathleen Judd
- Michael Kintner-Meyer
- Jen Lessick
- Tom McDermott
- Jodi Melland
- Sarah Newman
- Rebecca O'Neil
- Alice Orrell
- Rajiv Prasad
- Rob Pratt
- Danielle Preziuso
- Abhishek Somani
- Dennis Stiles
- Karen Studarus
- Jeremy Twitchell

[15] Investigating equity in the low-income residential building sector through the use of a Home Energy Scores data set in Portland (https://www.sciencedirect.com/science/article/pii/S2590252020300027).

Appendix B : Agenda

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Equity Workshop
PNNL Internal Review
Friday, December 11, 2020

AGENDA

DATE/TIME (Pacific)	TOPIC
10:00 – 10:20 am	Welcome Concept Overview Introductions Equity characteristics – health, racial, social, economic Environmental justice
10:20 – 11:00 am	Review of related work already happening at PNNL DOE Context – beyond sponsors Program lenses: • Storage – Jeremy Twitchell • Distribution systems – Juliet Homer • Renewables – Rebecca O'Neil • Community resilience – Simon Geerlofs • Buildings • Transportation
11:00 – 11:40 am	Review of the paper and research areas, broadly defined Stakeholders
11:40 – 12:00 pm	Next steps • Workshop summary • White paper • Continued coordination internally • Think

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