Measuring Equitable Impacts in the Clean Energy Transition

Leigh Michael, ILLUME
Stefani Penn, Industrial Economics

ABSTRACT

As the United States moves toward a clean energy future, it faces a reckoning: one that acknowledges that certain communities have experienced harms from traditional energy systems. To account for this, federal and state governments have introduced policies including Justice40 and New York State's Climate Leadership and Protection Act to ensure the clean energy transition centers equity. But how do you go about understanding whether a policy is working as intended? How do you measure whether policies are achieving equitable outcomes?

This paper shares promising practices around how jurisdictions can approach measuring equitable processes and outcomes in clean energy investments. Leveraging our experience with states, agencies, and utilities, we discuss strategies to:

- Convene collaborators (community members and decision-makers): Engage those who represent priority populations that are integral in the decision-making process.
- Define 'benefits:' Work with key community members and decision-makers to define which benefits (and risk reductions) from the clean energy transition are most meaningful to them.
- Leverage data: Collaborate with agencies, utilities, and other entities to understand what data can be leveraged to measure benefits.
- Develop replicable methods: Develop sound, replicable methods to measure the benefits that are accruing in communities that have been overburdened by pollution and public health risks.
- Measure impacts: Leverage methodologies to measure impacts—be it benefits or burdens—to priority populations.
- Iterate and update: Review results with community members and decisionmakers who reflect the lived experiences of priority populations. As needed, iterate and update methods and approaches.

This paper will serve as a high-level roadmap to illustrate how equity impacts in the clean energy transition can be measured, shared, and improved upon.

Introduction

The United States (U.S.) is amid an important energy transition, where we move from burning fossil fuels for energy to generating energy through renewable non-polluting sources. The opportunity is expansive: In 2023, the U.S. generated only 13% of energy from renewable sources, while 79% of energy was generated by burning fossil fuels (EIA 2023). At the same time, a deep history of inequity and injustice underpins our energy systems, as structural racism spurred a century of disinvestment in racially segregated neighborhoods. This catalyzed an imbalanced distribution of costs and benefits of the energy system across the population. Those most endangered by energy generation hazards are also those least responsible for them.

The Biden Administration has prioritized efforts to work at the nexus of clean energy and environmental justice through Executive Orders 14057 (Catalyzing Clean Energy Industries and Jobs through Federal Sustainability), 14096 (Revitalizing our Nation's Commitment to Environmental Justice for All), and 14008 (Tackling the Climate Crisis at Home and Abroad). The federal government has declared a goal that 40% of the overall benefits of climate, clean energy, affordable and sustainable housing, and other related investments flow to disadvantaged communities. This is known as the Justice40 Initiative. While Justice40 asserted this goal, the federal government lacks a consistent framework within which it may clearly define, value, and measure benefits to disadvantaged communities. Other states have followed suit with legislation to advance *energy justice*, "the goal of achieving equity in both the social and economic participation in the energy system, while also remediating social, economic, and health burdens on those disproportionately harmed by the energy system (Department of Energy Office of Energy Justice and Equity 2024)." However, each state must determine how they will define, value, and measure those benefits in a way that aligns with the parameters of that state's demographics, needs, and energy system.

In this paper, we posit that, while federal and state-specific goals to ensure clean energy investments accrue in historically marginalized, underserved, and overburdened communities provide motivation for action, these goals do not extend far enough to include the practical and clear methods that are required to determine whether investments are meeting the goals or the moment.

We acknowledge that, while this framework provides some practical guidance on specific methods that can be used to calculate the monetary value of benefits, it does not supplant the need to engage meaningfully with those communities that have been historically marginalized, underserved, and overburdened to understand the unique and specific issues they face.

In this paper, we broadly refer to communities that have faced inequitable impacts from energy systems as **priority populations**. We acknowledge that, across industries and jurisdictions, many different words are used to describe what we refer to as priority populations (e.g., disadvantaged communities, underserved communities, historically disinvested communities, environmental justice communities). There is no singular term to encompass communities that may experience disproportionate impacts related to climate change and energy service delivery. Terms also have specific meanings in a variety of contexts. The future of equitable service will require new modes of collaboration between utilities, communities, and government. Coordination around common terminology is essential in designing initiatives and directing funds toward the end goal of equitably serving all communities.

We begin with background around the history of inequity that underpins our energy systems. We then provide context around key legislation seeking to usher forth an equitable clean energy transition. Next, we provide a replicable six-step framework entities can adopt to define and measure equitable outcomes. We complement this framework with case studies to illustrate how some entities have approached this work. We also acknowledge possible unintended consequences or potential implications, then conclude with key considerations.

Background: A past and present of systemic energy inequity in the United States

The history of energy inequity is rooted at the intersection of the industrial revolution, the use of inexpensive coal and oil for steam engines across industries, and red lining policies. The

very lifecycle of energy systems – from infrastructure siting to energy generation to distribution of energy– benefits and burdens people disproportionately, with Black communities, Indigenous communities, people of color, people who experience low-income, youth, older adults, recently arrived immigrants, those with limited English proficiency, and people with disabilities facing the most acute impacts (ACEEE 2024). Further, the historical, social, cultural, and economic dimensions of inequity are interrelated, as a 2022 Nature study posits: "energy inequity is not just a lack of money to meet basic energy needs – it is a lack of access to the capabilities that enable a sustainable and prosperous society built on just principles (Scheier and Kittner 2022)." We reference common 'themes' on inequity in the rest of this section, though we acknowledge that the burdens communities face are nuanced and often specific to geographies, demographics, and lived experiences. Further, exclusionary decision-making processes and policies have prevented priority populations from meaningfully engaging—or having their needs reflected—in energy systems. Therefore, this is not a complete summary of inequity but rather a means to illustrate and address the far-reaching ways that inequity shows up within the energy space.

Many adverse **health impacts** are caused by environmental pollutants, including, for example, exposure to air pollutants from power plant emissions and the heavy trucks that serve those plants, contaminated drinking water from improper storage of waste from fossil fuel burning plants, ingestion of emitted lead and mercury that has deposited in soils that make up backyards and agricultural lands. A 2023 study analyzed the relationship between Homeowners' Loan Corporation (HOLC) grading (i.e., redlining) and fossil fuel power plants. The study found that redlined neighborhoods had a higher likelihood of a plant being built in the community (72% higher between 1940 and 1969; 31% higher between 2000 and 2019) and higher present-day emissions of health harming pollutants compared with yellow-lined neighborhoods alone (Cushing, Li, and Steiger 2023). Some states are part of the Regional Greenhouse Gas Initiative (RGGI), a market-based emissions reduction program. In RGGI states, the percentage of people of color is nearly 24 percent higher than the percentage of white people living within ten kilometers of power plants. The percentage of people living in poverty is more than 15 percent higher than the percentage of people not living in poverty within five miles of power plants (Declet-Barreto and Rosenberg 2022). While RGGI reduces environmental burden on a broad scale, it does not address the localized disparities perpetuated by energy systems.

Beyond pollutant-related health impacts, the inequities in the **resiliency** of energy systems create additional burdens for priority populations. Resiliency is the ability of an energy system to rebound from a disruption; a reliable energy system is necessary to meet the ongoing energy needs of a community. Low-income communities, which often contain aging housing and overused infrastructure, tend to have less reliable energy connections than other communities, disrupting the energy access that is necessary for refrigerating food and keeping lifesaving medical equipment running.

The U.S. has permitted energy generating units, pipelines, hubs, and distribution points across the country to meet growing energy demands. In turn, the energy system has created **economic opportunity** within communities. The energy system brings with it jobs, both long-term operations and maintenance roles and short-term construction, engineering, planning, and demolition roles. However, utilities build energy infrastructure in communities that have lower property values so they can maximize their investments; these communities tend to experience lower incomes, and meaningful higher paying energy job opportunities are not necessarily available to those who are negatively impacted by the new infrastructure.

The transition to clean energy sources creates robust **workforce opportunities.** The 2023 U.S. Energy and Employment Report indicates that the energy workforce added nearly 300,000 jobs in 2022, 38% of which were clean energy jobs. Employment in clean energy jobs has expanded at a faster pace compared to overall U.S. job growth in recent years. The Department of Energy (DOE) reported that clean energy job growth increased beyond the overall increase in national employment (DOE Office of Energy Jobs 2023). However, the DOE also found that women and Black and Hispanic or Latino workers continue to be underrepresented in the industry. For example, Black workers comprise just 9% of the clean energy workforce, despite comprising 13% of the national workforce. The clean energy workforce has been filled predominantly by white non-Hispanic men (Muro, Tomer, Shivaram, and Kane 2019).

In addition, certain communities face disproportionately higher **energy burden,** which is defined as the percentage of gross household income spent on energy costs (Department of Energy Office of State and Community Energy Programs 2024). Households that pay more than 6% of their household income on energy costs have a high energy burden. High energy burdens require a disproportionate share of a family's resources to be spent on energy, reducing available funds that can be spent otherwise. A 2020 ACEEE study found that, while the median energy burden is 3.1%, the median energy burden for those experiencing low income is 8.1%. The study found that households of color are also disproportionally impacted, with 36% of Black households, 28% of Hispanic households, and 36% of Native American households experiencing a high energy burden (Drehobl, Ross, and Ayala 2020). Figure 1 summarizes the energy burdens across demographic subgroups (i.e., income, race and ethnicity, age, tenure, and housing type) compared to the national median energy burden.

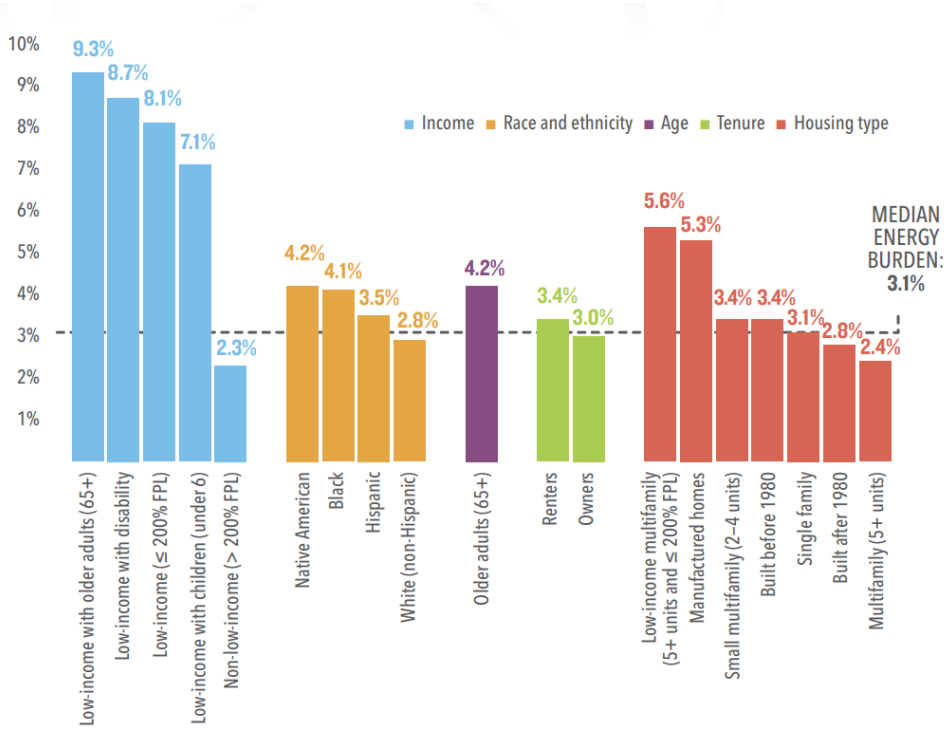

Figure 1. National energy burdens across subgroups (i.e., income, race and ethnicity, age, tenure, and housing type) compared to the national median energy burden. *Source*: Drehobl, Ross, and Ayala 2020.

As state, municipal, and federal agencies plan to deliver a clean energy transition that is distributed equitably, they must ground these efforts in the long standing history of inequity – that is, understand how inequity has shaped the lived experiences of certain communities, and then create a clear, measurable roadmap to resolve those inequities.

A Path Forward

As we look forward to a clean energy future, the federal government and states are seeking to usher forth an equitable clean energy system – one where, as the Pacific Northwest National Laboratory (PNNL) puts it, "*the economic, health, and social benefits of participation extend to all levels of society, regardless of ability, race, or socioeconomic status. Achieving energy equity requires intentionally designing systems, technology, procedures, and policies that lead to the fair and just distribution of benefits in the energy system (PNNL 2024)*." This requires thinking of energy systems broadly and thinking broadly of the ways in which energy systems can impact communities.

At the federal level, the DOE seeks to take this holistic approach through its implementation of Justice40. In coordination with the White House Environmental Justice Advisory Council, DOE identified eight priority areas for Justice40 implementation, (Department of Energy Office of Energy Justice and Equity 2024) including:

- Decrease energy burden in disadvantaged communities (DACs).[1]
- Decrease environmental exposure and burdens for DACs.
- Increase parity in clean energy technology (e.g., solar, storage) access and adoption in DACs.
- Increase access to low-cost capital in DACs.
- Increase clean energy enterprise creation and contracting (MBE/DBE) in DACs.
- Increase clean energy jobs, job pipeline, and job training for individuals from DACs.
- Increase energy resiliency in DACs.
- Increase energy democracy in DACs.

Similarly, New York State introduced the Climate Leadership and Protection Act in 2019, which mandates that a minimum of 35% of the State's clean energy investments benefit disadvantaged communities. New York State agencies, in concert with the Climate Justice Working Group, defined five key benefit categories to guide agencies, and entities on the tracking and reporting of investments to disadvantaged communities (NYSERDA 2024):

- Funding: dollars directed toward disadvantaged communities[1]
- Electricity and fuel savings
- Participant bill savings
- Health benefits
- Employment impacts

[1] Both the Department of Energy and NYSERDA use the term disadvantaged communities, or "DACs," to denote priority populations. Each entity uses unique criterion to *define* DACs.

Other states have adopted similar approaches of marrying clean energy goals with equity mandates, including Illinois (Climate and Equitable Jobs Act), Washington (Clean Energy Transformation Act), and Maine (Maine Won't Wait). In addition to state efforts, Executive Order 14008, Tackling the Climate Crisis at Home and Abroad, furthers a whole-of-government strategy to address current and historic environmental injustice through creating an equitable clean energy future. However, as states and the federal government develop the scaffolding of how to conceptualize equitable outcomes, many have not developed a clear process by which to measure and track those benefits. In the remainder of this paper, we share a framework—or a key process flow—entities can take to characterize impacts to priority populations, measure those benefits, and assess outcomes.

A Framework to Measure Progress Toward Advancing Equity

We invite readers to leverage this framework to conceptualize, advance, and measure equity within programs and policies. Importantly, this framework is grounded in methods that advance procedural equity, where "community members have authentic leadership roles that define, drive, and hold accountable clean energy policy and program decisions and outcomes (ACEEE 2023)." Deep, meaningful engagement with community members is critical to procedural equity. The IAP2 Public Participation Spectrum, shown in Table 1, outlines the range of roles the public can play in decision-making, with the ultimate goal of empowering the community to make decisions (IAP2 2018).

Table 1: IAP2 Public Participation Spectrum

	Inform	Consult	Involve	Collaborate	Empower
Public Participation Goal	To provide the public with balanced and objective information to assist them in understanding the problem, alternatives and/or solutions.	To obtain public feedback on analysis, alternatives and/or decision.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the preferred solution.	To place final decision-making in the hands of the public.

Promise to the Public	We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and aspirations, and provide feedback on how public input influenced the decision.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will look to you for advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.

Traditionally, energy policy- and program-making processes have **informed** or **consulted** the public. This paper calls for a means of engagement where agencies **involve**, **collaborate** with, and **empower** impacted communities. We acknowledge that this represents a significant paradigm shift and requires that entities significantly rework the traditional processes that make up their status quo. Therefore, as entities consider this new frontier of meaningful engagement, we encourage a flexible, iterative mindset and style of project management. Recent efforts like the Sustainable Square Mile System, led by Blacks in Green, a community-based organization in Chicago, have showcased the success possible when communities are empowered to take action in ways that they deem effective. The Sustainable Square mile incorporates clean energy through a local microgrid, horticulture to grow food, tourism, affordable high-performance housing, and waste management (Blacks in Green 2024).

Step 1: Convene collaborators (community members and decisionmakers)

First, create a mechanism to engage *collaborators,* community members and decisionmakers that represent and can reflect the perspectives and lived experiences of priority populations. While collaborator convening can take many different forms, we recommend a few key ingredients:

- **Define the decision-making power of the group:** Clearly define—and document—the decision-making power of the group. Work with community members to *co-create* the roles, responsibilities, and sphere of influence of the group.
- **Provide compensation:** All members should be compensated for their time. In addition, entities should consider other ways to minimize the burden on those engaged, including food, transportation stipends, and childcare.
- **Set a cadence:** Given the iterative nature of this process, one-time meetings are inadequate to build relationships or solutions. Instead, work with the group to define a recurring cadence (i.e. monthly, quarterly) to meet. Seek input from the team to determine timing (day vs. night) and location (in-person vs. virtual vs. hybrid) that creates the greatest opportunity for diverse attendance.
- **Earn trust:** Trust is built through being transparent about goals and following through to achieve them. Members of priority populations have historically been excluded from

energy system decision-making processes; therefore, government entities must work to overcome that history when building relationships in the community.

A few states have already developed systems to allow for robust engagement with community members. NYSERDA's Energy Equity Collaborative ("the Collaborative") is a "forum for collaboration between those that serve and represent historically marginalized communities and New York State (NYSERDA EEC 2024)." The Collaborative is made up of organizations and individuals who serve and reflect the heterogeneous disadvantaged communities across the state. It meets monthly to "ensure the experiences and needs of under-resourced and historically marginalized communities are front and center in decision-making and program planning."

Step 2: Define equitable outcomes

In partnership with community members, define meaningful equitable outcomes—or benefits—of the clean energy transition. This is an inherently iterative process, but typically involves a flow of board-to-specific thinking. We outline this process below:

- **Define benefit categories:** To begin, collaborators and entities should define key categories of benefits. Categories should be broad and help organize future thinking around specific, measurable benefits. Benefit categories include funding, health, economic mobility, resilience, workforce development, and others that may be specific to the local context. Importantly, these categories should reflect the past inequities that priority populations have experienced within energy systems. The inequities communities *have* faced are inextricably linked to the benefits clean energy systems should seek to make good on. In this phase, it is often useful to think broadly about the equity 'themes' collaborators wish to see advance in their communities; these will become more focused as entities and collaborators move through the framework.
- **Workshop potential benefits:** Next, agencies and collaborators should workshop the specific outcomes they wish to see under each benefit category. These benefits should answer the question: "what outcome do priority populations wish to see in their communities?"
- **Define benefit metrics:** Finally, collaborators should define clear, measurable metrics that can be used to measure progress toward achieving key benefits. This should be done in close partnership with agency partners – particularly data teams – to ensure benefit metrics are tied to data availability. For example, some potential benefits may be easily measurable immediately, while others may require new data collection and/or management processes to track. We discuss this more in Step 3.

DOE outlines how this practice can work in action through its guidance around Justice40 implementation. As Table 2 illustrates, DOE adopts the broad-to-specific approach to advance equitable impacts.

Table 2. Selection of DOE Justice40 Benefits and Metrics

Benefit Category	Benefit	Metric(s)
Funding	Increase funding in DACs	• Dollars spent [$] by DOE Covered Programs [$] in DACs
Energy Burden	Decrease energy burden in DACs	• Dollars saved [$] in energy expenditures due to technology adoption in DACs • Energy saved [MMBTU or MWh] or reduction in fuel [GGe] by DACs
Environmental Burdens	Decrease environmental exposure and burdens for DACs	• Avoided air pollutants (CO2 equivalents, NOx, SO2, and/or PM2.5) in DACs • Remediation impacts on surface water, groundwater, and soil in DACs • Reduction of legacy contaminated waste in DACs
Workforce	Increase clean energy jobs, job pipeline, and job training for individuals from DACs	• Dollars spent [$] and/or number of participants from DACs in job training programs, apprenticeship programs, STEM education, tuition, scholarships, and recruitment • Number of hires from DACs resulting from DOE job trainings • Number of jobs created for DACs because of DOE program • Number of and/or dollar value [$] of partnerships, contracts, or training with minority serving institutions (MSIs)

Step 3: Leverage data

Beyond community engagement, once the government identifies and allocates clean energy investments, relevant data are necessary to estimate benefits to priority populations. It is impractical and inappropriate to assume that the community, the local government, or local businesses will have captured all facets of data required to understand the monetary, health, workforce, and access related benefits that might accrue. In addition, many publicly available datasets are at a geographic resolution that is too coarse to be useful in smaller neighborhoods and communities. Therefore, it is necessary to collaborate with agencies, utilities, and other entities to understand what data are needed to measure benefits.

In New York State, the New York State Energy Research and Development Authority (NYSERDA) maintains a Clean Energy Dashboard to display data from many different sources in a format that can be easily leveraged by users whose goals may differ from one another (NYSERDA 2024). The Clean Energy Dashboard aggregates information from the State's utilities and programs to highlight progress in greenhouse gas emissions reductions, electricity peak demand reductions, electricity and fuel savings, participant bill savings, program expenditures, and renewable energy generation in service of the state's climate and clean energy efforts, including data from 2016 through the third quarter of 2023. This dashboard provides a vision of how government agencies can bring together data from different sources with significant investment in public facing data display and visualization.

In places that have not prioritized creating dashboards or data repositories, those aiming to understand benefits from clean energy investments and transition programs may leverage data from local utilities, state and local government organizations funding programs and projects aimed to decrease energy usage or incentivize a transition to clean energy, and community-based organizations and non-profits that have surveyed residents and business owners to understand impacts.

Step 4: Develop replicable methods

In trying to understand how the clean energy transition may differentially impact separate communities, users must develop sound, replicable methods to measure benefits and discern to whom they are accruing. While it would be useful to have *accurate* information about the monetary, health, job, and other benefits that are achieved by priority populations, data and methodological limitations prevent that accuracy. In lieu of a perfectly accurate calculation of benefits, we aim for consistent measurement and estimation of benefits across community types to ensure any error is random and not perpetuating systemic biases. Further, users should ground truth measurements within the community to ensure the data sources are not biased. For example, in some communities, measures of health impacts may be undercounted because community members do not have insurance and therefore do not use the medical system in the way that the data collectors intend. Users need to analyze and determine which assumptions they will carry throughout their benefits assessment process.

When analyzing benefits of the energy transition, users must first consider investments that are made in the community that will result in beneficial outcomes for the community. Investments are the first measure of benefits to a community, as that money is intended for and spent in consultation with the target community. At the outset, those aiming to understand equity impacts of the transition must consult with the community to determine:

- **What is included in the universe of investments?** That is, will administrative and measurement startup costs be included in calculating the funding that is available to priority populations? Will measurement efforts capture the funds and benefits that accrue in both standard and priority populations to calculate the percentage of total allocated to priority populations? Who is doing the measurement work, and how are they funded? How are in kind impacts measured?
- **What is the geographic scope of investments?** Users must define the scope of their investments, where benefits will accrue, and whether indirect or tangential benefits from communities outside of the targeted geographic scope will be considered. For example, will users capture the air quality benefits of program funding spent in an upwind community (and not in the community itself)? Will users capture benefits of program funding that is spent in the community that improves air quality in a separate downwind community?
- **Will the analysis include both place-based and decentralized investments?** Some clean energy investments are localized and specific (e.g., energy efficiency retrofits in community buildings) while others are decentralized (e.g., installation of electric vehicles in statewide fleets). What assumptions will users make regarding transport-related benefits,
- **Will the analysis capture changes in benefits related to the investment over time?** For example, clean energy infrastructure will benefit a community in the long term, but

an increase in construction vehicles traveling to the site to build the infrastructure will be a determent to the community in the short term.

Step 5: Measure outcomes

Planning for measuring benefits to priority communities makes up the majority of the effort required for measuring benefits to priority communities. Once users define the universe of investments and benefit types, identify the assumptions they will carry through the analysis, determine which models and data sources they will use, how they will capture the timeline and geographic scope of investments, and create replicable methods, it is time to perform those measurements. Measurements should be well documented and should be able to be replicated by any analyst who possesses the necessary information. As noted elsewhere in this paper, transparency in data sources, decisions, and analytical methods is critical to building and retaining trust within communities.

Continuing the discussion of NYSERDA's efforts, the agency published draft guidance for reporting community investments and benefits to disadvantaged communities in support of the implementation of the CLCPA in January 2024 (NYSERDA 2024). The guidance defines applicable investments and overall measurement approaches for benefit categories and metrics.

Step 6: Iterate and update

Over time, community needs and interests will change. More, different, and better data will become available. Clean energy investments, programming, and projects will transform to meet the current moment Thus, a critical step in this framework is to iterate and improve upon the data sources, assumptions, and methods, updating them in a way that is consistent with community needs.

The purpose of these measurement efforts is not just to understand the percentage of investments and benefits that are realized by priority populations; taken in the best light, the purpose is to identify gaps in programming that can be resolved to further direct benefits to communities that have been historically underserved. Continued iteration and updating of measurement will allow users to identify additional opportunities to fill gaps and create bridges to equity in the clean energy transition.

Potential Implications and Key Considerations

As we seek to define benefits toward priority populations—and measure the impact of those benefits—there are a few top-of-mind potential implications to consider. While this is not a full set of potential implications, we seek to show common pitfalls and key considerations.

First, it is essential to **follow the money.** Benefits—or burdens—to priority populations are tied to where money is spent and who has the decision-making power in those investments. Matt Tejada, former Director of Environmental Justice for the EPA, recently participated in *Environmental Justice: Taking Stock of Justice40,* a discussion hosted by Resources for the Future. During the discussion, he noted: "you can't talk about benefits if the conversation doesn't start with the money" as "money is the biggest benefit" to priority populations (Resources for the Future 2024). That is, if the community did not receive funding or investment in local clean energy infrastructure, capturing the related benefits is a much more fraught endeavor, as the

community itself was not centered in the decision making that may have received tangential improvements to air quality or job opportunities.

Community engagement should happen through authentic community leadership. This process can take time – and is often not in alignment with the typical cadence or decision-making structure of state agencies or federal bodies. Entities must reimagine traditional processes—and truly engage community members as fellow decision-makers—to enact effective community engagement. Further, in addition to empowering communities to determine the solutions to create clean energy resources and reduce inequities, communities must be able to dictate what solutions will *not* work for them. For example, communities should have the opportunity to influence denial of energy permits.

There are also key **data limitations** to consider. For example, understanding health impacts related to air quality includes significant methodological uncertainties that are unlikely to be resolved in a way that accurately captures benefits to priority populations. Pollutants are emitted from fossil fuel combusting sources, those pollutants mix in the air to create ambient health harming pollutants like fine particulate matter and ozone, and those ambient concentrations continue to move, and mix based on meteorology, topography, and other chemicals present in the air. Further, people do not stay in one place; individuals are exposed to air pollutants in their communities, at school or work, during their commutes, and inside their homes.

Finally, **flexibility and adaptability** are essential in reimagining how clean energy can benefit priority populations. While we introduce this framework to organize thinking around the measurement of equitable outcomes, we caution practitioners against approaching this process with an overly prescriptive mindset. This document specifically did not include a checklist of actions that government or private entities can take to address energy inequities in communities. Rather, this framework requires meaningful community engagement and direct investment to those communities to quantify relevant benefits.

Conclusion

This paper invites readers to reimagine how entities can consider—and hold themselves accountable for—the benefits of the clean energy transition. To achieve energy justice, we must clearly recognize how past harms have informed current inequities, develop solutions to both remediate those harms and benefit communities, and create systems to measure progress. This cannot be done without deep engagement with communities. By centering the lived experiences of priority populations in this work, municipalities, agencies, states, and other entities can create a path for a clean energy future grounded in the aspirations and needs of the people most affected by it.

References

ACEEE (American Council for an Energy-Efficient Economy). 2024. “Energy Equity.” https://www.aceee.org/topic/energy-equity.

Blacks in Green. 2024. “Our Approach.” https://www.blacksingreen.org/our-approach.

Cushing, L.J., Li, S., Steiger, B.B. *Historical red-lining is associated with fossil fuel power plant siting and present-day inequalities in air pollutant emissions*. Nat Energy 8, 52–61 (2023). https://doi.org/10.1038/s41560-022-01162-y.

Declet-Barreto J., Rosenberg AA. *Environmental justice and power plant emissions in the Regional Greenhouse Gas Initiative states*. PLoS One. 2022 Jul 20;17(7):e0271026. https://doi.org/10.1371/journal.pone.0271026.

DOE (Department of Energy) Office of Energy Jobs. (2023). United States Energy & Employment Report 2023. https://www.energy.gov/sites/default/files/2023-06/2023%20USEER%20EXEC%20SUMM-v2.pdf.

DOE (Department of Energy) Office of State and Community Energy Programs. 2024. "Low-Income Community Energy Solutions." https://www.energy.gov/scep/slsc/low-income-community-energy-solutions#:~:text=Energy%20burden%20is%20defined%20as,which%20is%20estimated%20at%203%25.

DOE (Department of Energy) Office of Energy Justice and Equity. 2024. "Justice40 Initiative." https://www.energy.gov/justice/justice40-initiative.

Drehobl, A., Ross, L., and Ayala, R. 2020. *How High Are Household Energy Burdens?* Washington, DC: American Council for an Energy-Efficient Economy. https://www.aceee.org/research-report/u2006.

EIA (Energy Information Administration). 2023. *Monthly Energy Review, May 2023*. Washington, DC: EIA. https://www.eia.gov/totalenergy/data/monthly/.

International Association for Public Participation (IAP2). 2018. "Spectrum of Public Participation." https://cdn.ymaws.com/www.iap2.org/resource/resmgr/pillars/Spectrum_8.5x11_Print.pdf.

Muro, M., Tomer, A., Shivaram, R., Kane, J., L. 2019. *Advancing Inclusion through Clean Energy Jobs*. Washington, DC: Brookings Institution. https://www.brookings.edu/wp-content/uploads/2019/04/2019.04_metro_Clean-Energy-Jobs_Report_Muro-Tomer-Shivaran-Kane.pdf.

NYSERDA (New York State Energy Research and Development Authority). 2024. "Draft Disadvantaged Communities Investments and Benefits Reporting Guidance Released for New York State Entities." Albany: New York Public Service Commission. https://www.nyserda.ny.gov/About/Newsroom/2024-Announcements/2024_01_03-DEC-and-NYSERDA-Release-Draft-Disadvantaged-Communities-Investments.

NYSERDA (New York State Energy Research and Development Authority) Energy Equity Collaborative. 2024. "Energy Equity Collaborative." Albany: New York Public Service Commission. https://www.nyserda.ny.gov/All-Programs/Energy-and-Climate-Equity-Strategy/Energy-Equity-Collaborative.

NYSERDA (New York State Energy Research and Development Authority). 2024. “Clean Energy Dashboard.” Albany: New York Public Service Commission. https://www.nyserda.ny.gov/About/Tracking-Progress/Clean-Energy-Dashboard.

NYSERDA (New York State Energy Research and Development Authority). 2024. “Draft Disadvantaged Communities Investments and Benefits Reporting Guidance Released for New York State Entities.” Albany: New York Public Service Commission. https://www.nyserda.ny.gov/About/Newsroom/2024-Announcements/2024_01_03-DEC-and-NYSERDA-Release-Draft-Disadvantaged-Communities-Investments.

Pacific Northwest National Laboratory. 2024. “Energy Equity.” https://www.pnnl.gov/projects/energy-equity.

Resources for the Future. 2024. “Environmental Justice: Taking Stock of Justice40.” https://www.rff.org/events/environmental-justice-series/environmental-justice-taking-stock-of-justice40/.

Scheier, E., Kittner, N. A measurement strategy to address disparities across household energy burdens. Nature Communications 13, 288 (2022). https://doi.org/10.1038/s41467-021-27673-y.