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Enabling an Equitable Energy Transition Through Inclusive Research

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Enabling an Equitable Energy Transition Through Inclusive Research

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Comprehensive and meaningful inclusion of marginalized communities within the research enterprise will be critical to ensuring an equitable, technology-informed, clean energy transition. We provide five key action items for government agencies and philanthropic institutions to operationalize the commitment to an equitable energy transition.

Leaders around the world are grappling with building climate-resilient infrastructure and transitioning away from fossil energy sources. At the same time, urgent concerns around equity, justice, and the impact of government energy policy on people of color and marginalized communities – whether by income, race, or geography – are being raised [1,2].

Technology will play a central role in the energy transition, whether it is innovations in existing technologies such as wind, solar, and storage or prospective approaches such as carbon capture and hydrogen [3]. However, the degree to which technological change exacerbates or reduces prevailing inequities and prevents or leads to new injustices will depend on the social and civic structures that govern technology design, deployment, and use. Too often research programs are missing specific equity, justice, and social sustainability aspects of energy systems. This has led to several critical issues (e.g., impacts of utility shut offs on minority communities) being understudied and under-addressed [4,5].

Ensuring that clean energy transitions are equitable is vital to securing a just and sustainable society [6]. To this end, the research enterprise – through its people, community, and institutions – has a critical role to play in informing energy transition strategies that address past injustices and mitigates future inequities [7].

Here, we identify research priorities at the intersection of energy technology and social justice and suggest actionable steps for funding agencies and scientific institutions to deliberately incorporate equity into research on the energy transition. We focus primarily on the US but, although institutional recommendations are broadly applicable, some pressing international equity questions are not addressed here. These international equity questions – with an emphasis on energy access,

differentiated responsibilities for emissions mitigation, and climate-related loss and damage as enshrined in the Paris Agreement – are a key part of international climate dialogue.

Where Energy and Equity Interact

A wide body of literature has engaged with the issue of defining equity. While definitions vary, a few consistent features emerge. A useful definition of energy equity must be measurable, context-specific, and focused on both procedures and outcomes. It should address both past and future harms as well as the potential for greater justice.

However, a solitary focus on easily quantifiable metrics, as often seen in requests for proposals, risks ignoring critical but difficult to quantify aspects of equity. For example, research on the use of clean cooking fuels in developing countries has used both quantitative and qualitative metrics to evaluate impacts [8,9]. All metrics – whether quantitative or qualitative –should be closely tied to observable impacts on communities that can be measured and tracked over time and space [10]. While measurements may not be quantifiable, they must be defined in a manner that is amenable to independent assessments. Thus, developing funding opportunities that solicit and value qualitative data on equity and justice would present a holistic approach to research on energy equity.

Whether outcomes are equitable depends on the design of a technology, on the full lifecycle impacts from development to demonstration and deployment, and on the existing inequities in society in which the technology resides. Equity outcomes in energy systems are influenced by organizations that fund research, institutions that invest in development of new systems, decision-making structures on siting, operation, and ownership of new technologies, and regulations that govern boundaries of use. In the absence of strategies to achieve justice that are informed by technology, technological change has the potential to intensify existing inequities [12,13].

However, the energy transition also provides an opportunity to end a variety of historical injustices that have been exacerbated by the design and operation of existing energy systems [14]. Thus, the interconnection between technology and policy innovation required to ensure equitable outcomes necessitates an integrated and inclusive research agenda that must cut two ways: social equity must inform research on energy technologies; an understanding of technology must inform research on energy equity and justice.

Who is Equity For?

Of primary importance is to consider who is asking the research questions and who is doing the research. Research related to the energy transition has the potential to be richer and more relevant to marginalized communities when it directly engages scholars from organizations within those communities; in the U.S., this would include historically Black colleges and universities (HBCUs), Hispanic serving institutions (HSIs), Tribal colleges, and other institutions that have strong ties to historically marginalized communities. Engagement does not refer to performative consultation, but rather encompasses financial and institutional support and a substantive role in setting the research agenda. This necessarily includes a large-scale investment in minority serving institutions (MSIs) to redress decades of historical neglect.

A low-carbon energy system will not necessarily be equitable, as shown in recent studies of injustice associated with renewable energy [11]. Conflicts and tradeoffs arise as impacts vary based on the scale of the community – individual, household, city, state, national, or global. Analyzed across these scales, equity can be relative. Well-intentioned policies have created winners and losers that exacerbated inequity [15]. Disparities can also exist across multiple dimensions – space, time, income groups, race, and gender [16–18].

These overlapping dimensions of inequity exacerbate the impact of even minor disparities in technology deployment or policy incentives. A solitary focus on income-based inequity, for example, risks masking challenges faced by individuals or groups across other dimensions like race, ethnicity, or gender [10,17,19,20]. Institutions should be sensitive to the multi-dimensional nature and compound effect of different forms of inequity while developing research agendas.

Recommendations for Funders

Incorporating equity within a research agenda requires fundamental changes to the grant making and reviewing process. We propose five key action items for government agencies and philanthropic organizations on procedural policies to operationalize the commitment to an equitable energy transition.

First, reframing equity as integral to energy technology research due to technology's impact on society. Second, direct engagement to solicit community input throughout the grant cycle including listening workshops, advisory boards, and review panels. Third, developing formal mechanisms to resolve challenges that arise from community engagement, including the potential for competing equity interests. Fourth, expanding review and award criteria to include assessments of community involvement, equity analysis, and multidisciplinary engagement. Fifth, instituting structural reforms to better fit the needs of interdisciplinary research at all levels: individuals, community groups, and universities.

While these recommendations can make research on the energy transition more equitable, institutions should ensure that steps undertaken to improve procedural and participatory justice are aligned with the goals of distributional justice and rapid decarbonization [21].

Reframing Equity.

Reframing equity as integral to energy technology research as opposed to a consequential framework can better help institutions formulate funding calls. For example, a recent Department of Energy funding call on carbon capture and sequestration only required analysis of equity impacts as part of the proposal but did not actually fund equity research. Grant making institutions should commit to sustained and expanded funding for research specifically focused on multi-dimensional energy equity at different spatial and temporal scales relevant to policy. Funding must also encompass technology transfer and small business innovation research, as well as support for the development of a robust community with diverse research networks and institutions.

Direct Engagement.

The research grant process – starting with the development of a call for proposals to the review and award of grants – has largely been insular and reflects existing inequities within academia. Enabling equity within existing institutional frameworks, therefore, requires significant procedural and institutional reform.

Leaders should commit to broadening representation in grant agencies and, more broadly, on boards, review panels, and program directorates to include perspectives from outside academia and from diverse backgrounds. Agencies must directly engage MSIs and community organizations to develop calls for proposals related to future technologies with potential for widespread deployment and use.

Such direct engagement can be accomplished by adapting existing mechanisms within the federal government to solicit community input to grant-making departments. For example, the NSF invites ad-hoc members from the public to constitute proposal review panels. Ensuring communities have a direct say in the research process ensures that agenda setting is inclusive and breaks through academic and technocratic echo chambers. This consultative process can be formalized through

statutory advisory boards to inform and advise on funding calls, proposal reviews, and grant awards. Importantly, these community-based advisory board members must be adequately compensated for their time [22].

Resolving Competing Equity Interests.

Involving communities directly into the research enterprise presents new challenges. First, grant making agencies must identify areas of research that would benefit from direct community input. Considerations include the availability of organizations with technical expertise, direct and near-term impacts of research on marginalized communities, and the extent to which impacts are localized.

Second, community members and academics might not always have the training or capacity necessary to work collaboratively with each other; enforcing such engagement without adequate training can be ineffective. Grant agencies should consider developing and requiring training programs to support researchers in more effective collaborations with community groups. These traineeships could be integrated with grant funding that will enable participants to apply the training to their new collaborations.

Finally, resolving conflicts that will inevitably arise when global benefits of energy technologies conflict with potential local harms will be key to fostering broad-based scientific inquiry. How to address these conflicts is itself an important aspect of future research.

Expanding Review and Award Criteria.

Developing broad-based review criteria that incorporate input from advisory boards can ensure high-quality research questions do not get drowned out by non-contextual but highly quantitative methods. Similarly, the standards set for what constitutes high quality data must be cognizant of

the availability of that data; that is, we do not want to only ask questions for which data already exists. Case studies and qualitative research are crucial for developing good research questions and motivating quantitative data collection. Proposal review criteria must also consider plans for and history of effective community engagement as well as inclusion of scholars with broad expertise. While such breadth requirements are embedded in some interdisciplinary programs within NSF, they should be expanded to all energy-related funding calls.

Long-term Structural Reforms.

Funders can flip existing approaches, providing communities with financial support to enable their deep engagement, allowing them to either lead proposals or collaborate with academics of their choosing. This reverses existing approaches to collaboration whereby lead investigators at universities seek out community organizations with which to collaborate. Traditional research funding agencies like NSF could partner with organizations that directly fund community groups such as the Department of Housing and Urban Development (HUD) to create programs that can only be accessed by community recipients. This provides community organizations with the agency and flexibility needed to drive equity-focused research.

A critical component of collaboration with community groups is trust. Trust is created not through representative tokenism on panels but by continuous engagement that provides resources, agency, and support to community groups. Institutions should develop mechanisms to provide long-term, flexible funding structures for teams to allow time to build trust between academics, local and national policy makers, and community members. The NSF's Engineering Research Center program serves as a good example of flexible, decadal funding awarded to multi-institutional and international partnerships focused on applied science and engineering research.

Agencies should invest in advancing the research careers of individuals from underrepresented communities with a goal to end the cycle of short-term and insecure academic appointments. Some effective approaches include dedicating funding streams for joint fellowships in engineering and social science, allowing recipients to train in non-academic environments, and encouraging collaborative partnerships with community organizations. In addition to immediate benefits, these recommendations will help create a pipeline of trained, interdisciplinary scholars who can take on leadership positions in the future. These funding streams should not be restricted to those with doctoral degrees but should be open to applicants with a wide range of expertise and interest including community leaders and practitioners. Collaboration across federal agencies such as the EPA and the Department of Energy on the Justice40 initiative can develop dedicated funding opportunities focused on energy justice [23].

Technology will play a key role in the global transition away from carbon-intensive fuels over the next three decades. These technologies will be embedded within our current energy system and – if not deliberately addressed – risk reinforcing existing inequities and injustice. Therefore, it is critical for governments and philanthropic foundations to identify and support robust research at the intersection of energy and equity.

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