Embedding Justice from the Beginning: JUST-R Metrics for Considering Energy Justice in Early-Stage Energy Research

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Background/Objectives. The concept of energy justice has attracted increasing attention in recent years but is often only applied in social science or energy policy work on deployed technologies. Yet, early-stage energy research happening now will determine the design and eventual impacts of technologies needed for a clean energy future. This late-stage integration of energy justice leaves us susceptible to identifying negative impacts of energy technologies only after significant time and funding have been spent on their research and development, often with limited remaining options to address them. Embedding justice considerations throughout R&D is a more efficient route to achieving fast, sustainable, and equitable decarbonization. However, there is a significant gap in knowledge on how to manage energy justice considerations in early-stage research – in no small part because it may be decades before the technology reaches users and we simply do not know what to measure. Here we fill this gap by developing metrics that can be applied by an individual researcher or project team on an immediate timescale.

Approach/Activities. The NREL team developed the Justice Underpinning Science and Technology – Research (JUST-R) metrics framework including 30 metrics from literature across energy and sustainability research disciplines and 20 new metrics developed to fill gaps in applicability to early-stage research. Technology Readiness Levels (TRLs), which measure the maturity of a technology under development, are used to organize these metrics along research stages from basic science (TRL 1) to technology demonstration (TRL 9). The framework maps metrics from TRL 1, the earliest stage of research, along each responsible research and innovation (RRI) dimension and distributional, procedural, recognition, and cosmopolitan tenets of energy justice. The metrics span every RRI dimension and every tenet of justice, exemplifying the comprehensive nature of the JUST-R framework. This approach was then evaluated across early-stage research projects at the National Renewable Energy Laboratory.

Results/Lessons Learned. In this work, we have developed the JUST-R metrics framework to facilitate measuring and managing energy justice considerations starting from the earliest stage of R&D. The novelty of this framework lies in its deliberate focus on metrics immediately applicable to early-stage research, spanning dimensions of RRI to consider the whole research process. A key outcome of our work and the case study conducted as part of the research is that decision maker values will drive how these metrics are used. This applies whether the metrics are being used institutionally to assess current or proposed research projects, for instance, to assign funding awards, or by project teams to manage the energy justice implications of their ongoing work. Importantly, for early-stage research, equitable deployment and use of the future technology is an extremely long-term reward, typically years or decades away. We expect that the short-term rewards provided by institutions – and therefore, institutional values – will have a greater impact on how these metrics are applied and their effectiveness.