

# Energy Equity in Power System Operations and Planning: Generation / DERs / Demand



## Overview of Issues and Challenges

Historically, data sets, modeling tools, and analysis to support grid planning and operation have focused on cost and reliability. Rarely are demographics and impacts on communities considered directly, making it difficult for decision-makers to understand the energy equity trade-offs of their decisions or include them directly in models. Moreover, increasing customer adoption of distributed energy resources (DERs), such as rooftop solar and storage, and demand electrification, including electric vehicles, can expose further inequities where undersized grid connections and distribution infrastructure can limit access for customers. Utility programs may also struggle with equitable cost allocation.

In this break-out session of the workshop, we will ask participants to consider the equity impacts and trade-offs in grid practices and modeling, including distribution and transmission upgrades, generation siting and cost, generation retirement, DER adoption and integration, and operations practices, particularly during extreme events. The session will also explore how our data sets, tools, and metrics could be augmented to give grid planners and operators a more complete understanding of the impacts on the communities they serve.

- **How can grid planning, which is primarily based on economics and reliability today, integrate energy justice metrics into modeling processes?** System-wide planning decisions typically start with a combination of capacity expansion and production cost models. These models solely minimize system costs under predefined reliability constraints. Detailed reliability, stability, and contingency analyses typically only consider engineering implications, but not demographics. Distribution planning is also typically limited to least-cost ways of providing reliability and power quality, potentially using load projections that may perpetuate historical biases. Energy justice metrics, if included, are mostly post-processed (i.e., assessed after the power system design is determined).

Capturing energy justice in the modeling requires energy equity–related data and region-specific standardized energy justice–related values that can be integrated into the modeling process. This could take multiple forms: they could be directly integrated into objectives or constraints, assessed as part of near-least-cost feasible alternatives, iteratively included (especially for non-optimization-based analysis), considered with multi-objective approaches such as Pareto analysis, or included using other approaches. Equity can also be incorporated as a metric in prioritizing grid infrastructure investments through proxies such as grid stress, level of anticipated DER adoption, and demographic data.

- **How can energy justice be factored into decisions around generator retirements and what replaces them?** As the electric grid transitions toward more reliance on clean energy, utilities will be faced with decisions about how to replace fossil-fuel power plants that provide specific grid needs in certain communities. Minority, low-income, and indigenous populations often bear a disproportionate share of damages from these resources. Including energy justice screening methods in grid planning decision-

making can improve outcomes for these communities. These methods and tools, along with community engagement, are important steps to inform us of how to retire uneconomic power plants and repower/replace those sites with affordable, equitable, and clean resources.

- **How can DERs, storage, and grid planning with greater emphasis on energy equity help address the negative impacts of climate-driven extreme events, particularly in isolated communities, including rural areas and tribal nations?** The impacts of climate change will vary considerably by region; however, rural and tribal communities may be particularly prone to the effects of climate change due to being more isolated with fewer robust connections to the energy system. Solar, wind, storage, robust transmission, microgrids, and other technologies can help overcome these challenges technically, but local communities may not be able to afford them. Moreover, local traditions may require careful engagement, such as for culturally significant lands.
- **With the rapid adoption and the uncertainty of electrified end uses, what must we consider to proactively plan distribution system upgrades that target specific communities, while not inadvertently limiting adoption due to biased assumptions?** Transportation electrification is one example of adoption and uncertainty driving distribution infrastructure upgrades. Community trends for public versus private transportation could influence charging infrastructure deployment decisions. However, these decisions risk biasing certain types of upgrades to different communities. Given limited utility resources and supply chain backlogs for this infrastructure (e.g., long service transformer lead times), careful consideration is warranted to avoid limiting a community's ability to adopt new electrified technologies based on potentially faulty assumptions of a community's needs or trends. A solution could be coordinating with other programs, such as those aimed at increasing equity in cooling, electric vehicles, home electrification, and electric panel upgrades, so the grid does not create a barrier for deployment.
- **What is the role for demand response/flexibility in low-income communities?** Demand response (or load participation) is often seen as a relatively low-cost option to secure system reliability in the future, particularly in high-income economies. However, some households may not be able to meet the demand response requirements as that could affect their well-being, such as pose health risks. Hence, demand response market pressures should only be imposed when energy consumption can be adjusted without reducing essential energy (i.e., taking into consideration the energy needs of customers). However, can these market pressures be negotiated, for example, through a rate/contract option? Also necessary is an understanding of the financial, technological, and social barriers that low-income households face in accessing and using demand response, which requires smart technologies.

## Motivating Questions

- **Main discussion questions:** What approaches, tools, and data sets are needed to help ensure that power system planning supports the economic, social, and health needs of all communities and all community members? How can we plan to achieve greater equity for all and understand the implications of our current power system on specific communities?
- Who within the community should have input into the power system planning process? How can their input be gathered and incorporated in power system modeling?

- Which specific needs do energy justice communities have and how can technology decisions be aligned with those? Do we need to invest in new technologies or enhance current technologies to align with energy justice goals?
- How can we assess the extent to which grid and other limitations may prevent customers from electrifying demand (electric vehicles, heat pumps, etc.) or connecting DERs? What approaches can help overcome such limitations?
- What are the appropriate metrics that measure the level of equity in power system operations? During extreme events?
- Can customers afford to play a role in terms of equity? Who can afford energy-efficiency devices and virtual power plants (VPPs)?

## Community Perspectives and Case Studies

[Kentuckians for the Commonwealth Just Energy Transition program](#): An environmental justice analysis was conducted to analyze spatial environmental justice considerations such as pollution, health problems, and vulnerable demographics in Kentucky, helping to identify which communities will benefit from this clean energy transition.

[LA100-Equity Strategies](#) showcases in-depth community engagement as a way to actively include the community voice in energy planning processes through a combination of rigorous social science and in-depth energy engineering and techno-economic analysis. It includes a strong set of analysis-baked strategies for enhancing equity not only for the power system but also for buildings, transportation, air quality, and other areas.

[Brockway et al. \(2021\)](#) used spatial analysis of hosting capacity and demographics to show that while grid challenges may hinder DER integration in general, they “also exacerbate existing inequities: households in increasingly Black-identifying and disadvantaged census block groups have disproportionately less access to new solar photovoltaic capacity based on circuit hosting capacity,” among other inequities.