

# Energy Equity in Power System Operations and Planning: Markets, Operations, and Planning



## Overview of Issues and Challenges

The United States' bulk electricity system is evolving to accommodate carbon emission reduction targets and combat climate change. For nearly every region, this means thinking strategically about adding new capacity, typically in the form of renewable generation or traditional generation with reduced emissions and—once levels of renewables are high enough—eventually adding storage resources in lockstep with new renewable capacity. At the same time, planning mechanisms consider resource retirement, capacity factors for traditional emitting resources, transmission line usage and potential transmission system upgrades, and overall grid reliability.

However, fundamental inequities have developed regarding the costs, benefits, and hazards of power systems for different populations, and we need to update planning and operational practices to help ensure a more just and equitable clean energy transition. Specifically, traditional electricity system operations and planning tools minimize total system costs without necessarily considering how these costs and corresponding system benefits are allocated across populations.

In this session, we will first review a non-exhaustive list of fundamental electricity system elements that may be impacted by implementing equity-informed operations and planning processes [1]. These elements include local reliability, resilience, project siting, market externalities, and local economics. We will then discuss some specific ways the models and tools currently used in electricity system operations and planning could be enhanced to capture equity objectives and improve social outcomes.

- **Local reliability: Electricity system planning assesses reliability of the grid as a whole and does not consider local reliability.** Models do not capture localized reliability implications. New metrics and methods may be needed to incorporate these considerations into planning models. The social cost of an involuntary outage may depend on location, the services disrupted, and the length of the disruption. Further, system restoration strategies can be revisited and revised to ensure that service restoration is prioritized for vulnerable populations and those more severely impacted by service disruptions.
- **Extreme conditions: Electricity system planning generally uses historical weather patterns to assess future reliability and does not adequately consider extreme weather conditions.**

Planning models should evolve to assess future potential for extreme weather. Today, historical average models are used for developing load estimates, but these may fall short of actual loads because of extreme weather, which is becoming more common with climate change. Accounting for these conditions, which disproportionately impact frontline communities, will help better inform outages.

- **Project siting: The siting of electricity generation resources, energy storage resources, and transmission infrastructure has localized land use and environmental impacts that should be captured in models to ensure that these resources' deployment supports equitable outcomes.** Impacts include air pollution, water runoff, negative aesthetics, and land use conflicts. Historically, coal power plant siting has disproportionately impacted black and low-income communities in the United States [2], and potential social impacts from emerging renewable technologies are still not well understood. Currently, siting decisions are made primarily on system resource adequacy and economic considerations. Social or equity-related factors are not generally considered. To ensure that historical inequities are not perpetuated, it is important to develop new planning methodologies that consider a wide range of localized siting impacts and capture the distribution of such impacts across populations.

Planning models and procedures are able to capture one socialized externality that impacts populations globally, namely, greenhouse gas emissions. These impacts are easier to capture because their social costs can be internalized at the system level through global emission constraints. However, other pollutants introduce health hazards specifically for populations that fall in the path of their emission, and mitigation measures should capture the extent of these localized impacts. This could be addressed by coupling electricity system models with air pollution models that are able to capture emission dispersion pathways.

- **Market externalities: Across much of the United States, electricity systems are planned and operated through organized wholesale markets that provide market signals to promote economically efficient behavior.** These markets have been in a state of evolution since their introduction in the early 2000s to accommodate the clean energy transition. For example, new grid services, increased frequency of market clearing intervals, co-optimized procurement of energy and ancillary services all help grid operators manage renewable resources. However, the role that electricity markets can or should play in supporting social equity objectives is still unclear. Market mechanisms typically presume to deliver socially optimal outcomes by promoting economic efficiency; however, such outcomes are dependent on the ability of market signals to capture all of the social costs and benefits associated with the development and operation of an electricity system. To capture equity objectives with a market framework, it is therefore important to identify clear market externalities that can be quantified and internalized into market operations and price formation procedures.
- **Local economics: The community economic implications of investment or generator retirement decisions are increasingly influencing planning decisions.** However, these

considerations are not always captured in planning procedures consistently, transparently, and in a rigorously quantitative way. Planning procedures can, therefore, benefit from integration with quantitative models that can assess how the benefits and costs of local job creation and dissolution and other economic impacts are allocated across populations to ensure equitable outcomes.

## Motivating Questions

- What is missing from the list above?
- What existing metrics can be used to assess equity in planning processes? What types of new metrics are needed?
- What is the lowest-hanging fruit for improving equity outcomes in the electricity system? How are these actions allocated across the following areas?
  - Policy and regulatory action
  - Stakeholder engagement
  - Models, tools, and data
  - Wholesale market design
  - Retail rate design
- What are the primary challenges that utilities and system planners face when attempting to realize equity objectives?
- How can the broader energy community assist in overcoming these challenges?
- What is the role (if any) of wholesale electricity markets in supporting the realization of equity objectives?
- If the proper policies and regulation are implemented, will markets automatically adapt or are more proactive changes in market design and market structure needed?

## Community Perspectives and Case Studies

Oregon: <https://www.oregon.gov/puc/Documents/CCEA-Equity-Impacted-Communities.pdf>

Hawaii: <https://www.utilitydive.com/news/hawaii-puc-equity-siting-energy-infrastructure/654109/>

New Mexico: <https://nmenergyequity.org/wp-content/uploads/2023/09/Empowering-NM-Town-Hall-Report.pdf>

Independent System Operator of New England: [https://www.iso-ne.com/static-assets/documents/2023/05/may2023\\_environmental-justice-in-power-system-planning.pdf](https://www.iso-ne.com/static-assets/documents/2023/05/may2023_environmental-justice-in-power-system-planning.pdf)

Federal Energy Regulatory Commission: <https://www.ferc.gov/equity>

[1] Goforth, T., T. Levin, and D. Nock. 2023. "Incorporating Energy Justice and Equity into Power System Models: A Review of Current Practices and Paths Forward." April 30, 2023. Working paper available at SSRN: <https://ssrn.com/abstract=4591242> or <http://dx.doi.org/10.2139/ssrn.4591242>.

[2] Thind, M. P. S., C. W. Tessum, I. L. Azevedo, and J. D. Marshall. 2019. "Fine Particulate Air Pollution from Electricity Generation in the U.S.: Health Impacts by Race, Income, and Geography." *Environmental Science and Technology* 53(23): 14010–14019. <https://pubs.acs.org/doi/10.1021/acs.est.9b02527>.