Equitable Electric Grid

Defining, Measuring, and Integrating Equity into Electricity Sector Policy and Planning

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Summary

Traditionally, electric grid planning seeks to maintain safe, reliable, efficient, and affordable service for current and future customers. As policies, expectations of the energy system, and the threat landscape evolve, additional objectives for power system planners are emerging, including decarbonization, resilience, and equity. Renewable and clean energy goals, especially in the context of deep decarbonization strategies, are changing the mix of resources on the electric grid and prompting new considerations for grid architecture. The increased frequency and severity of extreme weather events over the last two decades, coupled with cybersecurity concerns, have elevated resilience as a key system need. More recently, there has been greater focus on equity and energy justice in grid planning to ensure that disadvantaged communities are not adversely affected by grid modernization and have equal access to its benefits. In response, new thinking around multi-objective decision planning is exploring improvements in grid planning processes to better integrate approaches to meet decarbonization, resilience, and equity objectives. To provide a foundation for this work, a series of white papers was produced to summarize these emerging objectives.

This white paper presents an overview of equity in the context of electric grid policy and planning. It provides a working definition of equity, grounded in the literature on energy and environmental justice, and a synthesis of current and emerging metrics to benchmark system performance, evaluate investments, and explore tradeoffs (Section 1.0). This paper also provides a discussion of a) the policy prioritization of equity, with examples of relevant state legislation and executive orders, b) the delegation of regulatory authority and development of grid planning guidance for equity, and c) the status of utility integration of equity into grid planning processes (Section 2.0) and associated challenges and opportunities (Section 3.0). The key findings of this paper are summarized in Table S-1.

Table S-1. Summary Takeaways

	Findings
Section 1.0 Defining and Measuring Equity for the Electric Grid	• Various equity definitions and metrics exist, but they do not encompass the full range of equitable system attributes or performance outcomes. • Measuring equity, particularly as it relates to distributive justice impacts, requires the refinement and application of outcome-focused metrics to inform electric grid planning.
Section 2.0 Integrating Equity into Electric Grid Policy and Planning	• Policies do not clearly define equity objectives, requiring regulators to translate these objectives into actionable grid planning guidance for utilities. • Policy prioritization of equity has not translated into robust public utility commission planning guidance or utility integration into grid planning via performance assessment and investment prioritization.

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Acronyms and Abbreviations

HECO	Hawaiian Electric Companies
ICC	Illinois Commerce Commission (ICC)
LSE	Load Serving Entity
MOD-Plan	Emerging Grid Objectives and Multi-Objective Decision Planning
PUC	Public Utility Commission

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1.0 Defining and Measuring Equity for the Electric Grid

1.1 Equity Definition

Energy equity is the ability of the electric system to ensure that electricity system decision-making procedures are inclusive of and responsive to all affected stakeholders, including those historically burdened by and excluded from planning for the electricity system, and to fairly distribute the burdens and benefits associated with the provision of electricity. Implicit in this definition of energy equity is the recognition that disadvantaged communities have been historically overburdened by pollution, under-benefited by system investments, and underrepresented in electric grid decisions and decision-making processes [1]. These communities include low-income, marginalized, and/or vulnerable groups, such as communities of color, tribal communities, and rural communities. To achieve equity during the transition to a more sustainable energy system, technologies, procedures, and policies must be designed to enable the fair and just distribution of benefits in the energy system [1].

The focus on the transition to a more sustainable energy system has brought increased attention to electricity system inequities in areas such as the affordability and quality of electricity services; the availability of clean energy transition policies and programs; and the accessibility of electricity decision-making processes for disadvantaged and marginalized communities [2, 3, 4, 5]. Traditional rate-making generally did not take into account the differential affordability of electricity across income levels, despite the long-accepted proposition that electricity is an essential service. Unequal accessibility of energy efficiency and renewable energy programs and technologies threaten an equitable clean energy transition [6]. Low-income communities and communities of color bear disproportionate burdens of long-duration and widespread outages due to both slower restoration times relative to other communities and more limited access to resources that mitigate the results of these outages [7, 8, 9].These concerns underscore the need to integrate energy equity in all aspects of electric grid planning.

Energy equity builds on the concepts of energy and environmental justice. The latter refers to the implementation of equity in both the “social and economic participation of the energy system” and the mitigation of social, economic, and health burdens imposed on those disproportionately affected by the negative impacts of energy infrastructure [10]. This paper incorporates the four tenets of energy justice: recognition, distributive, procedural, and restorative justice in defining and measuring equity.

- Recognition justice entails understanding who is most burdened by modern energy systems;

- distributive justice identifies where those burdens are distributed;

- procedural justice focuses on how to procedurally engage the most vulnerable social groups in decision-making; and

- restorative justice looks at what to do in order to repair and mitigate those burdens [11].

There is growing interest in how to translate these justice dimensions into actionable grid planning practices [4, 11, 12, 13]. The energy justice tenets provide a useful framework for developing metrics that can integrate equity into grid planning [11].

1.2 Equity Metrics

Measurement strategies for equity across the economic, environmental, and social policy literature are complex and multifaceted [14]. With respect to energy equity, metrics center on the distribution of costs and benefits of the system, including allocation of burdens and opportunities in the transition to a more sustainable energy sector, as well as the processes by which these outcomes occur [13]. In the electricity context specifically, equity metrics have largely focused on 1) affordability, reliability, and resilience; 2) the availability of transition-enabling technologies, programs, and economic opportunities; and 3) the accessibility of electricity decision-making processes for communities bearing the burden of electric power system inequities and communities unevenly affected by climate change [2, 3, 4, 5]. However, electricity system equity also intersects with broader environmental, economic, and social justice issues, and thus measurement approaches should be inclusive of these wider dynamics.

Energy equity literature underscores the relationship between energy equity and four tenets of energy justice: distributive, procedural, recognition, and restorative justice [4, 10, 12]. Energy justice tenets can be translated into applied dimensions, concepts, and metrics, to inform equity measurement approaches, as depicted in Table 1 and Figure 1.

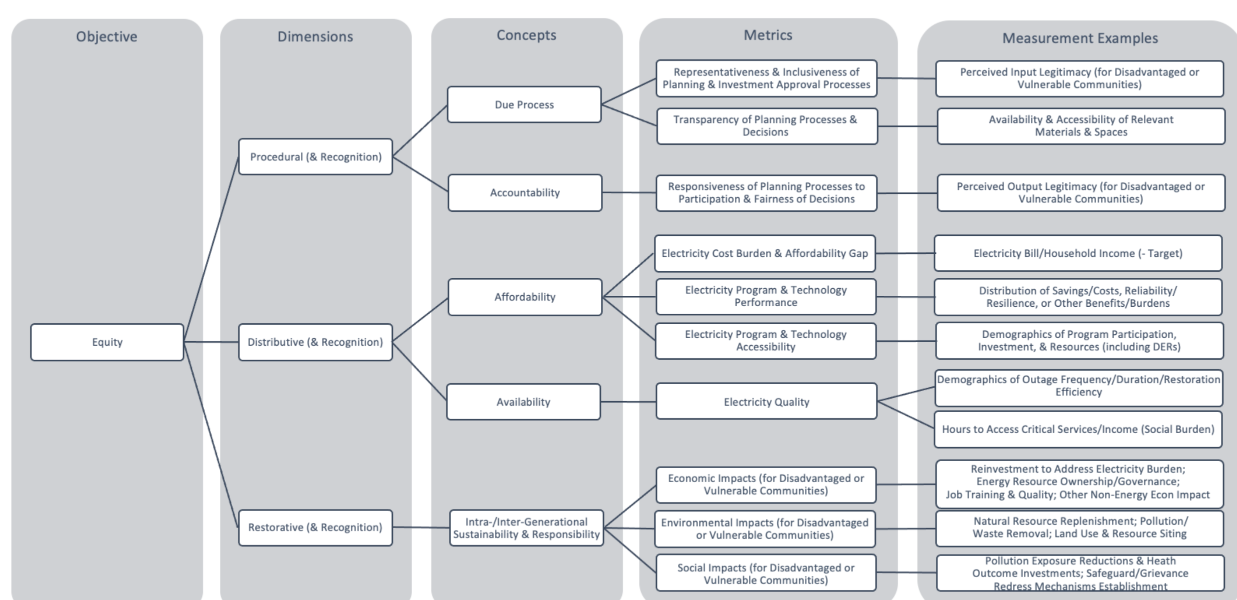

Figure 1. Equity Objective Dimensions, Concepts, Metrics, and Measurement Approaches

These equity metrics can be used to benchmark the extent to which the system addresses justice considerations such as due process, accountability, and transparency in energy decision-making (or procedural and recognition justice tenets), electricity affordability and availability (or distributive justice tenets), and intra- and intergenerational sustainability and responsibility with respect to grid planning outcomes (or restorative justice tenets) [4, 12, 13]. Because restorative justice aims to repair injustices—including by procedural, recognition, and distributive approaches—the dimensions in these columns may be related in practice. For example, distributive metrics may relate to restorative justice via reparation of electricity cost burden shouldered by energy-burdened communities. Notably, as discussed in more detail below, metrics across these categories may refer to outputs (e.g., the number of households receiving financial assistance) or outcomes (e.g., the reduction in energy burden).

Table 1. Equity Metrics

Procedural and Recognition *(due process and accountability)*	**Distributive and Recognition** *(affordability and availability)*	**Restorative and Recognition** *(generational sustainability and responsibility)*
• Representativeness and Inclusiveness of Planning and Investment Approval Processes (e.g., perceived input legitimacy for disadvantaged or vulnerable communities) • Transparency of Planning Processes and Decisions (e.g., availability and accessibility of relevant materials and spaces) • Responsiveness of Planning Processes to Participation and Fairness of Decisions (e.g., perceived output legitimacy for disadvantaged or vulnerable communities)	• Electricity Cost Burden and Affordability Gap (e.g., electricity bill/household income [- target]) • Electricity Program and Technology Performance (e.g., distribution of savings/costs, reliability/ resilience, or other benefits/burdens) • Electricity Program and Technology Accessibility (e.g., demographics of program participation, investment, and resources [including DERs]) • Electricity Quality (e.g., demographics of outage frequency, duration, and restoration efficiency; hours to access critical services/income [social burden]) [15]	• Economic Impacts for Disadvantaged or Vulnerable Communities (e.g., reinvestment to address electricity burden; energy resource ownership and governance; job training and quality; other non-energy economic impacts) • Environmental Impacts for Disadvantaged or Vulnerable Communities (e.g., natural resource replenishment; pollution/waste removal; land use and resource siting) • Social Impacts for Disadvantaged or Vulnerable Communities (e.g., pollution exposure reductions and heath outcome investments; safeguard/grievance redress mechanisms establishment)

Equity is unique among the identified emerging grid objectives in that it both serves as an independent objective but also provides a lens through which all other objectives (and associated metrics) can be assessed. With respect to traditional objectives, equity is often coupled with affordability. Improving assessments of electricity affordability may provide an opportunity for incremental improvements in grid planning processes by addressing equity, although affordability is only one component of equity. There are examples of considering cost and equity in decarbonization-driven generation planning [16]. Energy storage assets can play an essential role in enabling renewables integration as well as promoting resilience, reliability, and equity [12]. A decarbonized grid is often seen as a “de facto equity strategy” with the idea that a cleaner, more efficient, and more reliable grid would lower costs for ratepayers [17], and reduce direct effects to frontline communities most impacted by electric system externalities, including, but not limited to, reductions in air pollution [18].

There are also examples of jointly considering equity and resilience in integrated grid planning. Microgrid siting in Puerto Rico and electric vehicle charging infrastructure siting in Texas are examples of using a social burden methodology to enable an equity-inclusive approach to reliability and resilience investments [19, 20]. Strategies for co-optimizing resilience with equity considerations have also been a focus of the Resilience Working Group for integrated grid planning in Hawaii. The Working Group developed a scorecard with metrics that blend resilience with other planning goals such as reliability, renewable energy expansion, sustainability, affordability, and rate stability [21].

Thus, various metrics have been proposed to measure progress toward system equity, but greater refinement and application of outcome-focused metrics are ultimately necessary to inform electric grid performance-based assessments and prioritization of investments to equity. Rather than focus on retrospective measures of selected inequities in the electricity system, there are opportunities to prospectively evaluate how alternative grid investment strategies impact equity outcomes through metrics such as energy burden, energy efficiency savings, and outage restoration times for vulnerable communities [3]. Policy responses to energy poverty can focus on performance of programs for reducing energy poverty [5], underscoring the need for practical performance- or outcome-based investment approaches. Assessing the current state of grid planning is critical to identifying opportunities to expand traditional planning objectives (e.g., affordability) to address how an equitable grid should perform into the future.

2.0 Integrating Equity into Electric Grid Policy and Planning

2.1 Policy Prioritization of Equity in Grid Planning

Policymakers across all levels of government are increasingly emphasizing equity as an emerging objective for the electric power system [6, 22]. Environmental and economic justice are express aspects of the Biden administration's climate policy agenda [23], which has sharpened the focus on energy equity as an essential component of the just transition to a more sustainable and resilient energy sector. For example, the Biden administration has called for 40% of the benefits from federal investments in climate and clean energy to serve disadvantaged communities [23]. State and local governments have also begun explicitly addressing the equity implications in a wide variety of cases, including the transition away from fossil fuel generation and the need for workforce training and financial assistance for affected communities [24]. Almost half of the states took action on energy equity between January 2020 and July 2022, and six states had adopted some form of equity metric [25].

State and local policymakers have begun developing policies and practices specifically to introduce energy equity and justice considerations into grid planning processes by emphasizing participation in decision-making. The incorporation of equity into grid planning is still nascent, and it has most often occurred as part of establishing and implementing decarbonization policies. An increasing number of states are considering legislative approaches for safeguarding communities historically excluded from energy decision-making processes and who are overburdened by long-term pollution exposure [26]. Many of these approaches are extending consideration to the distributive and restorative elements of energy justice, such as ensuring the benefits of clean energy technologies and job creation opportunities reach low-income and underserved communities.

As depicted in Table 2, state initiatives have been critical to addressing energy justice considerations such as historical inequities in energy decision-making, but also in ensuring the benefits and burdens of the changing system are equitably distributed [27]. While some of these policies recognize the justice elements and offer indicators that can be used to establish the baseline state of equity (e.g., California), most do not provide metrics to track equity-related efforts and ensure progress is being made.

Table 2. Energy Justice Reflected into State Policies for Equity in Grid Planning

Jurisdiction and Policy	Dimensions of Energy Justice Included			
	Procedural	Recognition	Restorative	Distributive
Oregon (HB 2021) **[28]**	X	X		X
Washington (SB 5116, 2019) **[29]**		X		X
Connecticut (EO.3, 2019) **[30]**		X		
Illinois (SB 2408, 2021) **[31]**		X		X
California (SB 350, 2015) **[32]**	X		X	X
Hawaii (Decision/Order NO. 37787, 2021) **[33]**				X
Massachusetts (Chapter 8 of the Acts of 2021) **[34]**				X
Michigan (ED 2020-10, 2020) **[35]**		X		

2.2 Development of Grid Planning Regulation and Guidance for Equity

Although state and local policymakers have sought to introduce both equity and energy justice considerations into utility planning processes, often as part of establishing and implementing decarbonization or other environmental policies, this integration has yet to be translated into institutionalized grid planning practices. Table 3 provides examples of legislation that authorizes, permits, or directs utility regulators to consider equity, and associated public utility commission (PUC) actions.

Table 3. State Policies and Associated Regulatory Authorities for Incorporating Equity

Policy Details	PUC Authorities and Actions
California Clean Energy and Pollution Reduction Act (SB 350, 2015) **[32]**[1]	
• Requires the PUC to incorporate environmental justice into decision-making, including prioritizing disadvantaged communities in resource planning, and establishing an IRP process for utilities to incorporate decarbonization and equity considerations. • Directs the PUC to conduct a study on "barriers to access for low-income customers" to renewable energy, energy efficiency investments, and sustainable transportation options.	• Permitted the PUC to issue IRP requirements that must include an analysis of their impacts on disadvantaged communities.[2] • Led to Rulemaking Order 16-02-007, which stated the PUC "shall adopt a process" to file an IRP that ensures that load serving entities (LSEs): meet GHG emissions reductions established by the state, procure at least 50% renewables by 2030, enable just and reasonable rates, minimize impacts to ratepayers' bills, and ensure system reliability, sustainability, resilience, and diversity. • Established a "Disadvantaged Communities Advisory Group" to advise the CA Energy Commission and PUC.
Connecticut Executive Order 3 (EO.3, 2019) **[30]**	
• In order to reach decarbonization goals and spur "economic development throughout the state", select agencies must recommend decarbonization pathways	• Directs the Department of Energy and Environmental Protection, in conjunction with the Public Utilities Regulatory Authority, to analyze and "recommend strategies for achieving a 100% zero-

[1] The 2018 legislation that established the California's 100% carbon-free electricity by 2045 goal also directed the California Energy Commission (CEC), California Public Utilities Commission (CPUC), and California Air Resources Board to produce a joint report on implementation strategies [16]. The resulting 2021 report has a strong focus on energy equity, noting that implementation of the legislation will need to help low-income, disadvantaged, tribal, and rural communities "overcome barriers to clean energy," including issues of energy and pollution burdens, functioning during power outages, and workforce development. Specifically, the report highlights: "Keeping electricity affordable, with an emphasis on vulnerable populations and households that pay a disproportionately high share of their household income on energy; Reducing air pollution from local power plants, particularly in communities that experience a disproportionate amount of air pollution; Strengthening their ability to function during power outages and enjoy reliable energy in a changing climate; [and] Funding of training for high-quality jobs and careers in the growing clean-energy industry" [48].

[2] Including at a minimum: "i.) A description of which disadvantaged communities, if any, it serves (LSEs will be expected to make the determination of what is considered "disadvantaged" every two years); ii.) What current and planned LSE activities/programs, if any, impact disadvantaged communities; and iii. A qualitative description of the demographics of the customers it serves and how it is currently addressing or plans to comply with the requirement to minimize air pollutants" [49]. Disadvantaged communities are defined as follows: "any community statewide scoring in the top 25 percent statewide or in one of the 22 census tracts within the top five percent of communities with the highest pollution burden that do not have an overall score, using the most recent version of the California Environmental Protection Agency's CalEnviroScreen tool" [49]. The CalEnviroScreen is a mapping tool that uses environmental, health, and socioeconomic data to produce scores of pollution burdens at the census tract level, underscoring the importance of baseline data and metrics for understanding and targeting investments to address existing inequities [50].

Policy Details	PUC Authorities and Actions
consistent with the state's goal of 100% zero-carbon electricity by 2040 in their IRP.	carbon target for the electric sector" and ensure energy affordability and equity for all ratepayers during the resource planning process.
Hawaii Decision on Performance Based Regulation (Decision/Order NO. 37787, 2021) **[33]**	
• Establishes a performance-based regulatory framework that features an energy efficiency incentive mechanism to encourage collaboration between the utility and third-party efficiency program administrator to provide low-to moderate-income customers with opportunities to better manage energy consumption. • Includes several scorecards that provide a framework and evaluation criteria for customer equity; outlines metrics to evaluate utilities' performance in addressing low- to moderate-income customer affordability and distributed energy resource grid services.	• Per the PUC's decision, Hawaiian Electric Companies (HECO) must "adopt updated performance-based utility regulations to…cost-effectively achieve Hawaii's energy goals and deliver savings to customers". • Requires HECO "to submit draft tariffs to implement the [delineated] performance incentive mechanisms". • Requires HECO to report quarterly metrics on the number and percent of customers participating in distributed energy resource or demand response programs (with a target of 30% of all customers enrolled in one or more programs), as well as the number of low- to moderate-income customers participating in these types of programs.
Illinois Climate and Equitable Jobs Act (SB 2408, 2021) **[31]**	
• The Illinois Commerce Commission (ICC) must "complete a transition that includes a comprehensive performance-based regulation framework for electric utilities" to maintain service reliability and safety "particularly in low-income…communities", "decarbonize utility systems", maintain affordability for "all customers", and "address the particular burdens faced by consumers in environmental justice communities" (e.g., late fees).	• Requires the ICC to assess whether low-income discount rates for electric (and natural gas) residential customers are appropriate; authorizes the ICC to permit or require utilities to file a tariff establishing such rates. • Requires the ICC to make rules requiring utilities to produce transparent information about cost-saving mechanisms to lower monthly bills for consumers. • Requires utilities to file a multiyear rate plan where companies will work toward ICC-approved performance metrics; ends utility formula rates and transitions to performance-based ratemaking. • Requires utility companies to accurately report to the ICC on the number of shutoffs and reconnections on a monthly basis.
Maine Climate Action Plan (LD 1959, SP 697, 2022) **[36]**	
• Contains directive to include equity and EJ impacts directly into grid planning efforts, as opposed to a separate assessment process.	• Requires Maine's investor-owned utilities to conduct a five-year integrated grid planning process, with plans to include actions to help achieve state goal of GHG reduction to 80% below 1990 levels by 2050.
Maryland Climate Solutions Now Act (SB 0528, 2022) **[37]**	
• Establishes 2045 target for net-zero carbon emissions statewide. Adopts definitions of DACs ("underserved" and "overburdened" communities) for the purposes of identifying populations eligible for targeted funding and program efforts	• Requires all state agencies to consider climate impacts and impacts on DACs in all long-term planning and drafting of regulations. PSC to advise agencies on these impacts, including by using mapping/data tools to evaluate impacts
Massachusetts: An Act Creating a Roadmap for Massachusetts Climate Policy (Chapter 8 of the Acts of 2021) **[34]**	
• Department of Public Utilities "shall… prioritize safety, security, reliability of service, affordability, equity and reductions in greenhouse gas emissions to meet statewide greenhouse gas emission limits".	• Allows the department to direct electric and gas distribution companies and municipal aggregators with certified energy plans to jointly transfer funds for the purposes of implementing a clean energy equity workforce and market development program.
Michigan: Building a Carbon-Neutral Michigan (ED 2020-10, 2020 **[35]**	

Policy Details	PUC Authorities and Actions
• Requires the PUC to evaluate "the potential impacts of proposed energy generation resources and alternatives to those resources" and also evaluate whether the IRPs filed by utilities are consistent with the emission reduction goals outlined by the state. The PUC must also include "considerations of environmental justice and health impacts" under the Michigan Environmental Protection Act.	• Expands the PUC's environmental advisory opinion to investigate whether utilities are consistent with the emission reduction goals set forth by the state and whether considerations of environmental justice and health impacts are addressed within utilities' IRPs.
Minnesota 100% Clean Energy Law (HF 7, 2023) **[38]**	
• Establishes 100% renewable energy target. Requires siting decisions to prioritize locations where fossil fuel generators have retired or are retiring in order to minimize negative / disproportionate harms to those communities.	• Expands list of considerations for PUC includes job creation, labor, climate adaptation (especially in environmental justice communities), equitable benefits and opportunities from the clean energy transition, and priority for affordable electricity to LMI customers
Oregon Clean Energy Targets (HB 2021) **[28]**	
• Implementation of clean energy targets should minimize burdens for "environmental justice communities".[3] • Zero greenhouse gas electricity generation should (to the "maximum extent practicable") provide "additional direct benefits to communities…in the forms of creating and sustaining meaningful living wage jobs, promoting workforce equity and increasing energy security and resiliency."	• Directs utilities to convene a Community Benefits and Impacts Advisory Group (which must include "representatives of environmental justice communities and low-income ratepayers") to support the utilities' reporting on community benefits and impacts of the utility's clean energy plan.
Washington Clean Energy Transformation Act (SB 5116, 2019) **[29]**	
• Electric utilities "must ensure that all customers are benefiting from the transition to clean energy" through equitable distribution of energy and nonenergy benefits (e.g., public health and environmental benefits, and energy security and resiliency) and reduction of burdens to marginalized communities (e.g., costs and risks). • Defines "vulnerable populations" as "communities that experience disproportionate cumulative risk from environmental burdens" due to socioeconomic and/or sensitivity factors.	• Requires integrated resource planning (IRP) to include an assessment of energy and nonenergy benefits and reductions of burdens to vulnerable populations and highly impacted communities.

As shown in Table 3, policies for incorporating equity into utility planning processes have varied in definitions of equity, specificity of equity goals, and extent of regulatory authority delegated to PUCs. California's Clean Energy and Pollution Reduction Act (2015) requires the PUC to adopt a process for incorporating equity considerations—such as ratepayer affordability and pollution impacts on disadvantaged communities—into utility resource planning. It further charges the PUC to study barriers to clean energy opportunities for disadvantaged communities, which are also defined in the Act. This type of policy lends more clarity to the role and responsibilities of the PUC in integrating equity as an objective in utility planning processes.

Another consideration is the scope of equity impacts included in delegated authorities. For example, relatively few PUCs have the authority to consider nonenergy economic impacts (i.e.,

[3] Environmental justice communities are defined as including "communities of color, communities experiencing lower incomes, tribal communities, rural communities, coastal communities, communities with limited infrastructure and other communities traditionally underrepresented in public processes and adversely harmed by environmental and health hazards, including seniors, youth and persons with disabilities" [41].

the effects of PUC decisions on local, state, and regional economies); these are typically only considered to the extent they cause direct and measurable financial impacts on ratepayers [39]. According to a recent report by the National Association of Regulatory Utility Commissioners [39], 14 states, the District of Columbia, Puerto Rico, and Virgin Islands have no explicit consideration of nonenergy economic impacts in statutory language; 26 states have some partial level of authority to consider nonenergy economic impacts (consideration is often limited to specific regulatory actions such as renewable generation purchases); and 10 states have considerable flexibility in explicitly addressing economic development, job creation, and other nonenergy economic impacts.

In states with partial to substantial consideration of nonenergy economic impacts, PUCs have interpreted their authority in myriad ways, largely driven by statutes and top-down decisions [39]. For example, in Minnesota, commissioners used their authority to consider the nonenergy economic impacts related to Xcel's 2015 and 2019 integrated resource plan filings. The decision on the latter extended to consideration of nonenergy economic impacts through a community study on jobs, tax impact, and temporary and permanent employment opportunities associated with replacement solar and gas generation [39]. In Colorado, commissioners reviewed some of the nonenergy economic impacts associated with the Public Service Company of Colorado's 2017 and 2021 electric resource plans, including direct plant employment and broad local economic impacts (e.g., local tax base losses).

While there are relatively few examples of grid planning guidance that incorporate equity, some jurisdictions are leading in the development of best practices to address procedural and recognition justice through stakeholder engagement processes and resources for grid planning, as well as distributive justice via community impact analysis for grid investment scenarios. For example, in 2020, the Oregon PUC approved new guidelines for investor-owned utilities that explore emerging expectations for the electric grid, including incorporation of clean energy, inclusivity, and customer energy options, in addition to increased transparency in distribution system planning [40]. While the PUC did not agree to a number of stakeholder suggestions—including the proposal to have community-based organizations be financially compensated for their time and expertise in advising utilities on distribution system planning—it did move to adopt greater community engagement requirements by increasing the number of stakeholder meetings from a minimum of two to four.

Recent legislative developments have placed a stronger emphasis on both the procedural and distributive justice dimensions of equity. For example, 2021 legislation in Oregon directs utilities covered by the legislation to convene an external advisory group to support the utilities' development of biennial reporting on the community benefits and impacts of the utility, including metrics such as energy burden, socioeconomic, or environmental justice co-benefits, and investments in environmental justice communities [41].[4]

[4] Specifically, reports must include: "(A) Energy burden and disconnections for residential customers and disconnections for small commercial customers; (B) Opportunities to increase contracting with businesses owned by women, veterans or Black, Indigenous, or People of Color; (C) Actions within environmental justice communities within the electric company's service territory intended to improve resilience…or facilitate investments in the distribution system; (D) Distribution of infrastructure or grid investments and upgrades in environmental justice communities in the electric company's service territory; (E) Social, economic or environmental justice co-benefits that result from the electric company's investments, contracts or internal practices; (F) Customer experience, including a review of annual customer satisfaction surveys; (G) Actions to encourage customer engagement; and (H) Other items as determined by the electric company and the electric company's Community Benefits and Impacts Advisory Group" [41].

2.3 Utility Integration of Equity into Grid Planning

To understand the level to which equity is already embedded within common grid planning processes, a robustness assessment was conducted. The assessment uses a rubric scoring methodology, and considers a number of factors: a) the existing literature on the objective, associated metrics, and its role in grid planning; b) federal, state, and local policies and regulations that require or incentivize utilities to consider the objective in their planning processes; c) other market and technology drivers that have pushed planners to incorporate the objective to varying degrees; d) the (relative) assessment of traditional objectives; and e) insights from subject matter experts with experience in grid planning processes. The latter is particularly important to capture situational knowledge about the current practices and the extent to which policy prioritization of emerging objectives has led to institutionalized practices, whereby regulatory guidance or other standards provide for systematic consideration of emerging objectives in planning processes and integration into investment decisions.

Table 4 shows the extent to which equity has been integrated into the most common grid planning paradigms, with "none" indicating no translation of the objective into planning processes and "robust" indicating well-institutionalized implementation of the objective.[5] Of all the planning paradigms analyzed, integrated resource and distribution system planning give the most consideration to equity as an emerging objective, but only in a limited capacity. However, equity is not an objective formally captured within the transmission planning process.

Table 4. Equity Integration Robustness Assessment

Planning Paradigms	Traditional Objectives				Emerging Objectives		
	Safety	Reliability	Efficiency	Affordability	Decarbonization	Resilience	**Equity**
Integrated Resource	Connected	Robust	Robust	Robust	Robust	Limited	**Limited**
Transmission	Robust	Robust	Connected	Connected	Limited	Connected	**None**
Distribution System	Robust	Robust	Robust	Connected	Limited	Connected	**Limited**

With respect to integrated resource planning, equity as an objective is currently captured in a limited capacity. Because many groups in society are affected by the development and operation of the power system, there are a wide range of stakeholders that have justifiable reasons for being part of the decision-making process, including (but not limited to) utility representatives, consumers, and community advocacy groups. However, participation in utility resource plan

[5] The four scores used in the rubric— "robust," "connected," "limited," and "none"—are defined as follows:

- Robust: the planning paradigm systematically integrates the objective, with institutionalized implementation guidance/practices that guide quantitative evaluation (e.g., via performance-based metrics) and directly inform investment decisions
- Connected: the planning paradigm partially integrates the objective, but in the absence of institutionalized implementation guidance/practices, evaluation is largely qualitative and only indirectly informs investment decisions
- Limited: the planning paradigm integrates ad hoc references the objective, but the objective is neither discussed in detail nor quantitatively/qualitatively evaluated and thus does not inform investment decisions
- None: the planning paradigm does not integrate the objective (and thus does not inform investment decisions), suggesting that any policy prioritization of the objective has not translated into practice.

It should be noted that the rubric evaluates how well the emerging objectives are currently integrated into grid planning paradigms, not the extent to which these planning paradigms are aligned to eventually capture these emerging objectives.

proceedings have historically been limited to those familiar with the modeling techniques, forecasting tools, and sensitivity analyses used in the process, making accessibility to information a barrier to meaningful participation from other stakeholders affected by the planning process and its outcomes [42]. There are multiple angles for incorporating equity as a guiding objective in the development of resource planning, particularly through the lens of 1) promoting greater inclusivity in the stakeholder feedback process, 2) enhancing opportunities for communities to benefit from clean energy technologies and outcomes, or 3) addressing customer affordability impacts by considering assumptions about revenue requirements and cost allocation. For example, integrated resource plans have the power to address equity issues by expanding access for underserved and overburdened communities to participate in clean energy and energy efficiency programs [42]. The more explicit references or considerations of equity within resource planning are often connected to climate change impacts and environmental justice, as more states are requiring utilities to consider these elements within their planning efforts.

Equity as an objective is also currently not captured in most distribution system planning processes, but there are multiple avenues for incorporating equity as a guiding objective in distribution planning and integrated grid planning processes, by ensuring rate affordability, greater stakeholder inclusivity in the planning process, and increased access to energy efficiency and other demand-side management programs for energy-burdened communities. Although there are few case studies that highlight the ways in which equity can be operationalized within distribution system planning processes, there is increasingly greater consideration of how equity principles can be measured and meaningfully addressed within the context of distribution system planning since this level of planning addresses both state and community objectives.

The principles of equity are perhaps best captured in emerging grid planning paradigms such as integrated distribution system planning, a holistic, multi-objective planning approach. Traditional distribution planning is mostly conducted by the utility, or as an internal process with limited stakeholder input. Integrated distribution system planning operationalizes the equity principles of inclusivity due to its internal *and* external nature—it combines the internal utility process with external stakeholder engagement so that stakeholders can understand the technical and economic decisions and provide input at defined steps during the process [43].

While equity objectives are increasingly referenced in the policies that ultimately govern grid planning processes, the implications of the current system or potential investments are not evaluated in current grid planning practices. To the extent utilities are undertaking these equity-focused analyses, there may be opportunities to better integrate the data, analysis, and stakeholders into grid planning paradigms. Varied levels of precision and consistency in definitions of equity across jurisdictions are key challenges in developing standards that are applicable across institutional contexts. While there are some best practices emerging—particularly with respect to integrated distribution system planning, the lack of specificity in policy definition of equity and equity goals, and associated delegation of regulatory authority—has inhibited the flow from policy translation (how a regulator interprets top-down legislation and the authority delegated to them) to utility guidance (how a regulator informs utility actions based on policy aims) to objective formulation (how utilities use this guidance to map out the objectives that underpin planning considerations and resulting investments).

3.0 Challenges and Opportunities

In view of this baseline condition, there are several technical challenges to incorporating energy equity as a rigorous goal for future grid investments. These challenges are outlined below.

3.1 Translation of Equity Policy into Regulatory and Planning Practice

While state and federal energy policy priorities increasingly reflect equity concerns, the translation of such policies into guidance or requirements for grid planning practices is in the early stages. There have been efforts to bolster procedural equity, such as participation, outreach, and access, however, the distributive equity implications of the current system or potential investments are not quantitatively evaluated in current grid planning practices. Many state policies focus on the distributive impacts of the energy transition, but this has not yet been mapped back to integrating equity into grid planning. Moreover, states' policies for incorporating equity into utility planning processes have varied due to differences in the rigor of the policy language and level of authority afforded to the regulatory body. The ambiguity in policy language can make it difficult for a regulator to inform utility planning processes, especially when the policy also loosely defines the responsibilities and expected actions of the regulator.

3.2 Equity Metrics and Measurement Approaches for Investments and Tradeoff Balancing

Integrating emerging objectives into grid planning paradigms requires development of definitions, metrics, and measurement strategies. While the literature and early policies and practices provide a rich set of candidate metrics for equity, moving from metrics to actual measurement is a substantial undertaking. There may be opportunities for incremental expansion of grid planning approaches to better reflect equity, for example, affordability metrics could be extended to better reflect distributive dimensions.

Because equity introduces a significant amount of new social information into an engineering process, there is still work to be done to understand and account for the relationships between investments in the grid and outcomes for customers and affected stakeholders. For example, there may be an assumption that development of more renewable energy is parallel to achieving equity, but the amount of development, who pays for the development, where it is sited, whether it supports local interests, and who profits from these investments are all considerations for an equitable grid investment strategy. As such, outcome-bases metrics will play an important role in integrating equity into investment decisions within grid planning processes and in considering tradeoffs and balance performance across equity and other traditional and emerging objectives (e.g., decarbonization and resilience)

3.3 Meaningful Involvement and Understanding of Vulnerable Communities in Grid Planning

Equity has received little consideration across resource, transmission, and distribution planning paradigms. While equity has gained policy traction recently, it has not resulted in robust regulatory guidance for utilities or been holistically integrated into grid planning schemes. Underlying challenges include vague policy language or unclear expectations on how to address equity in the electric sector, ambiguity in regulatory authority to guide objective integration into grid planning, difficulty translating unclear policy into meaningful utility planning guidance, and insufficient incentives for utilities to meaningfully integrate (or prioritize) equity as a grid planning objective.

Meaningful involvement of understanding of vulnerable communities is critical to addressing these gaps. Recognizing community knowledge and information is an important element of formulating equity policies and practices. Energy equity, by definition, recognizes that disadvantaged communities have been historically excluded from planning for the electricity system and burdened by pollution, insufficient energy infrastructure, and other impacts. Building legitimacy and trust in an equitable electric system requires the meaningful involvement of those who have been historically neglected by that system. These affected parties are also key to shaping what equity means and what that might look like in terms of outcomes, which are critical parameters to forming objectives. Transparent partnerships with vulnerable communities also build confidence in the planning process down the line.

4.0 Conclusion

An equitable electric grid fairly distributes burdens and benefits and ensures that electricity decision-making procedures are inclusive of and responsive to *all* affected stakeholders, including those historically burdened by and excluded from planning for the electricity system. While an increasing number of policies and regulatory dockets outline equity considerations for the operation of the electric grid and its impact on customers, equity has not been systematically integrated into grid planning processes. Policies do not always clearly define equity objectives and associated delegated authorities, making it difficult for regulators to translate these objectives into actionable grid planning guidance for utilities (including identification of metrics). Additionally, existing equity metrics do not encompass the full range of equitable system attributes, nor performance outcomes, making it difficult to comprehensively evaluate system performance. Further refinement of equity metrics is needed to understand the tradeoffs and complementarities within equity objectives and among equity and other traditional and emerging objectives.

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