Check for updates

Moving beyond "believers vs. deniers" labels: a public response-centered framework for energy justice in the emerging renewable energy sector

Idowu O. Kunlere* and Kalim U. Shah

Joseph R. Biden, Jr. School of Public Policy & Administration, University of Delaware, Newark, DE,
United States

The global shift toward renewable energy raises concerns that the legacy of
energy injustice—historical imbalances in the distribution of benefits and burdens
from fossil fuels—may persist within renewable systems intended to address
climate change. Current research highlights that energy injustice could threaten
the success of this transition, yet limited focus has been placed on understanding
public responses to these emerging injustices. Existing frameworks often reduce
public opinion to simplistic binaries (for example, "supporters vs. opponents"),
which fail to capture the nuanced and diverse perspectives necessary for a
comprehensive understanding of public sentiment on energy issues. To address
this, we introduce the "PARO framework," a novel tool that categorizes public
responses to energy injustice within the renewable energy context. The PARO
framework broadens the analytical lens on public opinion, offering insights that
can guide more targeted and effective solutions for promoting equitable energy
transitions.

KEYWORDS

energy justice, renewable energy, public response, energy transition, PARO framework

1 Introduction

Energy justice has become a central framework in both traditional and renewable
energy sectors, emphasizing the fair distribution of energy's benefits and burdens across
society. It advocates for equitable access to energy, fair participation in decision-making,
and accountability for the negative impacts of energy production and consumption
(Jenkins et al., 2016a). Sovacool and Dworkin (2015) define energy justice as striving
for a global energy system where the rewards, such as electricity, and the costs, such as
pollution, are shared equitably. McCauley (2018) extends this, asserting that energy justice
encompasses social and environmental rights across all energy systems. In essence, energy
justice strives for a just and sustainable energy system for all (UN, 2020; UNDP, 2020;
Weforum, 2015).

At its core, energy justice aims to ensure that energy production and consumption
are fair, with benefits and harms distributed equitably, and that marginalized communities
have a voice in decision-making. This principle applies to both fossil fuel and renewable
energy systems. However, the shift toward renewable energy introduces new challenges,

such as land use conflicts, unequal access to clean energy, and socio-economic disruptions (Sovacool and Dworkin, 2015). These issues highlight the need for updated tools to address evolving energy justice concerns (Sovacool et al., 2017).

Public responses are integral to energy justice debates, reflecting how communities, policymakers, and organizations engage with energy equity issues. These responses—ranging from activism and policy advocacy to opposition and inaction—offer insight into how communities perceive issues like unequal resource access and uneven environmental burdens, particularly during renewable energy transitions. Initially hailed as a solution, renewable energy has also raised concerns about perpetuating or introducing new forms of injustice. Resistance to projects like wind farms and solar installations, especially in rural areas, underscores the need for procedural justice, ensuring all stakeholders, particularly marginalized groups, have a say in energy decisions (Velasco-Herrejón and Bauwens, 2020; Songsore and Buzzelli, 2016).

Scholars such as Heffron and McCauley (2017) argue that energy justice frameworks must adapt to these changing public responses by enhancing procedural and recognition justice to include historically excluded voices. The discourse surrounding renewable energy has thus shifted toward embedding justice in every aspect of energy policy and implementation.

While several frameworks address energy justice—such as the Energy Justice Metric (Heffron et al., 2018) and the "whole systems approach" (Jenkins et al., 2014; Mejía-Montero et al., 2021)—they primarily focus on balancing affordability, sustainability, and security. McCauley et al.'s (2013) framework, which incorporates distributive, procedural, and recognition justice, provides deeper insights into energy transitions. Similarly, van der Wel et al. (2024) apply public values theory to explore how societal values influence energy decisions.

Despite these contributions, significant gaps remain in understanding public responses to energy justice issues, particularly the diversity of public reactions and their underlying motivations. For example, scholars such as Heffron and McCauley (2017), Sovacool and Dworkin (2015), and Jenkins et al. (2016a) have largely focused on institutional and policy-driven perspectives, overlooking the diverse range of public reactions—from passive acceptance to active resistance—and their underlying motivations.

Similarly, current models often oversimplify public responses into binary categories—such as "support" or "oppose"—that fail to capture the complex and varied nature of public reactions to energy projects. As a result, they overlook the broader spectrum of public engagement, from passive acceptance to active resistance. A more nuanced understanding of these responses is crucial for effectively applying energy justice frameworks and addressing public concerns.

This paper introduces the PARO framework, a conceptual tool designed to fill these gaps by categorizing public responses to energy justice in the context of renewable energy transitions. The PARO framework offers a broader lens to analyze public reactions, considering passive, reactive, and proactive behaviors. While this paper focuses on the conceptual development of the framework, its empirical application will be reserved for future research. The goal is to improve our understanding of public responses to energy justice in renewable energy transitions and

offer a valuable tool for policymakers, energy developers, and community leaders as they work toward creating fair and equitable energy systems.

2 Literature review

2.1 Energy justice in traditional (oil and gas) sector and renewable energy

Global energy demand has driven heavy dependence on fossil fuels for over a century, with significant environmental costs (Akporiaye, 2023; Alexeev and Zakharov, 2022; Robbins et al., 2014; Rahman, 2004; Kovarik, 2005). As highlighted by mounting scientific evidence, fossil fuel emissions are increasingly linked to climate change (IPCC, 2021).

In the last few years, energy justice research in the oil and gas sector has revealed pervasive inequalities, which can be categorized into four major themes: climate change (USEPA, 2022; Cramer et al., 2018), economic instability (Belarbi et al., 2021), environmental pollution (Nwilo and Badejo, 2005), and social inequality (Bartiaux et al., 2019). For example, oil exploration in Nigeria's Niger Delta has severely damaged the environment, undermining livelihoods and deepening social inequality, exacerbated by poor governance and corruption (Dulal et al., 2009). Thus, the global shift toward renewable energy sources like solar and wind, termed the energy transition, offers a promising alternative (UNDP, 2015). These renewables produce minimal emissions, positioning them as key solutions to climate change (USEIA, 2019, 2021).

In recent years, renewable energy has increasingly been positioned as the antidote to the environmental and social harm often associated with the fossil fuel industry. While it offers significant benefits—such as reducing greenhouse gas emissions and improving energy security—it also introduces justice-related challenges. Renewable projects can, in some cases, deepen inequalities and contribute to energy injustice (Welton and Eisen, 2019; Sovacool, 2021; Sovacool et al., 2019b; Bartiaux et al., 2019; Heffron and McCauley, 2017, 2014; Finley-Brook and Holloman, 2016; Baker, 2015; Nwilo and Badejo, 2005). Haarstad and Wanvik (2017) conceptualize the instability of oil landscapes and suggest that these instabilities are mirrored in the renewable sector, where the socio-environmental impacts are still unfolding. This paradox risks undermining the energy transition goals by exacerbating pollution, economic instability, and social inequities. Scholars like Jenkins et al. (2016a) and Sovacool et al. (2017) argue that fairness and equity must apply to renewable energy just as they do to fossil fuels.

However, the clean energy transition may also disrupt labor markets (Okoroafor et al., 2022; Nanayakkara et al., 2021; Carley and Konisky, 2020; Sovacool et al., 2019a; Welton and Eisen, 2019; Finley-Brook and Holloman, 2016; Evans and Phelan, 2016). As jobs in fossil fuels decline, employment opportunities in renewables increase—but without proper planning, workers and oil-dependent regions could face unemployment and economic distress (Scheer et al., 2022; Mohommad and Kim, 2022; Grubert, 2020; Craig et al., 2019; Calcar and Scholten, 2018; Banteli and Gwilliam, 2014; Lantz

and Tegen, 2009). Additionally, large-scale renewable projects can disrupt ecosystems and displace communities (Rehbein et al., 2020; Chock et al., 2020; Stoms et al., 2013), complicating efforts to ensure an equitable energy transition for all (Welton and Eisen, 2019).

2.2 Public response to energy (in)justice

Public responses to complex issues are a key study area across various disciplines. Researchers have explored public reactions to challenges such as climate change (Chilvers et al., 2014), transportation (Rachman et al., 2021), drought (Owens et al., 2003), and institutional change (Shah et al., 2021). These responses reveal underlying values, motivations, and perspectives on energy justice and help gauge acceptance or resistance to developments in the energy sector. Understanding public perceptions of energy (in)justice allows for solutions aligned with societal concerns, leading to more effective interventions.

Despite increasing activism, current energy justice frameworks inadequately address public responses. While highlighting distributional, procedural, and recognition justice, they often overlook the complexity of public engagement. This omission fails to capture how communities interact with energy injustice, particularly in renewable energy contexts. Addressing this gap requires integrating public responses more systematically into energy justice frameworks. Public responses are more than participation; they reflect the frustrations, aspirations, and agency of those affected by energy systems. Whether in protests, advocacy, or calls for community-controlled projects, these reactions mirror lived experiences of energy injustice. Often fragmented or episodic, they demand a structured approach to inform more equitable energy policies and practices.

2.3 Energy justice conceptual frameworks

The evolving discourse on energy justice addresses the challenge of ensuring equity in energy transitions, production, and consumption. Scholars recognize that energy systems are embedded in social, environmental, and political contexts, often leading to injustices that disproportionately affect vulnerable communities. Central to this discussion is the need to incorporate public responses and behaviors into energy justice frameworks—a growing area of interest for researchers.

Previous studies have explored various aspects of energy injustice, including its dimensions (McCauley et al., 2013), conceptualization (Sovacool and Dworkin, 2015), measurements (Meenar et al., 2022; Sharma, 2021), impacts (Alford-Jones, 2022), and policy solutions (Sokołowski and Heffron, 2022). This cross-disciplinary approach enriches our understanding and offers potential solutions. Langemeyer and Connolly (2020) explored the possibility of integrating justice concepts into the design and management of critical public systems, including urban infrastructure and utilities. They argue that existing frameworks may not be enough to bridge the gap between theoretical discussions of energy justice and achieving tangible results that directly impact citizens. Their work emphasizes the importance

of practical solutions that address issues like access to affordable energy and fair distribution of resources. Another example comes from Bouzarovski and Simcock (2022), who focused on integrating spatial considerations with energy justice. They employed the term "spatial justice" to analyze how geography can affect energy access and outcomes. Their study explores how geographical disadvantages exacerbate vulnerabilities and contribute to energy poverty.

Similarly, studies by Alford-Jones (2022) and Sokołowski and Heffron (2022) delve into the links between energy justice, public policy implementation, and potential policy failure. Their work builds upon the notion that energy justice has far-reaching implications, impacting policies for traditional (fossil fuels) and renewable energy sources (solar, wind). Alford-Jones (2022) uses Guatemala as a case study to illustrate how neglecting energy justice can hinder the successful implementation of renewable energy policies. When communities are not included in the decision-making process or experience negative consequences from renewable projects, their opposition can stall progress. Conversely, ensuring fair access to energy benefits and mitigating potential harm fosters community buy-in and facilitates smoother policy implementation.

A key framework (Table 1) is the triumvirate energy justice theory (McCauley et al., 2013), which addresses systemic inequalities through distributive, procedural, and recognition justice (Jenkins et al., 2016a; Sovacool and Dworkin, 2015). Distributive justice, in particular, emphasizes fair access to energy and mitigating harmful consequences like pollution and environmental degradation.

Procedural justice emphasizes fair, inclusive decision-making in the energy sector, ensuring that all stakeholders, regardless of background, have a voice in shaping policies and projects. Communities directly impacted by energy infrastructure should influence how these projects are planned and executed, with transparency and accountability being essential. Recognition justice focuses on acknowledging diverse values and experiences and addressing historic power imbalances that have marginalized certain groups within the energy system (Carley and Konisky, 2020; Outka, 2018; Walker, 2009). It aims to integrate all perspectives into decision-making to promote a just and equitable energy future.

Wood and Roelich (2020, 2019) critique McCauley et al.'s (2013) "triumvirate" model of energy justice for its top-down, expert-driven nature, which neglects the lived experiences of those directly impacted by energy injustices. This oversight creates an incomplete understanding of public responses to energy policies, especially in marginalized communities (Velasco-Herrejón and Bauwens, 2020). By focusing on experts, frameworks like McCauley et al.'s (2013) fail to capture how communities define justice within specific socio-economic and cultural contexts. Public response is crucial for the success of energy transitions, highlighting the need for bottom-up approaches where communities co-create justice frameworks, ensuring they reflect real public concerns.

Early works by Jenkins et al. (2014, 2016a) also laid the foundation for energy justice, emphasizing distributional, procedural, and recognition justice—focusing on fair energy

TABLE 1   Dimensions and tenets of energy justice.

S/N	Tenets	Focus	Features
1.	Distributive Energy Justice	Identifies the distributions of rewards and burdens of energy production in a community	• Privileges and vulnerabilities • Actors and their locations
2.	Procedure Energy Justice	Identifies decision-making processes in an affected community	• Power dynamics (political economy), Administrative, and Judicial dimensions
3.	Recognition Energy Justice	Identifies vulnerable people in the affected community	• Vulnerable people in at-risk communities.

distribution, inclusive decision-making, and recognizing marginalized groups. Their "whole systems approach" highlights justice across the energy lifecycle. However, despite characterizing energy injustices such as those in the Energiewende in Germany and ethnic minority imbalances, this framework does not focus on analyzing how the public responds to energy injustices. Instead, it frames justice largely as a normative goal to be pursued by institutions, with little engagement with the public's active participation in these processes.

In parallel, Heffron and McCauley (2017) expanded the concept by advocating a multidisciplinary approach that integrates law, policy, and economics. Their Energy Justice Metric offers a structured tool to evaluate energy systems. However, it falls short in capturing the qualitative complexities of public responses, treating the public more as passive recipients than active participants in energy transitions. This oversight points to a crucial gap in understanding how public responses affect the success or failure of energy justice efforts.

On the other hand, McCauley's (2018) and Heffron et al.'s (2015) "energy trilemma" addresses the tension between energy policy's political, economic, and environmental dimensions, aiming for sustainable, equitable outcomes. This framework is particularly valuable when energy (in)justice issues span multiple disciplines, each with potentially conflicting priorities. While this framework aids decision-making, real-world applications are often complex and unpredictable. However, Ciplet's (2021) evaluative framework addresses this challenge by providing a structured method for visualizing ideal energy justice outcomes. It offers clarity by simulating conditions for ideal energy justice, helping translate principles into practical solutions.

Recent scholarship, such as van der Wel et al. (2024), emphasizes integrating public values into energy transition policies, marking a shift from earlier top-down approaches. Although van der Wel et al. (2024) recognize that public perceptions of fairness are key to socially sustainable energy transitions, their study lacks a dedicated framework for capturing diverse public responses, especially among social groups defined by race, class, or geography. However, as Sovacool et al. (2017) and Jenkins et al. (2016a,b) note, energy justice frameworks are still evolving and must account for the complexities of global transitions. Public opposition to renewable energy, often rooted in concerns over fairness and equity, can hinder progress. To address this, frameworks must incorporate public responses and the broader social, economic, and cultural factors shaping responses to energy justice initiatives.

2.4 Theoretical gaps in public responses in current energy justice frameworks

As energy justice frameworks for understanding public responses continue to evolve, public response frameworks within related, more established subfields, such as climate justice, can enhance our understanding of public responses to energy justice issues. In this context, we draw from existing studies on public responses to climate change that could offer a valuable, albeit limited, foundation for exploring similar dynamics in energy justice.

In climate justice literature, public opinion is often oversimplified into binary categories such as "believers" and "deniers" (Krishna, 2021; Karakas and Mitra, 2020; Corry and Jorgensen, 2015). This binary approach overlooks the spectrum of attitudes between these extremes. For example, O'Neill and Boykoff (2010) introduce "skeptics" or "contrarians," yet even this fails to capture the full complexity of public attitudes, where individuals may acknowledge climate change but question specific mitigation strategies or support renewable energy projects while expressing concerns about their local impact.

Similarly, traditional methods like surveys and questionnaires, used to gauge attitudes toward energy justice (Velasco-Herrejón and Bauwens, 2020; Greenacre, 2016; Newcomer and Triplett, 2015), often frame it as a binary issue, resulting in an incomplete and sometimes misleading picture of public sentiment (Heiervang and Goodman, 2011; Goyder, 1986). These tools tend to present energy justice as merely a choice between support or opposition, overlooking the nuanced perspectives that shape public opinion. However, public attitudes toward energy justice are more complex, reflecting overlapping concerns beyond approval or rejection. While many recognize the need for affordable, clean energy, they may also have reservations about the local impacts of energy projects, such as health risks or environmental degradation. Consequently, public responses are diverse, with support for sustainable energy transitions often existing alongside resistance to projects perceived as detrimental to local interests.

This same oversimplification also often permeates public response discussions on energy justice, framing them as mere support or opposition to issues like shale gas extraction and wind energy (Carley and Konisky, 2020; Cowell et al., 2011; Neville et al., 2017). However, as Howarth and Sharman (2015) and Chateauraynaud and Zittoun (2014) point out, public opinion is more nuanced. People may support renewable energy in principle while expressing concerns about local impacts. For instance, factors

such as visual aesthetics, fairness in decision-making, and trust in local authorities shape attitudes toward wind farms (Fournis and Fortin, 2016; Cass and Walker, 2009; Gross, 2007). These complexities challenge the simplistic binary view of "supporters" versus "opponents" and highlight the importance of context-specific concerns.

Acknowledging these limitations, scholars argue for modified energy justice frameworks incorporating public responses and grassroots activism (Crespo Montañés et al., 2023; Powell and Long, 2010). Howarth and Sharman (2015) advocate for an approach that recognizes the fluid nature of public views, which can shift from skepticism to acceptance based on local experiences and information.

To address these challenges, we propose the PARO framework, a conceptual tool designed to analyze public reactions to energy justice broadly. Unlike binary models, PARO acknowledges a spectrum of responses, ranging from outright opposition to enthusiastic support, reflecting diverse motivations and concerns.

3 The PARO framework: a conceptual tool for public response categorization

3.1 Insights from some related studies on public responses

At least 13 key issues related to public responses to energy injustice could be identified in the existing literature (Table 2), highlighting the tension between simplification and nuance in understanding public responses to energy justice. These can be further grouped into four broader categories that reflect the dominant themes of existing research: Energy Justice Theory, Social Acceptance of Renewable Energy Projects, Social Movement Theory, and Public Response Theory (Table 2). These categories appeared across multiple studies, often in adapted or varied forms, revealing commonalities and complexities in how public engagement with energy justice has been studied. This grouping allows organizing public responses in ways that reflect the multi-dimensional and evolving nature of energy justice.

A central theme is that perceptions of fairness strongly influence energy policies (Table 2). Distributional justice, for instance, shapes how communities view the costs and benefits of energy transitions (Heffron and McCauley, 2017). Procedural justice emphasizes public involvement in decision-making, with marginalized communities often feeling excluded from energy processes (Jenkins et al., 2016a). Public resistance to renewable energy projects is another recurring theme, often driven by perceived injustices in development processes. Sovacool et al. (2017) and Sovacool and Dworkin (2015) show that local opposition arises when communities sense unfair treatment, especially when projects are imposed without proper consultation or compensation.

Studies such as Gross (2007) and Yenneti and Day (2015) clearly distinguish between procedural justice (fair decision-making) and distributional justice (fair distribution of benefits and burdens). Both are crucial for public acceptance, but procedural justice often presents the greater challenge to community buy-in. Wüstenhagen et al. (2007) propose a framework for social acceptance that includes socio-political, community, and market

acceptance, highlighting the need for alignment between public and institutional support. Velasco-Herrejón and Bauwens (2020) advocate for the capability approach to energy justice, emphasizing community empowerment and active participation in decision-making, moving beyond mere consultation.

Public resistance, often manifesting in protests or grassroots movements, emerges when communities feel unfairly treated, particularly when vulnerable groups are disproportionately affected. Devine-Wright (2009) discusses "place-protective action," where opposition arises when energy projects threaten local environments. Similarly, Sovacool (2017) describes resistance to low-carbon transitions in the Nordic region. However, public responses are not always confrontational—many communities passively accept or disengage from energy justice issues due to feelings of powerlessness or resource limitations.

3.1.1 Strengths and weaknesses of the conceptual categorizations

These categorizations incorporate multiple dimensions of justice and multi-scalar perspectives. Jenkins et al. (2016a) offer a comprehensive framework integrating distributional, procedural, and recognition justice. This approach enables a holistic view of public responses. However, some studies, like Jenkins et al. (2014) and Heffron et al. (2015), overemphasize institutional responses, overlooking grassroots resistance or disengagement. While passive resistance is acknowledged, many studies focus on overt forms of engagement, such as protests. Furthermore, most categorizations are based on European and North American case studies, leaving public responses in the Global South underexplored, limiting the frameworks' applicability to diverse socio-economic and cultural contexts.

Next, we distilled the 13 categories into 16 sub-themes, which were then organized within the PARO framework. This thematic analysis examined public responses to energy infrastructure projects and renewable energy transitions, particularly to emerging issues such as disengagement, passive acceptance, and silent resistance. Thus, the themes of ignorance, denial, assumption, buck-passing, muted or weak response, and frontal response were derived from analyzing the sub-themes by focusing on how communities could respond to energy injustice issues (Table 3). The thematic categorization is based on how public responses evolve based on their responses to injustice, empowerment, and trust in institutions. Each sub-theme was categorized under one or more of the six main themes according to its potential impact and the nature of public engagement.

For instance, sub-themes like "Public Perceptions of Fairness" and "Justice in Energy Transitions" reflect a certain level of assumption, where communities might believe that fairness will prevail or expect justice without actively resisting or contesting energy projects. Themes like "Frontal Response" were derived from more active sub-themes, such as "Resistance to Energy Projects," "Social Movements and Collective Action," and "Contestation and Resistance," where communities are engaged in direct opposition to perceived injustices. The themes "Buck-passing" and "Denial" were linked to situations where communities or authorities shift responsibility or ignore injustices, as seen in sub-themes like "Exclusion from Decision-Making" and "Trust and Procedural

TABLE 2 Conceptual analysis of public responses to energy justice.

General groupings	Conceptual categorization	Strengths	Weaknesses	Reference(s)
Energy justice theory	Distributional justice	Accounts for how energy resources and burdens are shared	Limited focus on how different public groups articulate their grievances	Heffron and McCauley (2017)
	Procedural justice	Emphasizes public participation in decision-making	Often overlooks the dynamics of power and exclusion in local contexts	Jenkins et al. (2016a)
	Recognition justice	Highlights the need to respect diverse cultural contexts	Challenges in operationalizing this concept in policy mechanisms	Sovacool et al. (2017)
	Energy trilemma	Captures the balance between equity, security, and sustainability	Public perceptions of this balance are highly contextual, making generalizations difficult	McCauley (2018); Heffron et al. (2015)
	Social movement theory	Offers insights into public mobilization and resistance	Lacks a clear mechanism to address passive or disengaged public responses	Sovacool et al. (2017)
Social acceptance of renewable energy projects	Capability approach	Emphasizes community empowerment, which can lead to greater acceptance and long-term sustainability of projects.	Difficult to implement in practice, especially in contexts where communities are not well-organized or lack institutional support.	Velasco-Herrejón and Bauwens (2020)
	Social acceptance framework	Comprehensive, covering political, community, and market acceptance; highlights the complexity of acceptance in energy transitions.	Generalized framework; does not account for local or context-specific factors that might influence public responses in different regions or communities.	Wüstenhagen et al. (2007)
	Procedural vs. distributional justice	Clear distinction allows for a focused examination of fairness in both process and outcomes, addressing different aspects of justice in energy transitions.	Overemphasis on procedural justice may overlook deeper systemic issues, such as historical grievances or structural inequalities in distributional outcomes.	Gross (2007); Yenneti and Day (2015)
	Spatial justice	Highlights the role of land politics and spatial inequality in shaping public responses; focuses on marginalized communities and vulnerable groups.	Limited application outside of large-scale, land-intensive renewable energy projects; does not explore broader spatial dynamics in urban or non-rural settings.	Yenneti et al. (2016)
	Public mobilization (resistance)	Social movement theory enriches the understanding of active resistance	Lacks depth in categorizing passive or disengaged responses	le Maitre et al. (2024); Hall et al. (2013)
Social movement theory and public response theory	Place-protective action	Provides a nuanced understanding of local resistance beyond selfish motivations, emphasizing emotional and cultural factors.	May overlook broader structural inequalities and focus too much on local-level dynamics.	Devine-Wright (2009)
	NIMBY (not in my back yard)	Highlights the localized nature of public resistance, acknowledging that energy transitions may disproportionately impact certain communities.	Risk of oversimplifying public resistance as mere selfishness, ignoring legitimate environmental and justice concerns.	Boyle et al. (2019); Smith and Klick (2007)
	Contestation	Captures the dynamic and evolving nature of public responses, showing that they are not static but subject to change.	Limited application to contexts outside of low-carbon transitions; may not capture passive forms of resistance adequately.	Sovacool (2017)
	Social movements	Offers a framework for understanding collective action and how individual grievances become mobilized.	Overemphasis on organized movements, which may neglect more passive or disengaged forms of public response.	Tarrow (2011); McAdam et al. (2001)
	Disengagement and passive acceptance	Highlights that not all public responses are confrontational, some are passive, reflecting disengagement from the process.	May overlook why disengagement occurs and fails to connect it adequately to issues of justice or systemic barriers.	Velasco-Herrejón and Bauwens (2020)

Fairness". Table 3 shows likely themes obtained from the initial conceptual categorizations.

3.2 The proposed PARO framework

The PARO (Public Awareness, Responsibility, and Outcomes) framework emerges as a response to this gap, offering a more nuanced and structured way to interpret public reactions to energy injustice, particularly within the renewable energy sector. Unlike existing frameworks, which often treat public engagement as secondary or peripheral, the PARO framework places public responses at the center of analysis. It categorizes responses into six classes—ignorance, denial, assumption, buck-passing, muted or weak response, and frontal response—grouped into three overarching themes: overlaying, burden-shifting, and corrective actions. This categorization allows for a more granular understanding of how different segments of the public engage with energy justice issues, from passive indifference to active advocacy for change.

TABLE 3 Thematic analysis table.

S/N	Sub-themes	Description	References	Theme
1	Public perceptions of fairness	How communities perceive the justice dimensions of energy projects, particularly distributional justice	Heffron and McCauley (2017); Sovacool and Dworkin (2015)	Assumption
2	Resistance to energy projects	Public opposition to renewable energy infrastructure, mainly due to siting decisions	Sovacool et al. (2017); Sovacool and Dworkin (2015)	Ignorance, frontal response
3	Exclusion from decision-making	Communities feel excluded from the processes that shape energy policies, affecting procedural justice	Jenkins et al. (2016a); van der Wel et al. (2024)	Denial, buck-passing
4	Capabilities and empowerment	Public responses depend on their perceived capacity to influence energy decisions and access resources	Wood and Roelich (2019, 2020)	Frontal response, assumption
5	Cultural recognition	Public responses are shaped by the extent to which their cultural and social identities are acknowledged	van der Wel et al. (2024); Sovacool et al. (2017)	Denial
6	Justice in energy transitions	The broader concept of fairness in energy transitions, balancing security, equity, and environmental goals	Heffron et al. (2015); Jenkins et al. (2014)	Assumption
7	Public acceptance of renewable energy	Community and market acceptance of renewable energy technologies, with attention to social justice.	Wüstenhagen et al. (2007); Gross (2007); Velasco-Herrejón and Bauwens (2020); Mejía-Montero et al. (2021)	Muted or weak response
8	Procedural and distributional justice	Fairness in decision-making processes and the distribution of energy project benefits and burdens.	Gross (2007); Yenneti and Day (2015); Velasco-Herrejón and Bauwens (2020)	Assumption, buck-passing
9	Spatial justice	The impact of land politics on community responses, especially in vulnerable communities.	Bouzarovski and Simcock (2022); Yenneti and Day (2015); Yenneti et al. (2016)	Frontal response, denial
10	Community empowerment and capability	Emphasizes building the capability of communities to engage in energy justice issues.	Velasco-Herrejón and Bauwens (2020); Mejía-Montero et al. (2021)	Frontal response
11	Place-protective action	Public opposition to energy projects based on emotional attachment and cultural identity tied to specific locations.	Devine-Wright (2009)	Frontal response, denial
12	Contestation and resistance	Communities contest energy projects they view as unjust or poorly implemented, often leading to active resistance.	Sovacool (2017); Tarrow (2011)	Frontal response
13	NIMBYism and localized concerns	Public resistance focused on protecting local areas from perceived negative impacts of energy infrastructure projects.	Devine-Wright (2009); Sovacool (2017)	Frontal response, buck-passing
14	Social movements and collective action	Grievances related to energy justice are often expressed through social movements, which mobilize public opposition.	Tarrow (2011); McAdam et al. (2001)	Frontal response
15	Disengagement and passive acceptance	Public responses can also be passive, where people either accept energy projects or disengage from the justice debates.	Sovacool (2017); Devine-Wright (2009)	Muted or weak response
16	Trust and procedural fairness	Trust in institutions is critical in shaping public responses, with higher trust leading to lower resistance.	Jenkins et al. (2014); Heffron and McCauley (2017)	Assumption, ignorance

What sets the PARO framework apart from other models is its focus on both the range and the depth of public responses. Rather than treating public engagement as a monolithic phenomenon, the PARO framework acknowledges that various factors, including social, economic, and cultural contexts shape responses to energy injustice. It also recognizes that public responses evolve over time, influenced by external factors such as policy changes, technological advancements, and community awareness campaigns. By capturing these dynamics, the PARO framework provides a more comprehensive lens through which to assess the effectiveness of public participation in rectifying energy injustice.

3.2.1 Elements of the PARO framework on energy injustice

The PARO framework consists of six classes grouped under three major categories. It also employs three main yardsticks in classifying public responses to energy injustice. The three yardsticks are (i) **P**roblem **A**wareness, (ii) **R**esponsibility, and (iii) **O**utcome (Table 4).

"**P**roblem **A**wareness" is a property that identifies whether or not a subject recognizes energy injustice as a critical societal issue. This property also measures or seeks to understand a subject's knowledge level, perception, underlying assumptions, or biases about energy injustice. Here, the goal is to ascertain whether or not the subject knows about or accepts the peculiarities and importance of energy injustice.

A critical limitation of existing public response categorization frameworks is that they often fail to capture how well people understand such issues (public awareness) before categorizing their responses to them (public responses). Unlike the PARO framework, which explicitly incorporates a measure of public awareness, many other frameworks overlook this crucial aspect, leading to a less comprehensive representation of public sentiment and engagement. By failing to account for the level of awareness, these frameworks may miss critical dimensions and underpinnings of how the public perceives and reacts to issues, ultimately affecting the effectiveness of the strategies derived from them.

Understanding people's awareness of energy injustice as a problem is essential because problem awareness creates the foundation of how such people react to the issue. Furthermore, as a relatively emerging issue, many still do not know about energy injustice and may not identify or describe it accurately or realize its importance, which could, in turn, influence their response to it.

On the other hand, "**R**esponsibility" is a property that describes how the subject interacts with or responds to energy injustice. Here, the goal is to ascertain whether or not the subject takes any step or accepts responsibility for drawing attention to or addressing the identified energy injustice. This property is critical in understanding the position and responses of decision-makers to energy injustice. Usually, however, accepting "responsibility" to address energy injustice may depend on the subject's acquaintance with and understanding of what energy injustice means and represents. In summary, however, two typical mutually exclusive options are possible here: yes, the subject accepts responsibility, or no, the subject does not accept responsibility (Table 4). However, exceptions exist whereby the subject may not necessarily be a distinct "yes" or "no" but may alternate between a yes and no (Table 4).

Lastly, "**O**utcome" describes the likely result of the subject's approach to addressing or the subject's position on energy injustice. The current study considers "outcome" as the summation of the conscious and subconscious impacts of the subject's awareness and approach to energy injustice. It is important to note that irrespective of the subject's awareness or lack of awareness of energy injustice and whether or not the subject accepts responsibility for addressing energy injustice, choices have consequences, and so, those choices, actions, or inaction produce outputs that may address or worsen the situation. Thus, "outcome" seeks to understand how a subject's awareness, position,

FIGURE 1
Public responses to energy injustice under the PARO framework.
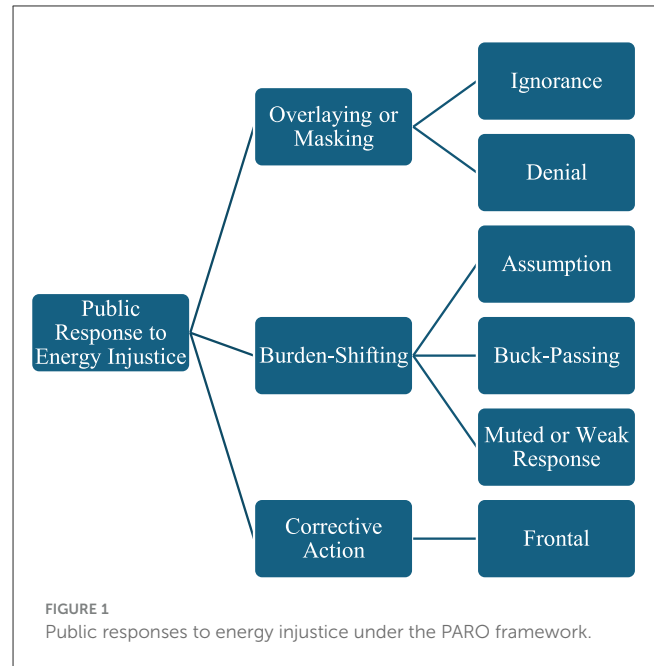
or approach impacts consequences associated with energy injustice, whether those consequences become milder or more intense, or whether appropriate tools and strategies are developed to address them.

3.2.2 Types of responses to energy injustice under the PARO framework

The current study proposes three main public responses to energy injustice in the emerging renewable energy sector. These are (i) Overlaying or masking, (ii) Burden-shifting, and (iii) Corrective action (Figure 1).

Overlaying, also called masking, refers to a situation whereby an individual, organization, or group overlooks the occurrence, impacts, or dangers that energy injustice could pose in critical areas such as the emerging renewable energy sector. However, overlaying could result from two leading causes: first, ignorance, and second, denial. "Overlaying from ignorance" happens when an individual, organization, or group is unaware of energy injustice due to the paucity of relevant information. Being an emerging field of interest, limited knowledge and public awareness exist about energy injustice, and many remain uninformed about its occurrence or threats. So, it is not unusual that many across different communities or countries may not have heard about energy injustice or may not genuinely know it exists or understand its essence.

On the other hand, "overlaying from denial" is a situation whereby an individual, organization, or group baselessly, without evidence, or despite growing evidence, overlooks or dismisses the occurrence and impact of energy injustice. However, overlaying from denial may occur due to misinformation, which is often common for political, socio-cultural, or other reasons. However, it could also result implicitly (due to lack of accurate information, for example, in information-challenged areas) or explicitly (despite the availability of accurate information, for example, amongst

TABLE 4 Types of responses to energy injustice in renewable energy development (using the PARO framework).

S/N	Types	Dimensions	Public awareness (does the subject know about energy injustice, and to what extent?)	Responsibility (does the subject accept responsibility for addressing the identified energy injustice?)	Outcomes (what is the outcome of the subject's action or inaction?)
1.	Overlaying or masking (overlooks the occurrence and impact of energy injustice)	I. Ignorance	Unaware that energy injustice exists.	No	Energy injustice remains unsolved and could worsen.
		II. Denial	Dismisses that energy injustice exists or minimizes its impact without evidence. Often happens implicitly due to a lack of awareness or ignorance, misinformation, or explicitly with people who should know better.	No	Energy injustice remains unsolved and could worsen.
2.	Burden shifting (transfers the responsibility to address energy injustice to another actor along the chain)	I. Assumption	Assumes that energy transition will naturally address the sources of energy injustice.	No	Energy injustice remains unsolved and could worsen.
		II. Buck-passing	Recognizes energy injustice as a problem but blames others instead of addressing it and so does not act.	No	Energy injustice remains unsolved and could worsen.
		III. Muted or weak responses	Acknowledges energy injustice as a problem but employs inadequate responses in terms of approaches, solutions, or policies.	Yes/No	Energy injustice remains unsolved and could worsen.
3.	Corrective (dynamic, frontal, or hands-on)	I. Frontal	Makes attempts to understand and proposes practical solutions to energy injustice holistically.	Yes	Energy injustice could be addressed and solved.

people who have access to information and who ordinarily should know better). Note that "denial" could also include situations where communities are excluded from decision-making processes but may not actively resist, leading to passive responses. Finally, the subject does not accept responsibility for addressing energy injustice during overlaying; thus, the underlying causes or impacts are left unaddressed.

Burden-shifting refers to a situation whereby an individual, organization, or group is aware of the occurrence or potential impacts of energy injustice but, rather than address the problem, attempts to transfer responsibility for managing or addressing the energy injustice to another individual, organization, or group. Burden-shifting may occur in three dimensions: first, assumption; second, buck-passing; and third, muted response. "Burden-shifting by assumption" occurs when an individual, organization, or group is aware of the energy injustice associated with the oil sector, for example, but assumes that the transition to renewable energy sources will automatically wipe off those injustices. Assumption also refers to where communities or individuals may perceive fairness or assume justice without active contestation, such as "Public Perceptions of Fairness." Thus, the steps needed to

address energy injustice in renewable energy development are left unaddressed.

"Burden-shifting by buck-passing" occurs when an individual, organization, or group recognizes the threats of energy injustice but blames others rather than addressing them. So, the "buck" is passed to another person or group who may not address the problem; hence, the problem persists or festers. Buck-passing could also reflect scenarios where communities shift the responsibility to institutions or other entities without taking action themselves, as in "Exclusion from Decision-Making" (Table 3). Lastly, "weak or muted response" refers to a situation whereby an individual, organization, or group is aware of the occurrence and threats of energy injustice but ends up ineffectively addressing the problem through inadequate, weak, or intentionally defective strategies, tools, or policies. Muted or Weak Response is linked to situations where the public's response is passive, as reflected in "Disengagement and Passive Acceptance" (Table 3).

"Corrective action", also known as the dynamic, frontal, or hands-on approach, is a crucial strategy in addressing energy injustice. It involves individuals, organizations, or groups who are aware of the threats of energy injustice and take conscious,

continuous steps to improve public understanding and develop holistic solutions. This proactive approach is the most effective way to draw public attention, mobilize resources, and develop the necessary tools, techniques, and strategies to address the threats of energy injustice and achieve the sustainability goals of energy transition and renewable energy development.

3.3 Connecting findings to the larger discourse on energy justice

The study offer new insights into public responses to energy injustice within the emerging renewable energy sector, broadening the scope of how such issues are understood and managed. Energy justice has often focused on fairness in energy distribution, access, and participation in decision-making processes in the energy sector. However, the proposed framework—categorizing public responses into six key themes of ignorance, denial, assumption, buck-passing, muted or weak response, and frontal response—adds a nuanced dimension to this discourse by exploring how different levels of awareness and action shape public responses to clean energy projects.

While much of the traditional system fails to capture a community's potential wide spectrum of views, the PARO framework goes beyond the narrow two-way (support or oppose) classification system to conceptualize a new basis for researchers to interrogate different public responses to energy injustice. Moreover, the framework is easy to use, adaptable to different situations and communities, and can be framed to understand subtle or mainstream responses to energy injustice.

Unlike previous models primarily focusing on distributional and procedural justice, the PARO framework emphasizes the complex social, cultural, and psychological factors influencing public perception and behavior in energy transitions. For example, studies on community opposition to renewable energy infrastructure, often categorized under "NIMBYism" (Not In My Backyard), can be understood as a combination of "denial" and "buck-passing." Communities may reject the broader benefits of renewable energy projects in favor of local interests, shifting the burden of development to other regions. These patterns are not merely reactionary; they are deeply embedded in social and cultural narratives that influence public attitudes.

Similarly, the sub-theme of "disengagement and passive acceptance" aligns with the theme of "muted or weak response" in the PARO framework. In regions where energy injustice prevails, disengagement from decision-making often results from disempowerment. Studies on procedural justice have demonstrated that exclusion from participation can lead to passive acceptance or complete disengagement, categorized in the PARO framework as "muted or weak response." This highlights the importance of ensuring participatory justice in energy transitions—a key issue the PARO framework aims to address.

In the broader context of energy justice, the demand for equitable transitions involves more than technical solutions. It requires social acceptance, inclusivity, and fairness in decision-making processes. The sub-themes explored in this study—such as fairness, exclusion from decision-making, and

cultural recognition—align with established concepts in energy justice but provide a more structured analysis of how these issues manifest in public responses. For example, public opposition to energy projects, often rooted in procedural and distributional injustices (Heffron and McCauley, 2017; Jenkins et al., 2016a; Sovacool and Dworkin, 2015), can be categorized as "frontal responses" in the PARO framework, reflecting direct challenges to perceived injustices.

Similarly, disengagement and passive acceptance align with the theme of "muted or weak response," highlighting the importance of engaging marginalized communities early and often. For example, public opposition to energy projects (resistance) can be linked to deep-rooted concerns over procedural and distributional injustices, where communities feel excluded from decision-making processes or burdened disproportionately by energy infrastructure. The categorization of this response under the theme of "frontal response" reflects how such opposition is often a direct and vocal challenge to perceived injustices. Similarly, sub-themes such as disengagement and passive acceptance can be connected to "muted or weak responses," where communities either lack the necessary information to engage critically with energy projects or feel powerless to influence outcomes.

By framing public responses in these six thematic categories, the framework goes beyond existing discussions of resistance or acceptance. It offers a broader lens through which to understand how public attitudes evolve, especially in relation to issues of trust, empowerment, and cultural recognition. This categorization allows policymakers, scholars, and practitioners to not only assess the spectrum of public engagement but also to identify where interventions can be most effective in fostering more equitable outcomes.

4 Implications and potential for future research

4.1 Applying the PARO framework to energy justice

4.1.1 Assessing awareness within the PARO framework

The PARO framework raises critical questions about who determines energy injustice, how responsibility is allocated, and which metrics are appropriate for assessment. However, the PARO framework is grounded in established energy justice principles, providing a secure theoretical foundation for its application. It acknowledges that energy injustice is context-specific and shaped by institutional, legal, and societal recognition of harm, exclusion, or inequity. The "triumvirate" framework of energy justice—distributional, procedural, and recognition justice—is foundational for identifying and assessing instances of injustice (Heffron and McCauley, 2017; McCauley et al., 2013).

In the PARO framework, these dimensions could serve as reference points for assessing whether or when an energy injustice has occurred. For instance, distributive justice concerns are raised when there are inequities in energy access, such as disproportionate energy costs for low-income households. Procedural injustice, on the other hand, may emerge when affected communities

are excluded from key decision-making processes. In contrast, recognition injustice could become evident when specific groups' cultural or social identities are ignored or diminished in energy transitions. Other energy justice frameworks could also provide useful parameters for determining energy (in)justice within the PARO framework. The Energy Justice Metric proposed by Heffron et al. (2015) and Heffron et al. (2018) offers a detailed approach to evaluating justice across different energy systems by mapping out specific harms and benefits. This metric could be integrated into the PARO framework by helping quantify the impact of energy injustices and providing a clear set of evaluative criteria for assessing harm.

Similarly, the "whole systems approach" (Mejía-Montero et al., 2021; Jenkins et al., 2014) broadens the discussion on energy justice by positioning it within socio-technical systems. This method evaluates energy (in)justice by analyzing access and fairness and the social, environmental, and technical dynamics that shape energy infrastructures. Such a comprehensive perspective is critical for the PARO framework, enabling it to capture the intricate forms of injustice that arise during renewable energy transitions.

To assess awareness, the framework suggests qualitative tools such as surveys, interviews, and ethnographic studies to gauge how individuals or communities perceive and understand instances of energy injustice. This may involve evaluating whether respondents recognize specific instances of inequitable energy distribution or exclusion from decision-making processes. Drawing on environmental psychology, the framework can incorporate self-reported awareness (Passafaro et al., 2019; Morton et al., 2017) and observable behaviors such as participation in public forums or activism.

Rather than relying on a single authority or a narrow set of parameters, the framework advocates for a pluralistic approach to justice determination, including legal, societal, and institutional lenses and distributive, procedural, and recognition-based perspectives. This approach is essential for analyzing energy justice in complex, real-world scenarios where power dynamics, resource allocation, and community participation are deeply intertwined.

4.1.2 Assessing responsibility within the PARO framework

The concept of responsibility within the PARO framework is essential to understanding how public responses to energy justice unfold. Responsibility is not merely a rhetorical stance but is also reflected in tangible actions. The framework draws on qualitative and quantitative measures to evaluate whether a subject has accepted responsibility for addressing energy injustices. Rhetorical responsibility can be identified through public statements, policy documents, or organizational commitments that signal intent to address energy injustice (Marais, 2012; Castelló and Lozano, 2011). These can include formal commitments to national or local energy policies, participation in public consultations, or articulating justice principles within corporate social responsibility reports (Healy and Barry, 2017; Miller and Richter, 2014; Lindgreen and Swaen, 2010).

However, responsibility cannot be fully captured through rhetoric alone. The PARO framework also emphasizes the need for measurable actions, such as implementing policies, allocating resources, and developing projects to correct energy injustices. For example, a government's commitment to renewable energy transition can be assessed by examining legislative actions, budgetary allocations to marginalized communities, or implementing equitable energy access programs (Walker and Day, 2012). Thus, responsibility is seen as a dual process: rhetorical commitment establishes intent, while actionable steps reveal the practical efforts to achieve justice. This two-pronged approach provides a more comprehensive measure of responsibility and helps distinguish between empty rhetoric and genuine commitment to addressing energy inequalities.

4.1.3 Assessing outcomes of public responses in the PARO framework

The PARO framework categorizes outcomes of public responses to energy justice by considering three core dimensions: scope, effectiveness, and sustainability. These dimensions acknowledge that responses vary in both intensity and impact. Scope assesses whether outcomes address energy injustice on a local or systemic level. Localized solutions like community-based renewable projects may resolve specific energy access issues but fail to address broader systemic inequalities. Systemic solutions, like policy reforms or large-scale infrastructure improvements, have the potential to impact energy justice on a national or global scale (Jenkins et al., 2016a). Effectiveness evaluates how well a response mitigates or resolves the energy injustice. It can be measured through tangible improvements such as better access to affordable energy or reduced pollution in disadvantaged communities. Policy evaluations in energy justice often focus on the concrete benefits interventions provide to marginalized populations (Sovacool et al., 2019b). Sustainability considers the long-term impact of the response. While temporary solutions may provide immediate relief, sustainable interventions address root causes and offer lasting benefits. These outcomes are measured by long-term improvements in affordability, accessibility, and equity within energy systems (Heffron and McCauley, 2017).

4.2 Clarifying the relationship between the PARO framework elements and response categories

The PARO framework, designed to assess public responses to energy injustice, functions as an interconnected process where each element—problem awareness, responsibility, and outcomes (Table 4)—progresses sequentially and interdependently. A deeper understanding of this relationship is key to explaining how public perceptions of energy injustice evolve and the subsequent actions taken or avoided. The framework's ability to capture this complexity is evident in how varying levels of awareness shape the acceptance or rejection of responsibility and how this, in turn, leads to differing outcomes in addressing energy injustices.

For instance, a lack of problem awareness (ignorance or denial) precludes the acceptance of responsibility and hence leads to poor or non-existent outcomes (Table 5). Conversely, greater awareness can lead to stronger responsibility acceptance and more dynamic

TABLE 5 Key concepts and relationships in the PARO framework.

S/N	Key concept	Description	Examples/elaboration
1	Interdependence of PARO framework elements	Problem awareness, responsibility, and outcomes are interconnected and progress sequentially.	Lack of awareness precludes responsibility, leading to poor outcomes. Conversely, awareness fosters responsibility and dynamic responses.
2	Overlaying responses	Public either denies or is unaware of energy injustice, leading to inaction.	Ignorance or denial results in energy injustice being overlooked or worsened.
3	Burden-shifting responses	Public shifts responsibility to others, avoiding direct action.	Assumption that energy transition will address injustice, or passing blame without action.
4	Corrective responses	Public takes active steps to address energy injustice, acknowledging the problem and proposing solutions.	Greater awareness leads to responsibility acceptance, resulting in proactive solutions.
5	Exploration of fairness and cultural recognition	Framework addresses issues of fairness, exclusion, and cultural recognition through the responsibility and outcomes elements.	Fairness is evaluated in decision-making inclusivity, and cultural recognition in the effectiveness of solutions.

responses to energy injustice, leading to better outcomes. Similarly, in *overlaying* responses, individuals or groups deny or are unaware of energy injustice. This lack of awareness means they do not recognize their responsibility in addressing the issue, resulting in outcomes that perpetuate or even exacerbate the injustice. On the other hand, the *corrective* response typifies a scenario where heightened awareness leads to active responsibility, fostering meaningful action to rectify the injustice. By presenting these as interlinked processes rather than isolated events, the framework offers a dynamic approach to analyzing public responses across different stages of energy justice engagement.

The PARO framework also enables a broader exploration of key social justice themes, such as fairness, exclusion, and cultural recognition. For example, fairness is examined through decision-making inclusivity in assessing the "responsibility" component—whether marginalized communities are given equitable opportunities to participate in renewable energy transitions. The framework's "outcomes" element is equally equipped to evaluate how solutions consider cultural recognition, particularly in contexts where proposed solutions must resonate with affected groups' cultural values and practices. Thus, it can capture how cultural recognition—or lack thereof—affects the efficacy of proposed solutions to energy injustices. Failure to do so often results in ineffective interventions, as seen in cases where energy policies disregard the socio-cultural realities of local communities, perpetuating exclusion from the decision-making process. By embedding these themes into its core elements, the PARO framework categorizes responses and provides a robust tool for disentangling complex issues around public perceptions of energy injustice.

This layered relationship between awareness, responsibility, and outcomes helps to understand better why certain responses succeed while others fail. It also elucidates how perceptions of fairness, exclusion, and cultural recognition shape responses to energy injustice, particularly within the renewable energy transition.

4.3 Practical and policy implications policymakers and researchers

The proposed framework offers practical tools for guiding policy, fostering public engagement, and driving more equitable energy transitions. First, it provides policymakers with a structured way to assess public attitudes toward energy projects, anticipate these responses, and design more targeted communication and participation strategies. Understanding whether communities are operating from ignorance, denial, or buck-passing can help design targeted interventions that address the root causes of disengagement or opposition. For instance, if a community's response is primarily categorized under "ignorance," efforts can be made to increase transparency and provide more information about renewable energy projects' potential benefits and risks. If the dominant response is "denial," policies might focus on building trust and ensuring that local communities have a meaningful role in decision-making.

Second, the framework can guide public engagement strategies by highlighting the importance of cultural recognition and empowerment in shaping responses. Likewise, in situations where denial or buck-passing are dominant, NGOs can work on building trust and fostering dialogue to address the root causes of these responses, often related to historical marginalization or exclusion from decision-making processes. Communities that feel excluded from decision-making or unrecognized in the planning of energy projects are more likely to engage in buck-passing or frontal responses. Therefore, involving local communities in the early stages of project planning and ensuring that their cultural and social identities are respected could shift public responses toward more constructive forms of engagement.

Finally, in the context of equitable energy transitions, the framework underscores the need for a holistic approach that considers both the technical and social dimensions of energy justice. While renewable energy projects are crucial for decarbonization and mitigating climate change, they must also be designed and implemented in just and inclusive ways. The thematic categories identified in this framework can help policymakers and project developers identify potential conflict areas and work proactively to address them, ultimately leading to smoother project implementation and more sustainable outcomes.

5 Conclusion

5.1 Limitations, scope, and future research

It is important to note that the present study is conceptual in nature and aims to provide a theoretical foundation for

understanding public responses to energy injustice. The empirical application of the PARO framework—its use in analyzing real-world cases—will be the focus of a follow-up study. This paper lays the groundwork by developing the framework based on existing literature and theoretical insights, offering a tool for future empirical work. The forthcoming study will involve the application of the PARO framework to specific cases of public engagement with renewable energy projects, thus demonstrating its practical utility.

This distinction between the conceptual foundation and empirical application is essential to understanding the scope of the current paper. While this study contributes a new theoretical lens, its empirical validation and application are deliberately planned for subsequent research. Similarly, applying this framework to energy justice within the renewable energy sector opens up new research and policy development avenues. Future studies could apply the framework to different case studies of renewable energy projects, comparing how public responses vary across different socio-political contexts and identifying which factors are most effective in mitigating resistance and fostering acceptance. Additionally, the framework can be adapted to explore public responses to other aspects of energy transitions, such as adopting energy efficiency technologies or shifting toward decentralized energy systems.

This framework can serve as a valuable tool for governments and energy companies seeking to design more inclusive and just energy transitions. By recognizing the diverse range of public responses and the factors that drive them, policies can be tailored to ensure that all voices are heard and the benefits of renewable energy transitions are shared equitably. In doing so, the framework contributes to a more comprehensive understanding of energy justice and its role in shaping the future of sustainable energy systems.

The PARO framework, like any analytical model, has limitations. While it significantly contributes to categorizing public responses to issues like climate change and energy justice by introducing six categories across three classes, it remains a developing tool. Unlike existing frameworks with only two or three classes, the PARO framework broadens public response categorization by emphasizing public awareness as a starting point. However, it does not capture every potential response. Non-traditional or emerging reactions may fall outside its current scope, highlighting the need for ongoing refinement as public response studies evolve. Additionally, the PARO framework still requires further empirical testing and field analysis. Future studies can be built on this framework to collect public response data and evaluate how closely these responses align with the PARO categories.

In conclusion, despite its limitations, the PARO framework offers valuable analytical and practical insights and provides a foundation for further studies in energy and environmental justice. Future research can build on it by incorporating empirical data and refining its categories to capture a broader range of public responses. This could lead to a deeper understanding of energy injustice.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

Funding

Acknowledgments

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The author(s) declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

Publisher's note

References

Akporiaye, A. (2023). Evaluating the effectiveness of oil companies' Corporate Social Responsibility (CSR). *Extract. Indust. Soc.* 13:101221. doi: 10.1016/j.exis.2023.101221

Alexeev, M., and Zakharov, N. (2022). Who profits from windfalls in oil tax revenue? Inequality, protests, and the role of corruption. *J. Econ. Behav. Organiz.* 197, 472–492. doi: 10.1016/j.jebo.2022.03.010

Alford-Jones, K. (2022). How injustice can lead to energy policy failure: a case study from Guatemala. *Energy Policy* 164:112849. doi: 10.1016/j.enpol.2022.112849

Baker, L. (2015). The evolving role of finance in South Africa's renewable energy sector. *Geoforum* 64, 146–156. doi: 10.1016/j.geoforum.2015.06.017

Banteli, A., and Gwilliam, J. (2014). Linking higher education training and industry in the Welsh low carbon sector. *Educ. Alternat.* 12, 277–288. Available at: https://orca.cardiff.ac.uk/id/eprint/64313/1/1409886763454314.pdf (accessed March 20, 2024).

Bartiaux, F., Maretti, M., Cartone, A., Biermann, P., and Krasteva, V. (2019). Sustainable energy transitions and social inequalities in energy access: a relational comparison of capabilities in three European countries. *Global Transit.* 1, 226–240. doi: 10.1016/j.glt.2019.11.002

Belarbi, Y., Hamdi, F., Khalfi, A., and Souam. (2021). Growth, institutions and oil dependence: a buffered threshold panel approach. *Econ. Model.* 99:105477, doi: 10.1016/j.econmod.2021.02.018

Bouzarovski, S., and Simcock, N. (2022). Spatializing energy justice. *Energy Policy, Energy Policy* 107, 640–648. doi: 10.1016/j.enpol.2017.03.064

Boyle, K. J., Boatwright, J., Brahma, S., and Xu, W. (2019). NIMBY, not, in siting community wind farms. *Resource Energy Econ.* 57, 85–100. doi: 10.1016/j.reseneeco.2019.04.004

Calcar, C. V., and Scholten, D. (2018). *The Dutch Energy Transition: Shifting Topology and Fortunes.* Available at: http://resolver.tudelft.nl/uuid:24a0498c-4dad-444f-a37a-5505b86a3c3d (accessed January 20, 2024).

Carley, S., and Konisky, D. M. (2020). The justice and equity implications of the clean energy transition. *Nat. Energy* 5, 569–577. doi: 10.1038/s41560-020-0641-6

Cass, N., and Walker, G. (2009). Emotion and rationality: the characterisation and evaluation of opposition to renewable energy projects. *Emot. Space Soc.* 2, 62–69. doi: 10.1016/j.emospa.2009.05.006

Castelló, I., and Lozano, J. M. (2011). Searching for new forms of legitimacy through corporate responsibility rhetoric. *J. Busin. Ethics* 100, 11–29. doi: 10.1007/s10551-011-0770-8

Chateauraynaud, F., and Zittoun, P. (2014). *The Future They Want – or do Not Want: Shale Gas Opponents vs. Proponents Between Local Motives and Global Scenarios.* Available at: https://www.ippapublicpolicy.org/file/paper/1433252643.pdf

Chilvers, J., Lorenzoni, I., Terry, G., Buckley, P., Pinnegar, J. K., and Gelcich, S. (2014). Public engagement with marine climate change issues: (Re)framings, understandings and responses. *Global Environm. Change* 29, 165–179. doi: 10.1016/j.gloenvcha.2014.09.006

Chock, R. Y., Clucas, B., Peterson, E. K., Blackwell, B. F., Blumstein, D. T., Church, K. D., et al. (2020). Evaluating potential effects of solar power facilities on wildlife from an animal behavior perspective. *Conserv. Sci. Pract.* 3:319. doi: 10.1111/csp2.319

Ciplet, D. (2021). From energy privilege to energy justice: a framework for embedded sustainable development. *Ener. Res. Soc. Sci.* 75, 1–13. doi: 10.1016/j.erss.2021.101996

Corry, O., and Jorgensen, D. (2015). Beyond 'deniers' and 'believers': towards a map of the politics of climate change. *Global Environm. Change* 32, 165–174. doi: 10.1016/j.gloenvcha.2015.01.006

Cowell, R., Bristow, G., and Munday, M. (2011). Acceptance, acceptability and environmental justice: the role of community benefits in wind energy development. *J. Environm. Plann. Manage.* 54, 539–557. doi: 10.1080/09640568.2010.521047

Craig, O. O., Duvenhage, D. F., Brent, A. C., and Dinter, F. (2019). An analysis of local manufacturing capacity, economic and trade impact of concentrating solar power (CSP) in South Africa. SOLARPACES 2018: International Conference on Concentrating Solar Power and Chemical Energy Systems. *AIP Conf. Proc.* 25:130002. doi: 10.1063/1.5117644

Cramer, W., Guiot, J., Fader, M., Garrabou J., Gattuso, J.-P., Iglesias, A., et al. (2018). Climate change and interconnected risks to sustainable development in the Mediterranean. *Nature Clim. Change* 8, 972–980. doi: 10.1038/s41558-018-0299-2

Crespo Montañés, C., O'Shaughnessy, E., Bednar, D. J., Nock, D., Carley, S., Kammen, D. M., et al. (2023). Enabling and centering equity and justice in clean energy transition research. *Joule* 7, 437–441. doi: 10.1016/j.joule.2023.02.005

Devine-Wright, P. (2009). Rethinking NIMBYism: The role of place attachment and place identity in explaining place-protective action. *J. Community Appl. Soc. Psychol.* 19, 426–441. doi: 10.1002/casp.1004

Dulal, H. B., Shah, K. U., and Ahmad, N. (2009). Social equity considerations in the implementation of Caribbean climate change adaptation policies. *Sustainability* 1, 363–383. doi: 10.3390/su1030363

Evans, G., and Phelan, L. (2016). Transition to a post-carbon society: linking environmental justice and just transition discourses. *Energy Policy* 99, 329–339. doi: 10.1016/j.enpol.2016.05.003

Finley-Brook, M., and Holloman, E. L. (2016). Empowering energy justice. *Int. J. Environ. Res. Public Health* 13:926. doi: 10.3390/ijerph13090926

Fournis, Y., and Fortin, M. J. (2016). From social 'acceptance' to social 'acceptability' of wind energy projects: towards a territorial perspective. *J. Environm. Plann. Manage.* 60, 1–21. doi: 10.1080/09640568.2015.1133406

Goyder, J. (1986). Surveys on surveys: limitations and potentialities. *Public Opini. Quart.* 50, 27–41. doi: 10.1086/268957

Greenacre, Z. (2016). The importance of selection bias in internet surveys. *Open J. Statist.* 6, 397–404. doi: 10.4236/ojs.2016.63035

Gross, C. (2007). Community perspectives of wind energy in Australia: the application of a justice and community fairness framework to increase social acceptance. *Energy Policy* 35, 2727–2736. doi: 10.1016/j.enpol.2006.12.013

Grubert, E. (2020). Fossil electricity retirement deadlines for a just transition. *Science* 370, 1171–1173. doi: 10.1126/science.abe0375

Haarstad, H., and Wanvik, T. I. (2017). Carbonscapes and beyond: Conceptualizing the instability of oil landscapes. *Prog. Hum. Geogr.* 41, 432–450. doi: 10.1177/0309132516648007

Hall, N., Ashworth, P., and Devine-Wright, P. (2013). Societal acceptance of wind farms: analysis of four common themes across Australian case studies. *Energy Policy* 58, 200–208. doi: 10.1016/j.enpol.2013.03.009

Healy, N., and Barry, J. (2017). Politicizing energy justice and energy system transitions: fossil fuel divestment and a "just transition". *Ener. Policy* 108, 451–459. doi: 10.1016/j.enpol.2017.06.014

Heffron, R., McCauley, D., and Zarazua de Rubens, G. (2018). Balancing the energy trilemma through the Energy Justice Metric. *Appl. Energy* 229, 1191–1201. doi: 10.1016/j.apenergy.2018.08.073

Heffron, R. J., and McCauley, D. (2014). Achieving sustainable supply chains through energy justice. *Appl. Ener.* 123, 435–437. doi: 10.1016/j.apenergy.2013.12.034

Heffron, R. J., and McCauley, D. (2017). The concept of energy justice across the disciplines. *Energy Policy* 105, 658–667. doi: 10.1016/j.enpol.2017.03.018

Heffron, R. J., McCauley, D., and Sovacool, B. K. (2015). Resolving society's energy trilemma through the Energy Justice Metric. *Ener. Policy* 87, 168–176. doi: 10.1016/j.enpol.2015.08.033

Heiervang, E., and Goodman, R. (2011). Advantages and limitations of web-based surveys: evidence from a child mental health survey. *Soc. Psychiat. Epidemiol.* 46, 69–76. doi: 10.1007/s00127-009-0171-9

Howarth, C. C., and Sharman, A. G. (2015). Labeling opinions in the climate debate: a critical review. *WIREs Clim. Change* 6, 239–254. doi: 10.1002/wcc.332

IPCC (2021). "Summary for policymakers," in *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge University Press), 3–32.

Jenkins, K., McCauley, D., Heffron, R., and Stephan, H. (2014). Energy justice, a whole systems approach. *Queen's Polit. Rev.* 2, 74–87. Available at: https://cris.brighton.ac.uk/ws/portalfiles/portal/484893/Energy%20justice%20a%20whole%20systems%20approach%20-%2010.08.2014.pdf (accessed March 19, 2024).

Jenkins, K., McCauley, D., Heffron, R., Stephan, H., and Rehner, R. (2016a). Energy justice: A conceptual review. *Ener. Res. Soc. Sci.* 11, 174–182. doi: 10.1016/j.erss.2015.10.004

Jenkins, K. E. H., Heffron, R., and McCauley, D. (2016b). "The political economy of energy justice in Canada, the UK, and Australia: a nuclear energy perspective," in *The Palgrave Handbook of the International Political Economy of Energy*, eds. T. Graaf, B. Sovacool, A. Ghosh, and M. Klare (London: Palgrave).

Karakas, L. D., and Mitra, D. (2020). Believers vs. deniers: climate change and environmental policy polarization. *Eur. J. Polit. Econ.* 65:101948. doi: 10.1016/j.ejpoleco.2020.101948

Kovarik, W. (2005). Ethyl-leaded gasoline: how a classic occupational disease became an international public health disaster. *Int. J. Occup. Environ. Health* 11, 384–397. doi: 10.1179/oeh.2005.11.4.384

Krishna, A. (2021). Understanding the differences between climate change deniers and believers' knowledge, media use, and trust in related information sources. *Public Relat. Rev.* 47:101986. doi: 10.1016/j.pubrev.2020.101986

Langemeyer, J., and Connolly, J. J. (2020). Weaving notions of justice into urban ecosystem services research and practice. *Environ. Sci. Policy* 109, 1–14.

Lantz, E. J., and Tegen, S. (2009). *NREL Response to the Report 'Study of the Effects on Employment of Public Aid to Renewable Energy Sources' from King Juan Carlos University (Spain).* Available at: https://www.nrel.gov/docs/fy09osti/46261.pdf (accessed January 24, 2024).

le Maitre, J., Ryan, G., and Power, B. (2024). Do concerns about wind farms blow over with time? Residents' acceptance over phases of project development and proximity. *Renew. Sustain. Energy Rev.* 189:113839. doi: 10.1016/j.rser.2023.113839

Lindgreen, A., and Swaen, V. (2010). Corporate social responsibility. *Int. J. Manag. Rev.* 12, 1–7. doi: 10.1111/j.1468-2370.2009.00277.x

Marais, M. (2012). CEO rhetorical strategies for corporate social responsibility (CSR). *Soc. Busin. Rev.* 7, 223–243. doi: 10.1108/17465681211271314

McAdam, D., Tarrow, S., and Tilly, C. (2001). *Dynamics of Contention*. Cambridge: Cambridge University Press.

McCauley, D. (2018). *Energy Justice: Rebalancing the Trilemma of Security, Poverty and Climate Change*. Cham: Palgrave Macmillan.

McCauley, D., Heffron, R. J., Stephan, H., and Jenkins, K. (2013). Advancing energy justice: the triumvirate of tenets. *Int. Energy Law Rev.* 32, 107–110. Available at: https://dspace.stir.ac.uk/bitstream/1893/18349/1/IELR%202013.pdf (accessed May 12, 2024).

Meenar, M., Heckert, M., and Adlakha, D. (2022). "Green Enough Ain't Good Enough:" public perceptions and emotions related to green infrastructure in environmental justice communities. *Int. J. Environ. Res. Public Health* 19:1448. doi: 10.3390/ijerph19031448

Mejía-Montero, A., Lane, M., Horst, D. V., and Jenkins, K. E. (2021). Grounding the energy justice lifecycle framework: an exploration of utility-scale wind power in Oaxaca, Mexico. *Energy Res. Soc. Sci.* 75:102017. doi: 10.1016/j.erss.2021.10 2017

Miller, C. A., and Richter, J. (2014). Social planning for energy transitions. *Curr. Sustain./Renew. Energy Reports* 1, 77–84. doi: 10.1007/s40518-014-0010-9

Mohommad, A., and Kim, J. (2022). "Jobs impact of green energy," in *IMF Working Papers*. Available at: https://www.imf.org/en/Publications/WP/Issues/2022/05/27/Jobs-Impact-of-Green-Energy-518411 (accessed January 25, 2024).

Morton, T. A., van der Bles, A. M., and Haslam, S. A. (2017). Seeing our self reflected in the world around us: the role of identity in making (natural) environments restorative. *J. Environ. Psychol.* 49, 65–77. doi: 10.1016/j.jenvp.2016.11.002

Nanayakkara, S. U., Greenaway, A., Speer, B. K., Aznar, A., Doris, E., Romero-Lankao, P., et al. (2021). (Invited) Understanding workforce development needs for an equitable transition to clean energy systems. *ECS Meet. Abstr.* MA2021-02 1335. doi: 10.1149/MA2021-02441335mtgabs

Neville, K., Baka, J., Gamper-Rabindran, S., Bakker, K., Andreasson, S., Vengosh, A., et al. (2017). Debating unconventional energy: social, political, and economic implications. *Ann. Rev. Environ. Resour.* 42:061102. doi: 10.1146/annurev-environ-102016-061102

Newcomer, K. E., and Triplett, T. (2015). "Using surveys," in *Handbook of Practical Program Evaluation,* eds. K. E. Newcomer, H. P. Hatry and J. S. Wholey (Hoboken, NJ: John Wiley & Sons). doi: 10.1002/9781119171386.ch14

Nwilo, P. C., and Badejo, O. T. (2005). Oil spill problems and management in the Niger Delta. *Int. Oil Spill Conf. Proc.* 1, 567–570. doi: 10.7901/2169-3358-2005-1-567

Okoroafor, E. R., Offor, C. P., and Prince, E. I. (2022). "Mapping relevant petroleum engineering skillsets for the transition to renewable energy and sustainable energy," in *Paper presented at the SPE Nigeria Annual International Conference and Exhibition* (Lagos). doi: 10.2118/212040-MS

O'Neill, S. J., and Boykoff, M. (2010). Climate denier, skeptic, or contrarian? *Proc. Nat. Acad. Sci.* 107, E151–E151. doi: 10.1073/pnas.1010507107

Outka, U. (2018). "Chapter 2: Fairness in the low-carbon shift: learning from environmental justice," in *Energy Justice* (Cheltenham: Edward Elgar Publishing).

Owens, T., Hoddinott, J., and Kinsey, B. (2003). Ex-ante actions and ex-post public responses to drought shocks: evidence and simulations from Zimbabwe. *World Dev.* 31, 1239–1255. doi: 10.1016/S0305-750X(03)00068-8

Passafaro, P., Livi, S., and Kosic, A. (2019). Local norms and the theory of planned behavior: Understanding the effects of spatial proximity on recycling intentions and self-reported behavior. *Front. Psychol.* 10:744. doi: 10.3389/fpsyg.2019.00744

Powell, D., and Long, D. (2010). "Landscapes of Power Renewable Energy Activism in Diné Bikéyah," in *Indians and energy: Exploitation and opportunity in the American Southwest*, eds. S. Smith and B. Frehner (Santa Fe, NM: School for Advanced Research Press), 231–262.

Rachman, F. F., Nooraeni, R., and Yuliana, L. (2021). Public opinion of transportation integrated (Jak Lingko), in DKI Jakarta, Indonesia. *Proc. Comp. Sci.* 179, 696–703. doi: 10.1016/j.procs.2021.01.057

Rahman, M. (2004). *Oil and Gas: the Engine of the World Economy*. Available at: https://opec.org/opec_web/en/press_room/900.htm (accessed March 1, 2024).

Rehbein, J. A., Watson, J. E. M., Lane, J. L., Sonter, L. J., Venter, O., Atkinson, S. C., et al. (2020). Renewable energy development threatens many globally important biodiversity areas. *Glob. Chang. Biol.* 26, 3040–3051. doi: 10.1111/gcb.15067

Robbins, P., Hintz, J., and Moore, S. A. (2014). *Environment and Society: A Critical Introduction, 2nd Edn.* Chichester; West Sussex: John Wiley & Sons, Ltd.

Scheer, A., Schwarz, M., Hopkins, D., and Caldecott, B. (2022). Whose jobs face transition risk in Alberta? Understanding sectoral employment precarity in an oil-rich Canadian province. *Climate Policy* 22, 1016–1032. doi: 10.1080/14693062.2022.2086843

Shah, K. U., Raghoo, P., and Surroop, D. (2021). An institutional-based governance framework for energy efficiency promotion in small island developing states. *Climate* 9:95. doi: 10.3390/cli9060095

Sharma, N. (2021). Public perceptions towards adoption of residential Solar Water Heaters in USA: A case study of Phoenicians in Arizona. *J. Clean. Prod.* 320:128891. doi: 10.1016/j.jclepro.2021.128891

Smith, E. R. A. N., and Klick, H. (2007). "Explaining NIMBY opposition to wind power," in *Annual Meeting of the American Political Science Association,* 1–19.

Sokołowski, M. M., and Heffron, R. J. (2022). Defining and conceptualising energy policy failure: the when, where, why, and how. *Energy Policy* 161:112745. doi: 10.1016/j.enpol.2021.112745

Songsore, E., and Buzzelli, M. (2016). Ontario's experience of wind energy development as seen through the lens of human health and environmental justice. I*nt. J. Environ. Res. Public Health* 6:684. doi: 10.3390/ijerph13070684

Sovacool, B. K. (2017). Contestation, contingency, and justice in the Nordic low-carbon energy transition. *Energy Policy* 102, 569–582. doi: 10.1016/j.enpol.2016.12.045

Sovacool, B. K. (2021). Who are the victims of low-carbon transitions? Towards a political ecology of climate change mitigation. *Ener. Res. Soc. Sci.* 73:101916. doi: 10.1016/j.erss.2021.101916

Sovacool, B. K., Burke, M., Baker, L., Kotikalapudi, C. K., and Wlokas, H. (2017). New frontiers and conceptual frameworks for energy justice. *Ener. Policy* 105, 677–691. doi: 10.1016/j.enpol.2017.03.005

Sovacool, B. K., and Dworkin, M. H. (2015). Energy justice: conceptual insights and practical applications. *Appl. Energy* 142, 435–444. doi: 10.1016/j.apenergy.2015.01.002

Sovacool, B. K., Kester, J., Noel, L., and de Rubens, G. Z. (2019a). Energy injustice and nordic electric mobility: inequality, elitism, and externalities in the electrification of vehicle-to-grid (V2G) transport. *Ecol. Econ.* 157, 205–217. doi: 10.1016/j.ecolecon.2018.11.013

Sovacool, B. K., Martiskainen, M., Hook, A., and Baker, L. (2019b). Decarbonization and its discontents: a critical energy justice perspective on four low-carbon transitions. *Clim. Change* 155, 581–619. doi: 10.1007/s10584-019-02521-7

Stoms, D. M., Dashiell, S. L., and Davis, F. W. (2013). Siting solar energy development to minimize biological impacts. *Renew. Energy* 57, 289–298. doi: 10.1016/j.renene.2013.01.055

Tarrow, S. (2011). *Power in Movement: Social Movements and Contentious Politics (3rd ed.).* Cambridge: Cambridge University Press.

UN (2020). *Transforming our World: the 2030 Agenda for Sustainable Development*. Available at: https://sdgs.un.org/2030agenda

UNDP (2015). *Transforming Our World: the 2030 Agenda for Sustainable Development*. Available at: https://sdgs.un.org/publications/transforming-our-world-2030-agenda-sustainable-development-17981 (accessed March 1, 2024).

UNDP (2020). *The SDGS in Action*. Available at: https://www.undp.org/sustainable-development-goals (accessed March 1, 2024).

USEIA (2019). *Today in Energy*. Available at: https://www.eia.gov/todayinenergy/detail.php?id=38053 (accessed March 1, 2024).

USEIA (2021). *Short-Term Energy Outlook*. Available at: https://www.eia.gov/outlooks/steo/ (accessed March 1, 2024).

USEPA (2022). *Sources of Greenhouse Gas Emissions*. Available at: https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions (accessed March 1, 2024).

van der Wel, K., Akerboom, S., and Meijer, A. (2024). *A public values perspective on energy* justice: building a theoretical lens for understanding decision-making in the energy transition. *Ener. Res. Soc. Sci.* 116:103677. doi: 10.1016/j.erss.2024.103677

Velasco-Herrejón, P., and Bauwens, T. (2020). Energy justice from the bottom up: a capability approach to community acceptance of wind energy in Mexico. *Energy Res. Soc. Sci.* 70, 101711. doi: 10.1016/j.erss.2020.101711

Walker, G. (2009). Beyond distribution and proximity: exploring the multiple spatialities of environmental justice. *Antipode* 41, 614–636. doi: 10.1111/j.1467-8330.2009.00691.x

Walker, G., and Day, R. (2012). Fuel poverty as injustice: integrating distribution, recognition and procedure in the struggle for affordable warmth. *Energy Policy* 49, 69–75. doi: 10.1016/j.enpol.2012.01.044

Weforum (2015). *What are the Sustainable Development Goals?* Available at: https://www.weforum.org/agenda/2015/09/what-are-the-sustainable-development-goals/#:$\sim$text=After%20three%20years%20of%20negotiations%20and%20debate%2C%20193,%E2%80%93%20build%20on%20the%20Millennium%20Development%20Goals%20%28MDGs%29 (accessed March 1, 2024).

Welton, S., and Eisen, J. B. (2019). "Clean energy justice: charting an emerging agenda," in *43 Harvard Environmental Law Review,* 307, Available at: https://ssrn.com/abstract=3256819 (accessed September 28, 2018).

Wood, N., and Roelich, K. (2019). Tensions, capabilities, and justice in climate change mitigation of fossil fuels. *Energy Res. Soc. Sci.* 52:114–122. doi: 10.1016/j.erss.2019.02.014

Wood, N., and Roelich, K. (2020). Substantiating energy justice: creating a space to understand energy dilemmas. *Sustainability* 12:1917. doi: 10.3390/su12051917

Wüstenhagen, R., Wolsink, M., and Bürer, M. J. (2007). Social acceptance of renewable energy innovation: an introduction to the concept. *Energy Policy* 35, 2683–2691. doi: 10.1016/j.enpol.2006.12.001

Yenneti, K., and Day, R. (2015). Procedural (in)justice in the implementation of solar energy: the case of Charanaka solar park, Gujarat, India. *Energy Policy* 86, 664–673. doi: 10.1016/j.enpol.2015.08.019

Yenneti, K., Day, R., and Golubchikov, O. (2016). Spatial justice and the land politics of renewables: dispossessing vulnerable communities through solar energy mega-projects. *Geoforum* 76, 90–99. doi: 10.1016/j.geoforum.2016.09.004