Journal of Sustainable Development of Smart Energy Networks

https://www.sdewes.org/jsdsen

Year 2027, Volume 15, Issue 1, 1030789

Original Research Article

The Justice Pathway and Perspectives in Energy Transition: Insights from a Multi-City Survey across Mediterranean Europe

***Bahanur Nasya*[1], *Yılmaz Vurucu*[2], *Batuhan Akkaya*[1]**
[1]Wonderland Platform for European Architecture, Vienna, Austria
e-mail: office@wonderland.com
[2] XsentrikArts, Vienna, Austria
e-mail: yilmazvurucu@x-arts.eu

Cite as: Nasya, B., Vurucu, Y., Akkaya, B., The Justice Pathway and Perspectives in Energy Transition: Insights from a Multi-City Survey across Mediterranean Europe, J. sustain. dev. smart. en. net., 15(1), 1030789, 2027, DOI: https://doi.org/10.13044/j.sdsen.d3.0789

UNCORRECTED PROOF

ABSTRACT

This paper examines the justice dimensions of Positive Energy District (PED) development across six Mediterranean cities participating in the POSEIDON project. Drawing on a multi-city expert survey, the analysis covers distributive, procedural, and recognition justice conditions at the inception stage of energy planning. Findings reveal persistent energy affordability stress, structural exclusions from participatory governance, and the systematic absence of community voices from diagnostic processes. Expert stakeholders consistently identify energy vulnerability among marginalised populations while remaining unable to reach them through existing engagement mechanisms. The paper helps argue that without an explicit justice-centred reorientation energy transition initiatives risk reproducing existing inequalities rather than transforming them.

KEYWORDS

Energy justice, Positive energy districts, Mediterranean cities, Energy poverty, Participatory governance, Urban energy transition, Community engagement, Stakeholder knowledge.

INTRODUCTION

Problem Background

The transition towards climate-neutral urban systems has become one of the defining challenges of contemporary urban development. Cities find themselves being increasingly required to simultaneously address climate change mitigation, energy security, energy affordability, and broader socio-economic disruptions associated with geopolitical conflicts, economic crises, and environmental change. Recent events, including the energy market disruptions following the war in Ukraine in 2022 [1] and renewed geopolitical tensions in the Middle East [2], have further exposed the vulnerability of existing energy systems and reinforced the urgency of accelerating urban energy transitions.

Traditionally, urban energy transitions have primarily been approached as technological and economic challenges, shaped by centralized governance structures and large-scale energy infrastructures. In this model, urban energy systems remain largely external to the communities they serve, limiting the ability of local actors and citizens to influence how energy is produced,

* Corresponding author

distributed, and governed. What's more, the transition towards renewable energy systems have been increasingly unfolding within existing urban environments through building retrofitting, local renewable energy production [3], energy efficiency measures, and the optimization of urban energy systems. While this impacts the life and work of all local stakeholders and citizens, their participation in the process is inevitable, yet not systematically facilitated.

As cities pursue climate neutrality through instruments such as Low Emission Zones (LEZs), Renewable Energy Communities (RECs), and Positive Energy Districts (PEDs), energy transitions are requiring changes and revisions in ownership structures, rights over decisions, governance arrangements, energy consumption practices, and everyday urban life. Positive Energy Districts, defined as urban areas that produce more renewable energy than they consume on an annual basis, have emerged as a flagship concept within European climate policy and have been institutionalized through the European Union's Mission on Climate-Neutral and Smart Cities [4]. Their appeal lies in their potential to simultaneously support climate neutrality, urban regeneration, energy efficiency, and improved quality of life. However, the implementation of PEDs also raises fundamental questions regarding affordability, participation, ownership, social inclusion, and energy justice in short.

Within this context, a significant distinction between the energy transition models emerges. In the case of a REC, citizens can mainly decide if they want to join as a producer, consumer or prosumer regarding the topic of energy. Within such structures, participation widely remains voluntarily, while energy is provided through the net, regardless. Similarly in LEZ, the mobility choices are affected by citizens, which may contain limitations on private vehicles. A PED on the other hand, encompasses and entails the management of energy needs–either through improved building or environment performances–which in turn, has an impact on the lives and budgets of the building owners, residents and users. The difference might seem blurred for non-experts, residents, owners and users, and the perception of the undertaking may be (in all three cases) viewed as being similar to urban renewal efforts. As the cases in the POSEIDON project evaluate, measures of energy needs reduction via improved buildings, integrated NBS systems and sustainable mobility alongside local energy production, making this project a suitable and beneficial candidate regarding the research results and gaps of PEDs, RECs and LEZs.

Literature Review and Research Gaps

Alongside technological developments, increasing scholarly attention has focused on a parallel and equally urgent question: who benefits from energy transitions, who bears their costs, and who has the power to shape them [5], [6]? These concerns have been conceptualized through the framework of energy justice, which emerged at the intersection of political philosophy, environmental studies, and energy policy research. Energy justice provides an analytical framework based on three interconnected dimensions: distributional justice, procedural justice, and recognition justice [7].

Beyond scholarly contributions, international organizations have begun translating justice principles into measurable frameworks; the IEA's Indicators Handbook for Just and Inclusive Energy Transitions, developed with the Global Commission on People-Centered Clean Energy Transitions under the South African G20 Presidency, operationalizes the G20 principles through a structured set of indicators for tracking ten Principles (ending energy poverty, social dialogue, stakeholder participation, policy inclusiveness and similar) [8].

Recent research on energy transitions and Positive Energy Districts has generated substantial knowledge regarding definitions [9], benefits [10], concerns towards implementation [11], technological solutions [12], governance models [13], roadmaps [14], energy communities [15], [16], and financing mechanisms [17]. Particular attention has been given to renewable energy communities and ownership models under the European Renewable Energy Directive (RED II), where public, community, cooperative, and private ownership arrangements have been explored as mechanisms for democratizing energy systems [15]. Similarly, PED research has contributed significantly to advancing energy modelling, building-

UNCORRECTED PROOF

integrated photovoltaics, district-scale optimization, governance coordination, and climate-neutral urban planning approaches [4].

However, despite the growing body of literature, several important challenges remain unresolved. First, existing research has been criticized for privileging technological and economic dimensions of the transition while paying comparatively less attention to social inequalities, participation processes, and questions of justice [9],[10]. Stakeholder engagement is frequently treated as a one-way communication event to inform stakeholders and residents about decisions made, rather than as a process shaped by unequal power relations, competing interests, and differentiated capacities for participation. This challenge becomes particularly significant within existing urban neighbourhoods, where energy transitions inevitably disrupt established social practices, ownership structures, and governance arrangements.

Second, the broader literature on energy justice and community energy reveals persistent tensions between the participatory ambitions of energy transitions and their practical implementation. Although energy communities have been widely promoted as mechanisms for democratizing energy systems [20], [21], empirical research has identified substantial barriers related to financial capacity, legal complexity, administrative burdens, and institutional support [22], [23]. Similarly, research on smart cities and sustainable urban transitions has demonstrated that technically driven interventions frequently reproduce existing social inequalities when decision-making processes are dominated by institutional actors and expert knowledge [20], [21].

While frameworks such as the quadruple helix model aim to bring together government, academia, industry, and civil society [24], their practical implementation often falls short of these ambitions, with limited evidence of meaningful co-creation and citizen influence in decision-making [25].

Third, existing empirical evidence on energy justice within Positive Energy District development remains limited in two important respects. Most studies focus either on theoretical frameworks [6], [7], [26] or on the evaluation of already implemented projects [27], [28]. Comparatively little attention has been paid to the diagnostic and inception phases of PED development, where stakeholder engagement, needs assessment, and project framing first emerge. Yet these early stages are particularly important because decisions regarding who participates, which vulnerabilities are prioritized, and whose knowledge is considered relevant effectively determine whose interests future energy transitions will serve [18], [27].

Furthermore, our review of recent systematic analyses [14], [12], [26] suggests that most documented frameworks originate from Northern and Central Europe experiences. Mediterranean cities, despite combining high renewable energy potential with significant social inequalities, energy poverty, governance complexity, climate vulnerability, and fragmented urban development patterns, remain comparatively underrepresented in the literature [29].This geographic imbalance raises important questions regarding the transferability of existing PED frameworks to Southern European contexts.

Research Approach

This paper argues that justice-related challenges can emerge during the early stages of Positive Energy District development, potentially influencing the subsequent trajectory of urban energy transitions. More specifically, it hypothesizes that justice-related challenges also emerge prior to project implementation: through how vulnerabilities are identified, participation processes are organized, and stakeholder knowledge is recognized.

Local experts and stakeholders are thus, well positioned to provide valuable insights into these conditions through their professional knowledge, personal and collective experience of local institutional, social, and governance contexts. Their perspectives make it possible to identify potential challenges and priorities before specific energy transition interventions are developed. The study therefore addresses the following overarching research question: How

UNCORRECTED PROOF

can expert assessments of local PED readiness reveal potential energy justice challenges during the early planning stages of Positive Energy Districts?

These challenges are not evenly distributed across contexts and where they surface more clearly, the paper argues, is in Mediterranean urban contexts, shaped by a combination of climate vulnerability, social inequality, institutional fragmentation, and diverse territorial conditions. Seen this way, energy justice should be understood not as an evaluative framework applied after implementation, but as a foundational principle shaping the design and governance of energy solutions from their inception.

MATERIALS AND METHODS

The POSEIDON Project as a Data source

To examine these questions, this paper revisits survey data collected within the framework of the POSEIDON (Positive Energy Initiatives in Districts for Neutral Mediterranean Cities) project, a collaborative initiative funded under the Driving Urban Transitions (DUT) Partnership [30]. The project supports six municipalities in Southern Europe in exploring opportunities and challenges associated with developing Positive Energy Districts (PEDs) within existing urban neighbourhoods. Rather than focusing on new urban developments, POSEIDON addresses the complexities of energy transitions in established urban environments.

The six participating municipalities are Antalya (Türkiye), Alcorcón (Spain), Rome (Italy), Marseille (France), Cesena (Italy), and Cascais (Portugal). They represent diverse urban contexts, including tourism-oriented economies, historic urban centres, metropolitan areas, industrial-port cities, and medium-sized settlements. Despite these differences, they share several challenges associated with Mediterranean urban regions, including climate vulnerability, ageing building stock, social inequalities, governance complexity, and the development of community energy initiatives.

Alongside exploring technological pathways towards climate neutrality, POSEIDON promotes participatory and place-based approaches through stakeholder engagement and Urban Living Labs. As part of these preparatory activities, an expert survey was conducted to assess local energy conditions, climate and social vulnerabilities, governance capacities, stakeholder ecosystems, and perceived opportunities and barriers to PED development. The POSEIDON survey served as a diagnostic instrument to inform the design of Urban Living Lab activities, capacity-building programmes, and locally adapted energy transition scenarios.

The survey involved 26 respondents from four stakeholder categories: public administration and decision-makers, academia, industry, and civil society organisations. Respondents were purposively selected by local project teams from outside the project consortium, based on their expertise, institutional roles, and involvement in local energy, sustainability, planning, and governance processes. The selection aimed to include perspectives from all four sectors of the quadruple helix approach [24]. This approach provided a practical way to understand local preconditions for PED development through diverse professional and sectoral perspectives.

The questionnaire combined structured and open-ended questions covering urban energy profiles, climate and social vulnerabilities, local policies and initiatives, stakeholder participation, governance capacities, energy communities, and expectations regarding PED development. Additional questions addressed preferences for Urban Living Lab activities, communication tools, and capacity-building needs. The resulting dataset–while originally collected to support PED planning and participatory activities–provides insights into perceived transition challenges, local priorities, and opportunities across the six municipalities and here serves as a basis for the secondary interpretive analysis of potential energy justice concerns presented in this paper.

UNCORRECTED PROOF

Research Design: Secondary Interpretive Analysis within an Energy Justice Framework

The methodological strategy adopted in this paper is a secondary interpretive analysis of the original POSEIDON survey data. Given that the survey was initially designed to assess local preconditions for Positive Energy District (PED) development rather than energy justice, the present study systematically re-examines expert assessments through an additional conceptual framework. This approach identifies potential justice-related concerns within the local conditions, challenges, and opportunities reported by respondents.

The research adopts an exploratory, qualitative, and comparative case-based design. Case selection was determined by the existing POSEIDON project partnership rather than theoretical sampling. The six partner municipalities provided an established framework for collaboration and access to local expertise. Each municipality is treated as a distinct case, enabling the identification of recurring concerns and differences in expert perceptions across local contexts. Stakeholder categories (public administration, academia, industry, and civil society) provide a secondary basis for interpretation where the available data permit [24], [31].

Energy justice provides the conceptual foundation for examining the social dimensions of energy transitions, particularly the distribution of benefits and burdens, participation in decision-making, and recognition of diverse social groups and knowledge systems [6], [7]. The study adopts the three-dimensional framework proposed by Walker and Day and subsequently developed by energy justice scholars [32] [7]. Distributional justice concerns the allocation of costs, benefits, risks, and opportunities associated with energy transitions. Procedural justice addresses participation, governance arrangements, access to information, and decision-making processes. Recognition justice concerns the acknowledgment of different social groups, their needs, identities, experiences, and forms of knowledge. Together, these dimensions provide the analytical structure for interpreting potential justice-related challenges during the early planning stages of PED development.

The analytical criteria were informed by established energy justice literature and research on justice indicators and assessment methodologies. Sovacool et al. [5] highlight the ethical considerations embedded in energy decision-making, while research on energy vulnerability and deprivation [29], [33] provides additional perspectives on affordability, unequal exposure, and access to resources. The IEA Indicators Handbook for Just and Inclusive Energy Transitions [8] offers practical examples concerning participation, inclusion, and governance. More recent studies by Apergi et al. [34], Baker et al. [35], and reviews of justice metrics [36] further inform the development of context-sensitive analytical criteria.

Following the principles of secondary qualitative analysis discussed by Heaton [37], the relevance of the original survey data to the new analytical objectives was considered. The questionnaire provides information on governance, stakeholder participation, communication, institutional capacity, and perceptions of vulnerability, as well as concerns related to affordability and climate risks.

The analysis followed three steps. First, the survey questions and responses were reviewed to identify themes relevant to energy justice. Second, these themes were categorised according to the three justice dimensions, as presented in Table 1. Distributional criteria included energy affordability, energy poverty, climate vulnerability, renewable energy access, and spatial inequalities. Procedural criteria addressed stakeholder participation, governance capacity, institutional coordination, communication, and citizen engagement. Recognition criteria included vulnerable groups, local knowledge, cultural diversity, energy literacy, and community priorities. Multiple dimensions were assigned where distinct justice-related concerns overlapped. Third, the findings were examined across the six cities to identify recurring patterns and differences in local conditions and expert perceptions.

UNCORRECTED PROOF

The analysis is primarily interpretive and descriptive. Although the study is qualitative in orientation, structured survey responses allow for limited descriptive quantification. Agreement rates by city and theme indicate how frequently particular concerns were reported among respondents. Combined agreement is calculated as the proportion of respondents selecting either "agree" or "strongly agree". Given the small number of respondents in each city, these rates are presented alongside their underlying counts.

These measures are treated as exploratory, perception-based indicators of potential justice-related concerns. The indicators are not intended to quantify the severity or prevalence of energy injustice. A more comprehensive assessment would require additional evidence, including municipal energy poverty statistics, socioeconomic and spatial data, and direct community participation records. Such information could complement expert assessments and support more robust indicators during subsequent PED planning and implementation.

The trustworthiness of the analysis is considered in relation to credibility, dependability, confirmability, and transferability [38]. Credibility is supported by drawing on perspectives from different stakeholder categories and municipalities and by considering both structured and open-ended survey responses. Dependability is supported by documenting the thematic categorisation and the criteria used to associate survey issues with the three energy justice dimensions. Confirmability is addressed by consistently distinguishing expert perceptions from directly observed conditions and community experiences. Transferability is considered through the contextual characteristics of the six municipalities, while recognising that purposive sampling and project-based case selection limit generalisation beyond comparable PED planning contexts.

Table 1. Association of POSEIDON Survey Themes with the Three Dimensions of Energy Justice [7]

Survey Issue	**PED Transition Challenge**	**D**	**P**	**R**
Increasing energy demand for cooling/heating	Energy efficiency and building retrofitting			
Increasing energy costs	Energy poverty and building retrofitting	✓		
Decrease in air quality	Decarbonization and urban environmental quality	✓		
Increased risk of heat-related deaths and illnesses	Climate adaptation and urban resilience	✓		✓
Increased stress on water resources	Climate adaptation and urban resilience	✓		
Decrease in water quality	Urban environmental sustainability	✓		
Future risks in continuous energy supply	Energy security and system resilience	✓		
Risk of affordability of local life	Just transition and social inclusion	✓		✓
Negative impacts on tourism/agriculture	Urban resilience and economic transition	✓		
Climate-related displacement	Climate adaptation and spatial justice	✓		✓
Temporary migration and second residences	Urban growth and territorial justice	✓		✓
Energy poverty	Inclusive energy transition	✓		✓
Building retrofit capacity	Building stock transformation	✓	✓	
Access to renewable energy investments	Renewable energy deployment and energy communities	✓		✓
Stakeholder participation	PED governance		✓	
Citizen participation	Co-creation and Living Labs		✓	✓
Community interest in participation	Community engagement		✓	✓
Community interest in energy projects	Energy communities and citizen ownership		✓	✓
Urban Living Labs	Participatory PED implementation		✓	✓

UNCORRECTED PROOF

Participatory planning workshops	Co-design and co-creation		✓	
Co-creation activities	Participatory governance		✓	
Collaboration among stakeholders	Multi-level governance		✓	
Municipal governance capacity	Institutional capacity		✓	
Interdepartmental collaboration	Integrated urban governance		✓	
Communication channels	Stakeholder engagement		✓	✓
Open data accessibility	Data governance and transparency		✓	✓
Awareness-raising activities	Citizen engagement and energy literacy		✓	✓
Energy literacy	Energy citizenship			✓
PED awareness	PED acceptance and legitimacy			✓
Knowledge sharing	Knowledge co-production		✓	✓
Vulnerable groups	Just transition and social inclusion			✓
Elderly populations	Inclusive energy transition			✓
Youth engagement	Intergenerational energy transition			✓
Local knowledge	Place-based transition			✓
Social inequalities	Just transition	✓		✓
Heritage and local identity	Context-sensitive PED development			✓
Community needs and priorities	Place-based transition			✓
Recognition of different territorial contexts	Territorial justice			✓
Capacity building	Governance and transition capacity		✓	✓

Methodological Considerations and Limitations

Several methodological limitations should be acknowledged. First, the analysis relies on expert perceptions rather than direct accounts from residents or energy users. The findings therefore reflect expert assessments of potential justice-related challenges rather than lived community experiences.

Second, the original POSEIDON survey was designed to support PED planning rather than explicitly assess energy justice. Its secondary interpretation is consequently limited by the scope of the questionnaire. Nevertheless, this approach offers an opportunity to identify justice-related concerns within broader discussions of urban energy transitions.

Third, the small sample of 26 respondents and purposive sampling strategy limit statistical generalisability. Individual responses can substantially affect agreement rates. Cross-city differences are therefore interpreted as indicative rather than representative. Furthermore, the selection of respondents by local project teams may have underrepresented critical or less-engaged perspectives and introduced social desirability bias.

Fourth, the absence of concerns in survey responses cannot be interpreted as evidence that these concerns do not exist. Differences in institutional, linguistic, and sociocultural contexts may also affect the comparability of responses across cities.

These limitations define the exploratory scope of the study. Rather than measuring the prevalence or severity of energy injustice, the analysis identifies potential justice-related concerns during early PED planning. The findings provide a basis for further investigation with residents and may inform more inclusive Urban Living Lab activities and energy transition scenarios.

UNCORRECTED PROOF

Generative AI tools were used solely for spell checking, grammar review, and language improvement. All suggestions were reviewed, edited as needed, and approved by the authors, who remain fully responsible for the content of the manuscript.

RESULTS AND DISCUSSION

Distributional Justice Dimensions of PED Transitions

The secondary interpretive analysis findings indicate that distributional justice concerns constitute one of the most significant dimensions shaping energy transitions across the six POSEIDON cities. Respondents consistently identified unequal exposure to climate risks, uneven access to energy transition investments, rising energy costs, and differentiated capacities to adapt to environmental change as major barriers to achieving a just energy transition. While the specific manifestations of these challenges vary according to local contexts, a common pattern emerges. The social and spatial distribution of both the benefits and burdens of the energy transition remains highly uneven across Mediterranean urban environments.

Affordability also emerged as a recurring vulnerability across all six pilot cities. Responses to the survey question addressing the "risk of affordability of local life (housing, transport, and energy costs)" revealed particularly high levels of concern in Marseille, Cesena, and Cascais, where all four respondents in each city expressed agreement or strong agreement (4 out of 4, 100%). Agreement was also substantial in Antalya (4 out of 5, 80%) and Rome (3 out of 4, 75%), while Alcorcón reported a lower level (2 out of 5, 40%). These findings highlight the importance of affordability in local energy transitions and align with broader European evidence demonstrating the interconnected nature of energy poverty, housing insecurity, and transport costs, which disproportionately affect lower-income urban households [33], [39]. The results suggest that distributive justice in Mediterranean PED transitions cannot be reduced to questions of energy access alone but must also account for wider affordability pressures of urban life.

The survey findings also reveal that vulnerability in affordability is highly context dependent. In Marseille, affordability concerns are inseparable from strong social inequalities and a fragmented urban structure characterised by differentiated housing conditions, income levels, and locational disparities between central and peripheral neighbourhoods [40]. Respondents explicitly acknowledged that the city's climate ambitions require significant investment not only to address climate change mitigation and adaptation goals but also to reduce the social vulnerability of disadvantaged populations. This observation suggests an awareness among local stakeholders that energy transition investments, if not carefully targeted, may exacerbate existing inequalities rather than reduce them.

In Rome, affordability pressures were similarly concentrated in specific urban territories. The San Basilio neighbourhood, identified as a candidate area for project implementation, was repeatedly described as experiencing multiple forms of vulnerability, including energy poverty, peripheral location related issues, ageing social housing stock, and limited access to organised community structures. These findings indicate that energy vulnerability in Rome is strongly spatialised and embedded within broader patterns of urban segregation and socio-economic exclusion.

In Antalya, the distributive dimension of energy transition takes a somewhat different form. Respondents identified a prevailing preference for short investment payback periods, typically not exceeding four years, as a major barrier to renewable energy adoption. This investment culture effectively functions as a distributive mechanism that systematically excludes households unable to afford substantial upfront investments, regardless of the long-term economic and environmental benefits associated with renewable energy technologies. Such findings demonstrate that distributive inequalities in energy transitions are not solely economic

UNCORRECTED PROOF

but are also shaped by local institutional and cultural contexts. In Antalya, respondents highlighted that access to the benefits of urban development and energy transition is unevenly distributed across social groups. While large-scale tourism investments and high-income coastal developments often have the financial and institutional capacity to influence urban transformation processes and access sustainability investments, lower-income households encounter substantial barriers to participating in decentralized renewable energy initiatives such as rooftop solar installations.

These findings correspond with what Heffron and McCauley [6] describe as a form of "reverse siting injustice." Rather than concentrating unwanted energy infrastructures within vulnerable communities, the challenge identified across the POSEIDON cities concerns the systematic exclusion of vulnerable populations from the benefits associated with desirable energy infrastructures and transition investments. Across all six cities, respondents suggested that investments in renewable energy systems, energy communities, and building renovation programmes tend to concentrate in newer, wealthier, and owner-occupied urban areas, while older social housing estates, rental housing stock, and peripheral neighbourhoods remain comparatively underserved.

Beyond affordability concerns, the survey reveals that climate vulnerability constitutes a compounding distributive risk across Mediterranean urban contexts. Increasing energy demand associated with cooling and heating requirements received strong support across all case cities, with respondents in Cesena and Cascais reporting 100%, 8 out of 8 respondents, covering all stakeholder types, agreement and respondents in Antalya reporting 80% agreement 4 out of 5 respondents, covering the majority of stakeholder types. Similarly, concerns regarding health were particularly high in Cascais (100%, 4 out 4), Cesena (100%, 4 out 4), and Antalya (80%4 out 5).

These findings are particularly significant from a distributive justice perspective because climate vulnerability is not socially neutral. Previous research has demonstrated that energy-poor households are simultaneously less capable of affording cooling technologies and more exposed to urban heat island effects due to their concentration in dense, poorly insulated, and less vegetated urban environments [29]. The survey findings from Marseille and Rome, both characterised by dense urban fabrics and significant concentrations of social housing, suggest that these patterns remain highly relevant within Mediterranean cities. Yet, despite recognising climate risks, only a limited number of respondents explicitly connected climatic vulnerability with broader social inequalities, indicating that distributive justice considerations remain only partially integrated into existing urban energy planning frameworks.

The case of Cesena provides a particularly illustrative example of the relationship between climate vulnerability and distributive justice. Respondents repeatedly referred to the devastating Emilia-Romagna floods of May 2023 as a catalyst for increased attention to urban resilience and climate adaptation policies. This event can be interpreted as a "crisis window" for transformative urban governance [41]. However, survey responses suggest that the resulting policy discourse remains largely focused on technical and institutional responses, with relatively limited attention given to the unequal distribution of flood impacts across different social groups and neighbourhoods.

Taken together, the findings suggest that the distributional dimension of Positive Energy District transitions is fundamentally shaped by existing social, spatial, economic, and climatic inequalities. Without explicit policy mechanisms designed to address affordability, vulnerability, and unequal access to transition benefits, there is a substantial risk that PED implementation may reinforce existing urban inequalities rather than reduce them. Consequently, distributive justice should be considered not as a secondary outcome of successful energy transitions but as a central design principle guiding the planning and implementation of Positive Energy Districts.

UNCORRECTED PROOF

Procedural Justice Dimensions of PED Transitions

The survey findings reveal that procedural justice challenges within the six cities are less a question of whether participation is formally supported and more a question of how participation is structured, who is able to participate, and whose knowledge is considered legitimate within energy transition processes. Across all six cases, respondents recognised stakeholder engagement, citizen participation, Urban Living Labs, and collaborative governance as essential components of PED development or energy community establishment. However, the findings simultaneously expose significant barriers to meaningful participation, persistent governance and knowledge asymmetries, and substantial capacity deficits that limit the ability of communities to influence energy transition processes. Rather than reflecting isolated local problems, these barriers collectively suggest that procedural injustice is embedded within the institutional architecture of contemporary urban energy governance.

A central finding of the survey is the existence of a significant expert-community gap in energy governance. Across the six cities, a structural disconnection persists between the institutional actors responsible for designing and implementing energy transition policies and the communities most affected by energy vulnerabilities and climate risks. This gap manifests itself in multiple and mutually reinforcing ways. In Rome, respondents outside public administration reported limited awareness of existing municipal energy initiatives and described public information systems as fragmented, difficult to access, and less comprehensive than those of comparable municipalities. Similarly, in Alcorcón, respondents identified the disconnect between municipal initiatives and citizen awareness as one of the most important barriers to energy transition, noting that low participation rates stem not from citizen indifference but from a combination of institutional distrust, limited communication, and the administrative complexity associated with energy projects. In Antalya, communities were frequently characterised as neutral toward energy transition initiatives, suggesting not active resistance but rather the absence of accessible entry points into decision-making processes.

These findings correspond closely with Walker and Day's conceptualization of procedural energy injustice, whereby those most affected by energy decisions are systematically prevented from meaningfully influencing them [32]. Importantly, such exclusion does not necessarily occur through explicit barriers but through participatory structures that implicitly assume institutional literacy, technical expertise, available time, and familiarity with administrative procedures. The survey findings suggest that these assumptions remain deeply embedded in the governance arrangements of all six cities, limiting the potential for genuinely inclusive and participatory energy transitions.

The second major procedural challenge concerns the existence of significant knowledge asymmetries within the institutional and expert communities themselves. A recurring pattern across the survey responses is that stakeholders from academia, civil society, industry, and public administration often possess only partial knowledge of existing energy initiatives, policies, and governance arrangements. In Rome, respondents explicitly observed that actors not directly involved in municipal administration frequently lacked awareness of ongoing public initiatives and policy developments. Similarly, in Alcorcón, the activities and services provided by the Community Transition Office were described as insufficiently visible even among engaged stakeholders and organised actors. In Antalya, the temporary closure of the municipality's Open Data Portal due to a cyberattack at the time of the survey highlighted the vulnerability and fragility of existing information infrastructures.

These findings demonstrate that procedural justice requires more than the existence of formal participatory mechanisms; it also requires equitable access to information and knowledge. As Arnstein argued, meaningful participation is impossible without access to the information necessary to engage effectively in decision-making processes [42]. When even institutional and expert actors experience difficulties accessing information and understanding governance processes, the informational barriers facing ordinary citizens become substantially greater. Consequently, improving procedural justice in the context of energy transitions

UNCORRECTED PROOF

requires not only expanding participation opportunities but also strengthening transparency, institutional coordination, and internal knowledge-sharing mechanisms.

A third procedural challenge emerging consistently across the six cities concerns the existence of significant capacity deficits at both institutional and community levels. In Cesena, respondents identified limited municipal capacity and insufficient interdepartmental coordination as major barriers to effective energy governance and integrated urban transition planning. In Marseille, despite strong political commitment to climate action, respondents expressed uncertainty regarding the city's practical implementation capacities and institutional readiness to deliver complex transition projects. Similarly, respondents in Alcorcón identified the Community Transition Office as a promising institutional mechanism that nevertheless remains constrained by financial limitations, bureaucratic complexity, and insufficient resources.

Importantly, these capacity deficits operate in both directions. On the one hand, they limit the ability of public institutions to engage effectively with local communities, coordinate across sectors, and implement complex transition initiatives. On the other hand, they constrain the ability of community organisations, neighbourhood associations, and citizen groups to participate meaningfully in energy transition processes. This dual capacity deficit reflects broader findings within the literature on community energy development in Southern Europe, which identifies administrative complexity, institutional fragmentation, and limited organisational resources as key barriers to the development of participatory energy systems [22]. The survey findings confirm these observations and suggest that capacity building should be understood not merely as a technical support mechanism but as a fundamental procedural justice intervention.

Urban Living Labs emerged as an important framework with great potential to address these procedural barriers. Across all six cities, respondents recognised the potential of Living Labs to facilitate collaboration, knowledge exchange, experimentation, and citizen engagement. However, survey participants consistently emphasised that effective Urban Living Labs require continuity, institutional commitment, accessible communication strategies, and long-term investment in trust-building processes. The findings therefore suggest that the success of participatory approaches depends less on the existence of consultation mechanisms and more on the capacity to establish durable institutional arrangements that enable genuine co-creation and shared decision-making.

Taken together, the findings reveal a fundamental tension within contemporary Positive Energy District development. While participation, co-creation, and stakeholder engagement are widely recognised as essential principles of sustainable urban transitions, their implementation remains constrained by structural governance inequalities, information asymmetries, and uneven institutional capacities. Consequently, procedural justice within Mediterranean energy transitions requires a shift away from top-down approaches toward governance models that prioritise transparency, capacity building, institutional coordination, and meaningful community empowerment.

Recognition Justice Dimensions of PED Transitions

The survey findings reveal that recognition justice constitutes perhaps the most fundamental challenge facing participative energy planning development across the six cities. Unlike distributive and procedural justice, which concern the allocation of resources and participation in decision-making processes, recognition justice asks a more fundamental question: whose experiences, knowledge, identities, and priorities are considered legitimate in defining the energy transition itself? The findings suggest that existing approaches to PED development continue to privilege institutional expertise, technical knowledge, and formal governance structures over the lived experiences and situated knowledge of local communities. Consequently, recognition injustice emerges not through explicit exclusion but through the

UNCORRECTED PROOF

institutional and epistemological assumptions that shape how energy transitions are conceived and governed.

The most significant recognition challenge identified by the survey concerns the structural absence of community voices from the diagnostic phase of the project development. As described in the methodology, all 26 survey respondents were institutional actors, including public officials, academics, industry representatives, and organised civil society actors. Although these respondents reside within and possess valuable knowledge about the participating cities, the communities most directly affected by energy vulnerability and climate change remain absent as subjects of inquiry. Elderly residents in Alcorcón, Arabic-speaking communities in Marseille, energy-poor households in Rome's San Basilio district, young people in Cesena, and migrant communities across several cities appear in the survey only through the interpretations and descriptions provided by experts rather than through their own experiences and perspectives.

This absence reflects a broader structural characteristic of urban energy governance and research processes, whereby participation mechanisms are often designed around institutional and project constraints, including budgets, timelines, technical expertise, and administrative procedures, rather than the needs and capacities of local communities [25], [43]. Schlosberg conceptualises recognition injustice as the systematic devaluation, marginalisation, or exclusion of particular social groups, their experiences, and forms of knowledge from decision-making processes [44]. In this respect, the survey unintentionally reproduces an existing pattern of recognition injustice by positioning expert knowledge as the primary epistemic foundation for Positive Energy District development. This observation does not diminish the value of expert perspectives. On the contrary, expert assessments of community conditions constitute an important form of evidence. However, it does require that the findings be interpreted critically, as representations of what experts understand about communities rather than direct accounts of how communities themselves understand their own needs, vulnerabilities, and capacities.

Interestingly, several respondents demonstrated awareness of this limitation. In Cascais, for example, respondents referred to population surveys indicating a high willingness among residents to participate in locally generated electricity initiatives, suggesting that direct engagement with communities can reveal preferences and capacities that may not be anticipated by institutional actors. This finding is particularly important within the context of the POSEIDON project, where the current diagnostic exercise functions as a preparatory stage intended to support the subsequent Urban Living Lab processes, which aim to engage citizens more directly in the co-design of Positive Energy Districts.

Beyond the absence of community voices, the survey findings also reveal important patterns of differential recognition within the expert community itself. Across all six cities, technical and institutional forms of knowledge, including engineering expertise, regulatory knowledge, technological innovation, and energy data, were consistently prioritised in respondents' descriptions of what PED development requires. In contrast, social and experiential forms of knowledge, including residents' experiences of energy poverty, neighbourhood organisations' understanding of local dynamics, and community intermediaries' ability to navigate social and cultural differences, were discussed less frequently and generally positioned as complementary rather than foundational forms of expertise.

This hierarchy of knowledge is visible in the stakeholder ecosystems identified by respondents. In Rome, the primary actors associated with Positive Energy District development included universities, municipal departments, technical experts, research institutions, and real estate actors, while neighbourhood associations, social services, and community organisations appeared less prominently and were described with less specificity. Similarly, respondents in Antalya emphasised the role of national ministries, municipalities, investors, and technology providers, while local communities occupied a comparatively marginal position within the

UNCORRECTED PROOF

governance framework. Marseille represented a partial exception to this pattern, where respondents explicitly identified organisations working on energy poverty and social vulnerability, such as GERES, Croix Rouge, and Soliha, as essential actors in the energy transition process. These findings suggest that community-level knowledge remains insufficiently recognised as a primary input into Positive Energy District design.

The differential recognition of knowledge has important practical consequences. When local experience, social knowledge, and community priorities are treated as supplementary rather than constitutive elements of the transition process, Positive Energy Districts risk becoming technically efficient but socially misaligned interventions. Such projects may successfully optimise energy performance while failing to address the priorities, capacities, and everyday realities of the populations they are intended to benefit [23], [45].

A third dimension of recognition justice identified by the survey concerns language, culture, and accessibility. Responses regarding the design of Urban Living Labs revealed the need for engagement materials and participatory activities to be developed in Turkish, Russian, Spanish, Italian, French, Arabic, English, and Portuguese. This linguistic diversity reflects the multicultural and socially heterogeneous character of Mediterranean urban regions. The explicit identification of Arabic-speaking populations in Marseille, Russian-speaking communities in Antalya, English speaking expats in Cascais, elderly populations in Alcorcón, and young people in Cesena demonstrates that effective participation depends not only on formal opportunities for involvement but also on the cultural and linguistic adaptation of participatory processes.

These findings resonate strongly with Fraser's (1996) argument that recognition justice requires not only acknowledging diversity but also restructuring institutional arrangements to ensure that particular cultural forms, communication practices, and social identities are not systematically disadvantaged [46]. The Urban Living Lab approach proposed within the project offers an important opportunity to address these challenges. However, this potential can only be realised if Living Lab processes are deliberately designed to accommodate linguistic diversity, cultural difference, varying levels of institutional literacy, and diverse communication preferences, rather than defaulting to participation formats calibrated primarily to educated, digitally connected, and institutionally experienced populations.

Taken together, the findings suggest that recognition justice remains one of the least developed dimensions of Positive Energy District transitions within Mediterranean cities. Although respondents increasingly acknowledge the importance of local knowledge, diversity, and place-based approaches, existing governance systems continue to privilege institutional expertise and technical rationality. Consequently, achieving recognition justice requires moving beyond the inclusion of communities as stakeholders toward recognising communities as legitimate producers of knowledge, holders of place-based expertise, and co-designers of urban energy futures.

UNCORRECTED PROOF

Key Patterns and Implications for Justice-Oriented Energy Transition

The comparative analysis of the six POSEIDON cities reveals several interconnected challenges across the three dimensions of energy justice. Despite differences in local economic, institutional, and territorial conditions, affordability, social vulnerability, limited public awareness, and governance capacity emerged as recurring concerns. These findings suggest that the challenges of urban energy transition extend beyond technological implementation and are closely connected to existing urban inequalities and institutional conditions.

From a distributional justice perspective, affordability emerged as a common concern, particularly in Marseille, Cesena, and Cascais. However, the nature of vulnerability differed across cities, reflecting variations in socioeconomic conditions, climate exposure, and demographic characteristics. These differences highlight the limitations of uniform energy transition approaches and the importance of examining how local conditions shape the potential distribution of transition costs and benefits.

Procedural and recognition justice concerns were closely interconnected. Limited awareness of PED initiatives, uneven access to information, and differences in institutional capacity suggest that participation depends not only on opportunities for engagement but also on stakeholders' ability to understand and influence planning processes. Although respondents emphasised the importance of pilot projects, Urban Living Labs, and capacity building, these mechanisms cannot be assumed to ensure meaningful participation without considering unequal power relations and the representation of vulnerable groups.

Institutional and territorial differences further shape these challenges. The contrasting conditions of tourism-oriented cities such as Antalya and Cascais, historically complex urban environments such as Rome, and cities facing distinct socioeconomic or climate-related pressures demonstrate the importance of place-sensitive planning. Institutional capacity therefore becomes relevant to energy justice not only through project delivery but also through the ability to recognise local needs and support inclusive decision-making.

Taken together, these findings indicate that the three dimensions of energy justice are not separate but mutually connected. Economic vulnerability can limit access to transition benefits, while information gaps and unequal participation can influence whose priorities are recognised in planning. Table 1 summarises these relationships and their implications for PED development.

Table 2. Energy Justice Dimensions Emerging from Expert Perspectives Across the Six POSEIDON Cities

Justice Dimension	Key Pattern	Evidence from Cities	Implication for PEDs
Distributional	Asymmetric distribution of energy-related risks and benefits	Heat vulnerability (Antalya, Rome, Marseille), water stress (Cascais), affordability concerns and unequal capacities for energy transition investments across cities	Energy justice requires equitable distribution of benefits (savings, comfort, generation) toward heat- and resource-vulnerable populations, with built-in affordability safeguards.
Procedural	Inclusion of affected residents and stakeholders in planning and decision-making	Living Labs, stakeholder participation, co-creation processes, municipal engagement, and calls for stronger citizen involvement across all case cities	PEDs should embed structured, ongoing participatory mechanisms (e.g., resident energy committees, co-design processes) into governance, not treat engagement as a one-off step.
Recognition	Lacking and lagging acknowledgement of diverse needs and voices	Low awareness of PEDs, energy literacy challenges, underrepresentation of citizens in energy discussions, and	PEDs need targeted outreach and energy literacy support to ensure vulnerable and underrepresented groups are identified,

UNCORRECTED PROOF

		recognition of vulnerable groups and local priorities	included, and their specific needs reflected in design.
Cross-cutting	Lack of people's perspective in the energy planning	People (including the stakeholders) do not know (or are purely informed) about project, ambitions and regulations. There are no or very limited communication paths or responsibilities set to deal with justice issues.	Energy transition require integrated justice strategies that address distribution, process, and recognition together, since gaps in one dimension reinforce gaps in the others.

The findings also suggest that expert-based readiness assessments can serve as an initial diagnostic tool for identifying potential justice-related concerns. However, translating these concerns into monitoring indicators requires additional socioeconomic and spatial evidence, together with direct community engagement, consistent with broader guidance on inclusive energy transition monitoring [8]. The findings can be condensed into an actionable justice-centred pathway that uses instruments already present in the analysis, with comparative conceptual assistance in a process of collective consenting, like in the PED Manifesto, moving from diagnosis to co-creational implementation [47].

CONCLUSIONS

The findings demonstrate that Positive Energy District transitions in Mediterranean cities are not merely technological transformations but fundamentally socio-technical, political, and territorial transition processes. The analysis further reveals that distributional, procedural, and recognition dimensions of justice are deeply interconnected and should be treated not as evaluation criteria applied after implementation but as fundamental design principles shaping the planning, governance, and implementation of Positive Energy Districts. Challenges related to affordability, climate vulnerability, participation, institutional capacity, and the recognition of local knowledge cannot be addressed independently; rather, they reflect broader structural tensions between technological innovation and social inclusion, institutional governance and community agency, and universal transition models and place-based realities.

The findings further suggest that existing Positive Energy District frameworks, which have largely emerged from Northern European experiences, require critical adaptation when applied to Mediterranean contexts characterised by climate vulnerability, social inequality, territorial diversity, and differentiated governance capacities. In this regard, place-based approaches, participatory governance, and the recognition of local knowledge emerge not as complementary components of energy transitions but as essential conditions for their legitimacy and long-term success.

These findings translate into a practical proposition for the six case cities and for comparable Mediterranean contexts. Justice-centered energy transition proceeds by pairing each diagnosed deficit with a corresponding design commitment: targeted redistribution of transition benefits toward vulnerable neighbourhoods, standing participatory structures with real decision rights, institutional recognition of community knowledge through multilingual and co-diagnostic engagement and indicator-based monitoring of all three justice dimensions from inception onward.

UNCORRECTED PROOF

More broadly, this study argues that the future challenge for Positive Energy District research and practice is not simply how to make energy transition more just, but how to design energy transitions in which justice itself becomes the organising principle of urban transformation. Such a shift may prove essential if energy projects are to contribute not only to climate neutrality and energy efficiency goals, but also to socially inclusive, democratically legitimate, and territorially equitable urban futures.

ACKNOWLEDGMENT

This research was conducted within the framework of the POSEIDON project, a European collaborative initiative supporting the development of Positive Energy Districts (PEDs) in six Mediterranean cities: Antalya (Türkiye), Alcorcón (Spain), Rome (Italy), Marseille (France), Cesena (Italy), and Cascais (Portugal). The authors would like to acknowledge all project partners and associated stakeholders for their contributions to the development of the research framework, data collection, and knowledge exchange activities.

The authors are particularly grateful to the municipal representatives, experts, researchers, practitioners, and civil society actors who participated in the survey and shared their knowledge, experiences, and local perspectives. Their contributions provided essential insights into the opportunities and challenges of implementing just and inclusive Positive Energy District transitions in Mediterranean urban contexts.

The POSEIDON project is supported by national funding agencies participating in the Driving Urban Transitions (DUT) Partnership, including the State Research Agency (AEI) and the Centre for the Development of Industrial Technology (CDTI) in Spain, the Austrian Research Promotion Agency (FFG) and the Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) in Austria, the Scientific and Technological Research Council of Türkiye (TÜBİTAK), the Agence de la Transition Écologique (ADEME) in France, and the Italian Ministry of University and Research (MUR). The authors gratefully acknowledge their financial support.

NOMENCLATURE

Abbreviations

PED	Positive Energy District
PEDs	Positive Energy Districts
REC	Renewable Energy Community
LEZ	Low Emission Zone
DUT	Driving Urban Transitions
ULL	Urban Living Lab
IEA	International Energy Agency
G20	Group of Twenty
NBS	Nature-Based Solutions
RED II	Revised Renewable Energy Directive
POSEIDON	Positive Energy Initiatives in Districts for Neutral Mediterranean Cities

REFERENCES

[1] A. Le Corre, “Four Years of War: What Ukrainian Cities’ Resilience Teaches Us.” Accessed: Jun. 19, 2026. [Online]. Available: https://energy-cities.eu/four-years-of-war-what-ukrainian-cities-resilience-teaches-us/

[2] A. M. Jaller-Makarewicz, “One Hundred Days of Disruption: How the Iran War Exposes Europe’s Energy Vulnerabilities.” Accessed: Jun. 19, 2026. [Online]. Available:

UNCORRECTED PROOF

https://ieefa.org/resources/one-hundred-days-disruption-how-iran-war-exposes-europes-energy-vulnerabilities

[3] N. Imran, M. M. Amjad, S. Malik, and D. Jones, "The Solarisation of Pakistan's Energy Economy: Distributed Solar is Driving Up Electricity Demand, Bringing Huge Social and Economic Benefits," Ember, Report, Jun. 2026. Accessed: Jun. 26, 2026. [Online]. Available: https://ember-energy.org/latest-insights/the-solarisation-of-pakistans-energy-economy/

[4] European Commission, "100 Climate-Neutral and Smart Cities by 2030: Mission Implementation Plan," Publications Office of the European Union, Luxembourg, 2022. [Online]. Available: https://research-and-innovation.ec.europa.eu/system/files/2021-09/cities_mission_implementation_plan.pdf

[5] B. K. Sovacool, R. J. Heffron, D. McCauley, and A. Goldthau, "Energy Decisions Reframed as Justice and Ethical Concerns," *Nature Energy*, vol. 1, p. 16024, 2016, doi: 10.1038/nenergy.2016.24.

[6] R. J. Heffron and D. McCauley, "The concept of energy justice across the disciplines," *Energy Policy*, vol. 105, pp. 658–667, Jun. 2017, doi: 10.1016/j.enpol.2017.03.018.

[7] K. Jenkins, D. McCauley, R. Heffron, H. Stephan, and R. Rehner, "Energy justice: A conceptual review," *Energy Research & Social Science*, vol. 11, pp. 174–182, Jan. 2016, doi: 10.1016/j.erss.2015.10.004.

[8] International Energy Agency, "Indicators Handbook for Just and Inclusive Energy Transitions." Durban, South Africa, Oct. 09, 2025. [Online]. Available: https://iea.blob.core.windows.net/assets/8b57f371-fb92-48db-8b41-5644f259140e/IndicatorsHandbookforJustandInclusiveEnergyTransitions1.pdf

[9] H. Vandevyvere, D. Ahlers, and A. Wyckmans, "The Sense and Non-Sense of PEDs—Feeding Back Practical Experiences of Positive Energy District Demonstrators into the European PED Framework Definition Development Process," *Energies*, vol. 15, no. 12, p. 4491, Jun. 2022, doi: 10.3390/en15124491.

[10] I. Bertolami, A. Bisello, M. Volpatti, and M. C. Bottero, "Exploring Multiple Benefits of Urban and Energy Regeneration Projects: A Stakeholder-Centred Methodological Approach," *Energies*, vol. 17, no. 12, p. 2862, Jun. 2024, doi: 10.3390/en17122862.

[11] S. Sareen *et al.*, "Ten questions concerning positive energy districts," *Building and Environment*, vol. 216, p. 109017, May 2022, doi: 10.1016/j.buildenv.2022.109017.

[12] X. Zhang, S. Penaka, S. Giriraj, M. Sánchez, P. Civiero, and H. Vandevyvere, "Characterizing Positive Energy District (PED) through a Preliminary Review of 60 Existing Projects in Europe," *Buildings*, vol. 11, no. 8, p. 318, Jul. 2021, doi: 10.3390/buildings11080318.

[13] D. Ahlers, P. Driscoll, H. Wibe, and A. Wyckmans, "Co-Creation of Positive Energy Blocks," *IOP Conf. Ser.: Earth Environ. Sci.*, vol. 352, no. 1, p. 012060, Oct. 2019, doi: 10.1088/1755-1315/352/1/012060.

[14] G. Turci, P. Civiero, I. Aparisi-Cerdá, I. Marotta, and G. Massa, "Transition Approaches towards Positive Energy Districts: A Systematic Review," *Buildings*, vol. 14, no. 10, p. 3039, Sep. 2024, doi: 10.3390/buildings14103039.

[15] B. Nasya, Y. Vurucu, and U. Stevens, "Bottom-up Energy Transition – Exploring Community Centred Development in Austria and Spain," *Journal of Sustainable Development of Smart Energy Networks*, vol. 1, no. 3, p. 1030694, 2026, doi: 10.13044/j.sdi.d3.0694.

[16] D. Süsser, M. Döring, and B. M. W. Ratter, "Harvesting energy: Place and local entrepreneurship in community-based renewable energy transition," *Energy Policy*, vol. 101, pp. 332–341, Feb. 2017, doi: 10.1016/j.enpol.2016.10.018.

[17] A. Kerstens and A. Greco, "From Buildings to Communities: Exploring the Role of Financial Schemes for Sustainable Plus Energy Neighborhoods," *Energies*, vol. 16, no. 14, p. 5453, Jul. 2023, doi: 10.3390/en16145453.

UNCORRECTED PROOF

[18] E. Lacroix and C. Chaton, "Fuel poverty as a major determinant of perceived health: the case of France," *Public Health*, vol. 129, no. 5, pp. 517–524, May 2015, doi: 10.1016/j.puhe.2015.02.007.
[19] B. Nasya *et al.*, "Multi-dimensional self-assessment matrix and scoring system for Positive Energy Districts," *Front. Sustain. Cities*, vol. 7, p. 1688667, Nov. 2025, doi: 10.3389/frsc.2025.1688667.
[20] R. G. Hollands, "Critical interventions into the corporate smart city," *CAMRES*, vol. 8, no. 1, pp. 61–77, Mar. 2015, doi: 10.1093/cjres/rsu011.
[21] A. Vanolo, "Smartmentality: The Smart City as Disciplinary Strategy," *Urban Studies*, vol. 51, no. 5, pp. 883–898, Apr. 2014, doi: 10.1177/0042098013494427.
[22] A. Caramizaru and A. Uihlein, *Energy communities: an overview of energy and social innovation*. in JRC science for policy report. Luxembourg: Publications Office of the European Union, 2020. doi: 10.2760/180576.
[23] J. Roberts, F. Bodman, and R. Rybski, "Community Power: Model Legal Frameworks for Citizen-Owned Renewable Energy," ClientEarth, London, Report, 2014. [Online]. Available: https://ssrn.com/abstract=4637691
[24] E. G. Carayannis and D. F. J. Campbell, "'Mode 3' and 'Quadruple Helix': toward a 21st century fractal innovation ecosystem," *IJTM*, vol. 46, no. 3/4, p. 201, 2009, doi: 10.1504/IJTM.2009.023374.
[25] C. E. Hoicka and J. L. MacArthur, "From tip to toes: Mapping community energy models in Canada and New Zealand," *Energy Policy*, vol. 121, pp. 162–174, Oct. 2018, doi: 10.1016/j.enpol.2018.06.002.
[26] PED-EU-NET, "PED Database." 2024. [Online]. Available: https://peddatabase.dutpartnership.eu/
[27] N. Simcock, G. Walker, and R. Day, "Fuel poverty in the UK: beyond heating?," *PPP*, vol. 10, no. 1, pp. 25–41, Apr. 2016, doi: 10.3351/ppp.0010.0001.0003.
[28] V. C. Broto and L. Westman, *Urban Sustainability and Justice: Just Sustainabilities and Environmental Planning*, 1st ed. Zed Books Ltd, 2019. doi: 10.5040/9781350223776.
[29] L. Papada and D. Kaliampakos, "Measuring energy poverty in Greece," *Energy Policy*, vol. 94, pp. 157–165, Jul. 2016, doi: 10.1016/j.enpol.2016.04.004.
[30] POSEIDON Project Consortium, "POSEIDON: POSitive Energy Initiatives in Districts fOr Neutral Mediterranean Cities." Accessed: Jul. 06, 2026. [Online]. Available: https://poseidon-project.eu/
[31] R. K. Yin, *Case study research and applications: design and methods*, Sixth edition. Los Angeles: SAGE, 2018.
[32] G. Walker and R. Day, "Fuel poverty as injustice: Integrating distribution, recognition and procedure in the struggle for affordable warmth," *Energy Policy*, vol. 49, pp. 69–75, Oct. 2012, doi: 10.1016/j.enpol.2012.01.044.
[33] S. Bouzarovski and S. Petrova, "A global perspective on domestic energy deprivation: Overcoming the energy poverty–fuel poverty binary," *Energy Research & Social Science*, vol. 10, pp. 31–40, Nov. 2015, doi: 10.1016/j.erss.2015.06.007.
[34] M. Apergi *et al.*, "An energy justice index for the energy transition in the global South," *Renewable and Sustainable Energy Reviews*, vol. 192, p. 114238, 2024, doi: https://doi.org/10.1016/j.rser.2023.114238.
[35] E. Baker *et al.*, "Metrics for Decision-Making in Energy Justice," *Annu. Rev. Environ. Resour.*, vol. 48, no. 1, pp. 737–760, Nov. 2023, doi: 10.1146/annurev-environ-112621-063400.
[36] N. Amosi *et al.*, "Reviewing metrics and indicators for energy, climate, and environmental justice: A synthesis of 25 years of research," *Energy Research & Social Science*, vol. 130, p. 104462, 2025, doi: https://doi.org/10.1016/j.erss.2025.104462.
[37] J. Heaton, "Secondary Analysis of Qualitative Data: An Overview," *Historical Social Research / Historische Sozialforschung*, vol. 33, no. 3, pp. 33–45, 2008.

UNCORRECTED PROOF

[38] L. S. Nowell, J. M. Norris, D. E. White, and N. J. Moules, "Thematic Analysis: Striving to Meet the Trustworthiness Criteria," *International Journal of Qualitative Methods*, vol. 16, no. 1, p. 1609406917733847, Dec. 2017, doi: 10.1177/1609406917733847.
[39] H. Thomson, C. Snell, and C. Liddell, "Fuel poverty in the European Union: a concept in need of definition?," *PPP*, vol. 10, no. 1, pp. 5–24, Apr. 2016, doi: 10.3351/ppp.0010.0001.0002.
[40] Ville de Marseille and Metropole Aix-Marseille-Provence, "Marseille 2030 Climate Objective: Climate City Contract, Action Plan Section," Ville de Marseille, Marseille, France, Climate City Contract, Apr. 2023.
[41] M. Pelling, *Adaptation to climate change: from resilience to transformation*, Online-Ausg. London New York: Routledge, 2010.
[42] S. R. Arnstein, "A Ladder Of Citizen Participation," *Journal of the American Institute of Planners*, vol. 35, no. 4, pp. 216–224, Jul. 1969, doi: 10.1080/01944366908977225.
[43] V. Castán Broto, *Urban Energy Landscapes*, 1st ed. Cambridge University Press, 2019. doi: 10.1017/9781108297868.
[44] D. Schlosberg, *Defining Environmental Justice: Theories, Movements, and Nature*. Oxford University Press, 2007. doi: 10.1093/acprof:oso/9780199286294.001.0001.
[45] E. M. Gui and I. MacGill, "Typology of future clean energy communities: An exploratory structure, opportunities, and challenges," *Energy Research & Social Science*, vol. 35, pp. 94–107, Jan. 2018, doi: 10.1016/j.erss.2017.10.019.
[46] N. Fraser, "Social Justice in the Age of Identity Politics: Redistribution, Recognition, and Participation," in *The Tanner Lectures on Human Values*, Stanford, CA: Stanford University, 1997.
[47] B. Nasya, Y. Vurucu, and B. Akkaya, *PED MANIFESTO turning the balance of local energy into positive*, 1. Auflage. Wien: wonderland, 2024.

UNCORRECTED PROOF