Futures 164 (2024) 103496

Contents lists available at ScienceDirect

Futures

journal homepage: www.elsevier.com/locate/futures

Narratives, expectations, and policy criteria for a democratic and socially engaging energy transition

Inês Campos [a,b,*], Miguel Brito [c], Stefan Pfenninger-Lee [d], Luís M. Fazendeiro [c], Guilherme Pontes Luz [c], Francesco Lombardi [d], Aías Lima [a], Cristina Madrid-López [e]

[a] *Ce3C, Faculdade de Ciências, Universidade de Lisboa, Lisboa 1749-016, Portugal*
[b] *CTAC, University of Minho, Campus Azurém, 4804-533, Guimarães, Portugal*
[c] *Instituto Dom Luiz, Faculdade de Ciências, Universidade de Lisboa, Lisboa 1749-016, Portugal*
[d] *TU Delft, Faculty of Technology, Policy, and Management, the Netherlands*
[e] *LivenLab, Sostenipra research group. Institut de Ciéncia i Tecnologia Ambientals, Universitat autónoma de Barcelona, Barclona 08193, Spain*

ARTICLE INFO

Keywords:
Narratives
Delphi
Survey
Sociopolitical acceptance
Transition
Energy democracy

ABSTRACT

Energy transition policies can be translated into narratives about how energy systems should change (e.g., towards a centralised or decentralised system). These narratives tend to reflect expectations, priorities, and perceptions on feasibility and the social acceptability of different policy options, as well as long-term goals and trade-offs, all of which influence policy criteria. Taking as its case study Portugal and the implementation of European directives there, this study aims to characterise energy transition narratives (e.g. a swift transformation to renewables) and interrelated policy criteria (e.g., participation of local communities), focusing on expectations for a socially engaging and democratic energy transition. The analysis builds on the results of a Delphi survey with 10 expert stakeholders, a citizens' survey (n=500), and a workshop with 19 participants. It identifies the most relevant criteria to stakeholders, as well as the importance of different underlying expectations, meanings, and attitudes shaping narratives about energy system futures. The findings indicate that criteria interrelated to narratives which highlight a promise of democratic energy governance may be less important for energy transition policies, and therefore undermine energy democracy goals. The conclusion highlights suggestions for policy and future research more likely to foster sociopolitical acceptance.

1. Introduction

Since energy system scenarios and policy should help plan the future, choices between preferred alternatives and their underlying narratives have important repercussions for sociopolitical acceptance of renewable energy technologies (Batel, 2020; Trutnevyte, 2014). Such acceptance is largely framed by crosscutting factors, related to social, economic, and environmental aspects (Cousse, 2021). While transparency, trust and citizen participation tend to favour higher sociopolitical, market and community acceptance of renewable energy technologies (Pahle et al., 2021), research into democratic and socially engaging energy transition policies is still

* Corresponding author at: Ce3C, Faculdade de Ciências, Universidade de Lisboa, Lisboa 1749-016, Portugal.
E-mail addresses: iscampos@fc.ul.pt (I. Campos), mcbrito@fc.ul.pt (M. Brito), s.pfenninger@tudelft.nl (S. Pfenninger-Lee), lafazendeiro@fc.ul.pt (L.M. Fazendeiro), gpluz@fc.ul.pt (G.P. Luz), f.lombardi@tudelft.nl (F. Lombardi), 1180080@isep.ipp.pt (A. Lima), Cristina.Madrid@uab.cat (C. Madrid-López).

https://doi.org/10.1016/j.futures.2024.103496
Received 24 April 2024; Received in revised form 19 July 2024; Accepted 23 October 2024
Available online 28 October 2024
0016-3287/

emerging. Energy democracy processes tend to be shifted to the background or even dismissed completely (Berthod et al., 2022), with consequences such as local contestation of renewable energy installations across Europe (Cousse, 2021; Karam & Shokrgozar, 2023; Siamanta, 2019).

A critical assumption is that while renewable energy systems will help achieve decarbonisation goals, these may be done without effectively ensuring the democratic participation of citizens and communities. Furthermore, alternative energy policy goals will entail different types of environmental impacts. For instance, a distributed urban system, relying on in-built infrastructure will likely have lower environmental and landscape impacts than a large-scale solar plant or a large wind energy installation in a rural region. Transparency regarding expected environmental and landscape changes will likewise impact sociopolitical and community acceptance, which can be influenced by place identities and landscape attachments (Devine-Wright, 2009).

This work sets out to understand how energy transition narratives interrelate with criteria for a socially engaging and democratic policy (Hermwille, 2016). Namely, how conditions for energy democracy, that is, the participation of citizens and communities in critical decisions about energy policies and plans, can be put into practice (Berthod et al., 2022; Burke & Stephens, 2017). This study, thus, asks which policy criteria translate into socially engaging and democratic energy transition narratives. The study builds on the hypothesis that criteria interrelated to narratives which highlight a promise of democratic energy governance may be less important for energy transition policies, and therefore undermine energy democracy goals (Burke & Stephens, 2017).

Energy transition narratives are understood as structured accounts or a form of storytelling about the future, influencing the trajectory of innovations (Borup et al., 2006). These narratives prefigure values and priorities based on expectations about the feasibility and the social acceptability of different technologies, thus helping social actors to navigate through complex social and technological changes (Brown & Michael, 2003; Luederitz et al., 2017).

This study considers specific narratives about renewable energy systems and their implications for energy democracy. While examining a pilot case (i.e. Portugal), two overarching narratives guide the identification of policy criteria that can foster more democratic and socially engaging energy transition policies. The analysis engages both expert stakeholders and citizens, based on the results of a Delphi study, a workshop with 19 stakeholder experts, and an online survey (n=500) for collecting insights into the sociopolitical acceptance of citizens regarding different renewable energy technologies (Devine-Wright, Batel, Aas, et al., 2017; Scherhaufer et al., 2018).

The identification of narratives in the context of the Portuguese energy system is based on the review of policy strategies and regulatory frameworks, adopted due to European Directives, and insights from published research related to the Portuguese case (Brás et al., 2024; Silva & Sareen, 2021). These narratives equally reflect broader European energy policy strategies and common concerns applicable to other European countries, such as centralised versus decentralised configurations, or increased demand flexibility versus large investments in storage capability (Carlisle et al., 2015; Narayanan et al., 2019; Powells & Fell, 2019).

Lastly, this study contributes to debates on the sociopolitical acceptability of renewable energy technologies (Batel & Rudolph, 2021; Bridge et al., 2013; Huber, 2015). Such debates are relevant for Europe as well as other regions in the globe, where fast-paced energy transition policies are implemented, and sustainability and energy democracy concerns become increasingly central (Bommel & Höffken, 2021; Dwyer & Bidwell, 2019).

The work is, hence, structured as follows: Section 2 provides an additional characterisation of the conceptual aspects framing this study; Section 3 presents the methods implemented; and Section 4 presents the results. These results are discussed in Section 5, leading to conclusions and policy implications distilled in Section 6.

2. Background

This section starts by delineating the overarching research and theory on Sustainability Transitions (Markard et al., 2012) and the Multi-Level Perspective (Geels et al., 2017), to then introduce concepts from the Sociology of Expectations (Borup et al., 2006) and their relevance for approaching socio-technical transitions, highlighting the implications of expectations, promises and narratives for the energy transition. The section ends by outlining the relevance of social acceptance of renewable energy technologies and sociopolitical expectations for the energy transition, with a focus on the Portuguese case.

A narrative approach is critical in sustainability research given the failure of decades of climate mitigation policy (Stoddard et al., 2021). Dominant sociopolitical narratives have proven unsuccessful in converging into imagined ways to live without fossil-fuel dependence, guided by the prevailing focus on economic growth and inevitable exploitation of people and natural resources, at the expense of wellbeing, inclusivity, and sustainability (Healy & Barry, 2017; Stoddard et al., 2021; York & Bell, 2019).

Sustainability transitions, or radical long-term socio-technical changes, develop along interrelated policy and decision-making processes involving diverse social actors and institutional settings (Frantzeskaki et al., 2012; Markard et al., 2012). Specifically, the Multi-level Perspective (MLP) offers a framework to analyse the dynamics of transitions in complex socio-technical systems (e.g., the energy system) (Sengers et al., 2019), and is relevant in framing transitions from a narrative perspective (Hermwille, 2016; Roßmann, 2021).

The MLP considers three interdependent system levels (Geels, 2011). At the micro level, socio-technical niches are protected spaces where transformative innovations emerge, including social innovations (Seyfang et al., 2014; Smith & Raven, 2012). At the meso level, the socio-technical regime (prevalent sets of rules, practices and cultures) is supported by established technologies, regulatory frameworks and markets (e.g. the fossil-fuel based energy system) (Smith, 2007; Turnheim & Geels, 2012a). The macro level is characterised by landscape pressures and broader contextual factors influencing socio-technical regimes and niches, such as climate change (Geels et al., 2017). These system levels are continuously interacting. For instance, regime shifts can be triggered by landscape pressures (e.g., climate change and the need to decarbonise the economy), which create opportunities for mainstreaming socio-technical innovations (e.g. expansion of renewable energies) (Geels, 2010; Markard & Truffer, 2008).

In the context of the MLP, narratives have been relevant to interpret the dynamics between niche innovations, regimes and landscape pressures (Hermwille, 2016; Luederitz et al., 2017). Particularly, within the field of Sociology of Expectations (Borup et al., 2006; Brown & Michael, 2003), narratives are understood as a form of storytelling about the future, influencing the trajectory of innovations, as they give meaning to expectations about socio-technical innovations (Borup et al., 2006). These (usually positive) expectations refer to the promises, and anticipated outcomes associated with emerging technologies and innovations. They are prefigurative in that they actively shape the future by influencing present actions (Roßmann, 2021). Such expectations are perceived to influence the decisions of various actors within a socio-technical system (Nerlich et al., 2023), by attracting support (e.g. new regulatory frameworks and policy) and resources (e.g., new investments, user adoption, research and development) for new technologies (Borup et al., 2006).

Within the MLP framework, positive expectations are important for fostering niche innovations which can challenge the stability of established regimes, eventually achieving alignment across various system levels (e.g., landscape pressures for decarbonising the energy system align with the development of renewable energy technologies) (Geels, 2002; Smith et al., 2005). Narratives emerge from these expectations and help frame our understanding of how social actors create diverse perspectives and agency, navigating across critical moments, where competing interests unfold over time (Tidwell & Tidwell, 2018).

Furthermore, narratives play a critical role in legitimising specific policy pathways (Luederitz et al., 2017). For instance, the energy transition may come with an expectation for higher community participation and energy democracy (Burke & Stephens, 2017). From these expectations, socio-technical innovations such as energy communities may also expand (Campos & Marín-González, 2020; Sundström & McCright, 2016). Thus, the promise of energy democracy implies not only a technological change to a low-carbon energy system but also overcoming path-dependent centralised energy investments and large-scale infrastructures, characteristic of the fossil-fuel-based regime. However, even if renewable energy-based systems are suitable for decentralised infrastructures and community-based governance models, investors and market agents may have expectations for the continuity of centralised and large-scale investments. Thus, as a tool for analysis, narratives bring to the foreground underlying perspectives, and competing interests across transition dynamics (Di Felice et al., 2021; Longhurst et al., 2016).

Additionally, social acceptance of renewable energy technologies (RET) can be characterised as a key expectation for advancing with the energy transition. Social acceptance of RET refers to how society at large supports socio-technical transformations in the energy sector (Chilvers et al., 2018; Wüstenhagen et al., 2007). The concept has been widely used in research into sociopolitical, community and market acceptance in the context of efforts for decarbonising energy systems (Batel & Rudolph, 2021; Farla et al., 2012). Research into social acceptance criticises "Not In My Back Yard" explanations of citizens' attitudes towards renewables as being too simplistic, overshadowing more complex relationships and influencing factors (Devine-Wright, 2005), such as place attachment and place identity processes – i.e., the emotional bonds between people and places (Bailey et al., 2016).

Previous research equally highlighted how alienating citizens and stakeholders from energy-related decisions has led to reproducing pre-existing distributional and procedural injustices, resulting in challenges for the social acceptance of RET (Batel, 2018; Bouzarovski & Tirado Herrero, 2017). Key factors for higher sociopolitical and community acceptance involve earning citizens' and stakeholders' trust, through information sharing, transparency and participation (Bidwell, 2016; Koirala et al., 2018; Mendonça et al., 2009).

Informed by this background research, the study builds on the hypothesis that important criteria, interrelated to dominant and alternative narratives of participatory and democratic energy governance, may be less important for energy transition policies, and therefore undermine energy democracy goals. Portugal offers a robust case study due to the country's advancement in the renewable energy sector, and to being, historically, an early adopter in the case of hydropower and wind energy. Portugal's key energy policy is based on a rapid expansion of renewable electricity generation. Key targets of its National Energy and Climate Plan (NECP) for 2021–2030 include 45–55 % reduction in greenhouse gas emissions, 80 % renewable electricity production, and 65 % energy dependency reduction. The plan focuses on solar and wind energy, aiming for 27 % and 31 % of national power, respectively, by 2030, and introduces offshore wind energy with a 2 GW installation target by 2030. However, policies resulting from these ambitious targets have given rise to local opposition, mainly in the Southern regions of the country, where very large solar parks are planned, signalling

Table 1
Main policy documents and relevant legislation regarding the energy transition in Portugal.

Documents	Type	Description
Roadmap for carbon neutrality by 2050 (RNC2050 2019)	Policy strategy	Sets carbon neutrality goal for 2050; describes transformation paths to achieve it;
National Energy and Climate Plan, NECP (Resolução do Conselho de Ministros n.o 53,2020, de 10 de julho, 2020)	Policy strategy	Sets the goals for 2030, in terms of energy efficiency, electrification, and renewable generation;
National Hydrogen Strategy (República 2020)	Policy strategy	Complements the NECP by proposing a strategy for implementing H2 technologies;
Climate Framework Law (República 2021, 98)	Climate legislation	Framework legislation that should underlie other types of legislation;
National Electricity System (Decreto-Lei n.o 15,2022)	Energy legislation	Reform of the electricity system, introducing specific regulations for energy communities;
Simplex law (Decreto-Lei n.o 11,2023, de 10 de fevereiro)	Environmental and licensing legislation	Introduces simplification of procedures for licensing of renewable energy projects;

emerging challenges for distributed and procedural justice aspects (Brás et al., 2024; Silva & Sareen, 2021).

3. Materials and methods

The methods include qualitative and quantitative approaches (Gibson, 2017). The identification of dominant and alternative transition narratives relied on a documentary review of regulatory frameworks and policy documents relevant to efforts to decarbonise the Portuguese energy system. Alternative narratives are also derived from published research on the energy transition drawing on empirical findings (Campos & Pontes Luz, Marín-González, et al., 2020, 2023; Delicado et al., 2016; Nordholm & Sareen, 2021; Sareen, 2024.; Silva & Delicado, 2017; Silva & Sareen, 2021; Wittmayer et al., 2022). The review of policy documents was updated throughout the research as new decree-laws were published. The main documents reviewed are listed in Table 1.

The narratives informed the design of a participatory approach, engaging stakeholders in a Delphi study and workshop (McGookin et al., 2021). In addition, the narratives also guided the design of a survey to Portuguese citizens (n=500). The integration of these methods is illustrated in Fig. 1 and allowed for the identification and validation of criteria for a democratic and socially engaging energy system while gaining insights into the sociopolitical acceptance of renewable energy technologies.

3.1. Delphi survey and workshop

The Delphi method was implemented between May and November 2022 to enable the identification and selection of policy criteria (Belton et al., 2019; Flostrand et al., 2020), namely, criteria that should be integrated and/or guide policies. The Delphi method is a technique used to achieve consensus among a panel of experts through multiple rounds of questionnaires, with feedback provided between each round. It is designed to gather opinions on specific topics by iteratively refining the inputs experts provide (Okoli & Pawlowski, 2004).

The approach is considered a foresight methodology, as it is often applied in studies seeking to gain insight into different possibilities for the future (Aengenheyster et al., 2017). The key principles of the method include the anonymity of experts, repetitiveness, feedback, and offering participants the possibility of reviewing and reconsidering their answers (Hirschhorn, 2019). These principles were upheld throughout this study, and all panel participants provided informed consent, following strict ethical guidelines. There are diverse types of Delphi approaches (e.g., policy, classical, decision-making) (Flostrand et al., 2020). This study was a policy Delphi study, which primarily seeks to explore and discuss different policy criteria, or specific policy directions for the future (Linstone & Turoff, 2011).

The Delphi involved ten energy and climate experts, including policy (2 experts), technology and market (5), and civil society (3). Despite the low number of participating experts, an initial stakeholder mapping identified 87 stakeholders, across the market (48 stakeholders), government (24), communities (8) and civil society civil society and academia (7). Email contacts were sent to 49 of these stakeholders (as public email contacts were not always available), and only ten contacts confirmed their availability to participate. The low number of participants may have been affected by the timing of the study, which coincided with pandemic

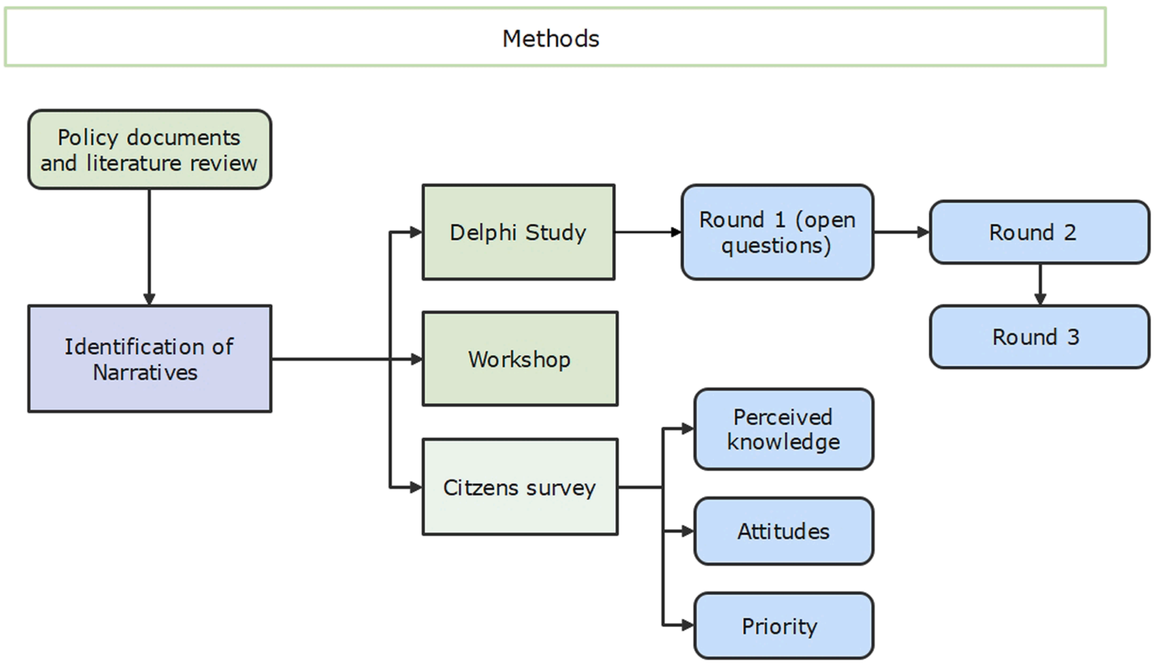

Fig. 1. Flowchart illustrating the methods of the study.

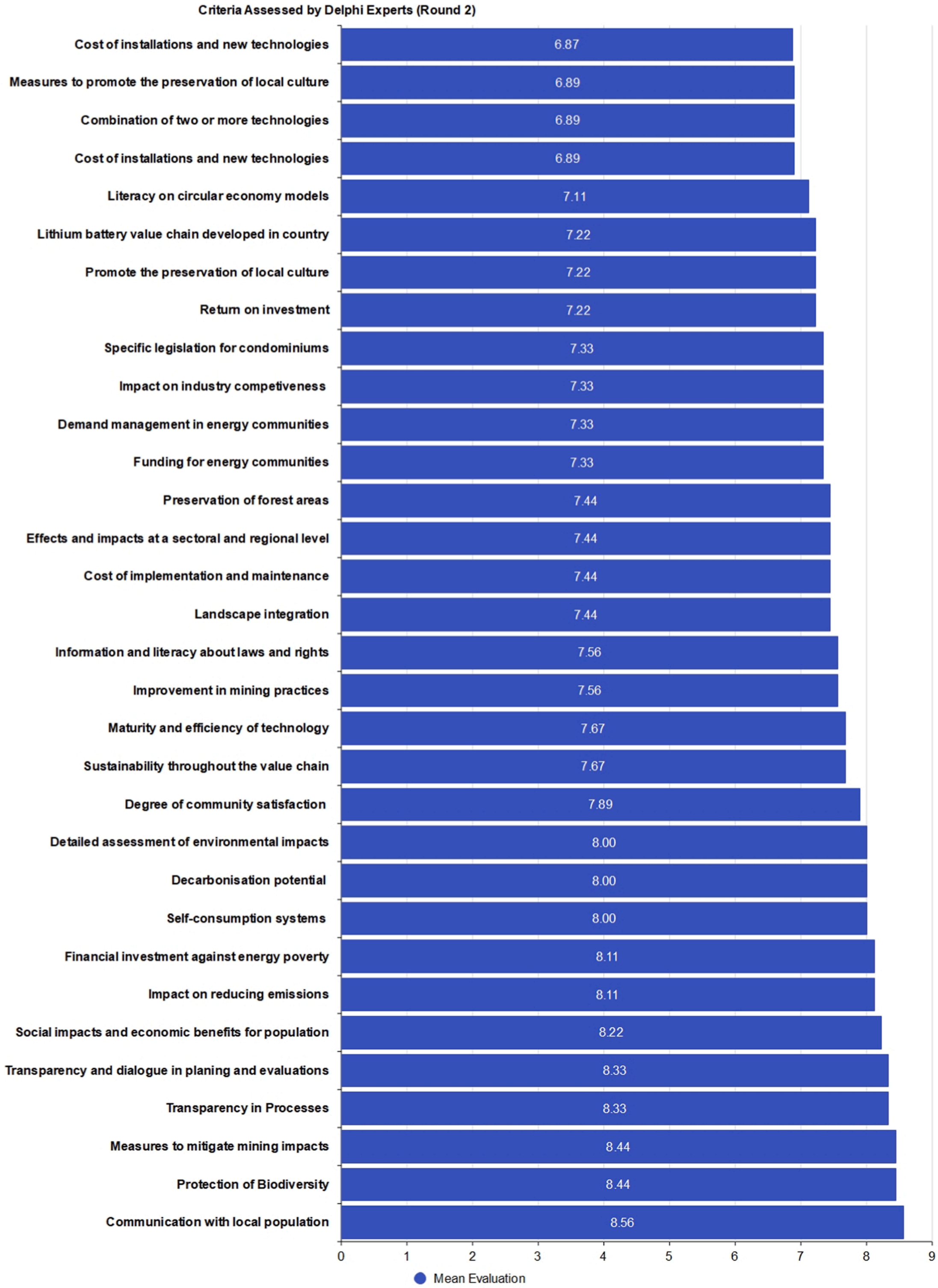

Fig. 2. Results of Round 2 of the Delphi study (mean evaluation of each criterion, from 1 to 9).

restrictions in 2022. Furthermore, the Delphi study is time consuming for research participants and most of these stakeholders are extremely busy, with limited time to participate in research activities.

In this study, the Delphi started with a process of collecting unstructured qualitative data, through an open-ended questionnaire, which resulted in responses that were thematically coded into key themes (using NVivo software) to create a structured questionnaire for the second and third-rounds, with close-ended responses (Braun & Clarke, 2012; McChesney & Aldridge, 2019).

The definition of the open-ended questions for the first-round questionnaire was informed by the identified narratives. The second-round questionnaire consisted of 43 closed questions, in which panel participants were asked to evaluate from 1 (not important) to 9 (extremely important) each of the policies and criteria related to the key topics identified in round 1. It is generally accepted that recommendations are positive when they vary between 51 % and 100 % (von der Gracht, 2012). Thus, the assumption for reaching consensus was a value lower or equal to 1 for the interquartile range of the different replies. The third and final round of the Delphi sought to reach a consensus among respondents. In this round, only the questions for which there was no consensus in the previous round were included. Lastly, the results required considering how each policy criteria, including consensual and non-consensual, related to the identified narratives.

The Delphi was complemented by a workshop exercise in which participants were asked to critically assess energy system scenarios that reflected the different narratives (McGookin et al., 2021). The online workshop, which took place in November 2022, introduced a wider reflection on stakeholder concerns regarding energy transition dynamics. Thus, a second panel of stakeholders was invited to the workshop to discuss specific topics related to the narratives identified. The list of stakeholder contacts produced for the Delphi was used to recruit workshop participants with 19 accepting to participate (including one participant who also took part in the Delphi). Participants represented market (5 participants), government (2), civil society and academia (7), and community stakeholder groups (5). They were asked to discuss three interrelated topics:

- What considerations need to be observed regarding scale and investments for a swift energy transformation?
- How do centralised versus distributed systems translate into different models of governance?
- How can storage versus flexibility be balanced for national self-sufficiency vs import-based systems?

The workshop followed a 'world café' technique (Fouché & Light, 2011), which enables a structured conversational process for knowledge sharing, where participants discuss a topic in small groups, rotating periodically, and interlinking discussions across groups. Thus, it encourages collaborative dialogue and the emergence of collective insights (Pagliarini, 2006). The technique was adapted for online use due to COVID-19 restrictions. Conference software allowed the creation of three break-out rooms, each focusing on one of the three topics, with a research team facilitator responsible for notetaking and reporting. Participants engaged in three discussion rounds, rotating through each room, followed by a collective session where facilitators presented the conclusions for each topic. The exercise results were recorded and transcribed. Workshop results were thematically coded using NVivo software. The identified themes further validated the policy criteria from the Delphi and their interrelations with the two narratives.

3.2. Citizens survey

The online survey of a representative sample of Portuguese citizens (n=500) enabled insight into the different attitudes towards new technological installations, guided by the hypothesis that Portugal's sociopolitical acceptance of renewable energy technologies (RET) is higher in the case of decentralised systems, with differences according to the specific technology. Specifically, the survey enabled measuring the perceived knowledge about different RET, the attitudes toward each technology, and the level of priority given to each technology. The technologies – i.e. solar, onshore wind, offshore wind, and green hydrogen -, were chosen based on the main investments foreseen for Portugal, according to the documents reviewed (see Table 1).

Data was collected throughout December 2022, through the services of a data collection company, using a questionnaire form coded by one of the authors. This form was applied via the professional company's platform to that effect and was active for two weeks. The questionnaire took no longer than ten minutes to reply. A participant information sheet and informed consent were included, following the ethical guidelines of the authors' university's ethical commission.

The design of the survey followed a stratified sampling process (i.e., dividing the targeted population into specific 'quotas' (Campos et al., 2023)). The quotas were determined according to the latest Portuguese census data (INE, 2021), with a total population of 10.112.553, and were based on age, the Portuguese NUT II regions (excluding the Azores and Madeira archipelagos), and gender. The sample assumed a large effect size (i.e., between 0.8 and 1) and was calculated to obtain a minimum of 0.80 of statistical power, and a significance of 0.05, following Cohen's method (Cohen, 2013). Cohen's method determines the likelihood that a study will detect an actual effect by integrating measures of effect size, sample size, significance level, and statistical power.

The questionnaire started with specific questions focussed on the three variables used for the survey sample (i.e., age, region, and gender). Next, citizens were asked about their concerns with climate change and biodiversity loss. Respondents used a scroll tool to signal the measure of their concern, between 0 (not concerned) and 100 (extremely concerned), including decimal values, which resulted in a continuous numeric variable.

The following questions focussed on asking respondents about their self-reported level of information on different technologies (a brief explanation was provided about each technology), as well as their perceptions regarding the most desirable "speed", and the most sustainable "scale" for investing in implementing these technologies.

The "speed" and "scale" variables aimed to measure respectively: (i) the level of priority preferred for implementing each technology; and (ii) the degree of support for a large-scale and centralised versus low-scale and distributed infrastructure for each technology. These questions equally used a measure from 0 to 100, and respondents were asked to use a scroll to indicate their chosen value. To assist respondents in choosing the value for "scale", for instance, it was explained that small-scale would be characterised by small infrastructures (such as rooftop solar panels and small wind turbines), while a large-scale would be characterised by very large solar and wind parks. The last set of questions concerned sociodemographic variables (i.e., income, education, and professional status) to further characterise the respondents' socioeconomic background.

Data Analysis took stock of the open-source Python computer language. Diverse Python libraries were used to develop the statistical analysis and data visualizations (i.e., *Pandas*, *Numpy*, *Matplotlib*, *Seaborn,* and *Scikit-learn*). Descriptive analysis comprised of descriptive measures (e.g., mean, mode, median, standard deviations, coefficient of variation, and the measures for skewness, and kurtosis) (Bickel & Lehmann, 2012), and explored relationships between numeric variables, such as correlations (Ezekiel, 1930). Regression analysis was also applied (Byrne, 2007) and conducted using the Python *Scikit-learn* library (Hao & Ho, 2019).

3.3. Limitations

A key limitation was the low number of participating experts in the Delphi panel, resulting in a set of issues for which no consensus could be found. This limitation means that the findings may lack generalisability, as the small sample size might not capture the full diversity of expert opinions; therefore, the results must be interpreted with caution.

The geographical scope is also a limitation, nevertheless, the baseline policy analysis is framed by European Directives, which are guiding energy and climate policy across all Member States. Another limitation is the focus on a Global North energy context, where countries need to successfully decarbonise their energy systems, with less concerns with compromising economic development, when compared to Global South countries. Thus, narratives and related policy criteria are most relevant for socially engaging and democratic energy scenarios in the context of Portugal and other European countries. Still, as a financially constrained country with ambitious decarbonisation targets, Portugal offers insights that can equally inform energy transitions in the Global South (Sareen et al., 2023).

Furthermore, the identified narratives (presented in Section 4) reflect critical discussions around renewable energy implementation, such as the configuration of new energy systems (e.g., centralised versus decentralised), which are crosscutting and likely relevant across diverse geographical and sociopolitical contexts.

4. Results

4.1. Regulatory and policy frameworks

Considering the specific decarbonisation targets for 2030 and 2050, Portugal was one of the first countries proposing to be carbon neutral by 2050, in 2016, at the COP22 in Marrakech. With the 2020 National Energy and Climate Plan 2030, the Portuguese Government committed to reductions between −45 % and −55 % in greenhouse gas (GHG) emissions by 2030, compared to the baseline year of 2005. This was later enshrined into the national Climate Framework Law as a target of at least −55 % by 2030, excluding land use change and forestry sectors. Developed in the context of the EU Clean Energy Package (Campos & Pontes Luz, Marín-González, et al., 2020), the NECP emphasises energy efficiency, electrification, and greater deployment of renewable energy, aiming at 9 GW of solar power and another 9 GW of (onshore) wind power installed by 2030. However, the plan scarcely mentions citizens and communities' participation in distributed systems, which indicates a stronger commitment to a centralised investment and management of renewable energy production.

Additionally, the National Hydrogen Strategy aims to increase the role of hydrogen technologies in the decarbonisation effort, with a focus on electrolysis via renewable electricity, so-called green hydrogen. Some of its goals for 2030 include mixing 10–15 % of green hydrogen in the natural gas network; having 2–5 % of green hydrogen in industrial energy consumption; and installing 2–2.5 GW of electrolysis capacity. The focus on hydrogen production highlights a vision for higher storage capacity, with less focus on transmission and system flexibility.

Furthermore, in 2022 the approval of a decree-law for the "organisation and functioning of the National Electricity System", transposed EU directives 2019/944 (i.e., the recast of the Internal Market for Electricity) and 2018/2001 (Recast on the promotion of the use of energy from Renewable Energy Sources). The decree-law includes provisions for the regulation of collective self-consumption and renewable energy communities, with a stated goal of incentivising citizen participation in the energy transition.

Finally, a new regime for the licensing of renewable energy projects as well as hydrogen and railway transportation (Decree-law 11, 2023) aims to accelerate the implementation of these projects, in view of decarbonisation targets. The decree-law enables waiving the stage of environmental impact evaluations for several types of energy installations. For instance, solar parks occupying areas smaller than 100 ha and wind parks with less than 20 turbines. The regime, thus, introduces a tension between the desirability of such projects and the potential impacts not being duly assessed.

4.2. Narratives

Two dominant and two alternative narratives were identified based on the documentary review. Portuguese legal frameworks are largely dependent on European Directives; therefore, these narratives can be applicable to other European countries. They are summarised as follows:

1) Swift Transformation vs Incremental Changes and Community Empowerment:

   Narrative I: Driven by the promise of economic growth, government and market stakeholders advocate for a swift transition towards sustainable energy. There are expectations for large investments and new energy exports in cutting-edge technologies like battery storage and green hydrogen. The emphasis is on rapid deployment and transformation, with the promise of achieving ambitious carbon reduction targets within a short timeframe. New industries are planned in rural and/or semi-rural areas, where new infrastructure is to be developed.

Alternative I: The top-down approach faces resistance from local communities and citizens, mainly in rural regions, who feel marginalised and excluded from decision-making processes, as natural landscapes are changing rapidly to accommodate new industries. Communities are concerned with impacts on land use, biodiversity, and the environment. This alternative advocates for a step-by-step transition that prioritises the needs and aspirations of local communities. It expects collaboration and citizen participation, including through cooperative investments in well-established renewable energy technologies (e.g., wind and solar).

2) Centralisation vs. Decentralisation and Self-Consumption:

Narrative II: Proponents of centralised infrastructures argue for large-scale investments in traditional energy grids and centralised power generation facilities. They highlight the efficiency and reliability of centralised systems, pointing to economies of scale and centralised control as key advantages. There is a perceived advantage to centralised control and management. Centralised energy systems are expected to allow for better coordination and optimisation of energy production and distribution, enabling operators to respond more effectively to fluctuations in demand and supply.

Alternative II: In contrast, advocates for decentralisation argue for distributed energy systems that prioritise local generation, storage, and distribution. New networks of interconnected microgrids, renewable energy sources, and community-owned infrastructure are envisioned. Decentralised systems are expected to offer greater resilience, flexibility, and sustainability, empowering communities to take control of their energy futures. The alternative also privileges transparency, energy sufficiency, and efficiency through well-planned self-consumption systems, with minimal environmental impacts.

4.3. Delphi study

The development of the first round of questions of the Delphi study was guided by the identified narratives. Questions on lithium mining and lithium battery development in Portugal were included due to increased discussions and policy plans for this industry in the country (Chaves et al., 2021). Although not directly related to renewable energy technologies those questions are related to Narrative I (i.e., new industries). Table 2 presents the qualitative open questions produced and posed to experts in the first Delphi round.

The results of the analysis of the answers to the first Delphi round are presented in Table 3. These results show the importance of socioeconomic and environmental-related aspects. For instance, 'job creation', 'communication with communities and local populations', 'preservation of forests', of the 'local territory and local cultures', restoration of 'existing ecosystems', and the 'participation of local communities' are among the key themes identified. These themes are crosscutting to the two narratives. 'Transparency' and the 'protection of consumers' were also highlighted by the Delphi panel experts, who emphasised the need to 'share information about laws and rights' and ensure that 'detailed environmental impacts are not overlooked' even in a swift transformation scenario.

Concerning pathways towards decentralised versus centralised systems, new policies, according to the panel, need to focus on 'developing mechanisms for ensuring a more inclusive participation of citizens' through, for instance, energy communities and self-consumption designs, exploring new 'financial mechanisms' that integrate possibilities for community participation, and 'targeted legislation at the level of condominiums'. These proposals are perceived to encourage diverse arrangements for self-consumption and collective ownership models in both urban and rural areas.

Lastly, regarding storage-based systems versus high flexibility, experts argued that new technologies need to be 'mature and efficient', enabling 'both flexibility and storage', targeting industrial sectors, and ensuring 'sustainability across the entire value chain', and until the 'technology's end-of-life', and should account for 'the development of new processes for battery recycling'.

The second round of (close-ended) questions was produced by taking stock of the policy criteria identified in round 1. Out of the 43 questions posed, 33 (i.e., 76.74 %) reached a consensual result in round 2 (i.e., the interquartile range is lower or equal to 1). The mean evaluation for all the questions which had a consensual result is presented in Fig. 1. The rows in the figure show the specific criteria that Delphi experts were asked to assess on a scale from 1 to 9.

After round 2, diverse criteria were still non-consensual, such as "job creation"; "participation of communities"; "restoration of ecosystems"; "avoid the use of areas free from human intervention"; "landscape integration"; "impact on the reduction of emissions";

Table 2
Questions for Delphi's round 1.

Question
In your opinion what are the most relevant policy criteria for an inclusive and sustainable energy transition, considering socioeconomic and environmental aspects?
Which policy criteria do you find most important to promote social acceptance of the energy transition?
The implementation of large-scale wind and photovoltaic installations implies landscape changes across the country, which policy criteria are in your view more relevant for reconciliating different dynamics for sustainable land use, in the context of renewable energy production?
Which environmental information (e.g., on data regarding existing resources, environmental externalities, etc.) seems to you the most important to ensure a transparent, democratic, and environmentally sustainable process, regardless of the speed of implementation?
To promote self-consumption (individual and collective) in a more inclusive and sustainable way, which policy criteria seem to you most relevant to guide innovation and policy development?
Which socioeconomic and environmental criteria and policy seem most relevant to consider when choosing different technologies and their use, such as green hydrogen for storage, to decarbonize the industrial sector?
Which criteria and policies are most important when considering projects for lithium mining/lithium battery development in Portugal?

Table 3
Summary of results from the qualitative analysis of the first-round results, grouped by themes.

Themes (alphabetical order)	Policy Criteria
Communication and Public Acceptance	Monitor the percentage of energy consumption and its source
	Reciprocity of environmental measures of the national energy system, in relation to the international market
	Bilateral communication with the community (public hearings and satisfaction surveys)
	Cost of facilities and new technologies
	Preservation of the territory and local cultures
Decentralised systems	Community satisfaction level
	Financial investment in the fight against energy poverty
	Financing mechanisms for energy communities
	Neighbourhood, town, or city with self-consumption systems
	Specific legislation at the level of residential condominiums
Environmental and resources information	Disclosure of environmental impacts
	Mitigation measures for mining impacts
	Preference for local and national companies in the exploration of resources in Portugal
	Transparency and integration of local communities
Inclusive and Sustainable Energy Transition	Preservation of forests
	Restoration of existing ecosystems
	Avoid using areas free from human intervention
	Participation of local communities
	Association of more than one technology in the same place of deployment
	Job creation
	Landscape integration
Land use management	Circular economy
	Detailed assessment of environmental impacts
	Information and literacy about laws and rights
	Protection of local consumers
	Transparency in processes
Lithium mining	Protection of Biodiversity
	Communication and transparency towards local populations
	Continuous improvement in mining practices and processes
	Export of raw material
	Impact of mining on GDP
	Lithium battery value chain developed in Portugal
	Social impacts and economic benefits for the local population
	Survey of satisfaction and social perception
Technology and decarbonisation	Decarbonisation potential
	Decreased energy dependence
	Effects and impacts at the sectoral and regional level
	Impact on industry competitiveness
	Implementation and maintenance cost
	Return on investment
	Sustainability across the entire value chain until the technology's end-of-life
	Technology maturity and efficiency

"financial investment against energy poverty"; "reduce energy dependency"; "maturity and efficiency of technologies". The non-consensual responses of round 2 were the basis for the round 3 questionnaire.

In round 3, a total of 77 % consensus was reached (i.e. number of consensuses divided by the number of questions in the round). The questions with the highest degree of consensus (100 %) were questions related to technology (e.g. "cost of implementation", "maturity and efficiency of technology"), related to investment aspects (e.g., "impact on industry competitiveness"; "return on investment") and to sustainability and decarbonisation (e.g. "sustainability throughout the value chain"; "decarbonisation potential"). Questions related to new policy and funding schemes for inclusive decentralised systems (e.g. "investment against energy poverty"; "self-consumption systems"; "funding for energy communities"; "demand-side management in energy communities"; "specific legislation for condominiums"; "literacy on circular economy models" and "degree of community acceptance"), had also a high degree of consensus (i.e., 83 %). Consensus was lowest for the criterion of "promote the preservation of local culture" (i.e., 50 %).

Nevertheless, there was still no consensus for some of the questions following round 3. Fig. 3 shows the mean value attributed to the consensual round 3 criteria, and Table 4 shows the non-consensual criteria and their mean evaluation. Some non-consensual criteria (e.g., "increase in lithium exports"; "impact of mining in GDP", and "national satisfaction survey") had low mean values (i.e., between 5 and 6 on a scale of 1–9), indicating they were not considered important by Delphi experts when compared to the other criteria.

The final step was to compare the policy criteria with the narratives. The criteria were also categorised according to political, economic, technological, environmental, and socioeconomic dimensions. Table 5 lists the different criteria grouped by dimension.

Some policy criteria are relevant to the two narratives and their alternatives, namely: "Combination of two or more technologies"; "Decarbonisation potential"; "Detailed assessment of environmental impacts", "Job creation"; "National satisfaction Survey"; "Social impacts and economic benefits" and "Sustainability throughout the value chain". Regarding Narratives I and II, which intersect concerning the focus on centralised investments and economic growth, the following criteria are relevant: "Cost of implementation", "Return on investment"; "Impacts at a sectoral and regional level".

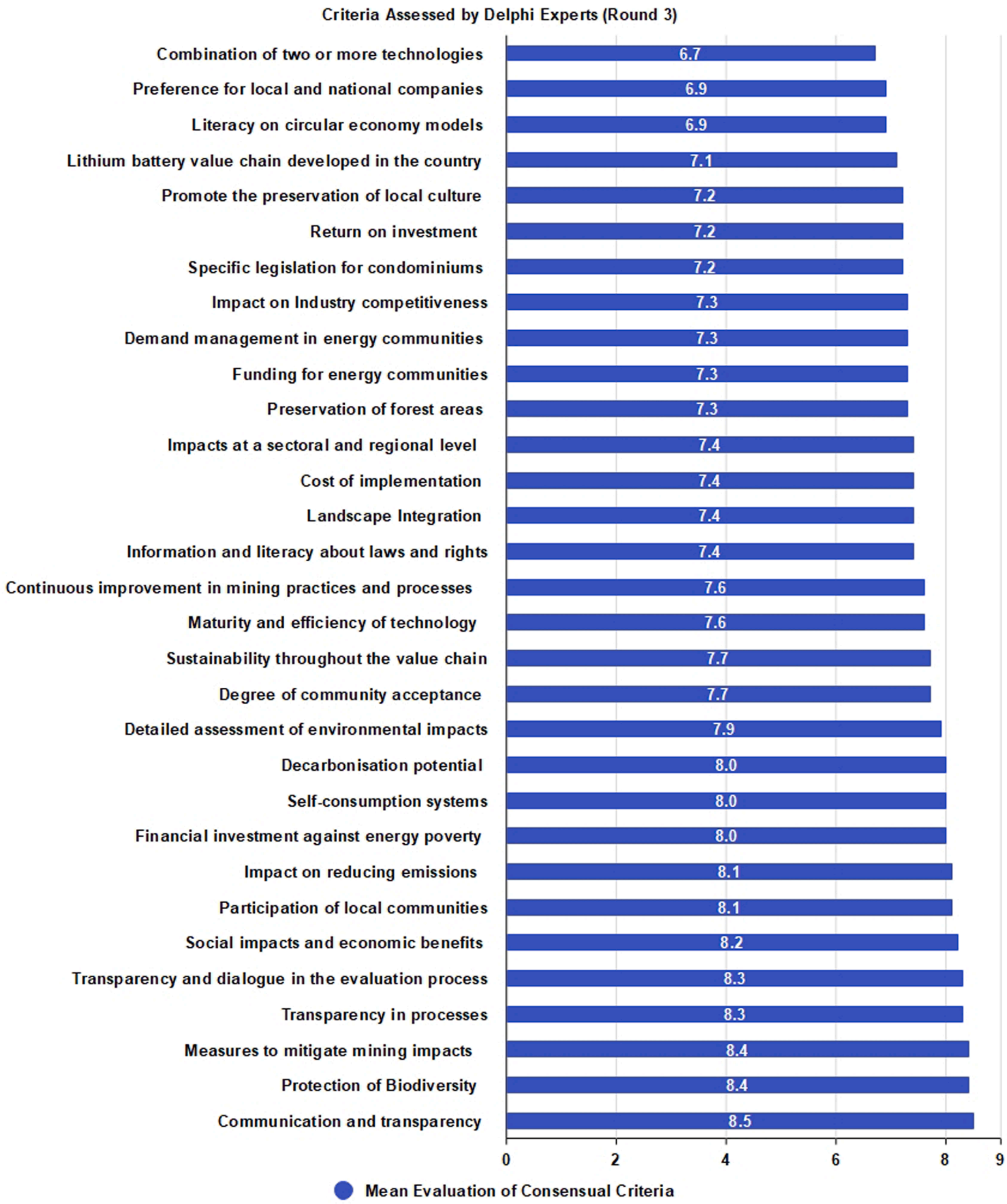

Fig. 3. Mean evaluations of Round 3 consensual criteria.

Concerning Narrative I, some criteria are particularly relevant, namely: "Increase in energy exports"; "Impact of lithium mining on GDP"; "Lithium battery value chain developed in country"; "Impact on industry competitiveness"; and "Improvement in mining practices and processes". Regarding Narrative II, the most relevant criteria are "Decrease in energy dependence"; and "Maturity and efficiency of technology".

Concerning the two alternatives, the most relevant criteria are: "Possibility of investment in new facilities by local communities"; and "Participation of local communities". These criteria also reflect the interrelations between the alternative narratives, since distributed energy systems entail in principle, cooperative investments, in the scope of energy cooperatives and/or energy communities.

Some criteria are mainly related to Alternative I, due to its concern for the social and environmental impacts of new renewable-energy related industries in rural regions (e.g., lithium mining), as well as concerns with lack of transparency and engagement of local communities. These criteria include: "Measures to promote the preservation of local culture"; "Literacy on circular economy

Table 4
Non-consensual assessments after round 3.

Non-consensual criteria	Mean Evaluation
Increase in lithium exports	5.0
Impact of mining on GDP	6.0
National satisfaction surveys	6.2
Possibility of investment in new facilities by local communities	7.4
Job creation	7.5
Public hearings	7.6
Decrease in energy dependence	7.7
Avoid the use of areas free from human intervention	8.0
Restoration of existing ecosystems	8.1

Table 5
Summary of final policy criteria.

Dimensions (alphabetical order)	**Criteria**	**Consensual?**
Economic	Cost of implementation	yes
	Cost of installations and new technologies	yes
	Return on investment	yes
	Financial investment against energy poverty	yes
	Funding for energy communities	yes
	Literacy on circular economy models	yes
	Preference for local and national companies	yes
	Lithium battery value chain developed in country	yes
	Impact of lithium mining on GDP	**no**
	Increase in energy exports	**no**
Environmental	Preservation of forest areas	yes
	Protection of Biodiversity	yes
	Decarbonisation potential	yes
	Sustainable land use	yes
	Detailed assessment of environmental impacts	yes
	Improvement in mining practices and processes	yes
	Restoration of existing ecosystems	**no**
	Avoid the use of areas free from human intervention	**no**
Political	Specific legislation for condominiums	yes
	Information and literacy about laws and rights	yes
	Decrease in energy dependence	**no**
Social	Social impacts and economic benefits	yes
	Transparency and dialogue in evaluation processes	yes
	Measures to promote the preservation of local culture	yes
	Participation of local communities throughout the process	yes
	Possibility of investment in new facilities by local communities	**no**
	Job creation	**no**
	Public hearings	**no**
	National satisfaction Survey	**no**
Technological	Maturity and efficiency of technology	yes
	Sustainability throughout the value chain	yes
	Combination of two or more technologies	yes
	Demand management in energy communities	yes
	Self-consumption systems	yes
	Impacts at a sectoral and regional level	yes
	Impact on industry competitiveness	yes

models"; "Financial investment against energy poverty"; "Information and literacy about laws and rights"; "Preservation of forest areas"; "Protection of Biodiversity"; "Restoration of existing ecosystems"; "Avoid the use of areas free from human intervention"; "Sustainable land use"; "Transparency and dialogue in evaluation processes"; and "Public hearings".

Concerning Alternative II, due to its focus on distributed energy systems, the following criteria are most relevant: "Funding for energy communities"; "Specific legislation for condominiums"; "Demand management in energy communities" and "Self-consumption systems".

4.4. Workshop

To further discuss the different policy criteria, the key topics for the "world café" workshop were: (1) swift transition versus incremental change; (2) centralised versus decentralised governance, and (3) self-sufficiency vs import-based. Similarly to the Delphi study, the workshop results show concerns with environmental impacts, community engagement, and the need for a technological plan that considers multiple social and economic dimensions.

Regarding Topic 1, participants preferred a faster pace due to the climate emergency, recognising that a government-driven process could be faster. Investments in new technologies such as offshore wind were considered the most important, while bioenergy raised several concerns and should be used only on a small scale. A slower pace, with incremental changes, was also considered to be harder to manage and to "control", and some participants suggested intermediate scales, with a fast-paced start which could later slow down.

Concerning Topic 2, the democratic management was a key issue. Participants considered that government-driven projects could work and could be a "great political bet" but could equally be "less democratic" when compared with community-driven projects. Individual and collective self-consumption systems were preferred, due to their lower environmental impact (large solar plants were perceived to pose environmental impacts), and higher efficiency, since there would be very little losses of energy if local systems were optimised to meet (self-)consumption needs.

Lastly, regarding Topic 3, participants posed more questions than assessments, considering that the pathways for increasing self-sufficiency in storage (e.g., hydrogen production) are perceived to be extremely expensive. Participants raised doubts about the possibility of increasing large-scale installed capacity in ways that could foster self-sufficiency. Instead, increasing demand-response flexibility, decentralised production, and developing local energy markets were argued as being more promising for decreasing external dependency. Furthermore, it was considered that energy policies should respond to critical questions related to the global geopolitical context (i.e., inflation trends due to the Ukraine-Russian war), for instance, by considering expected buying prices for external energy, comparing future and present costs.

Regarding the three topics together, participants found that decisions about who leads the transition (e.g., governments, market, local communities), are interrelated with a discussion on centralised versus decentralised, and with understanding priorities regarding how fast/slow the process should be, and the type of technologies to invest in. For instance, large-scale offshore wind energy would likely be under a more centralised and market and/or government-led approach, while small-scale solar could be mainly implemented by energy communities. Also, decisions on flexibility versus storage would need large investments in battery and storage technology and new regulatory frameworks that incentivise the development of effective flexibility models.

4.5. Citizens Survey

To further understand perceptions from a non-expert audience, the survey provided insights into Portuguese citizens' attitudes and preferences towards different renewable energy technologies.

Citizens are very concerned with climate change (mean=79.06; median=85); skewness is −1.0 and kurtosis is 0.6, indicating a leptokurtic distribution, where higher values are predominant. Concern with biodiversity loss has a lower mean value (i.e., skewness is 0.5, and kurtosis is −1.2), with a platykurtic curve. There is also a positive association between income and climate change concern

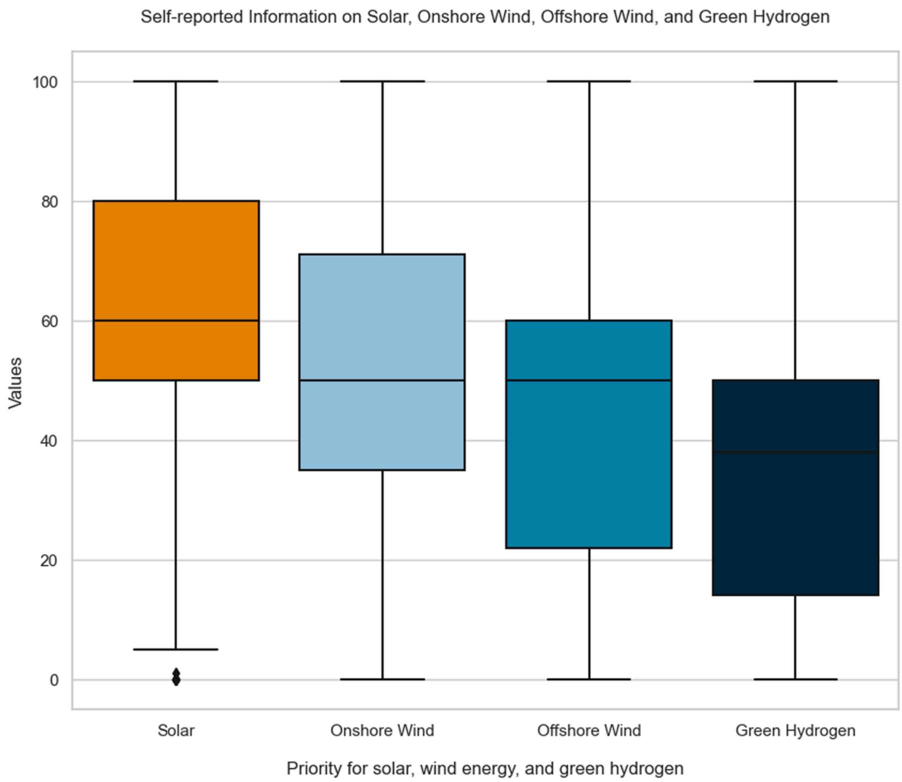

Fig. 4. Comparison of means for self-reported information on renewable energy technologies.

(Chi-square=67.5; p-v of 0.001026), and an association between those with higher education and higher concern for climate change (Chi-square= 62.5; p-value=0.00002767); and for biodiversity loss (Chi-square value is 62.5; p-value=0.00002767).

Citizens' self-reported information level is higher in the case of solar energy technologies (mean=60.5; median=60; Standard Deviation/SD=24.8), for which the preferred level of priority is also very high (mean=74.5; median=78; SD=22.2). Support for large-scale solar energy infrastructures is equally high (mean=71.2; median=75; SD=22.7).

By comparison, people self-report to be less informed about offshore wind (mean=43; median=50; SD=26.7) than onshore wind (mean=51.59; median=50; SD=26.7), although given the high standard deviations, the median values are more relevant and are the same for both technologies. Both the priority level (mean=70.18; median=71.5; SD=23) and support for large-scale infrastructures for wind energy technologies (mean=70.9; median=74; SD=22.2) follow closely behind solar energy technology. Figs. 4 to 6 show the boxplots for self-reported information, priority, and attitudes regarding the scale of infrastructures, comparing the technologies.

Correlations were found between the level of self-reported information on solar and onshore wind energy (coefficient=0.6; moderate correlation) and between self-reported information on offshore and onshore wind (coefficient=0.7; strong correlation). There is also a correlation between the level of self-reported information on green hydrogen and offshore wind (coefficient= 0.7).

The priority and support for the implementation of wind energy are correlated to the priority for the implementation of solar energy technologies (coefficient=0.7) and with the support for the implementation of large solar installations (coefficient= 0.6). There were no significant correlations between the self-reported information on different technologies and the priority for implementation, indicating, that being informed about the technologies is not a critical factor influencing citizens' recognition of the priority for implementing renewable energy.

Furthermore, an ordinary least squares linear regression model with simple coefficients shows the respondents' assessment of the priority for implementing wind energy is partly explained by the priority for solar energy implementation. The linear model explains a substantial proportion of variance ($R2 = 0.50$, $F (1, 498) = 488.47$, $p < .001$, adj. $R2 = 0.49$), and the effect of the priority for solar energy implementation is statistically significant and positive (this finding is illustrated in Fig. 7).

A similar regression model has been done to compare the priority for green hydrogen and solar and wind energy, in both cases the R-squared was 0.28, with p-values lower than 0.05, indicating both are statistically significant predictors. However, the R-squared value suggests these predictors only explain about 28.7 % of the variance. Thus, other factors not included in the model are also influencing the priority for green hydrogen.

5. Discussion

The characterisation of transition narratives and related policy criteria enabled a critical assessment of the key directions for

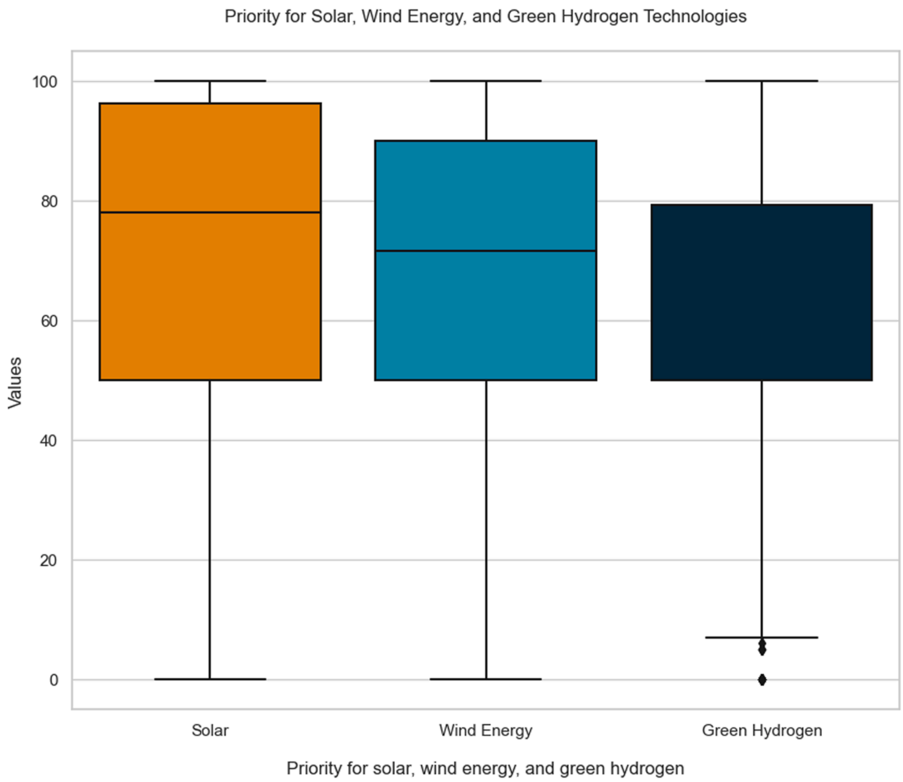

Fig. 5. Comparison of means for preferred priority for renewable energy technologies.

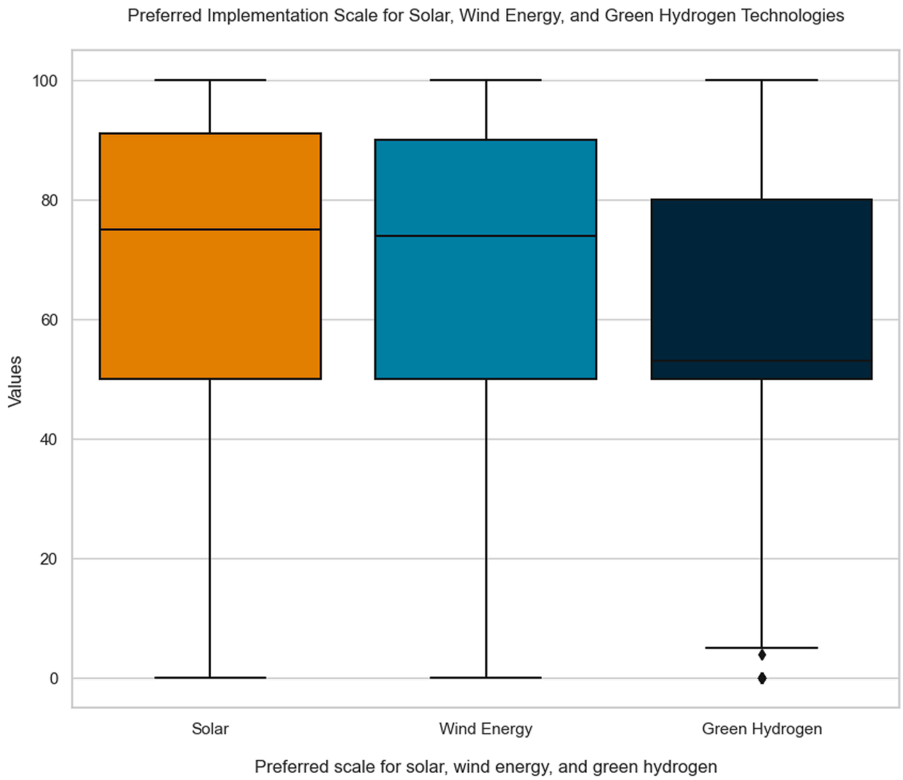

Fig. 6. Comparison of means for the preferred scale of renewable energy infrastructures.

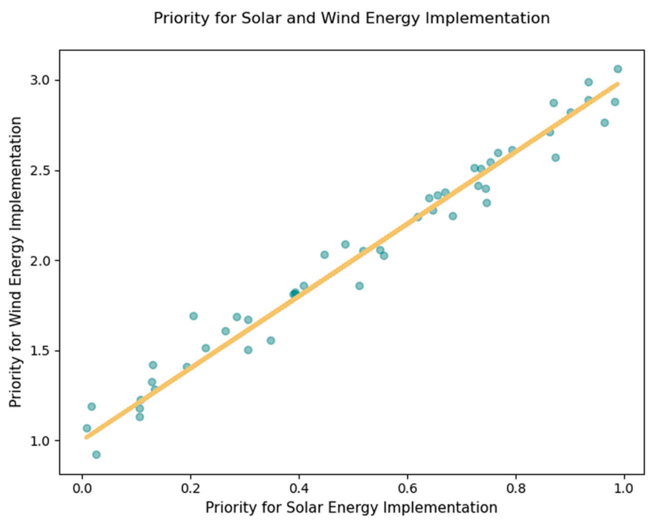

Fig. 7. Regression model between priority for solar and wind energy implementation.

democratic renewable energy systems (Berthod et al., 2022). Although two dominant narratives are prevalent within Portuguese policy and regulatory frameworks, most policy criteria pertinent to social acceptability and energy democracy are notably aligned with alternative narratives, characterised by a promise of energy democracy and decentralised governance of energy systems through e.g., energy communities.

By contrast, dominant transition narratives, largely upheld by Portuguese rules and policies, reflect the ideas and expectations of the fossil-fuel based socio-technical regime. For instance, similarly to structures and practices within the fossil-fuel energy regime, renewable centralised systems and top-down governance of renewable energy investments are framed by expectations of economic growth and the promise of new energy exports (Turnheim & Geels, 2012b). These expectations my lead to the reproduction of energy injustices characteristic of the fossil-fuel regime (Fuller & McCauley, 2016), including neglecting aspects of procedural justice (e.g., transparency, citizens' influence, community participation) (Knudsen et al., 2015).

Conversely, alternative narratives uphold socio-technical innovations, integrating promises for energy democracy, decentralised governance and social innovations. For instance, citizen and community-led investments may mean an expansion of socially innovative peer-to-peer exchanges and new demand-side management models, catering to higher flexibility in distribution (Buth et al., 2019; Georgarakis et al., 2021).

Although the identified criteria by Delphi experts should be cautiously interpreted given the small number of participating experts, relevant criteria to social acceptability are consistent with the focus of alternative narratives in community and citizens' participation, transparency, and distributed energy systems (Bidwell, 2016; Dwyer & Bidwell, 2019; Fast, 2013). Such criteria may be critical to prevent local opposition and foster higher levels of democratic engagement in governing the energy transition (Pahle et al., 2021). Despite being important for Delphi experts, these criteria are difficult to integrate into decision-making processes, which are often informed by quantitative data and energy system models, wherein these specificities are hard to introduce (Martin et al., 2023; Pfenninger & Pickering, 2018). Nevertheless, policymakers and energy regulators should pay due attention to expectations related to alternative narratives, such as "measures to promote the preservation of local culture", which play an important role in explaining local opposition to renewables (Devine-Wright, 2009), or the "possibility of investment in new facilities by local communities", also critical for higher community and sociopolitical acceptance (Brauwer & Cohen, 2020).

Furthermore, criteria such as "protecting biodiversity" or "measures to promote the preservation of local culture", although consensually found to be important do not appear to be relevant for mainstream energy policy. For instance, the so-called "environmental simplex-law" in Portugal (Decreto-Lei n.o 11,2023*, de 10 de Fevereiro | DRE*, 2023.) grants a mandate to simplify environmental assessment procedures. The regulation is in direct contradiction with the "detailed assessment of environmental impacts" and does not integrate measures to assess how new energy installations may impact local livelihoods (Karam & Shokrgozar, 2023; Silva & Delicado, 2017).

The survey results indicate public support for energy transition policies in Portugal is significant, as it has been found elsewhere in Europe (Liebe & Dobers, 2019). Renewable energy technologies such as wind and solar are mature technologies and perceived in similar ways by citizens, who attribute equal importance and priority to these technologies, when compared to green hydrogen technology. This is congruent with expert opinions, who consider the "efficiency and maturity of technology" an important criterion. Green hydrogen is also more suited to large-scale and centralised investments, interrelated to dominant narratives of a swift transformation, economic growth, and centralised systems (Kakoulaki et al., 2021).

In the scope of the dominant narratives, stakeholders value democratic decision-making (Bhardwaj et al., 2019), reiterating the relevance of negotiations and trade-offs between different and at times opposing perspectives, even within the same actor groups (Achiba, 2019; Heiskanen et al., 2018). These indicates that despite predominant expectations for maintaining the structures typical of the dominant socio-technical regime (i.e., centralised systems), there is an emerging alignment with alternative narratives, which uphold energy democracy practices.

Discussions on decentralised/centralised dynamics may build on the assumption that the transition to renewable energy systems necessarily entails an expansion of distributed systems, with a decentralised (community and citizen-led) governance (Katre & Tozzi, 2018). In other words, it may be naïve to assume that a 'centralisation' lock-in, interrelated to a 'carbon lock-in' is being challenged by solar, wind and other renewable energy technologies, supported by digital innovations and smart systems (Goldthau, 2014). Dominant energy transition narratives in Portugal seem to be mainly centred on a vision for a centralised system. Furthermore, criteria such as "self-consumption systems", or "aggregation of demand management in energy communities" may be difficult to integrate into energy policy targets, as these conditions are specific to energy markets and the capacity of citizens to invest in e.g., solar panels.

Additionally, considering the challenges in energy supply (i.e., fossil fuels) posed by wars in Europe and the Mediterranean (i.e., the Ukraine-Russian war, and the Israel-Palestinian conflict), European and world governments face significant challenges for energy security (Żuk & Żuk, 2022) and for a regime shift. Ensuring a secure energy supply may lead governments not only to continue subsidising fossil fuels but also to reduce their interest in delegating energy transition efforts to community and citizens-led projects. Instead, governments may opt for supporting fast and large-scale investments, including nuclear energy, which not only pose problems for social acceptance and citizens' engagement but offer scant possibilities for energy democracy (Carlisle et al., 2015; Cousse, 2021).

Furthermore, flooding events in Germany; and evidence of over 70.000 excess deaths due to high summer temperatures in Southern Europe (Ballester et al., 2023; Garside & Zhai, 2022) or increased fire risk across Europe (Ganteaume et al., 2021) contribute to higher landscape pressure (Geels, 2010). The urgency to implement climate and energy policies may push governments into opting for quick-fix solutions. Large-scale infrastructures may be faster to deploy in this context, although compromising efforts towards more democratic energy decisions (Brechin & Lee, 2023).

Lastly, new digital and artificial intelligence systems may come with unforeseen implications and foster new transition narratives. For instance, if the institutionalisation process of energy communities is controlled by large venture technological giants, who create new highly replicable prosumer models, these may exclude those that cannot offer flexibility services (e.g., poorer communities) (Narayanan et al., 2019; Powells & Fell, 2019). The scenario may fall short of a systemic transition, as only the "technical" part of the socio-technical system is truly transformed. Furthermore, a high degree of automatization may imply a level of delegation in the management of decentralised systems, which becomes devoid of a sense of community, thus turning the concept of 'energy community' into a technological optimisation model.

6. Conclusion

The study departs from the initial hypothesis that criteria interrelated to narratives which highlight a promise of democratic energy governance may be less important for energy transition policies, and therefore undermine energy democracy goals. The hypothesis is confirmed by the results.

According to Delphi experts, criteria pertaining to alternative narratives (which portray socio-technical innovations such as energy communities and renewable energy distributed systems) are crucial for fostering social engagement and facilitating democratic energy planning. However, the dominant transition narratives, anchored by a top-down approach, exhibit shortcomings in incorporating the diverse perspectives and visions of citizens and communities. In contrast, alternative viewpoints underscore the necessity of broader inclusivity and participatory frameworks.

The results of the Delphi study, workshop and survey highlight the importance of considering both environmental and social criteria, next to economic, financial, and technological aspects. Sociopolitical acceptance of renewable energy technologies, especially solar and wind technologies is on the higher end of the spectrum, and citizens are supportive of prioritising these technologies in future energy systems. There is less support from both citizens and stakeholders for green hydrogen. System configurations that combine both large-scale and small-scale systems of solar and wind energy are likely to benefit from higher social acceptance. Nevertheless, such investments should not compromise local livelihoods and cultures, as well as natural ecosystems.

Consequently, there is a pressing need for energy policies to prioritise considerations such as the impacts on local cultures, transparency, and principles for community participation. This includes facilitating direct co-ownership of new energy systems, exploring community financing models, and introducing participatory approaches, through mechanisms such as citizen assemblies and other democratic innovations.

Future research should consider how to combine goals for a swift energy transformation, with societal engagement and carefully planned investments that protect critical environmental and cultural resources. Alternative energy system models and policy visions are needed for the future, where centralised and distributed infrastructures work in tandem to shape dynamic socio-technical energy systems, based on the coordination of top-down and bottom-up processes. Research should equally look into differences between energy transition narratives in different regions of the world, comparing global Northern and Southern countries, in terms of the conditions for social engagement and energy democracy.

Lastly, by utilising narratives as an analytical framework, this study illuminates the uncertainties and limitations inherent in existing path dependencies related to the fossil-fuel based socio-technical regime. It emphasises the potentially disruptive effects of European and Mediterranean conflicts on the configurations of renewable energy systems, and possible consequences of digitalisation within distributed smart systems. These factors collectively impact energy democracy, as well as citizen and community engagement in the governance of energy systems.

Funding

The SEEDS project is supported by the CHIST-ERA grant CHIST-ERA-19-CES-004 and the Fundação para a Ciência e Tecnologia (FCT) (http://doi.org/10.54499/CHIST-ERA/0005/2019).

FCT funding includes as well the first author's post-doc contract 2020.01663.CEECIND/CP1605/CT0005, (https://doi.org/10.54499/2020.01663.CEECIND/CP1605/CT0005); and G. Pontes Luz Phd studentship (2021.06299.BD).

FCT also includes the following national funds: I.P./MCTES through national funds (PIDDAC) – UIDB/50019/2020 (https://doi.org/10.54499/UIDB/50019/2020), UIDP/50019/2020 (https://doi.org/10.54499/UIDP/50019/2020) and LA/P/0068/2020 (https://doi.org/10.54499/LA/P/0068/2020).

UAB is also funded by the National Research Agency, Government of Spain, grants, and the Department de Recerca I Universitats, Generalitat de Catalunya grant 2021 SGR 00734.

CRediT authorship contribution statement

Inês Campos: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Conceptualization. **Cristina Madrid-López:** Methodology, Conceptualization. **Aías Lima:** Investigation, Data curation. **Francesco Lombardi:** Writing – review & editing, Methodology. **Guilherme Pontes Luz:** Writing – review & editing, Investigation, Data curation, Conceptualization. **Luís Fazendeiro:** Writing – review & editing, Methodology, Investigation. **Stefan Pfenninger-Lee:** Writing – review & editing, Funding acquisition, Conceptualization. **Miguel Brito:** Writing – review & editing, Methodology, Investigation, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The authors acknowledge and thank the participation of all stakeholders in this study, who agreed voluntarily to participate in all

rounds of the Delphi questionnaire, as well as participation in the workshop and survey.

Data availability

Data will be made available on request.

References

Achiba, G. (2019). Navigating Contested Winds: Development Visions and Anti-Politics of Wind Energy in Northern Kenya. *Land, 8*(1), 7. https://doi.org/10.3390/land8010007

Aengenheyster, S., Cuhls, K., Gerhold, L., Heiskanen-Schüttler, M., Huck, J., & Muszynska, M. (2017). Real-Time Delphi in practice—A comparative analysis of existing software-based tools. *Technological Forecasting and Social Change, 118*, 15–27. https://doi.org/10.1016/j.techfore.2017.01.023

Bailey, E., Devine-Wright, P., & Batel, S. (2016). Using a narrative approach to understand place attachments and responses to power line proposals: The importance of life-place trajectories. *Journal of Environmental Psychology, 48*, 200–211. https://doi.org/10.1016/j.jenvp.2016.10.006

Ballester, J., Quijal-Zamorano, M., Méndez Turrubiates, R. F., Pegenaute, F., Herrmann, F. R., Robine, J. M., Basagaña, X., Tonne, C., Antó, J. M., & Achebak, H. (2023). Heat-related mortality in Europe during the summer of 2022. Article 7. *Nature Medicine, 29*(7). https://doi.org/10.1038/s41591-023-02419-z

Batel, S. (2018). A critical discussion of research on the social acceptance of renewable energy generation and associated infrastructures and an agenda for the future. *Journal of Environmental Policy Planning, 20*(3), 356–369. https://doi.org/10.1080/1523908X.2017.1417120

Batel, S. (2020). Research on the social acceptance of renewable energy technologies: Past, present and future. *Energy Research Social Science, 68*, Article 101544. https://doi.org/10.1016/j.erss.2020.101544

Batel, S., & Rudolph, D. (2021). A Critical Approach to the Social Acceptance of Renewable Energy Infrastructures. In S. Batel, & D. Rudolph (Eds.), *A critical approach to the social acceptance of renewable energy infrastructures* (pp. 3–19). Springer International Publishing. https://doi.org/10.1007/978-3-030-73699-6_1.

Belton, I., MacDonald, A., Wright, G., & Hamlin, I. (2019). Improving the practical application of the Delphi method in group-based judgment: A six-step prescription for a well-founded and defensible process. *Technological Forecasting and Social Change, 147*, 72–82. https://doi.org/10.1016/j.techfore.2019.07.002

Berthod, O., Blanchet, T., Busch, H., Kunze, C., Nolden, C., & Wenderlich, M. (2022). The Rise and Fall of Energy Democracy: 5 Cases of Collaborative Governance in Energy Systems. *Environmental Management*. https://doi.org/10.1007/S00267-022-01687-8

Bhardwaj, A., Joshi, M., Khosla, R., & Dubash, N. K. (2019). More priorities, more problems? Decision-making with multiple energy, development and climate objectives. *Energy Research Social Science, 49*, 143–157. https://doi.org/10.1016/j.erss.2018.11.003

Bickel, P. J., & Lehmann, E. L. (2012). Descriptive Statistics for Nonparametric Models II. Location. In In. J. Rojo (Ed.), *Selected Works of E. L. Lehmann* (pp. 473–497). Springer US. https://doi.org/10.1007/978-1-4614-1412-4_43.

Bidwell, D. (2016). Thinking through participation in renewable energy decisions. *Nature Energy, 1*(5), Article 16051. https://doi.org/10.1038/nenergy.2016.51

Bommel, N. van, & Höffken, J. I. (2021). Energy justice within, between and beyond European community energy initiatives: A review. *Energy Research Social Science*. https://doi.org/10.1016/J.ERSS.2021.102157

Borup, M., Brown, N., Konrad, K., & Van Lente, H. (2006). The sociology of expectations in science and technology. *Technology Analysis Strategic Management, 18*(3–4), 285–298. https://doi.org/10.1080/09537320600777002

Bouzarovski, S., & Tirado Herrero, S. (2017). Geographies of injustice: The socio-spatial determinants of energy poverty in Poland, the Czech Republic and Hungary. *Post-Communist Economies, 29*(1), 27–50. https://doi.org/10.1080/14631377.2016.1242257

Brás, O. R., Ferreira, V., & Carvalho, A. (2024). People of the sun: Local resistance and solar energy (in)justice in southern Portugal. *Energy Research Social Science, 113*, Article 103529. https://doi.org/10.1016/j.erss.2024.103529

Braun, V., & Clarke, V. (2012). Thematic analysis. In H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. Rindskopf, & K. J. Sher (Eds.), *APA handbook of research methods in psychology, Vol 2: Research designs: Quantitative, qualitative, neuropsychological, and biological* (pp. 57–71). American Psychological Association. https://doi.org/10.1037/13620-004.

Brauwer, C. P.-S. de, & Cohen, J. J. (2020). Analysing the potential of citizen-financed community renewable energy to drive Europe's low-carbon energy transition. *Renewable Sustainable Energy Reviews*. https://doi.org/10.1016/J.RSER.2020.110300

Brechin, S. R., & Lee, S. (2023). Will democracy survive climate change? *Sociological Forum*. , Article socf.12957. https://doi.org/10.1111/socf.12957

Bridge, G., Bouzarovski, S., Bradshaw, M. J., & Eyre, N. (2013). Geographies of energy transition: Space, place and the low-carbon economy. *Energy Policy*. https://doi.org/10.1016/J.ENPOL.2012.10.066

Brown, N., & Michael, M. (2003). A sociology of expectations: retrospecting prospects and prospecting retrospects. *Technology Analysis Strategic Management, 15*(1), 3–18. https://doi.org/10.1080/0953732032000046024

Burke, M. J., & Stephens, J. C. (2017). Energy democracy: Goals and policy instruments for sociotechnical transitions. *Energy Research Social Science, 33*, 35–48. https://doi.org/10.1016/j.erss.2017.09.024

Buth, M. C. (Annemarie), Wieczorek, A. J., & Verbong, G. (2019). The promise of peer-to-peer trading? The potential impact of blockchain on the actor configuration in the Dutch electricity system. *Energy Research Social Science*. https://doi.org/10.1016/J.ERSS.2019.02.021

Byrne, G. (2007). A statistical primer: Understanding descriptive and inferential statistics. *Evidence Based Library and Information Practice, 2*(1), 32–47. https://doi.org/10.18438/B8FW2H

Campos, I., Brito, M., & Luz, G. (2023). Scales of solar energy: Exploring citizen satisfaction, interest, and values in a comparison of regions in Portugal and Spain. *Energy Research Social Science, 97*, Article 102952. https://doi.org/10.1016/j.erss.2023.102952

Campos, I., & Marín-González, E. (2020). People in transitions: Energy citizenship, prosumerism and social movements in Europe. *Energy Research Social Science, 69*, Article 101718. https://doi.org/10.1016/j.erss.2020.101718

Campos, I., Pontes Luz, G., Marín-González, E., Gährs, S., Hall, S., & Holstenkamp, L. (2020). Regulatory challenges and opportunities for collective renewable energy prosumers in the EU. *Energy Policy, 138*, Article 111212. https://doi.org/10.1016/j.enpol.2019.111212

Carlisle, J. E., Kane, S. L., Solan, D., Bowman, M., & Joe, J. C. (2015). Public attitudes regarding large-scale solar energy development in the U.S. *Renewable and Sustainable Energy Reviews, 48*, 835–847. https://doi.org/10.1016/j.rser.2015.04.047

Chilvers, J., Pallett, H., & Hargreaves, T. (2018). Ecologies of participation in socio-technical change: The case of energy system transitions. *Energy Research Social Science, 42*, 199–210. https://doi.org/10.1016/j.erss.2018.03.020

Cohen, J. (2013). *Statistical Power Analysis for the Behavioral Sciences* (0 ed.).). Routledge. https://doi.org/10.4324/9780203771587

Cousse, J. (2021). Still in love with solar energy? Installation size, affect, and the social acceptance of renewable energy technologies. *Renewable and Sustainable Energy Reviews, 145*, Article 111107. https://doi.org/10.1016/j.rser.2021.111107

Decreto-Lei n.o 11/2023, *de 10 de fevereiro | DRE*. (n.d.). Retrieved 23 March 2023, from https://dre.pt/dre/detalhe/decreto-lei/11-2023-207272800.

Decreto-Lei n.o 15/2022 | *DR*. (n.d.). Retrieved 11 October 2023, from https://diariodarepublica.pt/dr/detalhe/decreto-lei/15-2022-177634016.

Delicado, A., Figueiredo, E., & Silva, L. (2016). Community perceptions of renewable energies in Portugal: Impacts on environment, landscape and local development. *Energy Research Social Science, 13*, 84–93. https://doi.org/10.1016/j.erss.2015.12.007

Devine-Wright, P. (2005). Beyond NIMBYism: Towards an integrated framework for understanding public perceptions of wind energy. *Wind Energy, 8*(2), 125–139. https://doi.org/10.1002/we.124

Devine-Wright, P. (2009). Rethinking NIMBYism: The role of place attachment and place identity in explaining place-protective action. *Journal of Community Applied Social Psychology, 19*(6), 426–441. https://doi.org/10.1002/casp.1004

Devine-Wright, P., Batel, S., Aas, Ø., Sovacool, B. K., LaBelle, M. C., & Ruud, A. (2017). A conceptual framework for understanding the social acceptance of energy infrastructure: Insights from energy storage. *Energy Policy*. https://doi.org/10.1016/J.ENPOL.2017.04.020
Di Felice, L. J., Cabello, V., Ripa, M., & Madrid-Lopez, C. (2021). Quantitative storytelling: Science, narratives, and uncertainty in Nexus innovations. *Science, Technology, Human Values*. , Article 01622439211053819. https://doi.org/10.1177/01622439211053819
Dwyer, J., & Bidwell, D. (2019). Chains of trust: Energy justice, public engagement, and the first offshore wind farm in the United States. *Energy Research Social Science, 47*, 166–176. https://doi.org/10.1016/j.erss.2018.08.019
Ezekiel, M. (1930). *Methods of correlation analysis* (pp. xiv) (p. 427). Wiley (pp. xiv).
Farla, J., Markard, J., Raven, R., & Coenen, L. (2012). Sustainability transitions in the making: A closer look at actors, strategies and resources. *Technological Forecasting and Social Change, 79*(6), 991–998. https://doi.org/10.1016/j.techfore.2012.02.001
Fast, S. (2013). Social acceptance of renewable energy: Trends, concepts, and geographies: social acceptance of renewable energy. *Geography Compass, 7*(12), 853–866. https://doi.org/10.1111/gec3.12086
Flostrand, A., Pitt, L., & Bridson, S. (2020). The Delphi technique in forecasting– A 42-year bibliographic analysis (1975–2017). *Technological Forecasting and Social Change, 150*, Article 119773. https://doi.org/10.1016/j.techfore.2019.119773
Fouché, C., & Light, G. (2011). An Invitation to Dialogue: 'The World Café' In Social Work Research. *Qualitative Social Work, 10*(1), 28–48. https://doi.org/10.1177/1473325010376016
Frantzeskaki, N., Loorbach, D., & Meadowcroft, J. (2012). Governing societal transitions to sustainability. *International Journal of Sustainable Development, 15*(1/2), 19. https://doi.org/10.1504/IJSD.2012.044032
Fuller, S., & McCauley, D. (2016). Framing energy justice: Perspectives from activism and advocacy. *Energy Research Social Science, 11*, 1–8. https://doi.org/10.1016/j.erss.2015.08.004
Ganteaume, A., Barbero, R., Jappiot, M., & Maillé, E. (2021). Understanding future changes to fires in southern Europe and their impacts on the wildland-urban interface. *Journal of Safety Science and Resilience, 2*(1), 20–29. https://doi.org/10.1016/j.jnlssr.2021.01.001
Garside, S., & Zhai, H. (2022). If not now, when? Climate disaster and the Green vote following the 2021 Germany floods. *Research Politics, 9*(4), Article 20531680221141523. https://doi.org/10.1177/20531680221141523
Geels, F. W. (2010). Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective. *Research Policy, 39*(4), 495–510. https://doi.org/10.1016/j.respol.2010.01.022
Geels, F. W. (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental Innovation and Societal Transitions, 1*(1), 24–40. https://doi.org/10.1016/j.eist.2011.02.002
Geels, F. W., Sovacool, B. K., Schwanen, T., & Sorrell, S. (2017). Sociotechnical transitions for deep decarbonization. *Science, 357*(6357), 1242–1244. https://doi.org/10.1126/science.aao3760
Georgarakis, E., Bauwens, T., Pronk, A.-M., & AlSkaif, T. (2021). Keep it green, simple and socially fair: A choice experiment on prosumers' preferences for peer-to-peer electricity trading in the Netherlands. *Energy Policy, 159*, Article 112615. https://doi.org/10.1016/j.enpol.2021.112615
Gibson, C. B. (2017). Elaboration, Generalization, Triangulation, and Interpretation: On Enhancing the Value of Mixed Method Research. *Organizational Research Methods, 20*(2), 193–223. https://doi.org/10.1177/1094428116639133
Goldthau, A. (2014). Rethinking the governance of energy infrastructure: Scale, decentralization and polycentrism. *Energy Research Social Science, 1*, 134–140. https://doi.org/10.1016/j.erss.2014.02.009
Hao, J., & Ho, T. K. (2019). Machine learning made easy: A review of scikit-learn package in python programming language. *Journal of Educational and Behavioral Statistics, 44*(3), 348–361. https://doi.org/10.3102/1076998619832248
Healy, N., & Barry, J. (2017). Politicizing energy justice and energy system transitions: Fossil fuel divestment and a "just transition. *Energy Policy, 108*, 451–459. https://doi.org/10.1016/j.enpol.2017.06.014
Heiskanen, E., Apajalahti, E.-L., Matschoss, K., & Lovio, R. (2018). Incumbent energy companies navigating energy transitions: Strategic action or bricolage? *Environmental Innovation and Societal Transitions, 28*, 57–69. https://doi.org/10.1016/j.eist.2018.03.001
Hermwille, L. (2016). The role of narratives in socio-technical transitions—Fukushima and the energy regimes of Japan, Germany, and the United Kingdom. *Energy Research Social Science, 11*, 237–246. https://doi.org/10.1016/j.erss.2015.11.001
Hirschhorn, F. (2019). Reflections on the application of the Delphi method: Lessons from a case in public transport research. *International Journal of Social Research Methodology, 22*(3), 309–322. https://doi.org/10.1080/13645579.2018.1543841
Huber, M. (2015). Theorizing energy geographies: Theorizing energy geographies. *Geography Compass, 9*(6), 327–338. https://doi.org/10.1111/gec3.12214
Kakoulaki, G., Kougias, I., Taylor, N., Dolci, F., Moya, J., & Jäger-Waldau, A. (2021). Green hydrogen in Europe – A regional assessment: Substituting existing production with electrolysis powered by renewables. *Energy Conversion and Management, 228*, Article 113649. https://doi.org/10.1016/j.enconman.2020.113649
Karam, A., & Shokrgozar, S. (2023). We have been invaded": Wind energy sacrifice zones in Åfjord Municipality and their implications for Norway. *Norsk Geografisk Tidsskrift - Norwegian Journal of Geography, 77*(3), 183–196. https://doi.org/10.1080/00291951.2023.2225068
Katre, A., & Tozzi, A. (2018). Assessing the Sustainability of Decentralized Renewable Energy Systems: A Comprehensive Framework with Analytical Methods. *Sustainability, 10*(4), 1058. https://doi.org/10.3390/su10041058
Knudsen, J. K., Wold, L. C., Aas, Ø., Kielland Haug, J. J., Batel, S., Devine-Wright, P., Qvenild, M., & Jacobsen, G. B. (2015). Local perceptions of opportunities for engagement and procedural justice in electricity transmission grid projects in Norway and the UK. *Land Use Policy, 48*, 299–308. https://doi.org/10.1016/j.landusepol.2015.04.031
Koirala, B. P., Araghi, Y., Kroesen, M., Ghorbani, A., Hakvoort, R. A., & Herder, P. M. (2018). Trust, awareness, and independence: Insights from a socio-psychological factor analysis of citizen knowledge and participation in community energy systems. *Energy Research Social Science, 38*, 33–40. https://doi.org/10.1016/j.erss.2018.01.009
Liebe, U., & Dobers, G. M. (2019). Decomposing public support for energy policy: What drives acceptance of and intentions to protest against renewable energy expansion in Germany? *Energy Research Social Science, 47*, 247–260. https://doi.org/10.1016/j.erss.2018.09.004
Linstone, H. A., & Turoff, M. (2011). Delphi: A brief look backward and forward. *Technological Forecasting and Social Change, 78*(9), 1712–1719. https://doi.org/10.1016/j.techfore.2010.09.011
Longhurst, N., Avelino, F., Wittmayer, J., Weaver, P., Dumitru, A., Hielscher, S., Cipolla, C., Afonso, R., Kunze, I., & Elle, M. (2016). Experimenting with alternative economies: Four emergent counter-narratives of urban economic development. *Current Opinion in Environmental Sustainability, 22*, 69–74. https://doi.org/10.1016/j.cosust.2017.04.006
Luederitz, C., Abson, D. J., Audet, R., & Lang, D. J. (2017). Many pathways toward sustainability: Not conflict but co-learning between transition narratives. *Sustainability Science, 12*(3), 393–407. https://doi.org/10.1007/s11625-016-0414-0
Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research Policy, 41*(6), 955–967. https://doi.org/10.1016/j.respol.2012.02.013
Markard, J., & Truffer, B. (2008). Technological innovation systems and the multi-level perspective: Towards an integrated framework. *Research Policy, 37*(4), 596–615. https://doi.org/10.1016/j.respol.2008.01.004
Martin, N., Talens-Peiró, L., Villalba-Méndez, G., Nebot-Medina, R., & Madrid-López, C. (2023). An energy future beyond climate neutrality: Comprehensive evaluations of transition pathways. *Applied Energy, 331*, Article 120366. https://doi.org/10.1016/j.apenergy.2022.120366
McChesney, K., & Aldridge, J. (2019). Weaving an interpretivist stance throughout mixed methods research. *International Journal of Research Method in Education, 42*(3), 225–238. https://doi.org/10.1080/1743727X.2019.1590811
McGookin, C., Ó Gallachóir, B., & Byrne, E. (2021). Participatory methods in energy system modelling and planning – A review. *Renewable and Sustainable Energy Reviews, 151*, Article 111504. https://doi.org/10.1016/j.rser.2021.111504
Mendonça, M., Lacey, S., & Hvelplund, F. (2009). Stability, participation and transparency in renewable energy policy: Lessons from Denmark and the United States. *Policy and Society, 27*(4), 379–398. https://doi.org/10.1016/j.polsoc.2009.01.007

Narayanan, A., Mets, K., Strobbe, M., & Develder, C. (2019). Feasibility of 100% renewable energy-based electricity production for cities with storage and flexibility. *Renewable Energy, 134*, 698–709. https://doi.org/10.1016/j.renene.2018.11.049

Nerlich, B., Morris, C., Price, C., & Harris, H. (2023). Biochar in the British print news media: An analysis of promissory discourse and the creation of expectations about carbon removal. *Science as Culture, 0*(0), 1–25. https://doi.org/10.1080/09505431.2023.2285057

Nordholm, A., & Sareen, S. (2021). Scalar Containment of Energy Justice and Its Democratic Discontents: Solar Power and Energy Poverty Alleviation. *Frontiers in Sustainable Cities, 3*, Article 626683. https://doi.org/10.3389/frsc.2021.626683

Okoli, C., & Pawlowski, S. D. (2004). The Delphi method as a research tool: An example, design considerations and applications. *Information Management, 42*(1), 15–29. https://doi.org/10.1016/j.im.2003.11.002

Pagliarini, R. (2006). The World Café – Shaping Our Futures through Conversations that Matter. *Journal of Organizational Change Management, 19*(2), 266–268. https://doi.org/10.1108/09534810610648951

Pahle, M., Schaeffer, R., Pachauri, S., Eom, J., Awasthy, A., Chen, W., Di Maria, C., Jiang, K., He, C., Portugal-Pereira, J., Safonov, G., & Verdolini, E. (2021). The crucial role of complementarity, transparency and adaptability for designing energy policies for sustainable development. *Energy Policy, 159*, Article 112662. https://doi.org/10.1016/j.enpol.2021.112662

Pfenninger, S., & Pickering, B. (2018). Calliope: A multi-scale energy systems modelling framework. *Journal of Open Source Software, 3*(29), 825. https://doi.org/10.21105/joss.00825

Powells, G., & Fell, M. J. (2019). Flexibility capital and flexibility justice in smart energy systems. *Energy Research Social Science, 54*, 56–59. https://doi.org/10.1016/j.erss.2019.03.015

Resolução do Conselho de Ministros n.o 53/2020, de 10 de julho, Pub. L. No. 53/2020, 133 Diário da República 2 (2020). https://diariodarepublica.pt/dr/detalhe/resolucao-conselho-ministros/53-2020-137618093.

Roßmann, M. (2021). Vision as make-believe: How narratives and models represent sociotechnical futures. *Journal of Responsible Innovation, 8*(1), 70–93. https://doi.org/10.1080/23299460.2020.1853395

Sareen, S. (n.d.). *The Sun Also Rises in Portugal*. Bristol University Press; Bristol University Press. Retrieved 9 July 2024, from https://bristoluniversitypress.co.uk/the-sun-also-rises-in-portugal.

Sareen, S., Shokrgozar, S., Neven-Scharnigg, R., Girard, B., Martin, A., & Wolf, S. A. (2023). Accountable solar energy transitions in financially constrained contexts. In B. Edmondson (Ed.), *Sustainability Transformations, Social Transitions and Environmental Accountabilities* (pp. 141–166). Springer International Publishing. https://doi.org/10.1007/978-3-031-18268-6_6.

Scherhaufer, P., Höltinger, S., Salak, B., Schauppenlehner, T., & Schmidt, J. (2018). A participatory integrated assessment of the social acceptance of wind energy. *Energy Research Social Science, 45*, 164–172. https://doi.org/10.1016/j.erss.2018.06.022

Sengers, F., Wieczorek, A. J., & Raven, R. (2019). Experimenting for sustainability transitions: A systematic literature review. *Technological Forecasting and Social Change, 145*, 153–164. https://doi.org/10.1016/j.techfore.2016.08.031

Seyfang, G., Hielscher, S., Hargreaves, T., Martiskainen, M., & Smith, A. (2014). A grassroots sustainable energy niche?:Reflections on community energy in the UK. *Environmental Innovation and Societal Transitions*. https://doi.org/10.1016/J.EIST.2014.04.004

Siamanta, Z. C. (2019). Wind parks in post-crisis Greece: Neoliberalisation vis-à-vis green grabbing. *Environment and Planning E: Nature and Space, 2*(2), 274–303. https://doi.org/10.1177/2514848619835156

Silva, L., & Delicado, A. (2017). Wind farms and rural tourism: A Portuguese case study of residents' and visitors' perceptions and attitudes. *Moravian Geographical Reports, 25*(4), 248–256. https://doi.org/10.1515/mgr-2017-0021

Silva, L., & Sareen, S. (2021). Solar photovoltaic energy infrastructures, land use and sociocultural context in Portugal. *Local Environment, 26*(3), 347–363. https://doi.org/10.1080/13549839.2020.1837091

Smith, A. (2007). Translating Sustainabilities between Green Niches and Socio-Technical Regimes. *Technology Analysis Strategic Management, 19*(4), 427–450. https://doi.org/10.1080/09537320701403334

Smith, A., & Raven, R. (2012). What is protective space? Reconsidering niches in transitions to sustainability. *Research Policy, 41*(6), 1025–1036. https://doi.org/10.1016/j.respol.2011.12.012

Stoddard, I., Anderson, K., Capstick, S., Carton, W., Depledge, J., Facer, K., Gough, C., Hache, F., Hoolohan, C., Hultman, M., Hällström, N., Kartha, S., Klinsky, S., Kuchler, M., Lövbrand, E., Nasiritousi, N., Newell, P., Peters, G. P., Sokona, Y., … Williams, M. (2021). Three decades of climate mitigation: Why haven't we bent the global emissions curve? *Annual Review of Environment and Resources, 46*(46, 2021), 653–689. https://doi.org/10.1146/annurev-environ-012220-011104

Sundström, A., & McCright, A. M. (2016). Women and nuclear energy: Examining the gender divide in opposition to nuclear power among swedish citizens and politicians. *Energy Research Social Science, 11*, 29–39. https://doi.org/10.1016/j.erss.2015.08.008

Tidwell, J. H., & Tidwell, A. S. D. (2018). Energy ideals, visions, narratives, and rhetoric: Examining sociotechnical imaginaries theory and methodology in energy research. *Energy Research Social Science, 39*, 103–107. https://doi.org/10.1016/j.erss.2017.11.005

Trutnevyte, E. (2014). The allure of energy visions: Are some visions better than others? *Energy Strategy Reviews, 2*(3–4), 211–219. https://doi.org/10.1016/j.esr.2013.10.001

Turnheim, B., & Geels, F. W. (2012a). Regime destabilisation as the flipside of energy transitions: Lessons from the history of the British coal industry (1913–1997). *Energy Policy*. https://doi.org/10.1016/J.ENPOL.2012.04.060

Turnheim, B., & Geels, F. W. (2012b). Regime destabilisation as the flipside of energy transitions: Lessons from the history of the British coal industry (1913–1997). *Energy Policy, 50*, 35–49. https://doi.org/10.1016/j.enpol.2012.04.060

von der Gracht, H. A. (2012). Consensus measurement in Delphi studies. *Technological Forecasting and Social Change, 79*(8), 1525–1536. https://doi.org/10.1016/j.techfore.2012.04.013

Wittmayer, J. M., Campos, I., Avelino, F., Brown, D., Doračić, B., Fraaije, M., Gährs, S., Hinsch, A., Assalini, S., Becker, T., Marín-González, E., Holstenkamp, L., Bedoić, R., Duić, N., Oxenaar, S., & Pukšec, T. (2022). Thinking, doing, organising: Preuring just and sustainable energy systems via collective prosumer ecosystems in Europe. *Energy Research Social Science, 86*, Article 102425. https://doi.org/10.1016/j.erss.2021.102425

Wüstenhagen, R., Wolsink, M., & Bürer, M. J. (2007). Social acceptance of renewable energy innovation: An introduction to the concept. *Energy Policy, 35*(5), 2683–2691. https://doi.org/10.1016/j.enpol.2006.12.001

York, R., & Bell, S. E. (2019). Energy transitions or additions?: Why a transition from fossil fuels requires more than the growth of renewable energy. *Energy Research Social Science, 51*, 40–43. https://doi.org/10.1016/j.erss.2019.01.008

Żuk, P., & Żuk, P. (2022). National energy security or acceleration of transition? Energy policy after the war in Ukraine. *Joule, 6*(4), 709–712. https://doi.org/10.1016/j.joule.2022.03.009