Received: 14 March 2019 | Revised: 9 March 2020 | Accepted: 4 May 2020

DOI: 10.1002/eet.1892

RESEARCH ARTICLE

Environmental Policy and Governance

WILEY

Delivering a timely and Just Energy Transition: Which policy research priorities?

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Funding information
Ministero dello Sviluppo Economico, Research Fund for the Italian Electrical System. European Commission, Grant/Award Number: H2020 Grant Agreement n. 763912 SMARTEES project

Abstract

In recent years, the concept of "energy justice" has attracted much attention and research effort. Although all policy issues related to energy justice are worthy of further study, the time constraints posed by the looming threat of climate change suggests the need for coordinated policy research efforts. At the current stage of development of European societies, we consider that four policy research strands might be most important in the light of specific evolving trends of European energy systems. Therefore, we propose these priorities as a shared research agenda for academic and policy researchers. In this article, we develop and discuss the following four research priority strands: (a) intergenerational justice and energy justice, (b) justice and energy vulnerability, (c) transformation of the social imaginary and energy infrastructure, and (d) damage, compensation, and energy infrastructure. For each topic, we highlight their critical issues and research opportunities. We conclude that these priorities are necessary not only to accelerate the energy transition but also to avoid negative impacts that climate change and the transition phase could produce on already established patterns of inequality.

KEYWORDS

energy justice, energy policy, energy transition, Europe, research priorities

1 | THE CURRENT EVOLUTION OF ENERGY SYSTEMS IN EUROPE

The purpose of this article is two-fold: first, to propose to the European scientific and policy communities a research agenda that focuses on four energy policy priorities and second, to invite other scholars and policy analysts to reflect and contribute critically on these same issues to advance a common understanding of contentious socioenergy problems and related policies of intervention whose relevance is pivotal for the energy transition (Sovacool, 2016). Previous researchers argued (Kern & Rogge, 2016, p.16) that "…the low carbon energy transition requires an increase in strategic policy intelligence, openness to experimentation and policy learning, new capabilities and novel procedural policy instruments…," therefore we think that prioritizing some key energy policy research areas is fundamental for speeding up and achieving a sustainable energy transition. In this section, we highlight the current and foreseeable trends in the evolution of the energy system(s), these serve the purpose of contextualizing our four proposed priority research areas, outlined in Section 2 and later further discussed individually in Section 3.

In Europe, new technologies make it possible to imagine a forthcoming development of the electricity network that evolves from a centralized system (hard energy paths) to a decentralized (soft energy paths) (as defined by Lovins (1977)) presenting locally distributed generation and involving a vast deployment of renewable energy (ETIP SNET, 2018). This decentralization could lead to the development of residential communities in which relative energy self-sufficiency is

achieved, thanks to a foreseeable increase in the economic viability of storage systems—for which there is mounting evidence in terms of improved "total generation system value" (de Sisternes, Jenkins, & Botterud, 2016).

The management of distributed generation systems associated with storage systems suggests the possibility of a new level of sharing of facilities and hence a new type of social interaction in neighbourhoods, which involves at least the shared financial management of some energy facilities (Parra et al., 2017; Wolsink, 2013).

It is conceivable that socially disadvantaged individuals will be unable to participate in this type of residential contexts as the purchase of a property in "energy community developments" would require the payment of a surcharge due to accounting for the costs of investment in technology, which would also be accounted for in monthly rates of rented accommodation (Wolsink, 2013).

Furthermore, a persistent resistance to shift toward a sustainable energy system, described in the past as a technology "lock-in" problem (Unruh, 2002), still motivated by the relative low price of some traditional sources, such as coal or older nuclear generation and by the survival of a system of incentives for fossil fuels (standing at $373bn in 2015; OECD, 2018), might exacerbate the problem of greenhouse gas emissions, thereby burdening future generations with the negative externalities resulting from traditional energy production.

Nevertheless, in the long term, the distribution and transmission networks will likely evolve toward a smart grid[1] model to accommodate the transfer of energy produced locally and to offer backup in case of lacking self-sufficiency (Wolsink, 2013). Indeed, further development of the grid could gain momentum from the diffusion of electric mobility, which presumably will require the extra-urban transmission of new electricity production needed to power mobility that has so far been based instead on internal combustion in vehicles (Leurent & Windisch, 2011).

Besides the usual impact of the electricity grid on the environment and the landscape, which is expected to be growing, the impact of any new renewable power infrastructure must be taken into account, and particularly wind farms, currently the cheapest of renewable energies, which often arouse opposition both by skeptics and by local environmentalists, who prioritize local environmental protection over global environmental concerns (Warren, Lumsden, O'Dowd, & Birnie, 2005). Any compensation issue or local benefit provision related to localization of locally unwanted land uses (LULUs) can be tackled in a number of ways, which are not yet consensual in both the policy and the academic communities.

We have highlighted these trends of development of the European energy systems, because, in our opinion, they show how the research directions, proposed in the next section, are relevant for current energy policy research developments. After Section 2, which introduces the four prioritized energy policy research areas, we detail in individual paragraphs in Section 3 the issues introduced in the light of the most relevant sourced literature.[2]

2 | A POSSIBLE SHARED EUROPEAN ENERGY POLICY RESEARCH AGENDA

In this article, we focus on four energy policy research priorities that we consider significant for all European countries. The rationale of proposing these research policy priorities lies in the necessity of defining and opening a debate on what are the most critical policy research areas that need to be tackled in order to facilitate and speed up the energy transition. This necessity is more than ever topical in consideration of the recent stance of the European Commission (2019) to achieve net-zero carbon emissions by 2050, thereby increasing the stakes over the previous objectives of achieving an 80% CO_2 emissions reduction by 2050 (from 1990 levels), a 60% by 2040 and a 40% by 2030 (European Commission, 2011).

This policy framework entails several consequences that generate significant challenges, which might cause social or political controversies, particularly in a European Union whose institutional and social context presents a not negligible average public debt (albeit with significant variations across countries) of 81% of GDP (Eurostat, 2018b), a constant presence of state deficit in the last nine years (2008–2017) (Eurostat, 2018a) and significant relative poverty, in 2016, 23.5% of Europeans were at risk of poverty or social exclusion (Eurostat, 2018c). In this context, the European governments might face the following tests: (a) increasing substantially the countries' renewable energy generation (European Commission, 2018), which might face local opposition for specific yet common types of infrastructures (e.g., wind turbines and biomass plants); (b) a further development of national grids and international interconnections, which are underdeveloped at the moment (Komendantova & Battaglini, 2016), again suitable to cause local social resistance, due to concerns regarding the landscape, health impacts, real estate depreciation, and other environmental issues; (c) Increasing public investments in the grid while attempting to contain energy prices, therefore forcing policymakers to decide how the financial burden should be shared on current and future taxpayers; (d) increasing investments in the whole system, for example, renewables and energy efficiency improvements in the building stock, when national economies might present slow growth, hence posing questions regarding the role of central governments in possibly facilitating or sustaining these investments and about which public resources should finance these policies.

These hurdles, faced by several European countries, could be more easily confronted if framed within the current debate held in social and policy energy research, which focuses on the concept of *energy justice* and its various theoretical and practical declinations. The reason being that only a justice-based approach could address equitably energy policy dilemmas and trade-offs, for example, needs of present versus future generations, social justice versus economic efficiency, protecting the global environment versus conserving local environments, which would arise when facing shared objectives for transitioning toward sustainable energy systems. As McCauley and Heffron (2018) argued, neoliberalism that has dominated the energy policy agendas in most countries, including Europe (LaBelle, 2017),

has created oligopolistic markets and has contributed to social inequality thereby failing to deliver "just outcomes."

Therefore, we advocate for an energy transition that can be considered socially and environmentally just, a Just Energy Transition that some authors (Heffron and McCauley, 2018; Healy & Barry, 2017; Newell & Mulvaney, 2013) have already pointed out as necessary and that was recently defined as "a fair and equitable process of moving towards a post-carbon society" (McCauley & Heffron, 2018, p. 2) and which they associated to the broader terms of the Just Transition originally arisen in discussion over the decarbonization of heavy polluting industries and its implication for worker's rights.

Therefore, we identified the following research issues, which should be further investigated to provide the necessary knowledge-based support for accurate policy decisions to be taken, for achieving the European and global decarbonization goals:

1 First, investigating the themes of *intergenerational justice and energy justice*: in this endeavor, we propose to focus on models and practices of justice between generations, trying to analyze critically how the key principles of equality, reciprocity, and distribution frame the relationship between present stakeholders and future stakeholders, in relation to the evolution and development of energy infrastructure. Specific attention should be dedicated to the theoretical intersection of the concepts of energy justice and intergenerational justice.

This should be seen a priority because the global environmental crisis and the challenges of building a green economy that are a consequence of such a crisis (Borel-Saladin & Turok, 2013) require a thorough understanding of what is a fair approach of dealing with the trade-off between today's use of nonrenewable resources (Meadows, Meadows, Randers, & Behren, 1973; Turner, 2008) versus their preservation for future generations. Furthermore, the trade-off between the use of financial resources for present generations and the debt growth affecting future generations is another important reason to engage in this area of policy research. The consequences of getting these trade-offs wrong could be dire for our descendants and would be compounded by present and future social and environmental inequalities (Pennock, Poland, & Hancock, 2015), which ties with the second area of policy research that we propose. Setting this priority is coherent also with European past and present policy statements, Göpel and Arhelger (2010) showed that the European Union started to refer to the need of protecting the interests of future generations as early as 1973. And even recently, referring to energy transition, the European Commission (2019, pp. 23–24) wrote that the European Green Deal "…supports the transition of the EU to a fair and prosperous society that responds to the challenges posed by climate change and environmental degradation, improving the quality of life of current and future generations." Whether the policy intention of acting fairly in favor of future generations expresses a clear commitment to intergenerational justice, the exact policy instruments that will be used in the years to come will need to be defined and so the balances between the interests of present and future European generations. This is nothing new, as choices have also been made in the past on specific instances, sometimes striking a balance arguably (Rietig, 2013) in favor of future generations but the depth of the transformations needed to achieve a zero-carbon society require even more delicate decisions between favoring current or future European citizens' needs.

2 Second, as a specific theme or research, we propose to investigate the relationship among *justice*, *energy*, *and vulnerability*. We suggest focusing on understanding the link between the different types of technologically induced vulnerabilities and the evolution of the energy system. Particular attention should be placed on possible socioeconomic impacts deriving from the development of energy infrastructure for subjects living in affected areas.

   The reason to choose this area of research as a priority lies in the necessity stated by the European Commission (2019) to shift toward a clean energy supply in order to achieve net-zero carbon while at the same time paying special attention to the trade-offs between the "economic, environmental and social objectives" (European Commission, 2019, p. 4). The Commission (2019) affirms that these trade-offs will be dealt with under the provisions of the European Pillar of Social Rights (EPSR) (European Parliament, Council of the European Union, & European Commission, 2017). Nevertheless, the EPSR is a mere enunciation of fundamental social rights that only to a limited degree address the problem of energy vulnerabilities and the implications of the energy transition for the existing energy-related social inequalities (Galvin, 2019) and for those to come as possible consequences of the energy transition.
3 The third proposed area of research proposes to investigate the *transformation of the social imaginary* of places affected by energy installations and its consequences in terms of place attachment and place identity. The desired output would be the identification of a set of variables suitable to anticipate critical issues regarding the interaction among natural, human and technological elements, in order to support ordinary policy evaluation tools of stakeholders (public and private), directly or indirectly involved in the planning phase of energy installations.

   Again, the need for vastly expanding sustainable energy supply (European Commission, 2019) makes this area one of the most urgent energy policy research priorities. Wide local resistance to wind energy has been the object of productive but yet non-conclusive research in the past 30 years (Rand & Hoen, 2017). However, further public acceptance problems are anticipated for energy infrastructure developments needed to decarbonize the current supply (European Commission, 2012).
4 Last, the fourth research strand proposes to investigate the concepts of *damage and compensation in relation to the energy infrastructure*. It aims to define and research the social, economic, and institutional sustainability of compensation forms. Specifically, it aims to define compensation forms and rehabilitation from actual or perceived, present or predictable, forms of damage. Particular attention could be given to different

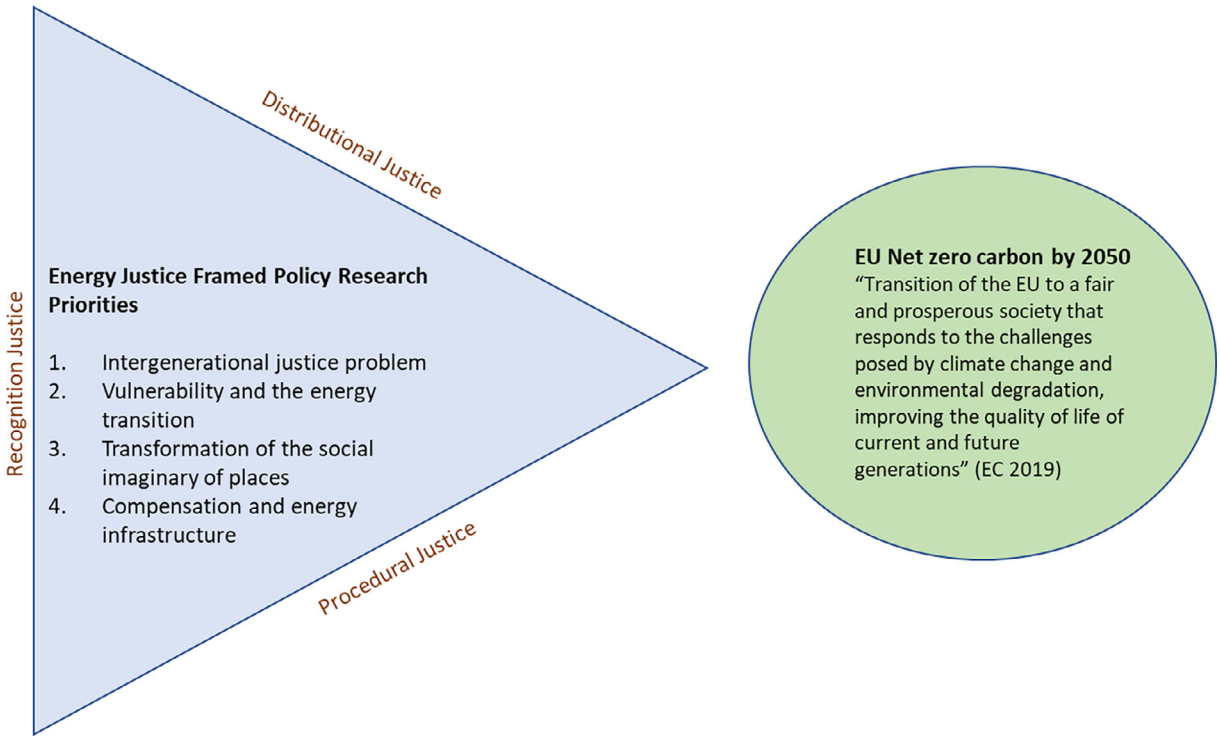

FIGURE 1 Energy justice framed policy research priorities for accelerating the European energy transition [Colour figure can be viewed at wileyonlinelibrary.com]

appraisals of damage, trying to understand the various ethical implications for the subjects directly concerned.

This fourth area of research ties to the previous two, it is founded on the same premise that the shift toward a sustainable Europe is necessary and urgent and thereby assumes that an extensive development of energy infrastructure will necessarily have local impacts that, at times, might be considered as unfavorable toward local communities. Exploring this research topic would help to address energy injustices and would possibly lay the foundations for policies of compensation suitable to increase the acceptability of energy infrastructure siting.

These energy research policy priorities (Figure 1), one could argue, might themselves make a trade-off between them necessary. It could be said, for example, that addressing issues of intergenerational justice (research Priority 1) might happen in detriment of the well-being of current generations (research Priorities 2, 3, and 4). In reality, this trade-off is just apparent at the surface, chiefly for two reasons: first, we argue for the need of establishing research priorities and not policy principles, this means that the purpose of research Priority 1 would be precisely that of resolving the trade-off between the needs and rights of present and future generations; second, it could be argued that addressing issues of intragenerational justice and equity (Sovacool & Dworkin, 2015) might itself help in preserving the environment for future generations (Wilkinson, Pickett, & De Vogli, 2010).

3 | INTERGENERATIONAL JUSTICE AND ENERGY JUSTICE

We are not aware if "intergenerational energy justice" has ever been defined as a concept. Nevertheless, considering the importance of intergenerational justice in any debate regarding the environment, climate change, and sustainability, we propose to refer explicitly to "intergenerational energy justice" as a state of policies conducive to an equitable distribution of finite natural and nonrenewable energy resources and aiming at preventing any severe damage of the biosphere, which takes account of the equal dignity and of the equality of rights of different generations, even when living in distant times.

The concept of intergenerational justice, especially in relation to climate change, was discussed by Barry (1997) as a matter of distributive justice and of conflict of interests between generations, which is derived from a premise of equality of all human beings, regardless of their time. This position is also accepted by Page (1999), which, however, poses a problem of identity and emphasizes that inevitably any policies to combat climate change will eventually affect the subjective identities of future generations, thereby questioning whether they can be considered just at all; nevertheless, he suggests that a solution to the problem is to consider collective, rather than subjective identities of the rights holders. Gardiner (2006) writes of the "pure intergenerational problem" to frame the intergenerational conflict about climate change, arguing that this can be described with two contrasting motives of individual and collective action: one pertaining to collective rationality, which would lead generations to cooperate in order

to leave to the next, and get from the previous, a natural environment that is not degraded; whereas a second motive, pertaining to individual rationality, would lead the individual or individual generations, (i.e., individuals living at the same point in time), to maximize the utility deriving from environmental degradation. Schuppert (2011), like Berry (1997), writes that the concept of intergenerational justice is founded on the principle of equality, articulated according to the axiom that all people share a set of common interests and the common interests of future generations have an equal dignity of those of the present generation.

Almassi (2017) however seems to adhere to what he claims to be a "relational" concept of interdependence regarding intergenerational justice: he considers the past, present, and future generations to be in continuity and therefore bound by a duty of reciprocity, from the obligation to protect new and future members of the community, as it was done by previous generations. It could be said, however, that this foundation principle of intergenerational justice is not far from that of equality, because if the obligations of previous generations are still valid for the present and for the future, it is because essentially these obligations are the same for individuals or collectives that have the same characteristics, that is, that can be considered as equals.

Sovacool and Dworkin (2015) make explicit reference to intergenerational justice when detailing the constituting principles of energy justice, and particularly, Sovacool et al. (2017, p. 687) define "Intergenerational equity," as follows: "Future generations have a right to enjoy a good life undisturbed by the damage our energy systems inflict on the world today." This concept is indicated by Sovacool et al. (2017, 2016) as one of the principles that characterize the concept of energy justice along with nine others, namely: availability, affordability, due process, transparency and accountability, intragenerational equity, responsibility, resistance, and intersectionality.

Despite the requirement of energy justice is animated by the 10 principles, it is also enunciated through a more concise definition by Sovacool and Dworkin (2015, p. 436): "…as a global energy system that fairly disseminates both the benefits and costs of energy services, and one that has representative and impartial energy decision-making."

McCauley, Heffron, Stephan, and Jenkins (2013) instead define energy justice as based on three tenets, specifically: (a) distributive justice, (b) procedural justice, and (c) recognition justice (see Figure 1). For these authors, the element of distributive justice finds its application both in relation to the spatial distribution of energy infrastructures and thus in their local environmental impacts on one side, and in relation with the distribution of benefits and costs of infrastructure among the whole population on the other. For procedural justice instead, they mean that all stakeholders should be able to participate equally in decision making about energy infrastructures. Finally, for recognition justice, they mean the need to recognize the dignity, the rights and needs of all individuals and social groups to be included and therefore avoiding the conditions of deprivation, often endured by socially disadvantaged groups. More recently, the definition of energy justice based on the three tenets has been reasserted by Jenkins et al. (2016, p. 180) who points out that the energy justice agenda "inspires both evaluative accounts and normative solutions." Furthermore Jenkins et al. (2016) make the point that the energy justice research perspective should be developed through a "whole-systems approach," which investigates energy systems in their entirety, therefore, avoiding the risk of conducting focused analysis on sections of the energy systems, which inevitably are interconnected.

Despite some seeming differences, it has been pointed out (Pellegrini-Masini, Pirni, & Maran, 2020) that the definitions of energy justice of Sovacool and Dworkin (2015) and of McCauley et al. (2013) are complementary and both share a common root in the concept of equality and its declinations of formal and substantive equality.

It is worth drawing attention on the fact that the concept of energy justice can be considered transversal and relevant, not only for the theme of intergenerational justice but also for the other research areas mentioned in Section 1: social vulnerability (whether economic or environmental), altered perception of places caused by the development of energy infrastructures, and, finally, compensation policies, which clearly belongs to the realm of restorative justice. In particular, the latter is considered by Heffron and McCauley (2017) as the principle that should animate policy interventions geared toward affirming energy justice.

However, the problem of quantitatively determining the conditions of injustice created by the energy system, and therefore the corresponding appropriate policies to counter them, is not a simple problem. In fact, it should be noted that the present approach to energy justice is criticized by some of the most prominent authors who engaged with it (e.g., Heffron & McCauley, 2017; Jenkins, McCauley, & Forman, 2017). Its conceptual development, which is very articulated, has not been followed yet by a necessary operationalization, which would allow the formulation of consequential policies. Heffron and McCauley (2017) advocate the need to translate the concept into a quantitative and possibly an economic dimension. Also, Heffron, McCauley, and Sovacool (2015) propose to develop the concept through an instrument which they conceived, called "energy justice metric." The energy justice metric is based on an energy trilemma, which would score each country (or possibly even a proposed infrastructure), based on three areas: "economics (energy finance)," "politics (energy security)," and "environment (climate change mitigation)." For each of these areas, the authors select some indicators and foresee the development of this tool, which is anticipated to be refined in the selection of indicators and their relative weight. A similar approach has been used by the World Energy Council (WEC) (2016) and WEC (2017) albeit presenting the energy trilemma as an expression of energy sustainability, arguably entailing in substance elements of justice, too. In this case, in fact, the trilemma comprises three areas: environmental sustainability, energy security, and energy equity.

Therefore, it should be noted that two areas are essentially named in the same way for both Heffron et al. (2015) and the WEC (2016) and WEC (2017), whereas a third one differs: the WEC defines the third, "energy equity," while Heffron et al. name it "economics." The respective selection of indicators follows the chosen

areas, with the work of the WEC selecting indicators such as access to electricity, access to clean cooking, quality of electricity supply, quality of supply in urban versus rural areas, electricity prices for the "energy equity" area, gasoline and diesel prices, and natural gas prices, whereas Heffron et al. select the indicators: cost–benefit analysis for new energy infrastructure, cost of subsidies for energy source extraction development and operation, cost of energy to disposable income ratio, and benefit for employment creation in the short to long term for energy infrastructure development for the "economics" area. This is a clear example of how similar metrics can differ in substance: arguably looking at the indicators, it could be said that the WEC metric seems to include more elements of energy justice than the metric proposed by Heffron et al., despite the first was inspired by an energy trilemma based on the concept of energy sustainability, whereas the second by a different energy trilemma based on the concept of energy justice. These considerations could lead to a wider discussion of the relation between the concepts of sustainable energy and energy justice that could be argued to have several overlaps if we consider that "sustainable development" is defined by the three paradigms of economic sustainability, environmental sustainability, and social sustainability (United Nations, 2015) and that "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987). However, on the topic of energy justice and its translation to policy tools, on the one hand, a quantitative dimension can favor an easier understanding of the concept by a part of the academic world and by policymakers, on the other hand, as we have seen by the cited examples, such metrics might end up being constructed, to some extent, according to subjective criteria, selected from a relatively narrow group of researchers and practitioners. In this respect, a further example worthwhile mentioning is the approach adopted by the European Commission who requested ENTSO-E (the association of transmission system operators[3]) to develop a harmonized energy system-wide cost–benefit analysis (CBA) at Union level for the appraisal of interconnection projects (Regulation No 347/2013). Notwithstanding the political support for this approach (ENTSO-E is currently developing the third version of the methodology), it has been already noted that the CBA obscures different stakeholder perspectives and is biased toward a particular set of values (Schmidt & Lilliestam, 2015). Hence, CBA is expected to increase, rather than to reduce, public opposition to power lines in Europe. In order to overcome the limits of CBA, a multicriteria approach has been proposed, which may support decisions on alternatives for grid reinforcement by including stakeholder preferences (Späth et al., 2017).

Another approach to gauge energy justice might at least in the first phase of the operationalization of the concept instead be the identification of the main policy interventions that could address those situations deemed to be considered as lacking energy justice. These policies would be selected in consideration of the principles that underpin the energy justice concept and evaluating their sustainability in the institutional context along with their suitability to gather consensus among stakeholders and citizens. This approach would have the advantage of avoiding the identification of policy instruments whose implementation is eventually found impracticable, because lacking social acceptability, or because meeting the hostility of public and private institutions (Steg, Dreijerink, & Abrahamse, 2006). But even if energy justice might only be slowly moving toward a phase of support for policy design, it has already been proven useful as a tool of analysis of the current and past energy policies in the specific European context, for example, LaBelle (2017) has shown that an energy justice-based policy analysis of European countries can be a useful tool to understand both the tensions within institutional energy system and their responsiveness to energy-related social issues, such as energy poverty, while at the same time highlighting how universal interpretations of energy justice, devoid of contextualization, might support policies whose unintended consequences are socially regressive.

Finally, it is worth noticing how the concept of energy justice, which we have shown to be linked to that of intergenerational justice, can be viewed as a recent theoretical development of the environmental justice concept (Sari et al., 2017), which is a concept that had already taken into account the problem of distributive injustices of resources at infra and intergenerational levels (Dobson, 2003). This surely does not come as a surprise considering that the concept of intergenerational justice lies at the heart of that of sustainable development (United Nations, 2015), which traces back its root to the seventies (Meadows et al., 1973).

4 | JUSTICE AND VULNERABILITIES

Vulnerability and justice in the energy sector can be conceptually framed in the broader theoretical concept of energy justice (Bouzarovski & Simcock, 2017; McCauley & Heffron, 2018). In fact, both the principles of distributive and recognition justice, which, according to McCauley et al. (2013), characterize the concept of energy justice, address the issue of vulnerability. Similarly, recalling the definition of energy justice of Sovacool et al. (2017), vulnerability could be easily linked to the energy justice principles of availability, affordability, and responsibility.

As recognized by Bouzarovski et al. (2017), energy vulnerability has been used in a variety of contexts and with different meanings and is a concept that is being developed theoretically.

It seems that two main sets of aspects of energy vulnerability could be outlined: (a) vulnerability aspects due to a physical impact of energy infrastructure, that is, the effects on the natural environment and its repercussions on the well-being of individuals, and (b) vulnerability aspects due to the economic impact of energy services' delivery, with particular reference to energy poverty.

The first has been researched within the field of risk studies in relation to the acceptance of some types of facilities, for example, nuclear plants (Moser, Stauffacher, Blumer, & Scholz, 2015). In this context, vulnerability "is conceived as a function of the exposure, sensitivity, and adaptive capacity" (Scholz, Blumer, & Brand, 2012, p. 318). This inevitably connects with the problem of acceptance that

has been addressed in terms of *acceptability* or *social acceptance*[4] of infrastructures by numerous authors and with reference to different types of infrastructure. In their seminal work on the social acceptance of renewable energy, Wüstenhagen, Wolsink, and Bürer (2007) introduced the three dimensions of social acceptance (sociopolitical, community, and market acceptance) and analyzed the main factors influencing sociopolitical and community acceptance, which are recognized as important factors for understanding the apparent contradictions between general public support for renewable energy and the public opposition of specific projects. Cohen, Reichl, and Schmidthaler (2014) state that despite the multitude of studies the definition of the concept is unsatisfactory and stress that it is often limited to the implied meaning of "lack of noticeable opposition" (Cohen et al., 2014, p. 5) Conversely, it has been defined as a positive action reflecting a positive attitude expressed through a particular behavior or opinion (Kraeusel and Möst (2012) in Cohen et al. (2014)). Both are definitions that Cohen and colleagues consider feeble, as they are based on subjective criteria. Cohen et al. (2014, p. 4) instead, offer a definition that they believe to be susceptible to measurement as it is based on objective criteria, related to economic benefits and theories of welfare:

> Social acceptance of new infrastructure occurs when the welfare decreasing aspects of the project are balanced by welfare Increasing aspects of the project to leave each agent at worst welfare neutral and indifferent to the completion of the project, or better off and supportive of the project.

Indeed, it seems that the quantitative approach of Cohen and colleagues can be just as objectionable as the selection of any quantitative indicators would be made subjectively by researchers and moreover would not be able to grasp the subjective dimension of the impact of an infrastructure, which pertains to the realm of the emotional and psychological well-being of those subjects residing in an altered environment.

As mentioned, the literature has flourished about the social acceptability of certain types of LULUs, particularly in relation to wind turbines, and several authors have attempted to revise and synthesize these research efforts (Bell, Gray, Haggett, & Swaffield, 2013; Bell, Gray, & Haggett, 2005; Devine-Wright, 2005, 2007). However, there are also some theoretical or empirical studies on the acceptability of infrastructure of the electricity grid (Batel, Devine-Wright, & Tangeland, 2013; Cain & Nelson, 2013), but they have been developed to a much lesser extent.

With regard, instead, to the issue of social vulnerability and the development of the electrical system, some studies addressing the problem of social and income differences in relation to energy consumption, energy savings, and the purchase of "green" technology can be traced (Poortinga, Steg, Vlek, & Wiersma, 2003; Poruschi & Ambrey, 2016). They do not seem to focus although on how technological innovation can adversely affect and possibly increase the social divide nor on how policy interventions can mitigate this effect. Studies that deal specifically with the issues of fuel poverty and energy poverty are instead widespread. The phenomenon of fuel poverty invests about 54 millions of EU citizens, that is, 10.8% of the European population (EU SILC estimates in Pye et al. (2015)).

"Fuel Poverty" is a concept that was developed in the United Kingdom, where it was initially defined as the condition of each family who was forced to spend more than 10% of its income on heating their home adequately. Whereas a newer definition, again pertaining to the realm of British Government policy, defines fuel poverty as the condition of a household that spends more than the national median spending on heating their home, therefore ending up, as a consequence, with a disposable income that places the household below the poverty line (Bouzarovski & Petrova, 2015). In other EU countries, only three, Ireland, France, and Cyprus, have legislated definitions (Pye et al., 2015).

Bouzarovski and Petrova (2015) point out that the meaning of "energy poverty" was mainly developed in the context of studies concerning developing countries, where it took on the meaning of lack of access to electricity and modern cooking or heating systems. However, the authors believe that this fuel/energy poverty is an outdated distinction and propose the single usage of the terms energy poverty with a definition that also includes the meaning of fuel poverty, hence defining it as the situation of those suffering domestic conditions that may impair their access to energy services, to the extent that this limits their participation in a lifestyle commonly shared by members of society to which they belong.

5 | TRANSFORMATION OF THE SOCIAL IMAGINARY

The social imaginary theory (Taylor, 2002) is an attempt at describing modern reality in a deterministic way, through the development of its cultural dimension. However, in the field of the social sciences applied to research, the perception of spaces, there are specific contributions, for example, "the social representations' theories," that cover the sociocultural dimension as a significant factor in determining the space and vice versa. In particular, Soja (1985, p. 98) states that "Social life is both space forming and space contingent" and Giddens in Halfacree (1993, p.27) states that "space represents the meshing together of structures, but it delineates the structures also themselves."

A well-known theory of social representations finds its formulation in the work of Moscovici, who believes that the social representations are mental constructs whose function is to represent the complexity of the outside world at the individual level, however, in doing so they actually define it (Halfacree, 1993).

Regarding the infrastructure of renewable energy, Moscovici's social representations theory has been used by Batel and Devine-Wright (2015) to explain what in the past has been called the "gap" between individual proenvironmental attitudes and inconsistent behaviors (Bell et al., 2005; Kollmuss & Agyeman, 2002). In fact, according to Batel and Devine-Wright (2015), social representations

in general and those of technological change specifically can assume multidimensional characterizations, either positive or negative, and can be articulated differently, depending on the time and the context when a subject expresses them. Either negative or positive representations will prevail, according to the individual's will to resist or not to change in that specific context. However, it might be noticed that this theoretical framework will not ultimately explain why a subject or group of subjects is orientated to support or oppose the forthcoming change. Batel and Devine-Wright believe, however, that the study of social representations of renewable energy technologies should be better developed to understand more thoroughly how they are formed and oriented, also in relation to the socially constructed identities of places (place identity) and in relation to the emotional ties that individuals develop with places (place attachment). Regarding the latter two concepts, there are studies that explore how the emotional bond with places, is perceived and how it evolves with the deployment of energy infrastructures. Furthermore, it was investigated how place attachment relates with the acceptability of these same infrastructures, accompanying oppositional attitudes, but not necessarily causing them, (Devine-Wright, 2009a, 2009b, 2013; Devine-Wright & Howes, 2010).

The discussion over the transformation of the social imaginary could be apparently disjointed by energy justice implications, but this is not the case. Jenkins et al. (2016) explicitly stigmatize what they term as "misrecognition and disrespect" as forms of injustice that affect negatively those citizens concerned with the siting of energy infrastructure and particularly wind turbines, whose place attachment is often unduly misrepresented as a manifestation of selfishness and labeled as nimbyism. The issue of place attachment and its relevance for just processes of energy infrastructure siting have been discussed not only with regards to wind energy but also other types of energy infrastructures, for example, for hydrogen network infrastructure (Scott & Powells, 2020). More broadly, the nexus between justice and facility siting, including energy infrastructure, was first explored in relation to environmental justice before energy justice appeared (Walker, 2009).

6 | FORMS OF COMPENSATION FOR DAMAGE

Within the theoretical energy justice framework, Sovacool et al. (2016) motivate the need of compensations, in relation to energy activities that have produced high levels of CO_2, according to a principle of corrective justice; these are conceived to place responsibility on an agent, or a group of agents, which have polluted a common good (i.e., the atmosphere) to the detriment of the community. The one principle recalled by Sovacool et al. (2016) is the widely acknowledged "the polluter pays" (de Sadeler, 2014), which foresees the obligation for economic agents to pay compensation for their produced negative externalities.

This is also the approach taken by Sorensen, Soderstrom, and Carnes (1984), who consider the negative impacts of energy infrastructure as negative externalities produced by market forces, so they provide a classification of externalities based on the concepts of noxious and obnoxious, on which finally a classification of incentives are based; among these, some forms of compensation are also included, which can be deployed to facilitate the acceptance of so-called "LULU" (Schively, 2007).

Sorensen et al. (1984) believe that only the communities affected by facilities that produce noxious effects should benefit from incentives. In fact, the same authors admit that the impacts are not easily determinable and that in some cases there may be subjective perceptions of the effects of an infrastructure; nevertheless, their stance is that it is possible to determine on a case-by-case basis whether some effects of a specific infrastructure are noxious and therefore if incentives are applicable.

Another view disregards the market approach based on negative externalities while promoting a concept of community benefits instead to be determined ahead of the construction of infrastructure. Regarding this, Cowell et al. (2011, p.542) write: "Benefits accepted in exchange for development rights in the context of genuine freedom to decline a proposal, or request modifications, allows the possibility that (some) community members can negotiate benefits that would leave them feeling at least no worse off overall." This is in the opinion of the authors a better approach than compensating for damage after that the infrastructure has been built and following criteria that do not include the possibility of a negotiation with the local community. Community benefits are now common in many countries, in relation to certain types of infrastructure, particularly, but not only, wind farms and transmission grid infrastructure (Centre for Sustainable Energy, 2005; Renewables Grid Initiative, 2016). There is some degree of dispute about the moral acceptability of these. Some parts of the communities, particularly those who oppose energy infrastructures in their area, define these benefits as an attempt to bribe communities and buy their consent, but there is evidence that the majority of concerned citizens see these incentives favorably (Aitken, 2010; Cass, Walker, & Devine-Wright, 2010). In this regard, the Centre for Sustainable Energy (2009) introduces several arguments to support the view that these benefits are appropriate and should not be considered as "bribes," although they are not thoroughly examined. Nevertheless, these benefits are nowadays an established practice, particularly regarding wind farms: in some countries, they are in the form of legally bound contributions, like in Germany, Denmark, and Spain (Centre for Sustainable Energy, 2009), whereas in the United Kingdom, they are voluntary, yet considered conventional common practice by commercial renewables producers and policymakers (DECC, 2014), who recognize them in two main categories: that is, "financial benefits" and "benefits in kind." The first is usually payments provided by the developer into a trust fund managed by the community or the local authority, whereas the second is usually new community facilities, or specific projects serving the community, paid for by the developer. In both cases, it is warranted some level of involvement of residents who are invited to express a preference for the destination of the benefits provided. This approach often leads to compensation actions not coherent with a real environmental rebalance and oriented to satisfy local interests, not always cohesive with a regional-scale

strategy (Maran & Garofalo, 2017). An alternative, more demanding approach restricts the possible compensation measures in order to rebalance the residual negative impact of the project, limiting them only to the compartment affected by the infrastructure. For instance, if the unavoidable impacts are related to the environmental component, the compensation should consist in the solution of the environmental problem of the project area, avoiding a simple money refunding or a contribution for social utilities. It is remarkable that this approach is being adopted in some recent regulations (e.g., the Italian guidelines for the renewable energy power plants).

7 | DISCUSSION

We have presented four priority energy policy research areas that we regard as suitable to support the energy transition: (a) intergenerational justice and energy justice, (b) justice and energy vulnerability, (c) transformation of the social imaginary and energy infrastructure, and (d) damage, compensation, and energy infrastructure. Although we have argued the reasons for choosing these four priorities in Section 2, we wish to point out now what the critical aspects and the research opportunities are that these areas present.

Regarding the first priority, focusing on intergenerational and energy justice, we observe that the concept of energy justice appears multifaceted and should be consolidated through a conceptual analysis intended to unify and simplify it in a single definition. This would ultimately serve the purpose of making it more readily operational in its application to energy policymaking. A recent attempt at reviewing the concept and finding a common root for different energy justice definitions (Pellegrini-Masini et al., 2020) goes in the right direction but leaves space for a further development that could achieve a policy implementable synthetic definition that at the moment appears still eluding current conceptualizations.

The concepts of intragenerational and intergenerational energy justice, which seem to be subsumed by that of energy justice, are concepts that appear to be more defined, even if their energy policy implications are still to a large extent unexplored despite few attempts (e.g., Pellegrini-Masini, Corvino, & Lonfquist, 2019; Pellegrini-Masini, Corvino, & Pirni, 2019; Schuppert, 2011). Policy research, therefore, could focus on policies of implementation that refer both to the concept of energy justice and to that of intergenerational justice, which, as we stressed earlier, is also a core concept of sustainable development. These policies could both have a preemptive or reparative aim and, once defined, should then be evaluated, in their economic, institutional and social sustainability through the survey of suitably selected citizens and stakeholders.

With regards to the second priority research area, justice and energy vulnerability, we note that a comprehensive concept of energy vulnerability does not exist in current literature, but it appears mainly connected to those of social acceptability of energy infrastructure on the one hand and that of energy poverty on the other. Attempting a comprehensive working definition, we could say, building on existing but still limited definitions (Bouzarovski, 2018; Scholz et al., 2012), that energy vulnerability is the condition of those who are susceptible for their own characteristics, material and psychological, to suffer the negative consequences resulting by the implementation of a specific energy infrastructure or by the development of the energy services in their national energy system. Definitions are critical to developing meaningful policies that might address societal problems; hence, achieving consensus is necessary on the meaning of energy vulnerability and its related concepts. Consequently, we see evident research needs regarding the pursuit of the identification and the sustainability of policies that can alleviate or resolve the conditions of vulnerability, whether they are determined by a specific infrastructure or from the current regimes of national energy systems.

Concerning the third research priority area, the transformation of the social imaginary and energy infrastructure, it seems that theories of social representations and related theories of place attachment and place identity have not yet provided a full understanding of the main determinants of opposition to the development of energy infrastructures, perhaps due to a constructivist approach, which appears wary of establishing generalizations (Mayring, 2007). Nevertheless, their contribution is useful to enrich the understanding of how meanings of energy infrastructures can influence citizens' lives, therefore, enabling an improvement of policy interventions that aim at delivering a Just Energy Transition. Regarding this area, we see the need to continue the research effort in clarifying the role of psychological place-related variables in relation to acceptance of energy infrastructure. The concepts of place attachment and place identity have undoubtedly a tradition of research in social psychology. They also appear relevant to the study of the acceptability of energy infrastructures such as the power lines and renewable energy installations, although their relevance is not yet fully understood and seems to harbor contrasting roles (van Veelen & Haggett, 2016).

Considering the fourth priority research area, damage, compensation, and energy infrastructure, it could be noted that there is no agreed definition of compensation, let alone the fact that transmission system operators and renewable commercial developers avoid explicitly of talking of compensation (Renewables Grid Initiative, 2016) and in some instances, see England, for example, this view is fully shared by policymakers (DECC, 2014). Nevertheless talking of compensation rather than benefits or incentives could be justified by the principles of energy justice earlier presented and advanced by several authors (McCauley et al., 2013; Sovacool et al., 2016). Talking of compensation implies the presence of some sort of "damage" or negative externalities, which, if recognized, would imply the need for a legal obligation of compensation. Community benefits instead, which could also be conceived as a legal obligation, appear unrelated to any negative externalities, therefore, they do not appear suitable to be based on a deterministic legal principle, and their entity is not related to any supposed damage and could be varying significantly from a context to another. Finally, the implementation of negotiation-based compensation/community benefits schemes would necessarily imply a delicate process of involvement of the local community, which is far from standardized by any research. Considering the critical issues emerging, the research possibilities regarding this area are plenty and

should also cover aspects of compatibility of any possible compensation policy with current European national laws. Consolidating the basis of principles related to energy justice and underpinning the concept of compensation should be a priority, as well as the identification of a multitude of options for policy implementation, which would then be researched in their economic, legal, and social viability and sustainability.

8 | CONCLUSIONS

This article has presented an energy policy research agenda inspired by the concept of energy justice that despite being thought for European countries, could be considered relevant for many western mature economies that share similar objectives of decarbonization and sustainable energy transitions.

Developing economies are less likely to face the same levels of social opposition toward the deployment of new energy infrastructure, and their strategy might, in some cases, be oriented more toward economic efficiency, rather than decarbonization, like it was for western economies a few decades ago (Komendantova & Battaglini, 2016). That being said, some issues presented are inevitably pertinent for any energy system, particularly the applicability of energy justice to policies concerning issues of vulnerability or of environmental degradation of future generations' livelihoods.

In Section 1, we highlighted some trends and relative issues in the evolution of current western energy systems that we feel are of widespread interest for the research community and pivotal to deliver a timely transition toward a just sustainable energy system:

- The pace of the transition to a sustainable energy system and the relative development of sustainable energy infrastructure, framed as an intergenerational justice problem that should motivate an adequate policy response.
- The lack of possibility for disadvantaged individuals to access and benefit from emerging sustainable energy technologies because of their lack of financial means (and/or because of low levels of education), and more generally the issue of energy vulnerability.
- The transformation of social imaginaries of public spaces affected by sustainable infrastructures and their effects on local resistance.
- Local resistance due to the localization of energy infrastructure and related policies of compensation rather than the current common voluntary provision of "community benefits."

In relation to the highlighted trends, we have proposed four research priorities in consideration of the ambitious policy objectives of the European Union (European Commission, 2019). These have been discussed in the light of the current literature, and we have discussed their related critical issues and research opportunities, believing that these can contribute to a debate in the field, and particularly to refocus research efforts on key research objectives that could enable more timely and effective policies for delivering the energy transition. In fact, we believe that while the pace of increase of new or simply exacerbated negative impacts of climate change is fast, the same unfortunately cannot be said for the progress of policy research and political decisionmaking (Simon, 2018). Hence, we consider it urgent to economize the efforts of the energy policy research community on shared goals, and this can be facilitated through adopting a shared research agenda and through agreeing what the critical issues are and the consequent research opportunities necessary to be tackled. Ultimately, this is paramount to progress timely toward an established policy vision capable of being implemented by national governments and of being encouraged by international institutions. Although we observe that research priorities are carefully established and communicated with regards to energy technologies, with only marginal considerations given to the role of citizens, unfortunately still narrowly and inappropriately defined only as consumers (European Commission, 2017), the same activity of establishing energy policy priorities concerning social aspects of the energy transitions appears to be missing but necessary, and to that end, we consider this article as a useful contribution to start a debate.

Most likely the developing harmful societal effects of climate change will deepen current social inequalities at the national and international levels and at intragenerational and intergenerational levels, as current research highlights (Berry, Sánchez-Arcilla Conejo, Betts, & Harrison, 2017). Therefore, we urge the energy policy research community to focus its efforts on those objects that might have a major impact in growing a culture of focused, sustainable policymaking, capable of delivering the timely and Just Transition to a decarbonized energy economy that we need to avert the worst climate change impacts.

ACKNOWLEDGMENTS

This work has been financed by the Research Fund for the Italian Electrical System under the Contract Agreement established with the Ministry Decree of March 23, 2006 and in compliance with the Decree of Minister of Economic Development April 16, 2018 and by the SMARTEES project, Horizon 2020 program, grant agreement n. 763912.

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ENDNOTES

[1]Actually, a universally agreed definition of a smart grid is missing; here, we use a generic concept of a grid enabling interactions and functions in the system. More formally, the definition of the European Smart Grid Task Force can be used: "Smart Grids are electricity networks that can efficiently integrate the behaviour and actions of all users connected to it — generators, consumers and those that do both — in order to ensure an economically efficient, sustainable power system with low losses and high quality and security of supply and safety," The Smart Grids Task Force was set up by the European Commission in 2009 to advise on issues related to smart grid deployment and development. The same definition was used by the European Commission in the Communication COM(2011) 202 "Smart Grids: from innovation to deployment."

[2]The databases researched were Scopus and Google Scholar. The databases were first searched in September 2017 and later in September 2018; the keywords used regarded the four themes of research proposed.

We present the keywords as follows, grouped under the number corresponding to themes introduced on p.3, and with the relative Boolean operators, when used: (a) "energy justice," "intergenerational justice" AND "energy justice," "intergenerational justice" AND "climate change," "intergenerational justice" AND "environment"; (b) "energy" AND "vulnerability," "energy justice" AND "vulnerability"; (c) "social imaginary" AND "energy," "social representations" AND "energy," "place attachment" AND "energy"; (d) "compensation" AND "energy infrastructure," "community benefits" AND "energy infrastructure." The literature found was selected and integrated with relevant literature already known by the authors.

[3]https://www.entsoe.eu

[4]In this document, the two terms are used interchangeably, as many authors seem to do; however, it is appropriate to specify that the acceptability is the quality according to which an object is likely to be accepted, whereas the acceptance is the act of accepting. It is evident that if it is questioned the acceptability of an object, consequently it will also be questioned its acceptance.

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How to cite this article: Pellegrini-Masini G, Pirni A, Maran S, Klöckner CA. Delivering a timely and Just Energy Transition: Which policy research priorities? *Env Pol Gov*. 2020;30:293–305. https://doi.org/10.1002/eet.1892