Energy Research & Social Science 79 (2021) 102191

Contents lists available at ScienceDirect

Energy Research & Social Science

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

From framework to boundary object? Reviewing gaps and critical trends in global energy justice research

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ARTICLE INFO

Keywords:
Energy justice
Literature review
Boundary concepts
Boundary objects
VOS viewer
Energy transition

ABSTRACT

The concept of energy justice (EJ) has gained importance in discussions about energy transitions, mainly due to a growing number of researchers working on the social implications of greenhouse gas emission reductions. At the moment, EJ is defined as a framework for discussing fairness in energy systems and operates as an umbrella term to signify various concerns related to energy development across diverse groups to enable communication. Thus, we call EJ a boundary object (BO) and discuss its further evolution into a standard, or its dissolution into several locally specific concepts. This study provides a systematic review of the literature that applies the concept of EJ: how its features developed and how it gained popularity in academic publications to mid-2019. We present a bibliometric overview of the number of occurrences of the concept across the literature using the Scopus and WOS databases (N = 182) and, using VOSviewer software, we describe similarities between research topics to which the concept was related. By mapping out its diverse thematic and geographic applications, we review the critical trends and claim that EJ can address real-life challenges. We submit that it will have more practical power once it starts being used more broadly to build cooperation among scholars, policymakers, activists, and grassroots movements.

1. Introduction

With projections of a steep increase in global energy consumption in the future, researchers and policymakers came to realize that moving away from fossil fuel combustion towards green and more energy-efficient economies requires global orchestrations. This, however, is difficult to achieve because it involves the coordination of national political, economic, and policy agendas [1,2]. The variety of locally and regionally expanding energy-related topics have been identified by researchers from Social Sciences and Humanities (SSH) [3] who proposed a concept of energy justice (EJ) as a means for developing common grounds for conversations in different social, cultural, and policy contexts [4,5]. We define EJ as "a framework for discussing issues of fairness between people, on both local and global scales, in relation to energy supply, production and consumption" (Galvin 2020). The EJ literature attempts to frame a concept as a tool for decision-makers, planners and policy experts to give people right to make decision regarding energy and equally share access to economic benefits of new energy systems [6–9]. This practical focus on justice is increasingly arousing global interest among scholars, which is well reflected in numerous publications that use this concept, including several special journals developed solely around it, such as *Energy Policy* (2018) [10] and *Energy Research and Social Sciences* (2016) [11].

It is clear that the concept of EJ has become significant for energy scholarship in humanities and social sciences [4,12–15]. Its ability to apply in different contexts and help dissect the justice dimension of various energy-related issues has already been noted [12,14]. However, many questions about the potential of EJ as a concept apt for grasping common dimensions of social challenges of energy transition processes remain unanswered. In the current state of the debate, we argue, EJ appears to manifest all of the defining features of a boundary object (BO) – an entity that plays a role in the proliferation and innovation of ideas or technologies across culturally defined boundaries [16]. First, it allows for coordination of energy-related research in SSH, without necessarily demanding a consensus from the researchers involved about the energy research agenda in this field of study (see Star [17] for defining features

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https://doi.org/10.1016/j.erss.2021.102191
Received 17 November 2020; Received in revised form 27 June 2021; Accepted 30 June 2021
Available online 16 July 2021

of a BO). Second, EJ circulates among various academic spaces generating more analysis of energy issues through SSH lens, regardless of the specific topic being studied or the methodology being employed. Still, EJ remains loosely defined in general use and has certain and specified uses demonstrated through particular case studies. BO is a valuable analytical device for examining the newly spreading concepts that are adaptable for new research and robust enough to maintain a fairly coherent conceptual viewpoint [18]. Thus, we explore whether the BO itself brings about some new relations in the academic field in terms of: (1) the geography of the coordinative circulation of EJ; (2) the various energy-related discourses that EJ appears within; and (3) the kinds of collaborative networks it makes possible.

As conceptual and review papers on EJ proliferate [8,13,19,20], EJ's definition becomes more stabilized. A loosely defined concept may become more standardized through common use [21]; thus, a question arises: is EJ still a BO, or is it already a standard? As a standard, EJ could, for example, become inscribed into considerable funding or educational programs. It could also become an important factor for developing agendas in academic journals. However, the opposite may occur, the definition of EJ may dissolve into many sub-definitions, and diverse research agendas practiced locally in various places around the world, are attuned to locally pressing challenges of the energy transition. An important question related to these possible scenarios for the evolution of the EJ concept is whether EJ will contribute to a proliferation of various theoretical, methodological, and practical approaches to energy problems depending on the context or whether it will lead to a standardization of research agendas and methodologies in the SSH research. We call these two diverging trends: "policization" and "anthropologization". The former signifies a birth of a new standard that may extend EJ's usefulness in the fields of national and transnational policy practice. The latter stands for a stronger contextualization of what EJ means for research partners in a given locality. Thus, the latter foregrounds the *emic* perspective over the modeling of a one-size-fits-all solution, even if that means more misunderstandings among locally embedded researchers and practitioners.

In this paper, we investigate the ways in which EJ has played the role of a BO which allowed for the emergence of research scholarship that can be re-constructed as EJ literature, without necessarily demanding any direct or consensual communication among the authors of particular texts. Our analysis also thrives on the possibility to delineate a field of research on EJ, name it as such, draw a boundary around it, and examine its structure, without ever asking all the authors whether they identify with this field, or, what this self-identification may mean for them. Thus, we see our own work as a move towards institutionalization or even standardization of EJ scholarship. At the empirical level, we explore the actors, groups or societies represented in the EJ literature with a particular interest in the questions of where the EJ discourse resonates more strongly and what its main concerns tackled globally are. In order to examine these issues, we identify clusters of topics, researchers and their distribution across countries and continents. By studying the distribution of the EJ-related scholarship, we investigate the emerging gaps and unequal distribution of interest in EJ globally and draw conclusions about the possible future of the EJ-inspired research on energy transitions.

Following this introduction, the second section offers an account of EJ's origins and discusses the main characteristics of BO. In the third section, we describe methods that we used to systematically review the EJ-related literature and continue with the presentation of results. Subsequently, in section four, we evaluate the evidence from the examined literature, applying it to our hypothesis about EJ as a BO of energy studies. The last section discusses the possibility of channelling the EJ concept into policy-relevant debates, as well as other EJ development possibilities.

2. Theoretical background: The genesis of energy justice and its status as a boundary object

The "ethical turn" in energy research has resulted in broadening the social science's scholarship towards energy issues not only by the application of social science methods but mainly by the focus on social, political, and cultural aspects in the energy field [22]. The inspiration for the concept of EJ can be traced back to the literature on environmental justice [23,24], which has specific origins in research and activism on racial inequalities in the United States of America (USA) concerning the uneven distribution of environmental risks of hazardous facilities [7,23]. Jenkins et al. [13] criticize environmental justice researchers for using the term as a label rather than active engagement in environmental and climate justice scholarship and their implementation, leading to action by influencing policy. Some potential pitfalls for EJ as a follower of environmental justice are pointed out by Heffron and McCauley [4], who highlight awaiting challenges: "This is an area where energy justice scholarship can learn and ensure that it crosses into policy – and … there needs to be clarity on the concept in order to ensure its engagement with policy" (p. 663).

EJ seeks to expand and influence policy-action while mirroring some of the concerns of environmental justice scholarship, specifically about the equal distribution of risks and benefits (distributional justice), open decision-making process (procedural justice), and the recognition of underprivileged groups (justice as recognition) [25,26]. Sovacool and Dworkin [7] argue that EJ directly draws from "these strands of thought" and involves the key elements: costs, benefits, and procedures in the analysis of energy projects. Thus, the EJ-inspired research is situated within a particular world view:

> an energy-just world would be one that promotes happiness, welfare, freedom, equity, and due process for both producers and consumers. It would distribute the environmental and social hazards associated with energy production and use without discrimination. It would ensure that access to energy systems and services is equitable. It would guarantee that energy procedures are fair and that stakeholders have access to information and participation in energy decision-making. [19 - p. 437, 22, 23 - p. 13]

Still, there are ongoing discussions concerning the benefits and opportunities that EJ can provide to different researchers in various research contexts [8,28]. One of the concerns of EJ development is an unequal distribution of case studies and empirical evidence coming from the developed and developing countries, with the bulk of studies coming from the former [29]. In this light, the use of concepts of justice, such as environmental justice, opens up further opportunities to express concerns of social groups in less powerful positions than actors who design and implement policies. The ambitious idea of EJ, that builds upon the notion of environmental and climate justice, goes beyond these justices by re-structuring and narrowing the concept, and making it more concise to fit into energy-specialized topics which would enable it to make a more substantial and targeted impact in the world's energy policy.

Taking into account all the aforementioned aspects of EJ, we argue that EJ is a BO that resides various social worlds and plays a facilitating role in the shared space between them. BO, introduced by Star and Griesemer [30], is characterized by interpretative flexibility and a structure common enough to make the objects a recognizable means of translation. "The creation and management of BO is key in developing and maintaining coherence across intersecting social worlds" [26 - p. 393]. EJ is a BO that primarily functions as a concept [31–33]; this means that it is mainly limited to a textual form but still preserves the feature to enable (re-)interpretations of reality and new narratives. They both, in turn, facilitate communication and cooperation among members of different backgrounds without forcing them to give up on the advantages of their respective and distinct perspectives [34–36]. The

scale, scope, and material/organizational structure of different types of BOs help decide whether artifacts (things, concepts, discourses, processes) can function as a BO in a particular field of action [17]. Star explains that "boundary objects are at once temporal, based in action subject to reflection and local tailoring, and distributed throughout all of these dimensions" [12–603]. This means that they are not constant and given eternally, as over time, they may become standardized and/or create residual categories, which can evolve into a new BO or become obsolete.

The focus on the development and transformative process of the boundary concept is described in landscape planning [37], although diverse areas such as educational practices, environmental studies, medicine, and organizational communication used the idea of BOs [38–40]. Recently, the "life cycle" of BOs was presented in the example of the ecosystem services (ES) concept, which explains various benefits that humans freely gain from the natural environment. For example, provisioning things such as energy and food, regulating shadow, air purification, and culture such as entertainment and aesthetics. The concept is based on market logic and has been widely discussed over the last three decades in various research areas, such as biodiversity conservation [41], landscape and spatial planning [42], and environmental management [43]. It was also utilized in practice to support public policies [44] aiming at sustainable development, such as in the process of Mapping and Assessment of Ecosystems and their Services in the European Union [45]. According to Steger et al. [46], in the first phase, ES began as a BO, with general meaning across user groups yet still allowing for local interpretation. In the second phase, standardization of ES services had been ongoing for decades, but in the United States, for example, the 2015 federal memorandum signals a renewed interest in standardized definitions and applications [46,47]. In the third phase, provisioning and regulating services received a bulk of pressure for standardization due to their material structure and relative ease of economic valuation of infrastructure. In the fourth phase, cultural services largely resisted standardization because they are intangible and difficult to quantify (residualization), which allowed them to persist as a BO.

What makes EJ into a BO is its role in encouraging researchers to develop practical frameworks that combine different disciplines [48] and providing researchers and practitioners with a common language for energy issues in various contexts. Its cohesive power, we argue, resides in its relative breadth, making EJ possible to be applied in different cases of energy transitions. The goal is to orient EJ towards action in order to make tangible changes on an international scale. At the same time, it is unclear whether EJ will evolve into a standard – a concept with a stable definition and meaning – or become strongly contextualized and embedded into local meanings and energy problems. It seems that simultaneously serving both may not be possible as standardization will come at the cost of losing contextual, local specificities whilst contextualization will make the EJ research (and concept) difficult to communicate within the policy field. While local contexts bring in some unique and irreducible empirical details, the policy field tends to operate with some context-free abstractions-standards, templates, and models applicable across different contexts. Thus, with this study, we aim at opening a discussion on the past, present, and future developments of EJ, arguing that the role of a BO achieved by EJ thus far is by no means necessarily its final stage of development.

3. Research methods

In order to provide a representative overview of a set of scientific papers on the EJ concept, we chose to use Scopus and Web of Science (WoS) Core Collection as they are comprehensive and multi-disciplinary databases of peer-reviewed scientific publications [18,49,50]. Given the academic origins of EJ, it is appropriate to anticipate a variety of uses of the concept, mainly formulated in the scholarly literature. Our research procedure was divided into two major phases and two samples: the quantitative Scopus database and the qualitative SLR sample. Data was gathered so as to include publications from January 1, 1984 to May 31, 2019.

While there has been one systematic review that fully presents the EJ concept based on 155 papers [51], and more conceptual reviews [4,12,29,52], there is no paper that employs co-citation, and co-occurrence literature review methods as well as a case-study mapping on the EJ topic. The unique aspect of this study is that our proposed framework envisions possible future developments of EJ as a BO that can provide direction, which might lead researchers towards greater openness and resistance to standardization. Additionally, we used the opportunity to discuss our findings with participants of a workshop organized by the authors within the Energy and Society Conference of the European Sociological Association in February 2021.

3.1. Sampling procedures

Our first step involved conducting keyword searches for "energy justice" in the "title, abstract and keywords" field in Scopus without a time limit in order to identify existing peer-reviewed literature dealing specifically with EJ. It resulted in a finding of 182 publications between 1984 and mid-2019 year (which we call "Scopus database sample" – see appendix A1). For our preliminary analysis, we used the Scopus analytical tool using this sample to examine the numbers of EJ papers in journals and disciplines assigned to EJ papers by the Scopus team of professional indexers [53]. With this sample, we mapped the bibliographic material by EJ research networks using the VOSviewer software [54,55]. VOSviewer automatically clusters fragmented knowledge from different domains according to their similarity and relatedness. The node in visualizations represents a particular bibliographic item, such as an organization or a country, and its size shows the counting of the evaluated item (citation or occurrence). We used VOSviewer software to perform data mining, mapping, and clustering of the papers from the Scopus sample. Authors and countries were labeled with colored circles, while the size of the circles was positively correlated with the co-occurrence of the authors' affiliations. The co-occurrence takes place when authors cooperate, co-author papers, and, consequently, appear more frequently in the same papers.

The second step, aimed at qualitative analysis, consisted of additional searching in WoS, resulting in the identification of 23 additional publications that were not included in the Scopus database. Next, we eliminated conference abstracts, book reviews, abstracts of books' chapters and four papers in languages other than English. Also, we reviewed all the papers and then noticed there was no mention of EJ in some papers included in the Scopus database, so altogether we excluded 46 texts listed in the Scopus and WoS databases. As a result, we have 159 publications directly related to our research aims which we use in further analysis (further called "SLR sample"). The flow of research sampling according to the PRISMA statement [56,57] is presented in Fig. 1 below.

By using the PRISMA statement, we provided full information to ensure consistency and completeness of the research results [56]. Then, for qualitative analysis of the SLR sample (N = 159), we prepared a protocol including 13 questions (see appendix A2). Each question was formulated in association with our research objectives and was built upon a preliminary literature review (see appendix A1). Questions sought to gather basic information about the reviewed literature.

The authors coded data independently to secure internal reliability of the process. Before the main analysis we double-coded 10% of all publications at the beginning stage in order to check and discuss the interpretations and uncertainties [58,59].

Furthermore, in the SLR sample, an explorative qualitative study was conducted. We coded all definitions of EJ that were identified in the dataset (N = 159) using the qualitative data analysis software Atlas.ti: 1) to keep order with a qualitative review, 2) to code and analyze the narratives of EJ (used words), 3) to track elements of definitions which

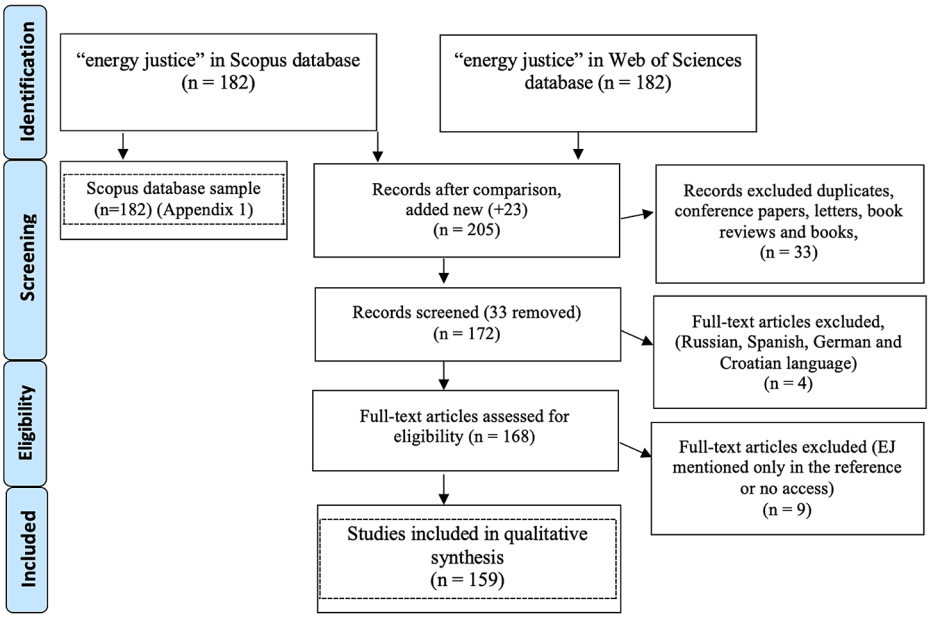

Fig. 1. Flow of research data according to PRISMA statement.

are stable/common and those which vary, and 4) to count author keywords (using crunch words function).

We also prepared visualization using the Mapchart.net [60] website to show the energy resources and EJ topics on the world map.

Additionally, comparisons of the keywords indicated by authors (in SLR sample) with the Scopus database sample were possible; as we noticed, the latter is more comprehensive (Scopus manually adds keywords based on the content of the article to improve search recall [53]).

3.2. Limitations

Similarly to other up-to-date literature reviews [61–65], our work also has several limitations. Firstly, we acknowledge that the focus on the scientific articles from the Scopus database, which does not include all works on EJ is a constraint. To minimize this limitation and to meet the criteria of reliability and reducing biases, we broadened the collections and compared papers from Scopus and WoS [66,67]; nevertheless, it still lacks series of papers not classified in the journals with Impact Factor (IF). Secondly, in our qualitative sample (SLR) we opted for reductions, i.e., we excluded chapters and conference papers (due to lack of full-versions online and no IF). Thirdly, we limited our study to papers published in English. Since English is the predominant language (with positive and negative consequences) in scientific publishing and it is even considered to be the modern *lingua franca* [68], we opted for the English language and we, thus, excluded only four texts from the list (written in Russian, Spanish, German and Croatian). We must mention that the review could differ if the analysis was based on all national/regional papers written in local languages (i.e., in the EU member states). Following that barrier, we further acknowledge that some of the writings might tackle the topic of EJ without mentioning the term (nor include the concept in the keywords). Finally, all papers were coded by the authors in task-division to verify the reliability of the coding process. This verification could be done on a bigger scale to confirm the coding process, which we completed in 2019.

4. Results

This section presents the review of the academic literature listed in the Scopus and Web of Science databases between 1984 to May 2019 and then presents the qualitative analysis with the use of the SLR sample.

4.1. Increase in the number of papers on energy justice over time

According to the Scopus analytical tool, there are 149 peer-reviewed articles, eight book chapters, seven reviews, six books, three short surveys, among others (editorials, conference papers, letters, etc.) among 182 documents published from 1984 to May 2019. According to the Scopus database, an increasing interest in EJ-related texts could be noticed between 2015 and 2019 (Fig. 2), and there are three leading journals focused on energy issues with 96 texts on EJ: *Energy Policy* (total: 37), *Applied Energy* (25) and – a relatively new journal – *Energy Research & Social Sciences* (34).

Fig. 3 demonstrates how many disciplines contributed to the EJ studies related within the 35 years. EJ combines interdisciplinary subjects, as the texts classified by Scopus are divided into study areas, such as energy (29.8%), environmental sciences (25.5%), social sciences (24.4%), and engineering (9.2%). The classification shows an equal number of publications in 3 primary disciplines assigned to the themes tackled in EJ papers. These studies could also be seen as more generally dealing with "the sustainability studies", especially if we sum up the less represented disciplines: Earth and Planetary Sciences: 2.6%, Economics, Econometrics and Finance: 2.3%, Business, Management and Accounting: 2.1%, Arts and Humanities: 2.1%, Biochemistry, Genetics and Molecular Biology: 0.5%. There is also a strong component of technical and engineering research papers within these disciplines. The results show that a broad spectrum of areas should be quickly growing into the next studies developed with the EJ concept.

4.2. Energy justice and its developing definitions

The term EJ had evolved throughout several conceptualizations from 2006 when first mentioned, to 2019, when we conducted the study. The SLR sample was used to review the concept's growth. However, between 2006 and 2011, only four papers were identified, of which three were classified as social sciences [69–71] and one as material sciences. The latter, published in 2006, had 156 citations in Scopus and defined EJ as a "global energy justice: providing affordable power to the billions of people in developing countries" [72] in an analysis of the photovoltaic (PV) electricity market and its development as a solution for rural settings. The social science papers from 2009 and 2011 used environmental justice as a baseline for the EJ topic. Then in 2012, another highly quoted paper (100 citations) was published which dealt with the

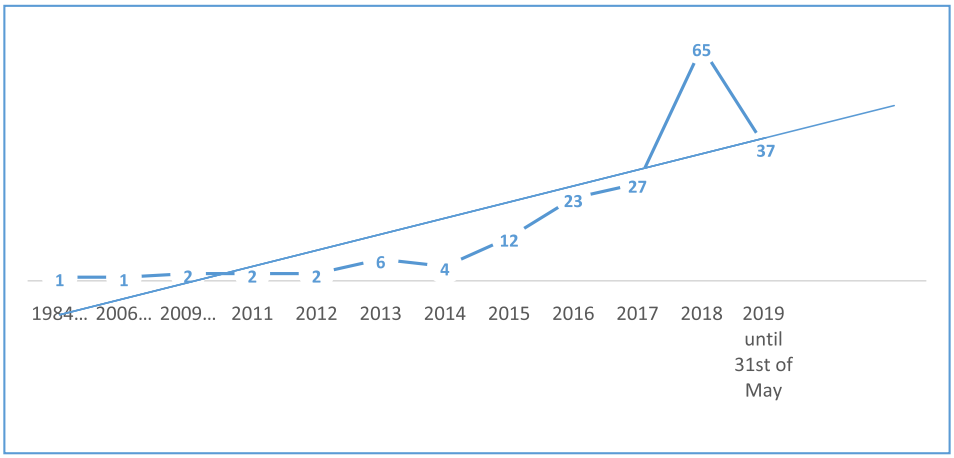

Fig. 2. Scopus database: (N = 182), The increase of documents on EJ yearly from 1984 to 2018, and 5 months of 2019.

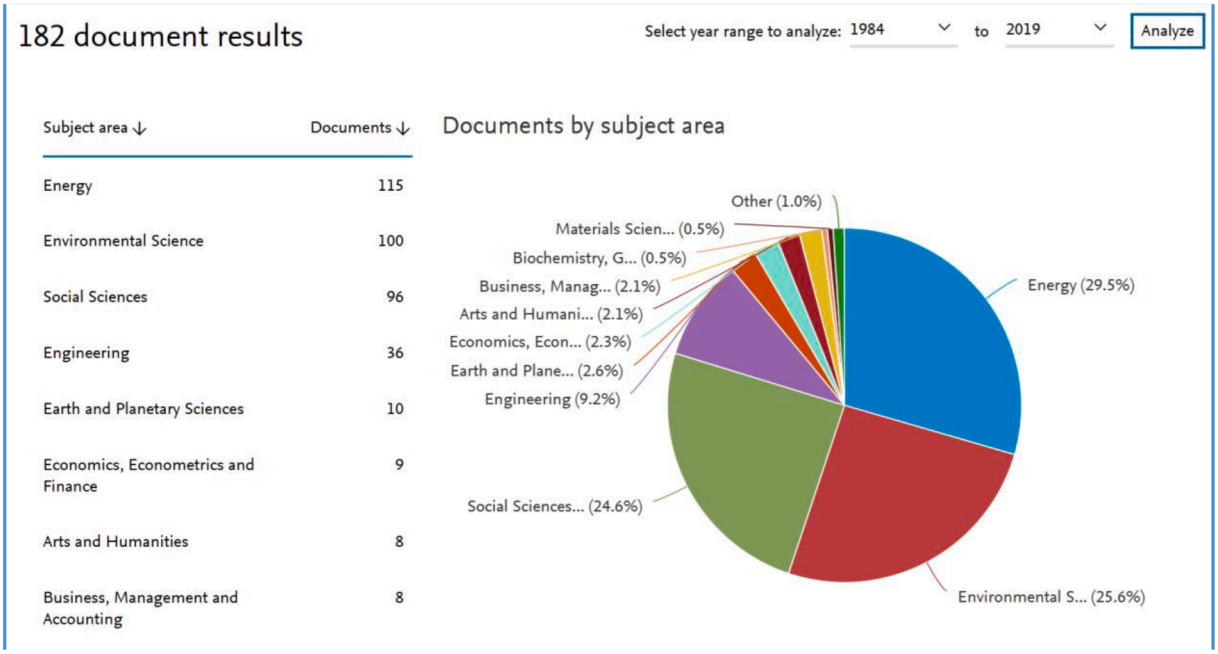

Fig. 3. Scopus database: (N = 182), Documents by subject area (source: Scopus).

challenges of energy governance, which are threefold: security, low-carbon transitions and EJ. This study put forward the thesis about an unjust global energy system that needs to be tackled with new energy policy:

> […] the global energy system is incredibly unjust, leaving billions of people without access to electricity or dependent on highly polluting traditional fuels for cooking and heating. Energy access was recently brought to the forefront of energy policy mainly by the rises of newly emerging economies in developing Asia. [73]

In 2012 and 2013, seven new papers were published. The working definition used in some highly cited papers from 2013 [74,75] (39 and 80 citations, respectively) was based on the words of the Chief Executive of National Energy Action (UK), Jenny Saunders:

> [In] the UK domestic sector context [energy justice is] about ensuring everyone can afford the energy they need for health and well-being. It comprises a range of factors which are to do with the distributive effects of how the competitive (or NOT too competitive) energy markets are working, and it is also to do with how government policies affect how energy is regulated, produced and priced, as well … as the way in which individual household reliance on energy and need comes into play, and ensuring the needs of vulnerable households are met. [74,76]

However, the content analysis of EJ definitions revealed that the most common reference (12 occurrences) is the one introduced by Sovacool et al. [19] (90 citations), who define EJ as a "global energy system that fairly distributes both the benefits and burdens of energy services, and one that contributes to more representative and inclusive energy decision making" (p. 4, see also [14,15,77–80]).

It had been slightly modified from the definition previously presented by Sovacool and Dworkin published in 2014 [28]: "we define the concept of 'energy justice' 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" [7]. What is more, Sovacool and Dworkin [7] pointed out the key components of EJ:

(1) Costs, or how the hazards and externalities of the energy system are imposed on communities unequally, often the poor and marginalized, (2) Benefits, or how access to modern energy systems and services

are highly uneven, (3) Procedures, or how many energy projects proceed with exclusionary forms of decision-making that lack due process and representation. (p. 437)

By doing this, they referred directly to the division of distributive, procedural and recognition justice.

It is noticeable that from 2013 onwards (and particularly in 2016 and 2017), most authors have acknowledged this trichotomous justice framework, drawing upon the literature on environmental and climate justice [9]. Bickerstaff et al. [81], explicitly included the topic of energy poverty in the EJ definition and characterized it as a "concept referring to the [uneven] social and spatial distribution of energy poverty and (…) the justice dimensions of (…) energy systems" (p. 2).

When tracking the conceptual development of the EJ definition, we found that EJ has rarely been described in the context of various philosophical and social traditions of thought. Sovacool and Dworkin [7] summarized the variety of ethical and philosophical EJ sources of inspiration; however, EJ has mostly drawn on the debates on environmental justice and some philosophical discussions on what social justice may entail [9,82]. Further, new inspirations are identified; for example Malakar et al. [83] use Amartya Sen's Hindu justice interpretation to study India's energy landscape and energy poverty and pursue policies that would implement EJ principles. An interesting and unique perspective is shown by Cerovac [84], who developed the question of global EJ in the light of evangelical and theological knowledge of Popes John Paul II, Benedict XVI, and Francis. On the other hand, Galvin [85] draws upon an approach to EJ through moral claims informed by Wittgenstein's philosophy.

Many papers emphasize distributive, procedural, and recognition justice, but most tackle the distributive aspects. The results show that 98 papers were based on (or at least mentioned in the research results or theoretical background) the concept of distributive EJ. In 87 cases, the focus was on procedural justice and in 76 on recognition justice. Among relevant papers, 75 of them used all three types of justice (trichotomous EJ framework), and 113 papers were also coded as "environmental justice" (in title, abstract, or keywords). However, some authors proposed new approaches using other dimensions of EJs. For example, Sovacool et al. [86] introduced a spatial perspective into a system approach to energy transitions and distinguished between energy justice tackled globally and locally. The table below presents some exemplifications of the main dimensions of EJ found in the literature (Table 1) (see also: Jenkins et al. 2016).

By showing only the most cited papers, the results presented in Table 1 are the exemplification of the EJ's concepts of flexibility and openness which are enhanced by different authors who focus on some particular dimensions of justice in the energy research. Although some standardization is recognized, EJ expands into various dimensions and covers more nuanced topics.

4.3. Keywords and topics covered

The keywords assigned by the authors also justify the rising interest in multidimensional linkages, particularly focusing on "energy policy" (52 times) and "decision-making" (19), which means that EJ aspires to enter policy discourse and decision-making processes. According to the Scopus analytical tool, the most commonly used keywords were as follows: "environmental justice" (39), "energy transition" and "sustainable development" (18), and "renewable energy" (16). According to our investigation with word crunch (using Atlas.ti) on the same Scopus database, there is also a high number of EJ papers with a connection to "transition(s)" (in 43 documents), "renewables" (together with "solar" and "wind" in 45 documents), "poverty" (in 28) and policy, law, and governance (together: 35). The comparison of both keyword analyses is presented in Table 2. It shows how the concept spreads and how vital energy policy and transitions (towards renewables) prove to be in the EJ papers.

Using our SLR sample, we also categorized the papers to check if they

Table 1
Dimensions of EJ concept based on Scopus cited quotes (*papers not in the Scopus database).

EJ -dimension/types	Example (based on Scopus cited quotes)	Author [Source]	No. Citations
Distributive justice: where are the injustices? (fair distribution)	Energy justice thus involves "choices about what kinds of energy systems to build for the future, where to build them, and how to distribute their benefits, costs, and risks"; "The distribution of energy production and use and their impacts is highly unequal, as are the resulting economic and political benefits"; "[In] the UK domestic sector context [energy justice is] about ensuring everyone can afford the energy they need for health and well-being"	Miller et al., 2013 [75] O'Rourke and Connolly, 2003 [87]* Saunders, 2011 [76]*	80
Procedural justice: Is there a fair process? (Decision-making processes)	"[…] energy justice requires the use of equitable procedures that engage all stakeholders in a non-discriminatory way"; "[…] just and equitable decision-making and results for all members of society at each stage of the energy cycle"; "[…] energy justice presents a useful decision-making tool that can assist energy planners and consumers in making more informed energy choices. It presents availability, affordability, due process, good governance, prudence, inter-generational equity, intra-generational equity, and responsibility as central energy justice principles".	Heffron and McCauley, 2014 [88] Heffron and Talus, 2016 [20] Sovacool and Dworkin, 2015 [7]	58 36 112
Recognition justice: Who is ignored? (inclusiveness)	It includes calls to recognize the divergent perspectives rooted in social, cultural, ethnic, racial and gender differences; "Beginning from the same basic assumption of interrelatedness, that meaningful recognition and fair procedures are prerequisites to distributional justice…"	Heffron and McCauley, 2014 [88] Gillard et al., 2017 [89]	58 17
Cosmopolitan/ universal energy justice	Energy justice as "including a transition from large-scale globalized markets to democratic, community-scale and re-localized economies;" "[…] approach of multinational energy justice as a means of considering justice manifestations either between neighbouring countries, or between countries that are	LaBelle, 2017 [90] Jenkins and Taebi, 2019 [91] Sovacool et al., 2013 [86]	12 0 24

(continued on next page)

Table 1 (*continued*)

EJ -dimension/types	Example (based on Scopus cited quotes)	Author [Source]	No. Citations
	geographically isolated but share common concerns or interests with regard to their energy systems and the risks they present"; "The definition for a universal energy justice stretches across countries", there is a "*trans*-boundary nature of energy injustice [which] requires a similar conception of the reach of moral and political responsibility."		
Particular/local energy justice	Sovacool, et al. (2013) introduce "particular" or "local" energy justice, which emphasizes local debate and choice. Particular energy justice relies on recognition justice of cultural and environmental factors influencing choices around energy technologies and policy preferences for the distribution of energy services.	Heffron et al., 2015 [92] Sovacool et al., 2013 [93]	60 24

Table 2
Word crunch of authors' keywords (Atlas.ti), excluding words: "energy" and "justice" and keywords from the Scopus analytical tool (Scopus database).

Word crunch of authors keywords (used with Atlas.ti)	Count	Indexed keywords (based on Scopus analytical tool)	Count
–		Energy Policy	52
		Environmental Justice	39
		Decision Making	19
Poverty	28	Fuel Poverty	13
		Energy Poverty	12
Transitions, transition	23	Energy Transitions	18
	20		
Policy,	21	Energy Policy	As
Law,	5		above
Governance	9		
Renewable	21	Renewable Energy	1611
Solar	16	Renewable resource	
Wind	8		
Climate	19	Climate Change	15
Environmental	17	Environmental Justice	39
Social	16	Social Justice,	13
Fuel	14	–	
Development	10	Sustainable Development	18

are more theoretical or empirical. More than half are coded as being simultaneously empirical and theoretical as they have aimed to develop the concept of EJ based on empirical evidence. The rest have been coded as research papers, which are either case studies (38) or theoretical overviews (37). Most of the latter were published in 2017 and 2018.

The topics covered in the examined papers address a vast array of other issues; however, they focus mainly on the problems of poverty as well as energy policy and decision-making processes related to energy transformation(s). More specifically, the main issue is the accessibility of energy in terms of fuel poverty, energy infrastructure policies, equity, and participation in energy-related decision-making processes [15,94]. Some authors discuss EJ with regard to global responsibilities for climate change as they see energy poverty being entangled into the nexus of energy security and climate change [12,95,96]. Others relate the concept of well-being with the concept of EJ; for example, Islar et al. [97] claim that EJ is about "respecting universal human rights and ensuring that every person has a right to the level of energy required to attain a minimum of well-being" (p.153). It must be recognized that EJ is not just relevant to energy transitions; however, this keyword is mostly connected to the orientation towards action – the grounding genesis of EJ [7].

4.4. Mapping the EJ concepts

We have also examined the groups of authors and countries that have created the EJ literature and studied the number of case studies carried out in their country-of-affiliation that are present in the reviewed texts (Figs. 4 and 5). In the following step, we cross-examined energy sources with the main topics of analysis and countries of each study. In around 50% of cases, the EJ concept was used in a general context without mentioning a specific source of energy, so we decided to plot on the map only those texts where energy sources were explicitly referred to.

Our results, juxtaposed with the data from the Scopus analytical tool, show that the researchers usually choose their own countries of affiliation as cases for analysis. There is a consistently high number of authors studying cases from their own countries: USA, UK, Germany, Denmark, Canada, and Australia – the only visible exception is India, which is examined by many authors from abroad (nine case studies). Most papers' interest lay in energy transitions with a slight inclination towards studying renewables in particular. Some of the country-level characteristics are noticeable; for instance, the topic of nuclear energy dominates in France and shale gas extraction in the Netherlands. However, generally, European cases examine EJ in the context of energy transitions more broadly, taking into account a diverse mix of fuels.

Renewable energy sources also predominate in the case studies from Canada, Mexico, Japan, and Sweden, which is likely connected to these countries' efforts to comply with climate change agreements to restructure their energy mixes. Australian and Chinese cases link EJ with coal, while in the USA most texts examine shale oil and gas extraction. Fig. 4 shows that renewables are also among the topics dealt with in some countries of the Global South, i.e., India, Brazil, Sri Lanka, Kenya, Mozambique. In Africa, which has a very low representation of country-cases, the EJ case studies describe energy-mix and energy transition only from South Africa, Sierra Leone and Morocco.

Additionally, we have analyzed how EJ papers differ regarding of relevant topics, and aspects of EJ tackled across countries and continents. In the United States, EJ research is extensive and complex. Besides studying poverty and inequalities in energy systems, the papers tackle the problem of energy efficiency [98,99], clean energy, and energy consumption [100,101]. Moreover, energy innovations, like compact fluorescent lamps, are analyzed, but also new energy systems or even bitcoins, and the issue of the privileged access to natural resources, [98,102] are subjects of studies. A large number of papers discuss the processes of public engagement [103], the role of activism [78], and methods such as public deliberation workshops [104] or participatory action research [105]. Similarly, in Canada and Australia, papers cover the themes of environmental activism and look at the activities of non-governmental organizations [78]; however, interestingly, they also focus on individual values in the case of heating and renewables [106,107]. In addition, in the United States and Australia, the EJ-related papers highlight some of the precautionary measures, hesitations, and technological risks related to nuclear power and waste repositories [71,102].

The majority of European case studies driven by the EJ concept concern energy transitions [108–112] and just transition [113,114], whereas the second most popular topic is energy poverty presented in its various dimensions, such as fuel poverty [115–117] and, more specifically, household-level energy poverty [118,119], gender differences in relation to energy supplies [77], as well as the children's position, low-income or families that have members who are living with disabilities

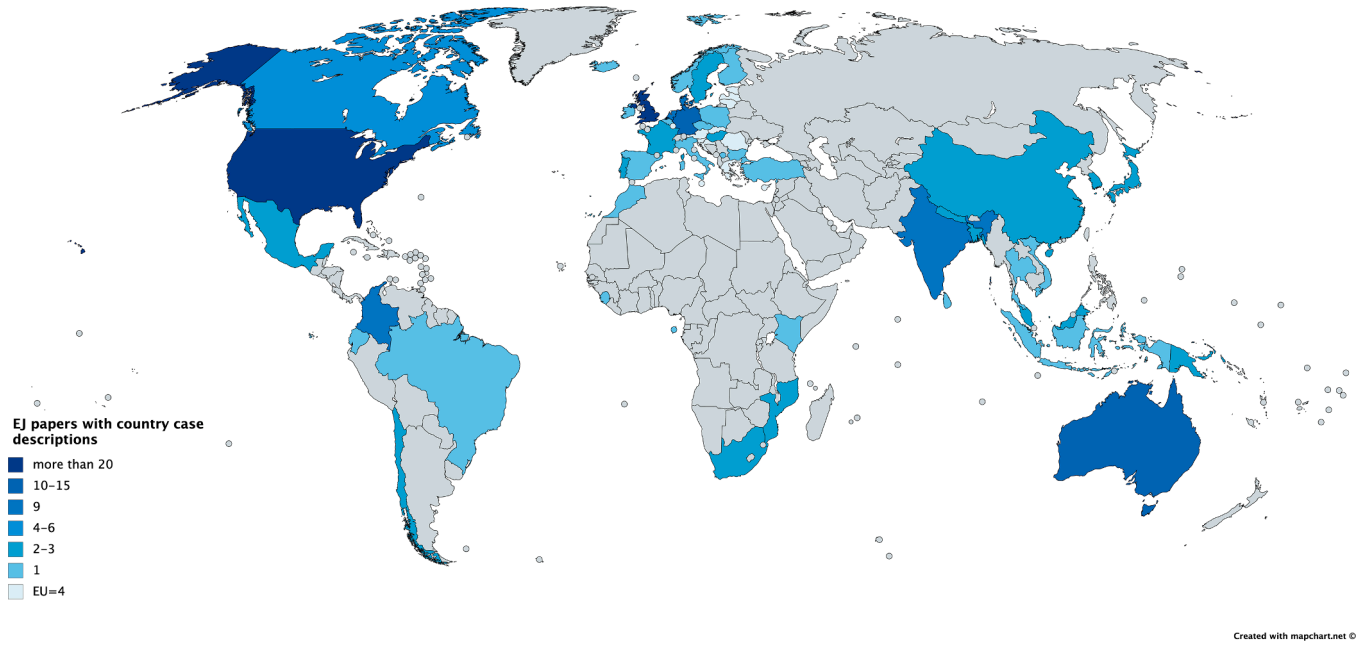

Fig. 4. Mapping of EJ papers (own analysis, used: mapchart.net).

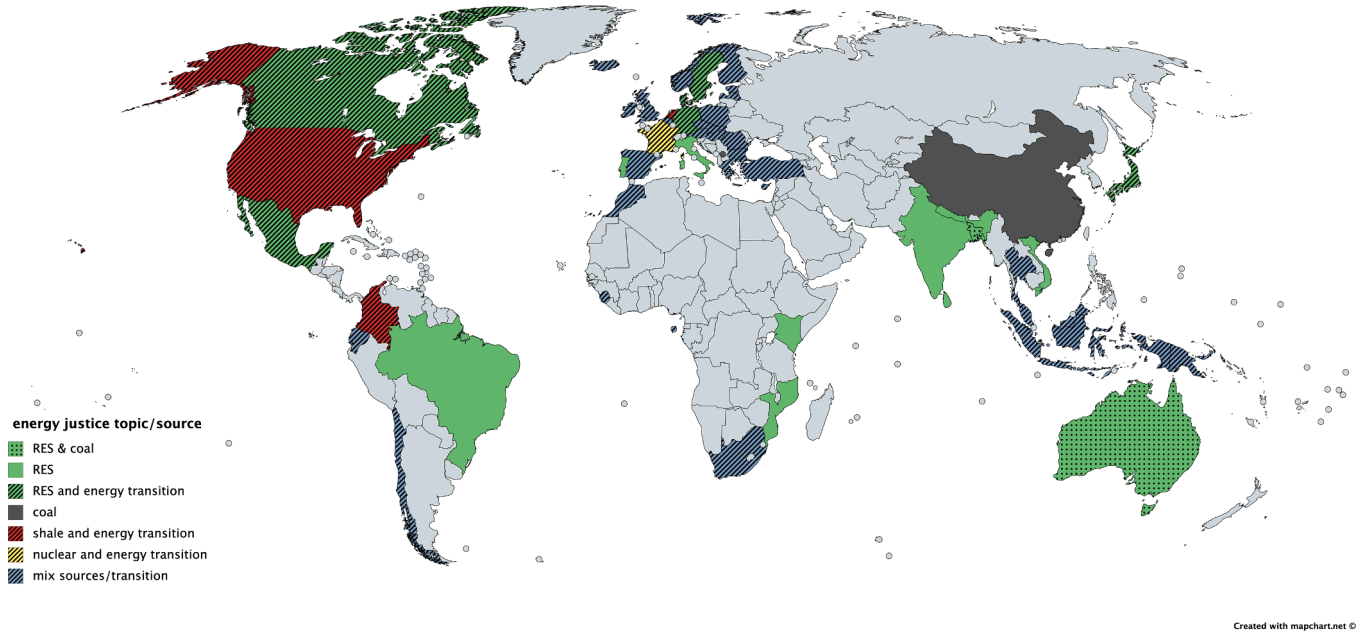

Fig. 5. Topics (energy sources) covered in EJ cases (own analysis, used: mapchart.net).

[89]. The analysis shows that governance [120], energy policy [90], and specific aspects of legislation [13,101,121] are gaining significance and are often examined under more general frameworks of sustainability and sustainable development goals in Europe [112,122,123].

In Asia, the dominant problem is air pollution which is a consequence of power and heat generation and industrial processes [124,125]. India's main interest lies in solar energy infrastructure and innovative renewables [126], but it also involves conflicts within local development projects and the marginalization of lower status groups [126–128]. Similarly, the problems of EJ in Korea and Japan are tackled through the cases of social and environmental inequality [129,130], and social peripheralization within nuclear policy [131]. The developing countries (Global South) are presented through issues such as climate justice, "common but differentiated responsibilities", and climate refugees [132–134]. It is worth noting that Australian and US studies focus on new, innovative technology, and energy solutions as well as more advanced techniques of social inclusion and participatory action methods. American fuel poverty is presented in the context of energy efficiency [135]. Contrarily, other countries, which could mostly be identified as the Global South, seek to develop the concept of distributive justice, and analyze the issues related to human rights and marginalization in the context of EJ [70,136,137].

What is more, our results further show a relationship between countries and the number of EJ publications. Authors affiliated to institutions in the UK, Denmark, the USA, and also Australia, Japan, Germany and the Netherlands represent the majority of publications published between 2012 and 2019. However, starting from 2018, the EJ papers have expanded beyond these countries. Through "the document

co-author visualization" in VOSviewer, we show the author-research network (Fig. 6). The minimum number of documents per author was set to two to build a co-authored visual network map of 43 items from 343 (17 of which are not connected). The largest set that is connected (through linking co-authorship) consists of 51 mainstream authors from a total of 343 authors in the Scopus database [55].

Two types of evidence are observed based on the VOSviewer analysis. First, 3–4 core authors managed to establish extensive research connections. Their cooperation started in early 2016 and remained very productive in 2019. Second, other collaborations have emerged but gathered fewer connections and resulted in fewer publications in total. Fig. 7 displays the collaboration between research networks with the account for their country affiliations, the number of papers, and the year of publication. The minimum number of documents and citations for each country was set at two, so a map with 18 items and 58 links was generated. This country-based research and affiliation analysis have shown that the EJ concept is gaining a greater global scope (new cooperation of researchers from Spain, South Africa, Japan, Norway, China), but major dynamics are still located in the USA and the UK.

4.5. Types of boundary objects and their life cycles

Star and Griesemer [30], and later Star [12, p. 605] strongly stressed that BO is not (only) about interdisciplinarity but it primarily enables a processual "tailored" collaborative work between groups without requiring them to reach a full consensus concerning the kind of work they do and how. Moreover, BOs evolve and, according to Star [17], have their own life cycles, which gives a clear sense of the fact that not all objects are BOs and that a given BO may not maintain this status permanently. There are also particular types of BOs, which helped us to grasp some more nuanced functions of the EJ concept analytically. Based on our qualitative analysis carried out on the SLR sample and through google search, we were able to identify four different forms of EJ as BOs: (1) a repository, (2) an ideal type, and (3) a coincidental boundary, while (4) standardization of EJ has not been identified fully yet (Table 3).

Star [17] sees these types as potentially occurring simultaneously, rather than being exclusive, while a BO transforms. The history of the EJ concept that we reconstructed in our analysis, and especially in the context of global efforts to reduce carbon dioxide emissions, shows that EJ first appeared as an ideal type with the postulates of distributive, procedural and recognition justice, and it still is the most prevalent and noticeable form of EJ in the academic literature. As such, it provides a general framework that might transform into a standard for SSH research on energy, but, according to our analysis, it still maintains flexibility and "openness" for various case studies (i.e., particular energy justice). Secondly, in many papers, EJ's definition is "taken for granted". In these cases, EJ helps to establish coincident boundaries between technical or economic studies of, e.g., energy prices, fuels, geology or technology, and SSH studies by providing a common dimension for the analysis – problems of justice and ethical issues. Also, the literature that we reviewed revealed an interesting journey that the EJ concept has made from the Global North to other regions, introducing connotations of global responsibility, sustainability and human rights. Moreover, it logically follows that research organized around the concept of EJ triggers participatory types of engagement in the field which may result in a growing awareness of people's own rights and due processes. EJ has also been used in research which enabled to communicate problems related to energy systems differently perceived by various stakeholders. Lastly, going beyond the literature that we studied, EJ has also appeared as a common phrase used by activists and grassroots movements located mainly in the USA active in primary social media such as Facebook, Twitter and Instagram: "Energy Justice is the grassroots energy agenda, supporting communities threatened by polluting energy and waste technologies" [138].

We call EJ a repository for shared understanding, as it is used by communities to map out all of the existing, proposed, closed and defeated dirty energy and waste facilities in the United States. As a repository, EJ allows for storage and further dissemination of information through social media of the Energy Justice Network, the aim of which is to collect data for further actions in policy movements. This, in turn, might present additional opportunities for professionals who organize expert help to provide communities with just and equal rights in the transition away from fossil fuels. For example, there is a group of lawyers who established the "Initiative for energy justice" that aims to: "(1) contribute to a bottom-up movement of energy justice …, (2) provide city and state policymakers with concrete energy policy frameworks and best-practice tools that foreground equity in the transition to renewable energy" [139].

At times, EJ may also be organized as a standardized form with some principles, agendas, or practical applications and recommendations for the future, but this is mainly led by the central academic researchers, such as Sovacool [86], who proposed the eight-principled decision-making framework.

We have also come across re-conceptualizations of EJ that attempt to stretch its definition beyond a topic-country scale towards regional

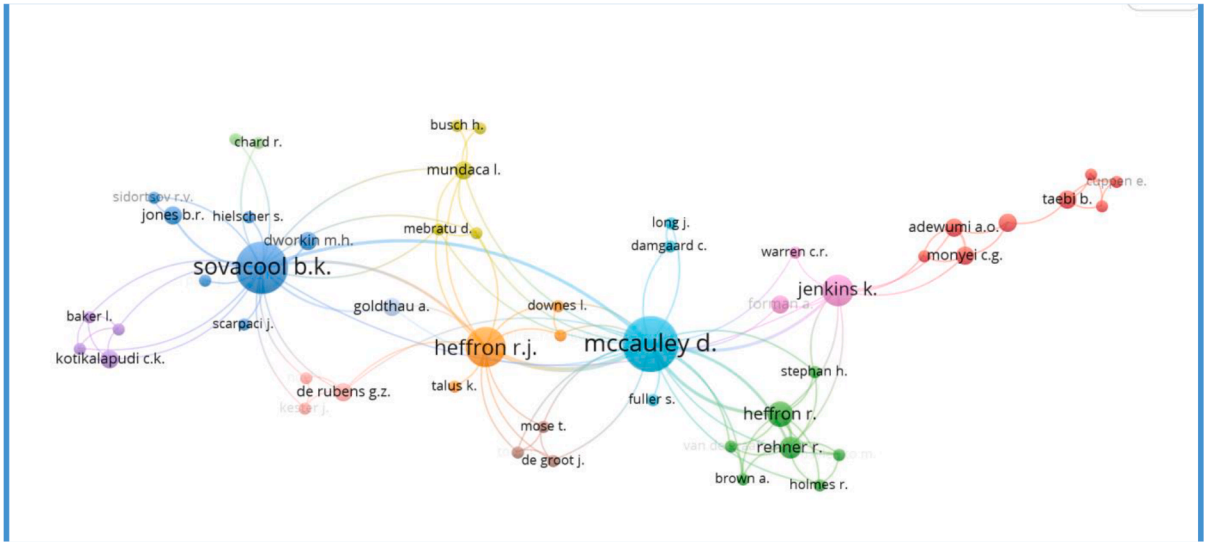

Fig. 6. The core network of co-authorship; node size indicates the number of papers (used VOSviewer, N = 182).

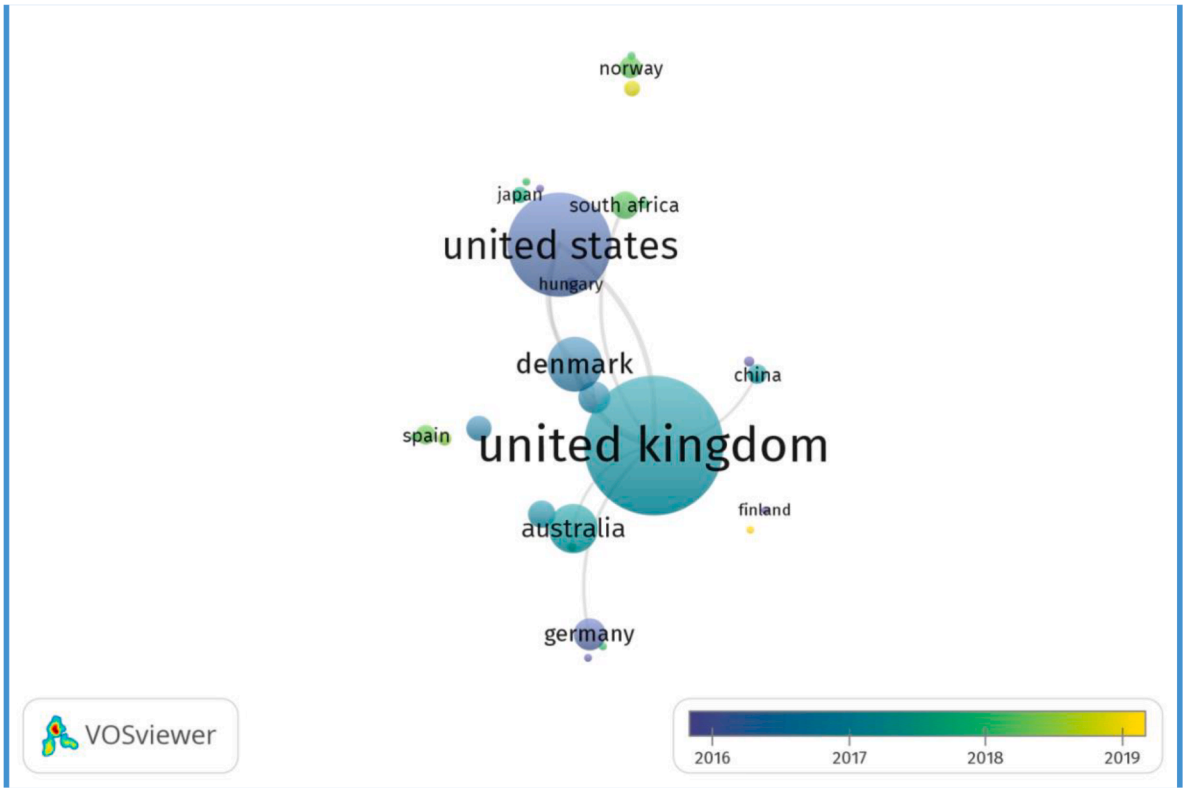

Fig. 7. The network of EJ-related research collaboration (used VOSviewer, N = 182) three-dimension: country affiliation, number of papers (node size) and year of publication (node color).

Table 3
Typology of EJ as boundary objects with relevant examples.

Types of boundary objects/concepts	Examples of Energy Justice
Repository: ordered storage of objects/concepts	In this case, EJ functions as a boundary concept that provides an overarching framework for collecting energy injustice cases. A good example of this is a website launched to inform about the "existing, proposed, closed and defeated dirty energy and waste facilities in the US". See: https://www.energyjustice.net/index.php/
Ideal type: an abstracted description of a concept which can be detailed and adapted	Researchers use EJ as a boundary concept according to the definitions provided mainly by Sovacool et al. [19] and other "core" researchers of EJ, (i.e., Sovacool and Dworkin [7], Jenkins et al. [12], Heffron and McCauley [4]). It is used as a framework/tool for studying and comparing particular cases in particular contexts.
Coincident boundaries: objects/ concepts having some boundaries but different internal contents	In these cases, the definition of EJ is usually "taken for granted," and the concept itself is adapted to particular cases and colored with their specificities, e.g., price, fuel, technology.
Standardized forms: Templates and rules that are commonly understood and followed	We argue that EJ has not yet been widely recognized as a template or a rule for organizing energy transitions locally, regionally or at the global level.

perspectives. It appears that in such cases, the ambition is to gain validity for discussing EJ at the broadest scale possible – preferably globally [12,140]. Nevertheless, the results of our analysis show that EJ is used primarily by the researchers from the Global North with a vast overrepresentation of researchers from the UK and the USA, thus making the perspective limited to the biggest, wealthiest, and most influential research institutions. However, despite this concentration, some peripheral groups have emerged as well. They often work towards adapting the concept of EJ (back) to their country-specific contexts, but not exclusively: some also reflect upon the universal, global aspects of energy justice [78,141,142]. At the same time, irrespective of the scale or the context, EJ tends to be referred to when some groups of actors look for restorative measures to make energy more accessible, affordable (due process, etc.) [86], and suitable for them.

Analyzing the spectrum of theoretical extensions of BO, Huvila et al. [143] identify the tendency from the exercise of control over other communities to acceptance of one interpretation of the concept and the evolution towards tolerance of internal change within the object [144,145]. The EJ example indicates the process of interpretations and translations in one community (i.e., academic) that transforms knowledge into differentiated views and ideas that expand into an agency of activists [146]. However, this is not an absolute path of evolution since, as Star [17] indicates, a thing can be formed as a BO in one type of its form (i.e., repositories) or in between social worlds by connecting the types (i.e., ideal types and repositories, academics and decision-makers or activists). Over time, BOs can become standardized, generate residual categories (that do not fit), and the latter may begin a new cycle of the BO development. Thus, what matters the most is the "movement" around the object/concept that "forms boundaries between groups through flexibility and shared structure – they are stuff of action" [12 - p. 603].

5. Discussion: Value added of BO

Our analysis has revealed a growth in the number of EJ-related papers in journals such as *Energy Policy*, *Energy Research and Social Sciences,* and *Applied Energy* over time. Considering the urgent energy transition needs, we presume this is a stable trend that will continue. The qualitative analysis of how EJ definitions have developed over time, revealed

that, although the core definition has remained quite general and constant, some new aspects have been added along the way. The concept's flexibility is proved by the ability to change while adjusting to local contexts. For example, the triple tenets of EJ have sometimes been accompanied by the "universal" or "cosmopolitan" notions of EJ, and "recognition justice" has been amended with the philosophical concepts of equity [53,83]. A relatively high level of discussion of each of three justice tenets proves the concept's evolution as attention has extended beyond the unfair distribution access to secure, affordable and clean energy supplies to probe why these occur. The application of EJ has also been quite extensive: from a local to a global scale, from particular local environments' plans to universal perspectives; however, the direction towards standard or proliferation of the concept is unsettled.

By showing the expansion of the EJ concept in many narratives in a global context, we claim that the scope of EJ is growing and that flexible adjustment of the concept to different contexts seems to be its strength. EJ maintains its coherence because its scale allows for cooperation and group communication. We stress the added value of the BO notion: its life cycle can be used to pose some hypotheses concerning the potential directions of the EJ transformation. The key issue here is the interplay between standardization and diversity of contextualized definitions and uses of the concept. Star [17] says that over-standardization implies the death of a BO, but in the case of EJ, this could imply a huge gain for the policy field – a gain of a standardized, abstracted notion of energy justice that can be implemented across different contexts. Therefore, we hypothesize that the future development of EJ may take either of these two directions: a greater contextualization into distinct and often distant geographical locations or standardization that would make EJ amenable in the field of policy action.

5.1. Geographical growth

Currently, the EJ research in focus is relatively centralized, which may be seen both as a positive and a negative aspect of the emerging field. On the one hand, the centralization of EJ research seems to provide some cohesion to the field of SSH research on energy, for example, by giving a relatively consistent definition of EJ. On the other hand, there are a few very centrally positioned scholars from the US- and UK-based institutions who investigate the issue of EJ. These scholars already play the role of the "academic trend-setters" and by concentrating EJ research within their hands – as MA thesis and Ph.D. dissertation supervisors, research grant PIs, editors, or reviewers – they may contribute to a growing standardization of the EJ concept and research unless they include contextualization of EJ and diversification of EJ research in their academic agenda. The latter would require greater involvement of "organic academics" from all over the world into EJ research through research grants' collaboration, invitations to contribute to edited volumes, or special issues of the most major journals. Based on our research, we can already observe that the concept of EJ shifts its meaning as it travels across different geographic spaces. A more organic, diverse, and dispersed development of EJ in various places worldwide may enrich communication and provide new dynamics in how the concept may grow beyond the regional-focused research networks.

Some of the analyses indicate that a division between countries, such as the West-East and South-North divides, results in the EJ development that does not suit local and regional contexts. Since the recommendations on how to implement EJ derive mostly from and for Western countries without much implication on the decision-making processes in the other parts of the world, the "western" mainstream understanding shapes the background of the concept and making it less easily "transferrable" to other cultures [14,83,147,148]. Malakar et al. [83] pointed out that EJ tackles justice issues and policies without the possibility to develop it globally, such as in India. For example, energy poverty is present in most papers across the continents, but the solutions and practices are not universal. Many scholars using the EJ concept share the ambition to make it broader and more globalized, yet the challenge is to transform ambition into action towards EJ-variety research cooperation and accumulation. International groups of researchers should work on EJ with the same significance in different places of the global system [8,12].

5.2. Action-oriented cooperation

Almost from the very beginning, EJ has linked conceptual and practical work aimed at building a more just energy future [12,82]. However, the practical usage of EJ requires further development to facilitate a broader space for thinking about and enacting the just and ethical arrangements in different contexts of energy production, consumption, and distribution [11,19,74,140]. Thus, EJ as a BO in the life cycle of change may, with time, become more involved in connecting the scientific and practical fields of energy transition. We argue that one way to achieve this is to organize more opportunities for the non-expert stakeholders and grassroots activists' involvement in debates on EJ [94,140,149,150].

Although it is an extremely demanding task for scholars to shift their approach towards policy-oriented action and activism, we can already see some signs of such engagement [29,94,151–153]. For example, EJ has been referred to in some of the high-level strategic programs or guidelines of various institutions and organizations, such as the Sustainable Development Goal 7 (and also SDG 12–13 and 15–17) and energy policies [141,142,154]. However, EJ could still play a more vital role in facilitating legitimate interventions of social scientists into energy-related processes and providing non-academic actors, such as policymakers, professionals, activists, local groups, with tools to debate the non-technical dimensions of the energy transition. As Hall [74] suggests, besides sharing information and knowledge on energy issues, more openness about energy production could help reduce some of the injustices currently caused by the lack of visibility [155]. This includes the new studies of gender-energy nexus [156,157]. The expansion of EJ in the fields of energy practice could also cause a greater integration of gender issues, as well as to account for national or local minorities and refugees.

Following Jenkins et al. [28], who have recommended that the academic community should think over their role in making EJ more impactful, we can also see the potential to cooperate with different "communities of practice" to enlarge the scope and scale of EJ. As our analysis has shown, EJ as an "ideal type" is open to scholars with prior experience in research. Thus, there is little transfer from academia to other groups. At the same time, what seems optimistic, is that equity, inclusiveness, and justice have recently been taken into consideration more often in energy policy and decision-making processes [5]. Gaining social acceptance for energy transition and enabling a broader implementation of this project will require deploying the concept of EJ by researchers together with activists. The use of participatory methods, such as Participatory Action Research [158,159], would provide new insights of experts, scholars, and activists working with stakeholders in engaging energy projects. NGOs, and business-oriented companies are the potential allies in providing support for the concept of EJ to start to operate in settings other than academia. Overall, from the very beginning of EJ's conceptual existence, it is important to understand what it does and not only what it is [7]. Researchers should be more focused not only on applied research but also on communicating their research projects and results with the selected groups of actors.

6. Conclusion

The literature overview through the SLR and bibliometric analysis of the EJ concept has shown the current trends in the academic field(s) discussing energy transitions. Not only did we reconstruct the most significant issues occurring in the literature, but we have also identified the most recognizable research networks indicating cooperation in the EJ-related research.

Although we acknowledge a number of limitations, we have presented the results of our analysis based on highly ranked academic journals included in the most important academic databases as these are the mainstream outlets for the discussion on EJ. After having developed a core definition based on distributive, procedural and recognition justice, EJ started a journey beyond the narrow network of the UK- and US-based researchers who had worked out this definition. As our study has shown, the core definition is robust enough to grant some stability and coherence to the EJ concept when applied in the studies of energy issues in different contexts and by researchers from outside the UK and US academic institutions. The centralization of the research on EJ has its historical dynamics; however, its resistance against standardization is visible. The EJ travels from the Global North to other regions, giving it some new connotations such as global responsibilities, sustainability, and human rights. At the same time, our analysis has revealed an interesting flexibility of the EJ concept that opens up more opportunities for further adaptations to the locally-specific case studies.

EJ is undoubtedly already a BO that has successfully coordinated research on energy in SSH without necessarily demanding a consensus among the researchers involved. Our analysis has shown that the future of EJ is marked by two tendencies that may currently be observed. Firstly, there is a push towards standardization of research and debates on energy in SSH that eagerly draw on the concept of EJ and try to turn it into a standard concern or perspective for SSH engagement related to energy transition through research as well as through interventions into the policy field. This may be called "policization" of EJ, which would imply a BO's transformation into a standard that can be used beyond academia, especially in bureaucratized settings of policy arenas. This can already be observed in the work of some NGOs and law companies. Secondly, there is a call for greater contextualization of what EJ actually means for people in particular localities, which, for example, has been expressed during the 5th Energy & Society conference (2021). This "anthropologization" of EJ would imply its dissolution as a BO into various *emic* definitions, an opposite direction than standardization, which some would welcome. Additionally, there is also an idea that the concerns highlighted by EJ research should be connected "back to the old" concerns represented by the research in environmental justice. Although this has not been directly concluded from our analysis, during the workshop, we have observed a strict divorce between: 1) the growing specialization of EJ, and 2) its standardization, which, as some argue, may harm the studies on energy transition. Thus, we argue, the two tendencies, namely standardization and contextualization, currently dominate the discussion on the EJ's future. However, it remains uncertain where the strategic decisions of the centrally positioned actors and those placed in less central positions will take the EJ as an object constitutive of new and important SSH research on energy.

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

This work has been funded by the European Union's Horizon 2020 Research and innovation programme "SECURe – Subsurface Evaluation of Carbon Capture and storage and Unconventional risks" (grant agreement number 764531 at Institute of Ethnology and Cultural Anthropology, Adam Mickiewicz University in Poznań), and National Science Center, OPUS "Powering the world: STS and anthropology towards social studies on new energies" (grant number 2017/25/HS6/00880). Krzysztof Mączka is supported by the Foundation for Polish Science (FNP).

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