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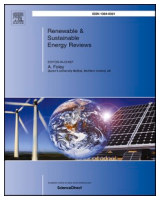

Thirty-five years of research on energy and power: A landscape analysis

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ABSTRACT

The urgent need to mitigate climate change and decarbonise the energy sector brings the risk that wider social and environmental concerns about the sustainability of energy systems are neglected. Countries may achieve decarbonization goals while reproducing or worsening the unequal distribution of access, opportunities, costs and burdens that is inherent to current energy systems. This study is motivated by the tension between visions for change towards sustainable energy systems and historic and contemporary inequities on the ground. The study contributes a quantitative, global-scope overview of existing research that places energy users and their lives at the centre of analysis for inclusive and equitable transitions. It further identifies the themes, concepts and perspectives that dominate scholarly debate and analyses the presence and relative influence of work that explicitly considers relations of power. The stepwise review uses the Scopus database and multiple bibliometric tools, covering the period until June 2022. It adopts a novel approach to identify dominant and marginal topics, geographical contexts and theoretical lenses employed including the uptake of critical social science approaches. The results indicate that dominant studies fail to engage critically with relationships of power. Even within the debate on "energy poverty", work based in critical theory approaches account for less than seven percentages of the total body of work. For work on "energy justice" and users, four percentages of publications account for gender. The dominant language is technical and depoliticized. The study identifies research gaps and promising avenues for further research.

1. Introduction

While there is growing recognition in international political arenas on the urgency and need to speed up energy transitions to curtail greenhouse gas emissions into the atmosphere, these transitions bear an inherent risk of exacerbating entrenched power dynamics, inequality in resource access and exclusion in decision-making spaces. In a sector predominantly occupied with material power, it is a paradox that power in the social sense is almost totally missing – how and why is that? Energy and climate justice scholars and practitioners worldwide have documented that the users (including women and other socially marginalized groups), communities, organisations and countries that are worst affected by accelerating climate change are largely absent in the decision-making spaces that could most effectively reduce emissions, leading to uneven distribution of costs and benefits [1,2].

Multiple overlapping research fields all speak to the issue of inclusive transitions to sustainable energy systems. Yet, there is currently a lack of comprehensive literature reviews that provide a global-scope overview of research on energy users explicitly viewed through a power lens. This knowledge gap hinders efforts to effectively rectify existing injustices in energy systems across the Global North and South and identify strategic points of intervention for inclusive and decarbonized energy futures. This review makes a contribution towards filling this gap by using database searches, bibliometric and spatial analysis, to quantitatively characterise the state-of-the-art in user-centred work on inclusive energy transitions.

Specifically, the study seeks to answer the following two questions: first, what is the state of research that aims to describe, understand, and inform inclusive and equitable transitions to sustainable energy systems from a user perspective? Second, how prevalent is the explicit consideration of power relations and exclusion mechanisms? These questions are addressed using a nexus-approach to identify the intersection across

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multiple bodies of research. This methodological approach is developed specifically for the scope and core concerns of the review and offers novel insights into connections across debates and fields, dominant and marginal topics, geographies and theoretical lenses employed.

The literature search used the Scopus database to identify trends in anglophone scholarly work and the relationship between different strands of work. The geographical scope is global and the analysis uses multiple tools for filtering and representing results. What emerges from this is an overview of the temporal, spatial and relational landscape of scholarships on energy transitions from a user perspective that helps elucidate both where the debate is concentrated and the degree to which power relations are given explicit attention. What comes further into view is knowledge gaps where evidence is either scattered or conspicuously absent.

Through this approach, the study makes a distinct and novel contribution by elucidating the global contours of research on inclusive and equitable energy transitions, thereby providing the research community with a clear picture of dominant perspectives and knowledge gaps that need addressing. In-depth analysis of thematics and findings within the bodies of research that make up this landscape is outside the scope of this study and an important avenue for further work.

This analysis is motivated by the tension between the risk that energy transitions, even if countries globally achieve decarbonization goals, reproduce or worsen the unequal distribution of access, opportunities, costs and burdens [3], and the possibility for transformative change that leads towards more equitable futures, envisioned in phrases like "just transitions" and "energy justice". Research in the fields of innovation and sustainability transitions, historical energy studies, and science and technology studies, have and continue to show that attempts at rapidly transforming energy sectors are shaped by historic and current injustices inherent to the sector. While this transformation itself will likely both generate new losers and worsen the situation for many people now experiencing energy poverty [4], the envisioned deep transformation [5] also represents both a need and opportunity to strategically address inequities and incrementally or radically move in new directions, towards alternative energy futures.

Beyond the research community, the study holds relevance for two groups primarily: policy makers and research funding agencies. The identification of knowledge gaps, geographical distribution of work and concentrated areas of debate informs policymakers on crucial points of intervention, aiding the formulation of regulations and standards that foster inclusivity and mitigate existing injustices. The review highlights areas where a stronger evidence base is needed to ensure that energy transitions effectively reduce emissions without perpetuating existing disparities. As various entities collectively strive for the ambitious targets set by the United Nations Sustainable Development Goals, a rich evidence base can help navigate the complexities of energy transitions on a global scale while recognising context specific preconditions. The overview of the research landscape can inform research funding agencies how to target their resource allocation and direct resources towards prioritized areas for better informed policy to improve the overall effectiveness of energy policy.

Section 2 accounts for the methodology employed, and strengths and limitations thereof. Section 3 is the result section that provides the mapping of the research landscape, organised around four thematic clusters that are used to systematise the search and identify work that apply a power lens to users in energy transitions. These four clusters are analyzed in turn for: the relative size of the broader research that is captured in the search and the sample within it that is explicity applying a power lens; trends in publishing; dominant language and prevalence of specific theoretical perspectives. The last sub-section 3.5, analyses the clusters geographically, mapping what world regions that the studies concern. Section 4 provides the Discussion which answers the research questions and discusses the findings. Further, it returns to study limitations and outlines key areas for further research. The final section 5 concludes.

2. Methodology

This review study uses database searches, bibliometric and spatial analysis, to characterise the state-of-the-art in user-centred work on inclusive energy transitions. The methodology provides a meta-level analysis of how thematic clusters and bodies of research relate. The motivation for a global geographical scope is the explicit attempt to balance the colonial heritage in whose work gets read and cited [6] by striving for equal attention to work on and from low- and middle-income countries. Temporally, the oldest article of relevance to the energy policy-energy use-gender nexus is from 1987 [7] up to work published in 2022. The study was carried out stepwise, starting with a literature search in the database Scopus, undertaken first, in August–September 2021, and second, in May–June 2022. This database includes articles, conference papers and book chapters from indexed journals, conferences and publishing houses. It excludes for example work published in predatory journals, non-indexed journals and conferences, and working papers. The drawback of using Scopus is that it excludes reports and studies published by non-academic institutions that may still be of high quality and expert reviewed. A tool like Scopus also reflects the historical dominance of Western research institutions setting standards for "good" research as well has having the resources to carry out research that meet those standards. Another obvious limitation is that the search is delimited to the English academic literature. Further work could complement this study with considering other types of publications and languages.

The literature search is undertaken based on a "nexus-logic". This means that the methodology is tailored to accommodate the multidimensional character of inclusive and user-centred energy transitions. There is more than one possible starting point, and these are complementary. Reflecting this, the searches use combinations of key words that come at the nexus from various directions. Fig. 1 shows the four thematic clusters that provide the chosen entry points into the research landscape: users, exclusion, gender and policy. These four are motivated by, first, the primary lens being user-centred work. Second, interest in inclusive transformations is premised upon historical and current exclusion, which is the underlying problem. Third, gender and biological sex remain central to understanding exclusion in the energy sector, prevalent both as explanatory factors and social categories. Fourth,

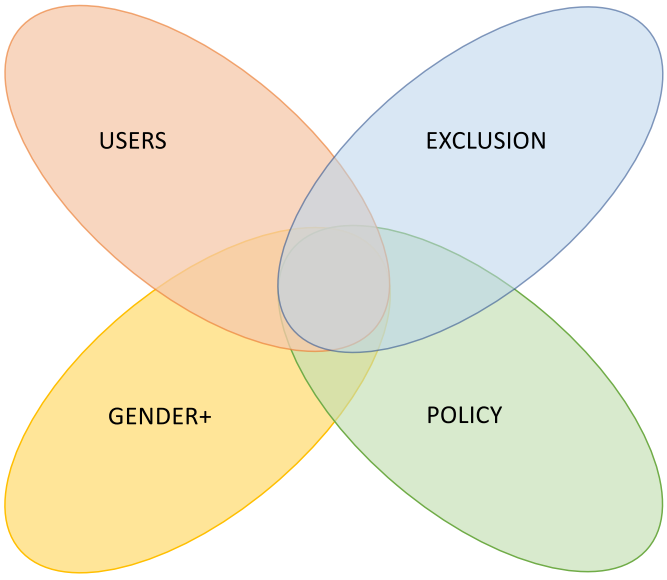

Fig. 1. Thematic clusters in the study. The overlapping area in the middle is where the main focus lies, and searches are tailored to identify work at these intersections. Gender + signifies the expansion beyond gender to intersecting power relations.

policy is here understood as a key mechanism and arena that shape directionality in change processes.

For each cluster, the search went from broad to narrow, using keywords to capture a main body of work, to which were added more specific keywords to narrow the search towards the intersecting nexus area between the clusters. All searches initially covered title, abstract and keywords. For each cluster, multiple variations of search strings were tested and compared for the most effective search, to ensure the net was wide enough to catch relevant work, and specific enough to avoid exaggerated number of hits. Whereas "energy policy" is straightforward as a keyword, capturing only work centred on "users" proved very difficult. The initial searches for the user cluster thus cast a broad net with variants including "use", "access" and "demand". It was hard to capture a focus on energy system transformation, as the term "transitions" is not widely used, but "renewable energy" or "sustainable energy" generate many hits. Therefore, transformation/transition is not used as a cluster as such.

Having identified appropriate clusters and search strings, the next step was to identify a suitable lens for capturing work that has a strong theoretical grounding in power sensitive perspectives. This research makes up a small part of the wider sample, but it is the intersecting area at the centre of the nexus. This lens is operationalised as a string of keywords taken from critical theory in the feminist, anti-racist and decolonial traditions which explicitly deals with aspects of social difference and power relations. In the following, it is labelled the "Power lens" (gender OR feminist OR intersectionality OR empowerment OR "indigenous people" OR decolon* OR queer OR LGBTQ) and it is used to narrow down each cluster. The effectiveness of the Power lens was then tested which showed the importance of going beyond gender as sole denominator for power relations. Primarily the term "indigenous people" increased the number of hits as it comes up in various discussions on land acquisition for renewables. In some instances, adding "women empowerment" as a search term improved relevance of results, and Table 1 indicates where it has been found relevant and precise enough to include.

The initial exercise resulted in 18 search strings and the same amount of publication lists. These results lists were double checked against a pre-compiled list of studies deemed relevant. If search strings failed to capture these publications, other strings were tried until all known articles had been found in at least one search. These results were presented to a group of 17 academics and practitioners in a workshop in September 2021. The in-depth discussions resulted in insights and suggestions for ways to improve and complement the literature search. All searches were then replicated in May–June 2022, and number of hits updated. Some search strings were also refined, some removed as they proved redundant and a couple new were added at this stage based on previous comments and discussions among the authors. Table 1 shows the final 14 search strings used, organized in the four clusters.

One should clarify that the logic underpinning how the specific strings in each cluster are built is not the only possible one, and with multiple concepts—for example energy poverty and energy justice – being multidimensional and linked. Variations to the cluster search strings would change the number of hits between and within clusters. It is therefore important not to assign too much importance to precise numbers but rather study the patterns shown in relative sizes and trends. However, given the focus on the intersecting space in the middle, and after multiple rounds of testing combinations, these 14 search strings arguably accomplish the task at hand. The strength of this uniquely tailored approach is the ability to capture a core within a multi-dimensional nexus.

Table 1 includes results also for title and abstract only. The motivation is that work that has an explicit focus on the topics will, in most cases, highlight these already in the title and abstract. This also addresses the fact that the field code "KEY" doesn't differentiate between author keywords and index keywords, meaning that some irrelevant articles end up in the resulting lists if index keywords include the search

Table 1
Results of Scopus searches, replicated and downloaded as CSV and BibTeX lists on June 16, 2022.

Search nr	Search string	Number of hits (unfiltered)
1a USER focus	TITLE-ABS-KEY ("energy justice" OR "energy democracy" OR "energy communities" AND citizen OR user OR grassroots OR "social movements" OR household OR community OR "just transition" OR co-creation OR participation)	i. 1862 ii. With TITLE-ABS 1604
1b USER focus and POLICY	TITLE-ABS-KEY ("energy justice" OR "energy democracy" OR "energy communities" AND citizen OR user OR grassroots OR "social movements" OR household OR community OR "just transition" OR co-creation OR participation AND policy)	i. 499 ii. With TITLE-ABS 317
1c USER focus and POWER LENS	TITLE-ABS-KEY ("energy justice" OR "energy democracy" OR "energy communities" AND citizen OR user OR grassroots OR "social movements" OR household OR community OR "just transition" OR co-creation OR participation AND women OR gender OR feminist OR intersectionality OR empowerment OR "indigenous people" OR decolon* OR queer OR LGBTQ)	i. 59 ii. With TITLE-ABS 48
1d DESIGN focus	TITLE-ABS-KEY (design OR "user innovation" AND "energy policy" OR "energy use" AND gender OR inclus*)	i.199 ii. With TITLE-ABS 98
1e DESIGN and POWER LENS	TITLE-ABS-KEY (design OR "user innovation" AND "energy policy" OR "energy use" OR "energy systems" OR electricity OR "energy transition" AND gender OR feminist OR intersectionality OR "women empowerment" OR "indigenous people" OR decolon* OR queer OR LGBTQ)	i.125 ii. With TITLE-ABS 88
2a ENERGY POVERTY	TITLE-ABS-KEY("energy poverty")	i. 1689 ii. With TITLE-ABS 1474
2b ENERGY POVERTY and POLICY	TITLE-ABS-KEY("energy poverty" AND "energy policy")	i. 360 ii. With TITLE-ABS 136
2c	TITLE-ABS-KEY("energy poverty" AND gender OR feminist OR intersectionality OR empowerment OR "indigenous people" OR decolon* OR queer OR LGBTQ)	i. 107
ENERGY POVERTY and POWER LENS	With women:	ii. With TITLE-ABS 89
	TITLE-ABS-KEY("energy poverty" AND gender OR feminist OR intersectionality OR empowerment OR "indigenous people" OR decolon* OR queer OR LGBTQ OR women)	iii. Adding "women" 141 iv. Adding "women" with TITLE-ABS 116
3a GENDER+ and RENEWABLE ENERGY	TITLE-ABS-KEY (gender OR feminist OR intersectionality OR "women empowerment" OR queer OR LGBTQ AND electricity OR bioenergy OR "solar PV" OR "solar power" OR "renewable energy")	i. 960
	With feminist:	ii. Search within results "feminist" 85
	(TITLE-ABS-KEY (gender OR feminist OR intersectionality OR "women empowerment" OR queer OR lgbtq AND electricity OR bioenergy OR "solar PV" OR "solar	iii. With TITLE-ABS 662 iv. With TITLE-ABS search within results "feminist"

(continued on next page)

Table 1 (*continued*)

Search nr	Search string	Number of hits (unfiltered)
	power" OR "renewable energy")) AND (feminist)	73
3b GENDER+ and ENERGY POLICY	TITLE-ABS-KEY (gender OR feminist OR intersectionality OR "women empowerment" OR queer OR LGBTQ AND "energy policy")	i. 174 ii. With TITLE-ABS
	With women:	80
	TITLE-ABS-KEY (gender OR feminist OR intersectionality OR "women empowerment" OR queer OR LGBTQ OR women AND "energy policy")	iii. Adding "women" 258 iv. Adding "women" with TITLE-ABS 113
3c GENDER+ and TRANSITIONS	TITLE-ABS-KEY (gender OR feminist OR intersectionality OR "women empowerment" OR queer OR LGBTQ AND electricity OR bioenergy OR "solar PV" OR "solar power" OR "renewable energy" AND transitions)	i. 66 ii. With TITLE-ABS 55
4a ENERGY POLICY focus on USERS	TITLE-ABS-KEY("Energy policy" AND (energy W/3 use) OR (energy W/3 demand) OR (energy W/3 access) OR "electricity access" AND "renewable energy" OR "sustainable energy")	i. 17,003 ii. With TITLE-ABS 1253
4b ENERGY POLICY and POWER LENS	TITLE-ABS-KEY("Energy policy" AND (energy W/3 use) OR (energy W/3 demand) OR (energy W/3 access) OR "electricity access" AND "renewable energy" OR "sustainable energy" AND gender OR feminist OR intersectionality OR empowerment OR "indigenous people" OR decolon* OR queer OR LGBTQ)	i. 108 ii. With TITLE-ABS 14
4c ENERGY POLICY and INCLUSION	TITLE-ABS-KEY ("Energy policy" AND (energy W/3 use) OR (energy W/3 demand) OR (energy W/3 access) OR "electricity access" AND "renewable energy" OR "sustainable energy" AND inclusion OR inclusive)	i. 199 ii. With TITLE-ABS 16

terms.

After settling on the final search strings, the next step was further analysis of each cluster. There are multiple tools to this end: first, adding search terms, for example adding "OR women empowerment" to the Power lens in search 3a, and adding "AND Africa" to search string 2a to check for work that is explicitly from that region. When interested in perspectives/topics that get recognition in the sense that they get referenced by other studies, the function "search within results" applies the field code ALL to the chosen keyword. For more common words (e.g. "bioenergy") this does not make sense, since the term is common in titles, which means it is found in the reference list, thus generating too many hits, while "feminist" works well with field code ALL, since it is unusual in titles and rarely referred to unintentionally. This way to filter results is thus helpful when one is interested to see to what extent a perspective is taken up and gaining recognition, or being marginalized.

Another tool used is Bibliometrix [8], using the programming language R, which uses the bibtext search data as input to generate visual analysis of publication trends, dominant concept (word clouds) and network analysis for author affiliation. For the geographical analysis, the author team has also manually screened results lists by title and read abstracts. These different tools and analytical exercises provide a quantified yet multi-dimensional meta-analysis of the research landscape.

3. Results. Mapping the research landscape

This section is organised by the four clusters, and combines descriptive analysis with some reflections on findings. Section 4 discusses how the four clusters relate.

3.1. The users as starting point

Taking the energy user as starting point, the first cluster focuses on debates and concepts that are explicitly foregrounding the lives of ordinary people and participation in energy system change. These include work on "energy justice", "energy democracy", "energy communities", in combination with terms that emphasize users' active roles or participation as citizens. The analysis also include "just transition" as possible term. The first broad search yields >1800 hits. As "policy" is added it shrinks to >490 hits, and the Power lens results in just below 60 publications. This equals around three percent of the larger body, while "gender" alone equals only one percent. Fig. 2 illustrates the relative sizes of the three searches.

Word clouds (Figs. 3 and 4) for 1a and 1c respectively shows that the language is primarily technical rather than user-centred, with the only explicit user noun in search 1a being "community" or "communities". Fig. 3 does not display other user-related terms such as "prosumers" or "residents" but includes "systems", "generation", "market", "demand" and "building".

Search String 1a: TITLE-ABS-KEY ("energy justice" OR "energy democracy" OR "energy communities" AND citizen OR user OR grassroots OR "social movements" OR household OR community OR "just transition" OR co-creation OR participation). Image generated in the R tool Bibliometrix.

Adding the power lens in search 1c results in a somewhat different word cloud in Fig. 4, with explicit mentioning of "women", "indigenous" and "groups" in addition to "communities". Still, other user nouns like "households" are absent.

Search String 1c: TITLE-ABS-KEY ("energy justice" OR "energy democracy" OR "energy communities" AND citizen OR user OR grassroots OR "social movements" OR household OR community OR "just transition" OR co-creation OR participation AND women OR gender OR feminist OR intersectionality OR empowerment OR "indigenous people" OR decolon* OR queer OR LGBTQ). Image generated in the R tool Bibliometrix.

Admittedly, search 1a is not very precise and generates quite a lot of irrelevant publications. This is because "energy" is a widely used term in the natural sciences, e.g. in medicine and biology, that is hard to completely avoid when using broad searches. Excluding entire disciplines brings the risk of missing relevant work that is found also in these fields. A filter is thus used within the search (adding AND "term") to identify sub-sets. "Energy communities" is the term tested that generates the most hits. At second place, >320 publications mention "energy

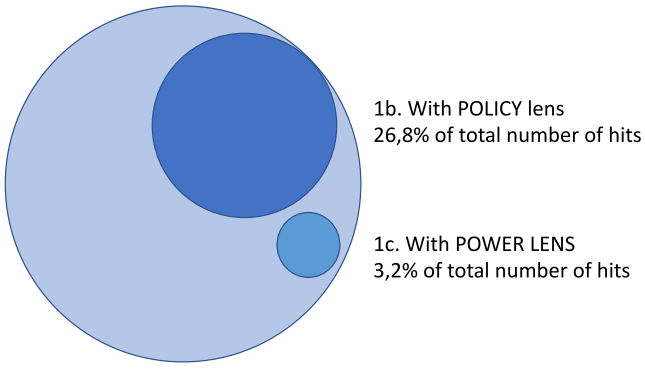

Fig. 2. Relative sizes of searches 1a (total number of hits >1860), 1b and 1c. source: Authors' illustration.

Fig. 3. Top 50 words occurring in abstracts for search 1a.

Fig. 4. Top 50 words occurring in abstracts for search 1c.

justice" in either title, abstract or keywords. Among those, around four percent, i.e. 13 publications use the term "gender". The concepts of "energy democracy" (>100 hits) and "just transition" (>50) are less commonly used. Even though gender is a marginal concept throughout, the other denominators from the Power lens are even more marginal in this research. Adding "feminist", "indigenous people" and "race" to the baseline search 1a yields only four, seven and 16 hits respectively. This may be compared to the interest in "peer-to-peer" transactions in energy which are of mentioned in 118 publications.

Here, it is important to note that user-centred perspectives on energy are also found in design-oriented studies. Thus searches 1d and 1e are added to capture work in the field of design that contribute to understanding of energy users in relation to policy and inclusion. Perspectives on design and "user innovation" address many types of design, for example, innovating technology, user interfaces, buildings, energy systems, but may also concern the design of policy itself. In fact, as seen in

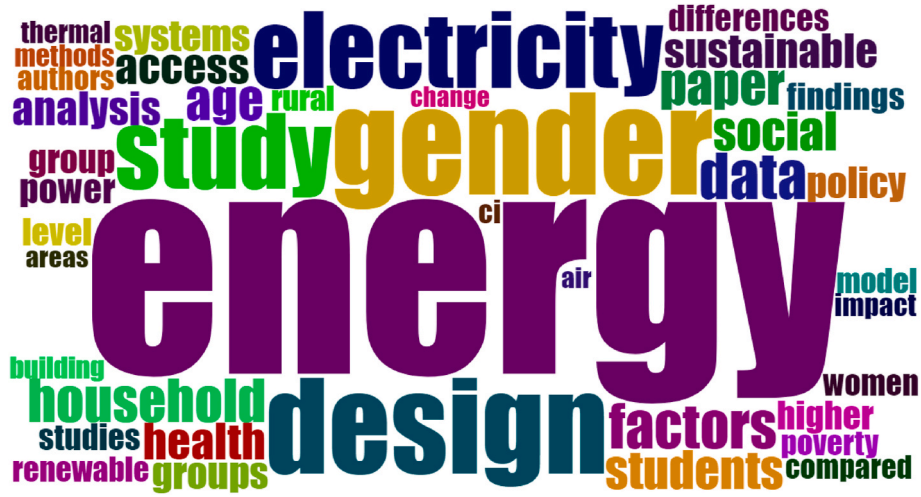

Fig. 5. Top 50 words occurring abstracts for search 1e.

Fig. 5, the word cloud of the 125 publications in search 1e includes various types of users (households, students, women). These are more visible in this body of literature, along with social characteristics (rural, age, gender). There is also an explicit focus on power, social differences, health and poverty.

Search String 1e: TITLE-ABS-KEY (design OR "user innovation" AND "energy policy" OR "energy use" OR "energy systems" OR electricity OR "energy transition" AND gender OR feminist OR intersectionality OR "women empowerment" OR "indigenous people" OR decolon* OR queer OR LGBTQ) Image generated in the R tool Bibliometrix.

Fig. 6 shows a positive trend in the number of studies per year within the sample of search 1e. This indicates increasing engagement in critical theory among energy use-oriented design studies, with the primary outlet journal being Elsevier's Energy Research and Social Science.

3.2. Exclusion as starting point

The second cluster shifts entry point and takes exclusion from energy services as an explicit starting point. To capture exclusion, the analysis uses "energy poverty" as key concept and from there add qualifying terms to map the research landscape. Search string 2a generates >1600 hits. This is however a relatively young concept. The oldest articles in this list are from 2000, which contrasts with the energy and poverty discussion that centred on access to fuel wood, governance of forests and women's drudgery in the 1980's, which was important to the "women in development" and feminist environmental movements [7]. The concept is also commonly linked to the idea of energy justice, bridging the user-exclusion interface.

Search 2b adds a policy focus to energy poverty resulting in 360 hits. Search 2c adds the Power lens, shrinking the hits to a sub-set of around six percents. This is somewhat remarkable given that the topic of energy poverty inherently addresses exclusion, and it is a well-known fact that women and minorities are over-represented among the energy poor [9]. A possibility would be that analyses of energy poverty rather take economic exclusion as primary starting point. However, adding "class" as a search term to the broad search 2a ("energy poverty" AND class) generates only 24 hits. It is thus unusual for studies labelled as dealing with energy poverty to adopt an explicit class lens. Still, it could be that more critical and progressive approaches receive attention even if they are less common. The analysis thus uses "search within results" (field code ALL) and find that feminist, intersectional, indigenous, decolonial, race, caste and ethnicity are concepts referred to in less than 50 publications each in our broadest search 2a. In the "energy poverty" research, these are clearly still marginal perspectives to the debate. This is confirmed visually by the word cloud in Fig. 7, which shows an emphasis on technical terms like "economic and social effects" whereas none of the concepts in the power lens show up among the 50 most common words. The language appears highly depoliticized.

Search String: TITLE-ABS-KEY("energy poverty")

Existing review papers that take stock of the energy poverty field confirm the dominance of index-based approaches to energy poverty that analyze economic dimensions [10]. These ignore the multi-dimensional causational factors as well as the differential socio-economic experiences of energy poverty among individuals, households and communities, especially in the context of climate change [11,12]. With regards to gender, Listo [13] argues, based on a review of the energy poverty discourse and the limited number of studies that engages with gender, that there exists a strong tendency of "feminization of the energy poverty narrative" accompanied with tech-driven "solutions" where stereotypical portraits of "third-world women" as energy poor and vulnerable are accepted without any deeper gender analysis of the energy problems, society and institutions.

Analyzing abstracts for articles in search 2a and b reveals that the most cited articles in the field pay no attention to gender or give it secondary treatment. The results indicate that authors who have published energy poverty studies both with and without an explicit gender lens gain less citations for their gender-focused publications [14,15] Energy poverty studies that are explicitly drawing on feminist or intersectional perspectives are quite recent, the first one appearing in 2012 [16].

A visualization in Fig. 8 of co-occurring keywords assigned by authors indicates that there are three larger thematic clusters within the energy poverty research. The first focuses on energy poverty in households—with an emphasis on affordability and vulnerability—while the two other cluster around the nexus of energy poverty-bioenergy/electricity—where energy access in low-income countries is more pronounced.

The publication trend for search 2a, shown in Fig. 9, evidences that

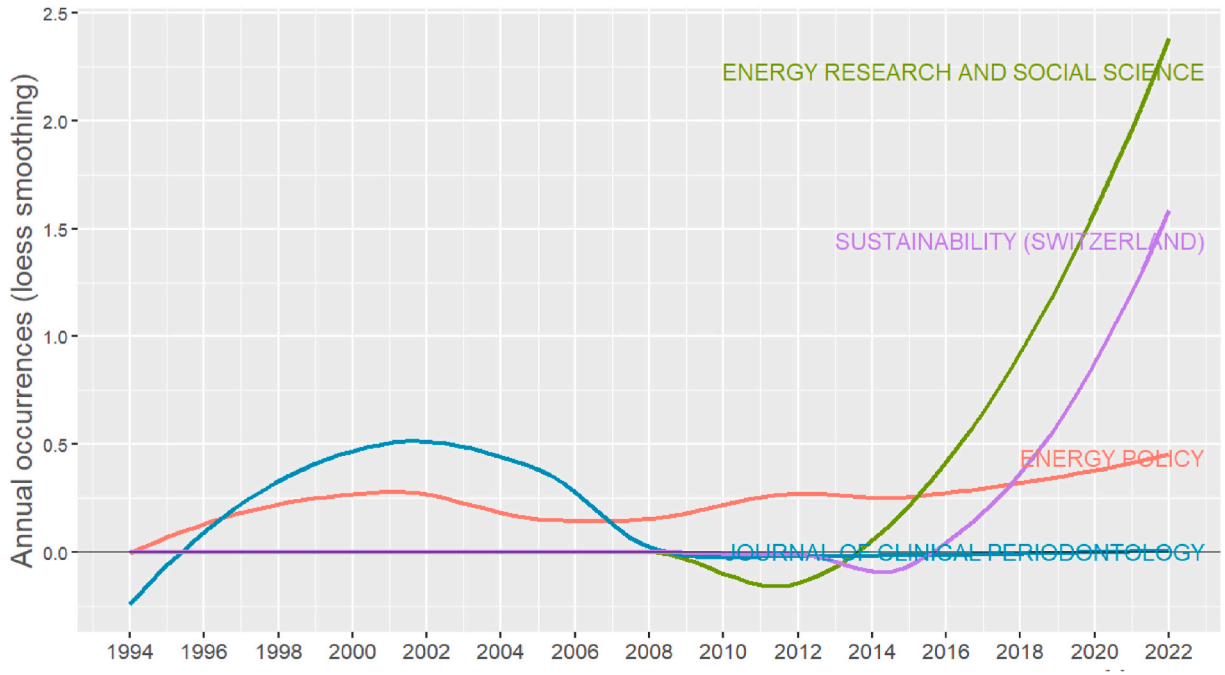

Fig. 6. Publication trend for search 1e. Source: image generated in the R tool Bibliometrix.

Fig. 7. Top 50 words occurring in abstracts for search 2a. Source: image generated in R tool Bibliomterix.

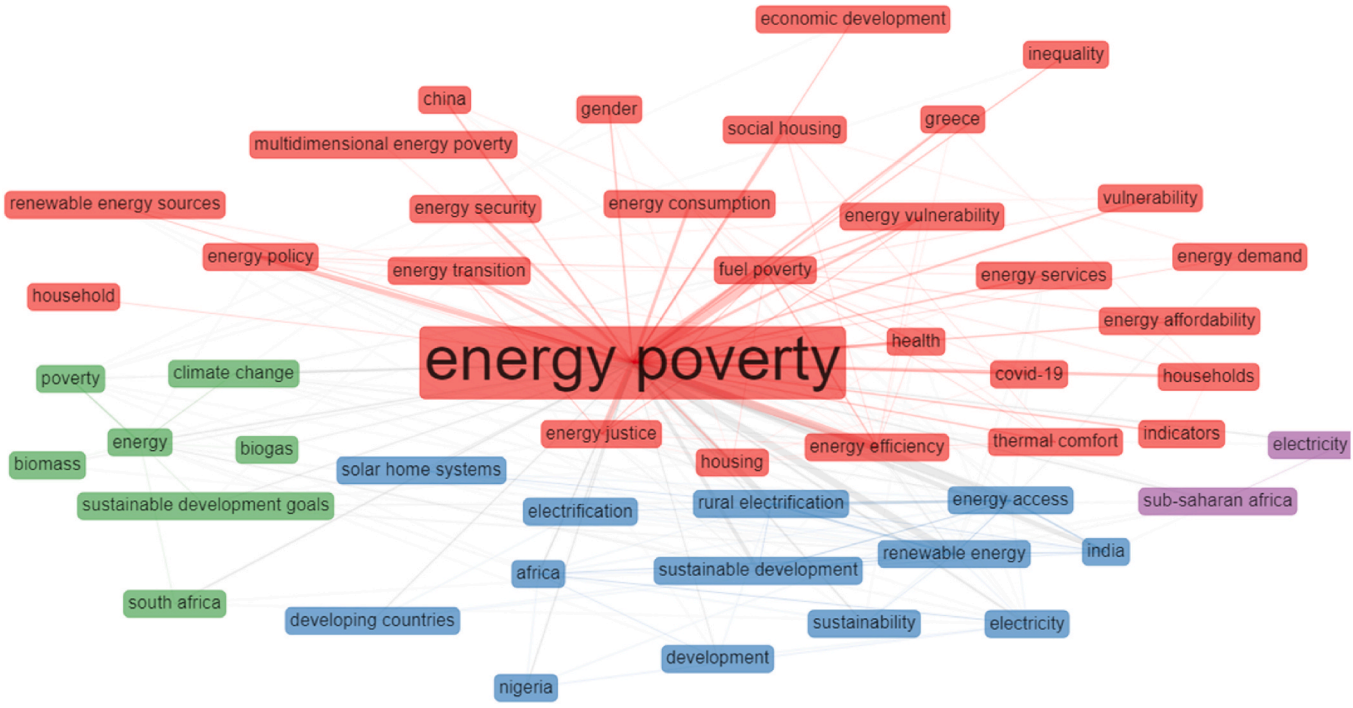

Fig. 8. Co-occurring author keywords for search 2a showing the top 50 co-occurring keywords. Color coding indicates clusters of co-occurring keywords. Image generated in the R tool Bibliometrix.

the concept of "energy poverty" is increasingly popular. Still, as regional markers are added to the search 2a (AND region), Africa is the world region that is most commonly mentioned (233 hits), followed by Europe (122 hits). The concept of "energy poverty" is thus bridging across Global South-Global North divides, and there is a link back to older studies on energy and development, which shows in how reference is made (field code ALL) to the African regional context in >700 documents in this list.

Search String 2a: TITLE-ABS-KEY("energy poverty"). Image generated in the R tool Bibliometrix.

3.3. Gender as starting point

The third cluster focuses on gender relations as the main point of gravity, given its centrality to critical theory analyses in the energy field. First, the broad search 3a uses gender/sex related terms (gender OR feminist OR intersectionality OR "women empowerment" OR queer OR LGBTQ) in combination with common energy sources or technologies. This search results in >950 hits. According to the statistics generated by the Scopus search program these publications are, by December 2022, primarily categorized as social science contributions, closely followed by the subject areas: medicine, environmental sciences and energy. While engineering accounts for around eight percent of publications, economics has a little over four percent of publications. Agriculture, a sector accounting for a huge part of female employment in low-income countries, is represented with only two percent of publications in this sample of research on gender and renewable energy technologies.

Unfortunately, the broad search 3a includes irrelevant publications (e.g. in medical science and engineering education). Fig. 10 shows the themes as they appear in authors' keywords. There is overlap in keywords especially from the cluster on exclusion, yet "policy" is not among the most common keywords. Sorting the result list by citations rather than relevance shows that among the 20 most cited papers for search 3a, only seven are relevant to the topic. Among these, only one has gender as primary focus whereas the rest are treating gender in passing, as one among many factors.

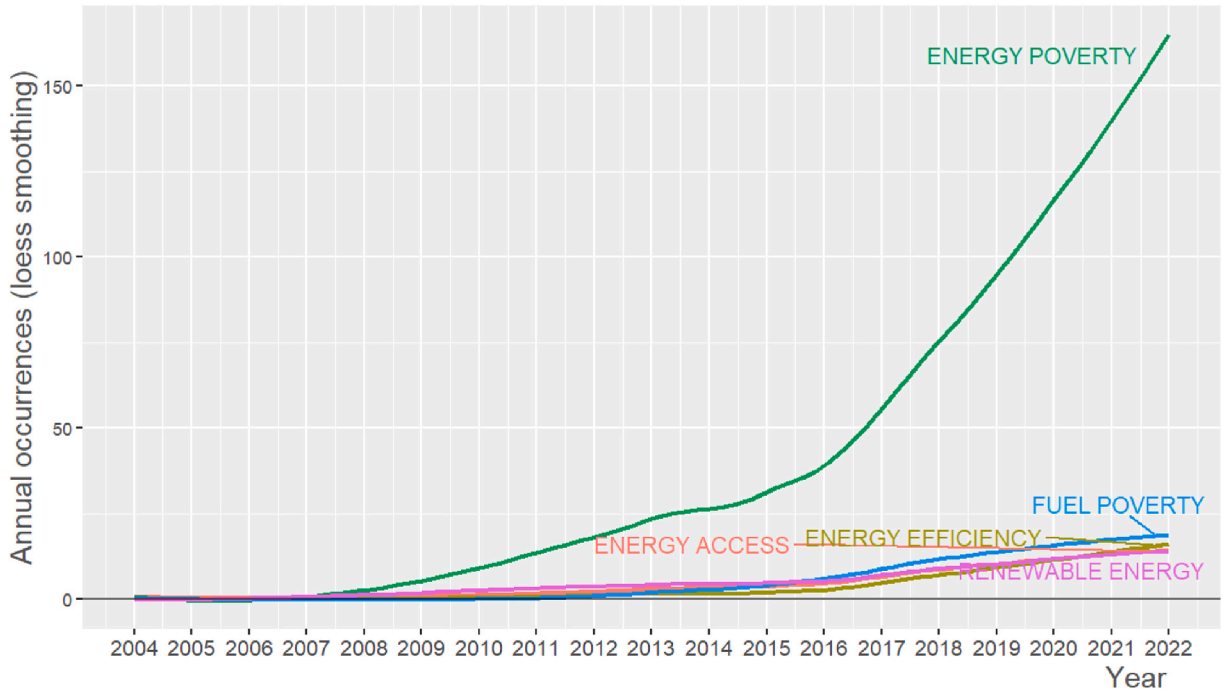

Fig. 9. Publication trend for search 2a showing the five most commonly occurring author keywords over time.

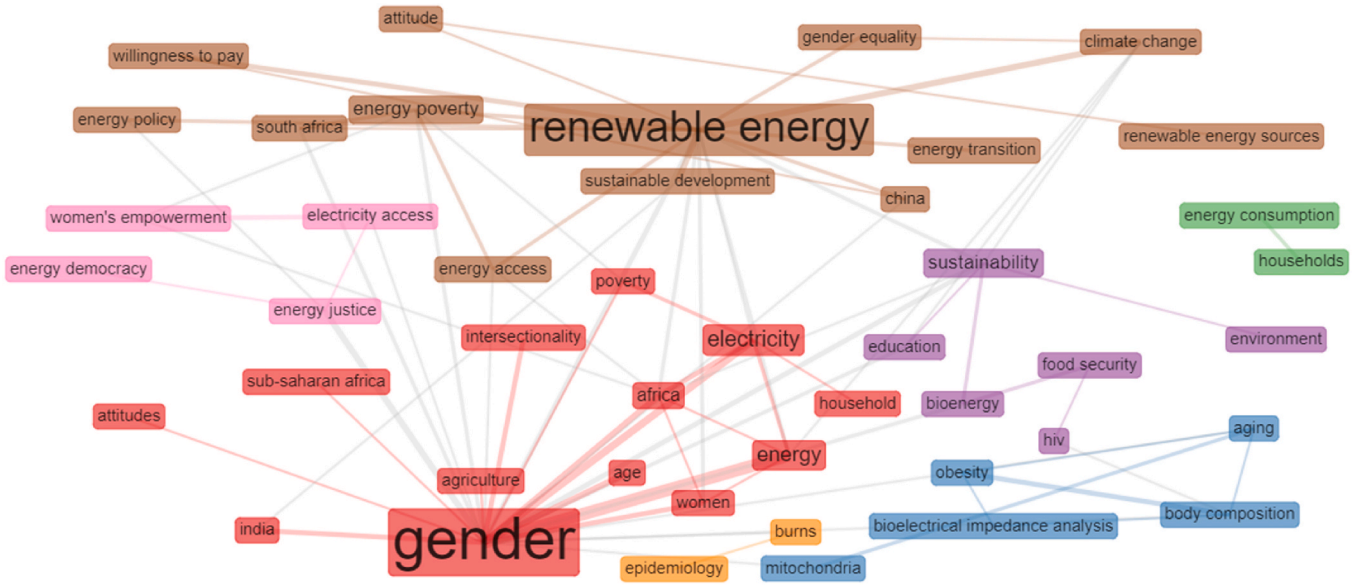

Fig. 10. Co-occurring author keywords for search 3a showing the top 50 co-occurring keywords. Colour coding indicates clusters of co-occurring keywords.

Search String 3a: TITLE-ABS-KEY (gender OR feminist OR intersectionality OR ”women empowerment” OR queer OR LGBTQ AND electricity OR bioenergy OR "solar PV" OR "solar power" OR "renewable energy"). Image generated in the R tool Bibliometrix.

To further unpack the content of the broad search, the study adopts different filters. There is tension in the gender-related studies between binary gender perspectives that take the categories of “women” and “men” for granted and non-binary perspectives that dispute these. However, non-binary understandings of gender are very rare in energy studies and this becomes clear as filtering by adding “queer OR LGBTQ” yields no results—clearly these perspectives are still missing.

The word “feminist” was used to search within results (field code ALL) and arrive at a set of relevant publications. The resulting list contains 85 papers, among which the most cited papers that explicitly adopt feminist/gender lenses and, also, have something to say from a user perspective, provide combined empirical and conceptual contributions [17–19] or literature review [20]. Looking at who, in turn, gets cited by authors in this filtered list, Fig. 11 reveals links to the wider gender and energy debate, where for example the article by Winther et al. [21] works as a point of reference, although it is not among the 85 papers. Fig. 12 in turn reveals the focus of the conversation amongst the explicitly feminist studies. There, “policy” is among the keywords, suggesting a stronger policy orientation in feminist-theory based work.

Other filters used included more specific variations of gender, such as “gender role”, ”gender equality”, ”gender relations”. Additional qualifiers are “decolonial”, “care”, ”caste”, and “indigenous people”. Each of

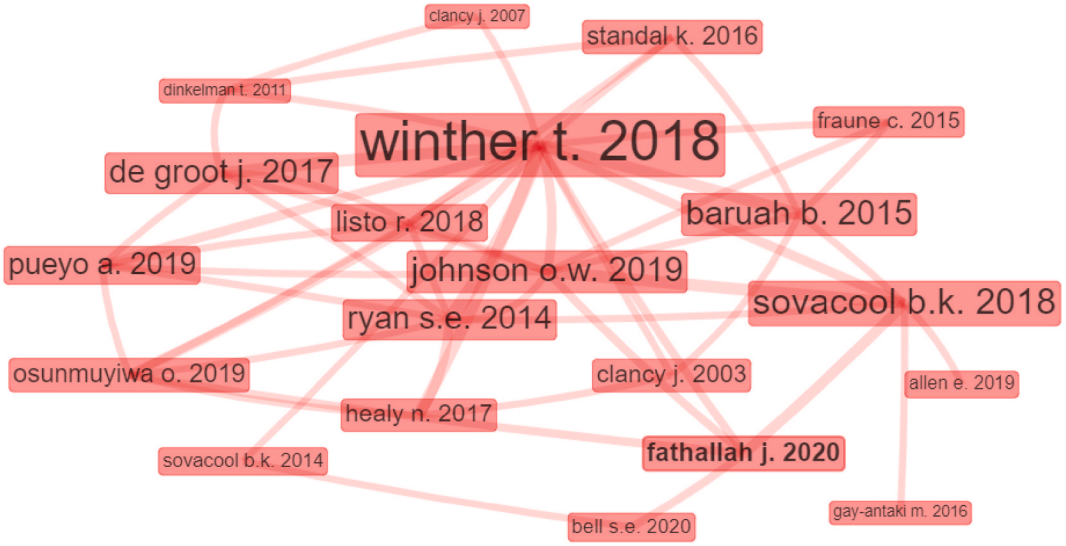

Fig. 11. Co-citation network for search 3a, displaying top 20 articles* (filtered by "AND feminist") For inclusion, articles must be jointly cited by articles within the search a minimum of 3 times. Image generated in the R tool Bibliometrix.

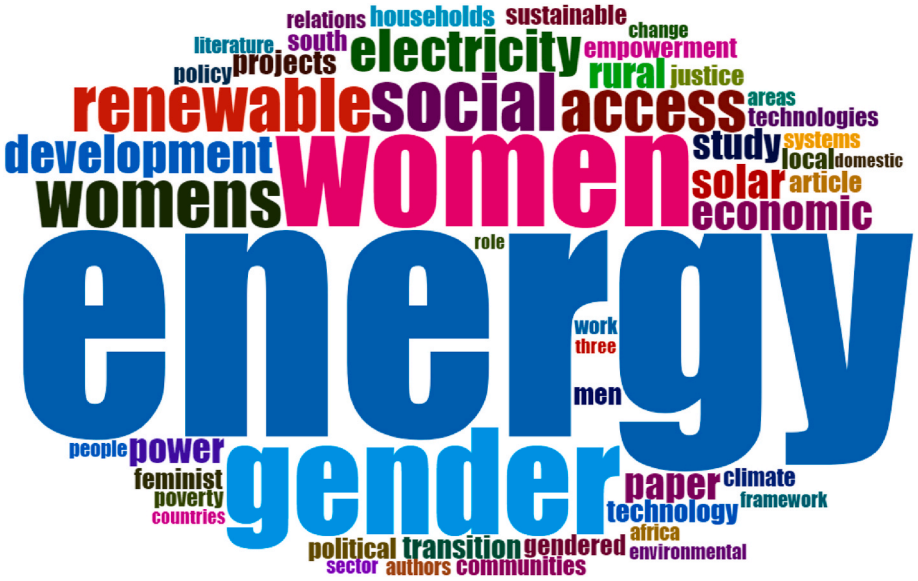

Fig. 12. Top 50 words in abstracts for search 3a (filtered for "AND feminist"). Image generated in the R tool Bibliometrix.

these searches return comparatively few hits. In total, all the filtering exercises result in a set of around 50 publications, that after reading abstract are shortlisted as highly relevant to be analyzed in future work.

The second search string, 3b, aims to capture the policy relevant articles. Adding policy results in 174 documents out off the total sample of >950 hits. The most cited article uses quantitative methods and treats gender (i.e. sex) as a given statistical category. However, among the top ten cited articles, the search also finds statistical studies that explicitly analyze sex differences in energy use [22,23].

3.4. Energy policy as starting point

The last search cluster takes as starting point energy policy and energy use, in combination with renewable or sustainable energy. There is, unsurprisingly, a big number of studies (>17,000 hits) on this broad topic. The top five subject areas are energy (>10,700 hits), environmental science (>5600 hits), engineering (>5500 hits), social sciences (>1900 hits) and computer science (>1600 hits). As the multiple variants of search lenses that explicitly seek out work addressing power relations (variant 4b) and inclusion (variant 4c) are added, the numbers shrink radically.

Fig. 13 shows the relative sizes of these bodies of research, that make up below one percent and around one percent respectively of the larger research, while Figs. 14 and 15 show the publication trends for these two bodies. The search results indicate that the yearly number of contributions in this vein has increased substantially in the past decade, indicating increasing interest in the scholarship. However, a closer look at the publication list 4b, representing the Power lens, reveals that the most cited articles (>100 citations) are in fact not primarily about gender or the other qualifiers. Instead, their main focus lies elsewhere (e.g. on energy justice or energy poverty) and gender is mentioned only in passing.

Search String 4b: TITLE-ABS-KEY("Energy policy" AND (energy W/3 use) OR (energy W/3 demand) OR (energy W/3 access) OR "electricity access" AND "renewable energy" OR "sustainable energy" AND gender OR feminist OR intersectionality OR empowerment OR "indigenous

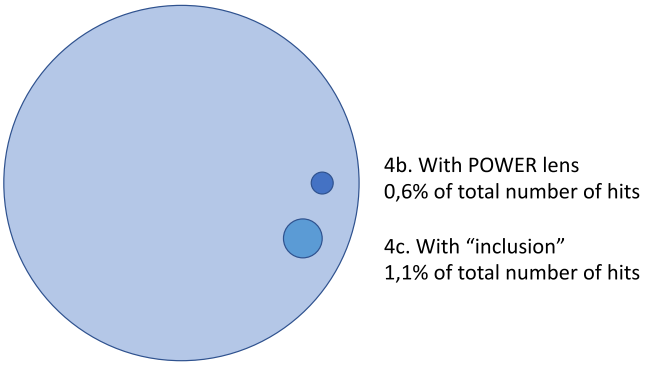

Fig. 13. relative sizes of searches 4a (total number of hits >17,000), 4b (108 hits) and 4c (199 hits). Image created by the authors.

people” OR decolon* OR queer OR LGBTQ)

Search String 4c: TITLE-ABS-KEY ("Energy policy" AND (energy W/3 use) OR (energy W/3 demand) OR (energy W/3 access) OR "electricity access" AND "renewable energy" OR "sustainable energy" AND inclusion OR inclusive)

The dominance of other perspectives is also confirmed by manual screening of the results list for search 4b, which reveals that 27 publications have “gender” or “women” in the title or as author keyword. Only 12 contributions refer to feminist theory somewhere in the text (filtering within search, field code ALL). The most common use is to treat gender/sex as a binary social category along with other socioeconomic factors.

Filtering within results shows that “empowerment” is mentioned in title, abstract or keywords in 47 documents, but only ten of these are explicitly about gender or women’s empowerment [see e.g. Refs. [24–26]]. The other studies discuss, for example, the empowerment of consumers, households, communities, the renewable energy sector etc. There is also a body of work (14 publications) that explicitly or in passing deal with energy projects and indigenous people.

The ten most cited publications in search 4b have no gender focus, apart from Ref. [27] where gender is mentioned as statistical variable. The broad net cast in the search explains why the top ten cited publications are not a good match to our research topic. Two review articles [28,29] collect around 40 citations. These mention gender in the abstract, but the primary focus lies on energy poverty and energy justice. The first two studies [30,31] that match the key nexus energy policy, users and gender are found further down the list, at place 15 and 16 in terms of citations. Both are published in the journal Energy Policy. However, these are more than 20 years old, which indicates little leverage despite being published in a prominent journal. It is not surprising but, arguably, problematic that the actual body of work that make an explicit contribution to advancing a gender analytical lens on energy policy and energy use, is small and marginalized in terms of citations and the associated recognition. Something to note here is that some articles that make the connection between energy policy and gender are not caught within this search as they are not pinpointing renewable or sustainable energy as topic. These are typically focused on a developing economy context and rather about energy access, women’s roles as energy providers or the lack of gender awareness in energy policy. These are however captured in our cluster three that uses gender as starting point (search 3a and 3c).

The positive trend identified is that the number of relevant publications per year is growing. However, considering the overall growth trend in research publications it may be that the relative size of this stream is shrinking compared to the broader field. To investigate this, Figs. 16 and 17 shows the share of articles published since 2017 which match the policy cluster search 4b and 4c, relative to the total publications by each journal. Firstly, this analysis demonstrates that the proportion of articles that fall within the set scope remains small in absolute terms.

Secondly, with regard to how this changes over time, the results are mixed across searches.

There is no clear trend: key energy journals are not specializing more on energy policy and energy use from a power or inclusion point of view within this time period, relative to other topics. This implies that there may be a risk of these themes getting “lost in the weeds” as journals publish ever-increasing numbers of articles, even as total publications which match these search terms increase. In contrast, Figs. 18 and 19 showing the exclusion cluster searches 2a and 2c establishes a clear

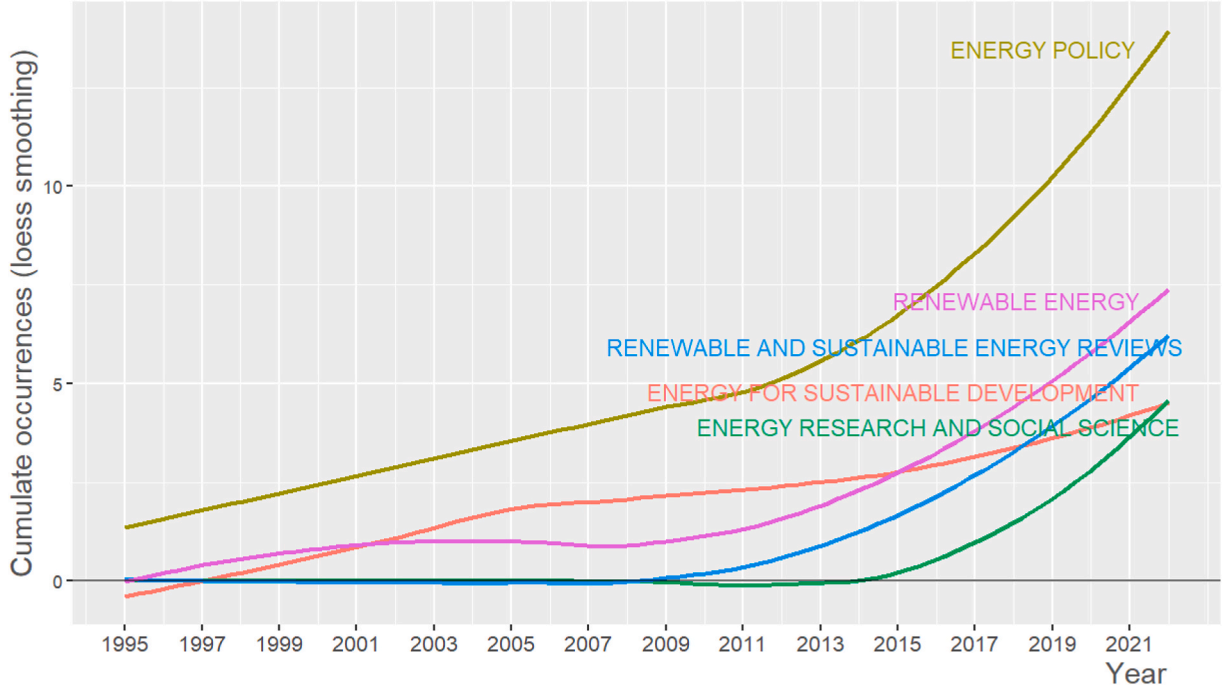

Fig. 14. Source growth for search 4b over time – new publications each year by journal.

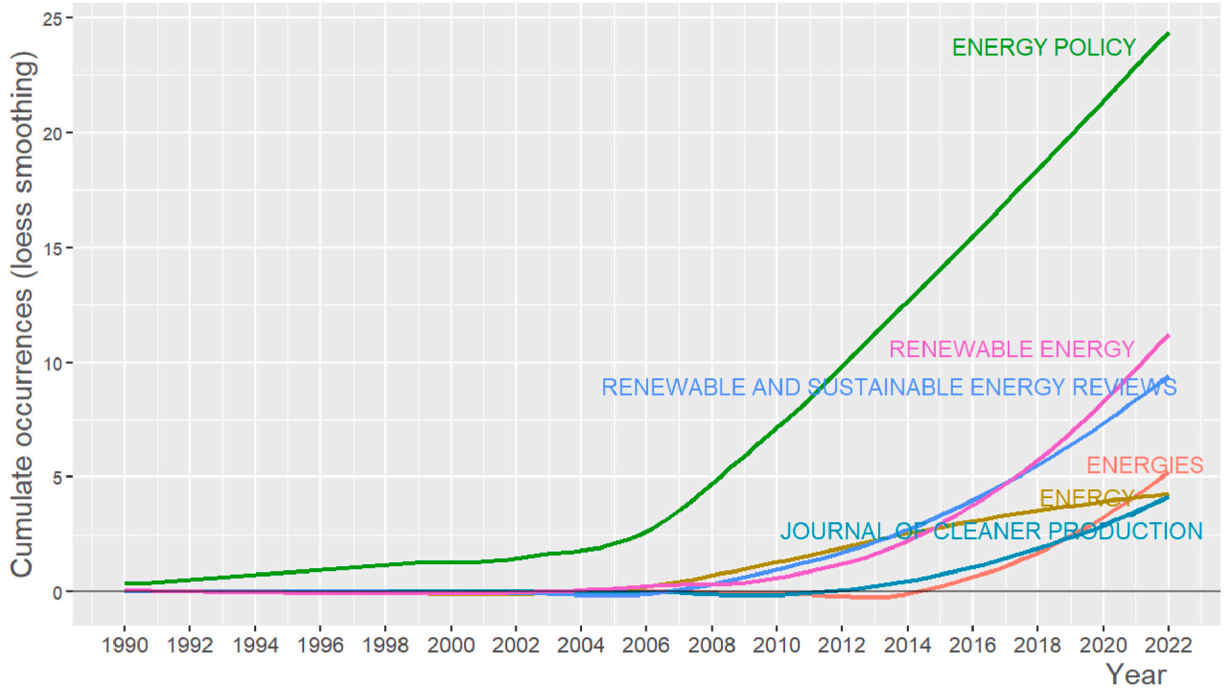

Fig. 15. Source growth for search 4c over time – new publications each year by journal.

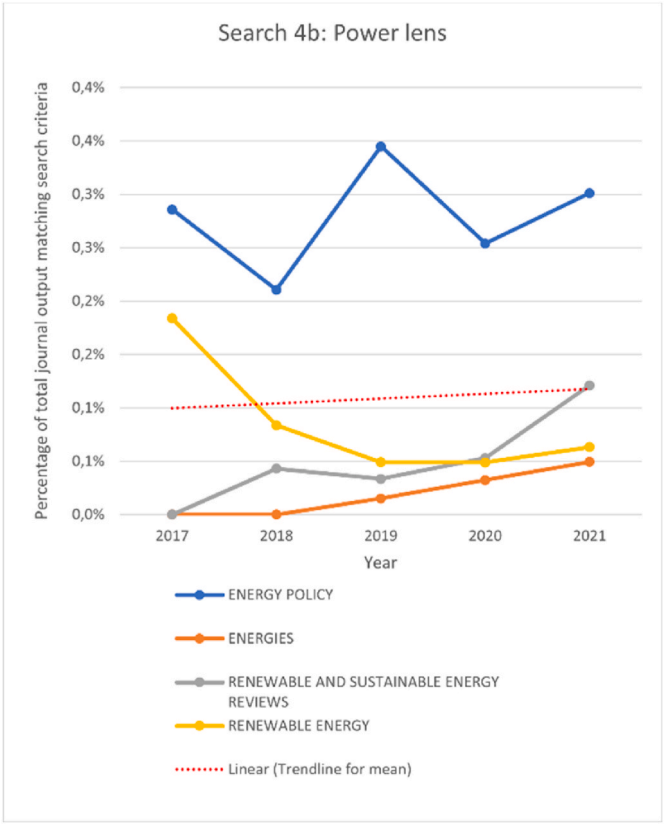

Fig. 16. (left): Share of articles published in selected journals 2017–2021 which match the search criteria. The number of matching articles are calculated as a percentage of total articles published by each journal each year, beginning in 2017 and increasing cumulatively over time. Each chart shows the four journals with the most articles published matching the search criteria during the period 2017–2021. Source: Data on journal publications per year from Elsevier Journal Insights combined with publication data for Scopus search strings.

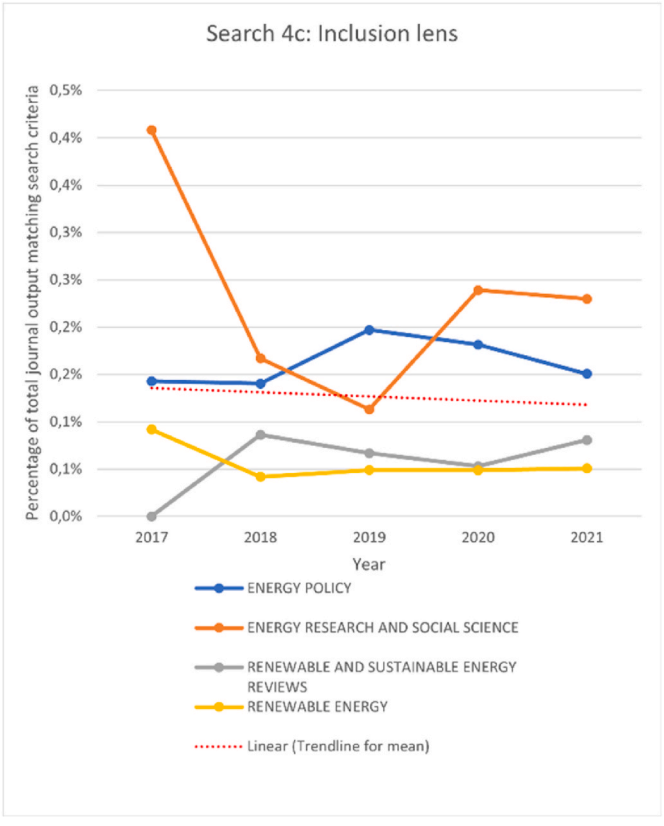

Fig. 17. (right): Share of articles published in selected journals 2017–2021 which match the search criteria. The number of matching articles are calculated as a percentage of total articles published by each journal each year, beginning in 2017 and increasing cumulatively over time. Each chart shows the four journals with the most articles published matching the search criteria during the period 2017–2021. Source: Data on journal publications per year from Elsevier Journal Insights combined with publication data for Scopus search strings.

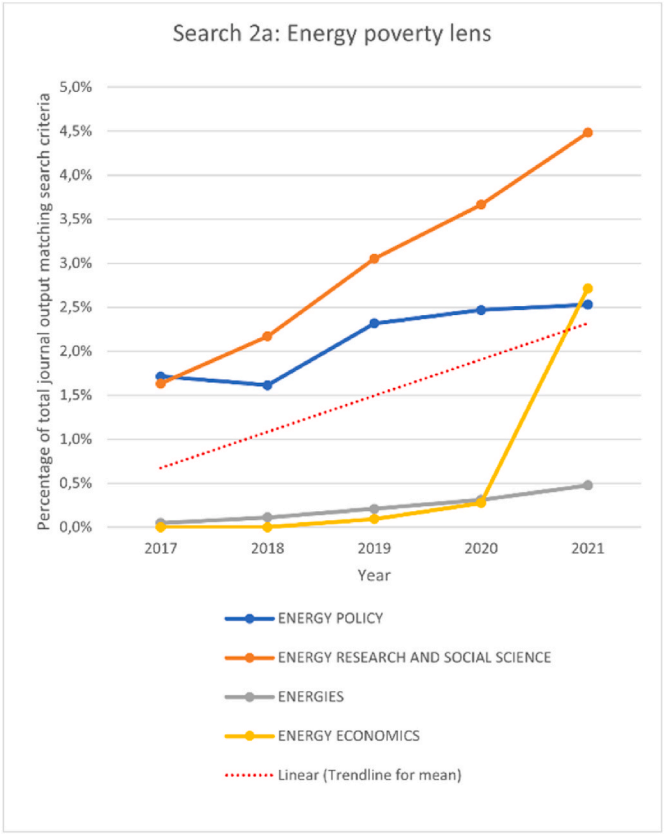

Fig. 18. (left). Share of articles published in selected journals 2017–2021 which match the search criteria. Source: Data on journal publications per year from Elsevier Journal Insights combined with publication data for Scopus search strings.

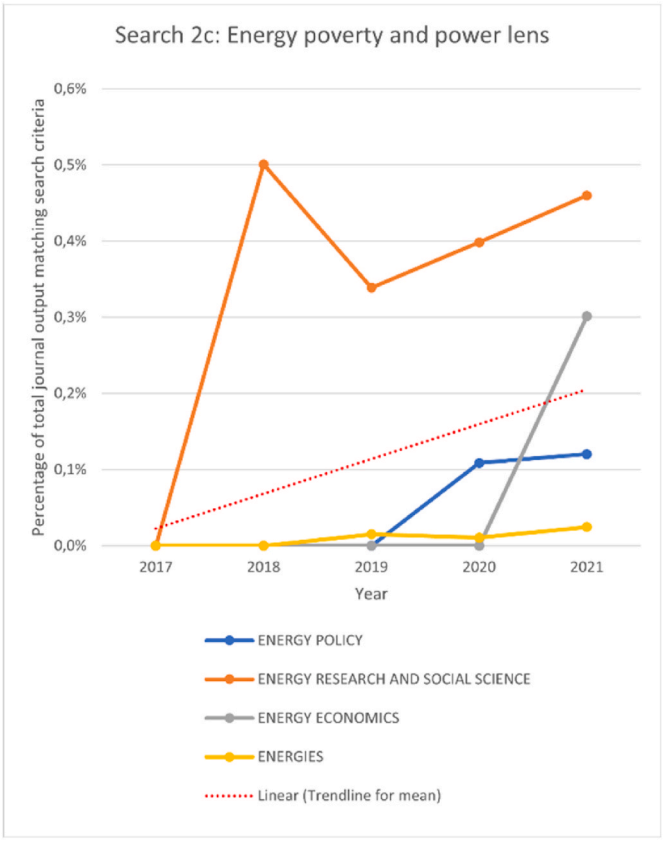

Fig. 19. (right). Share of articles published in selected journals 2017–2021 which match the search criteria. Source: Data on journal publications per year from Elsevier Journal Insights combined with publication data for Scopus search strings.

positive trend between 2017 and 2021. This indicates that these journals are increasingly specializing in research themes related to energy poverty, since the share of articles being published which match these themes is outpacing total journal output.

3.5. *Comparisons across clusters: geographical dimensions to the research*

The review's geographical scope is global, and the analysis is also aiming to understand the geography of research—where studies are done, where there is plenty of evidence and what contexts are little studied or not at all, but, also, where the scholars are affiliated.

A geographical analysis (by screening all abstracts in searches 1c, 2c, 3a variant ii (AND feminist) and 4b) of the country and/or regional focus of studies provides for a comparison across the four clusters. Table 2 shows the number of publications per cluster in terms of regional focus, i.e. where empirical studies specify the location.

Whereas studies from Asia and Europe dominate the policy cluster, Africa and Asia dominate the exclusion and gender clusters. Cross-regional studies are common for the first two clusters and totally missing in the gender cluster, where the statistical studies are either within-country, or for a few countries in the same region. It is perhaps notable that North America is less represented across all clusters.

Checking instead the geography of author affiliations for the same four searches, the analysis finds that institutions in the United Kingdom and United States dominate publishing. High income countries dominate for all searches but work on energy poverty, applying our Power lens, include contributions from institutions in India and Ghana, both lower-middle income countries, and from South Africa, and China as upper-middle income countries. The Western institutional dominance mirrors the overall pattern within energy studies as broad field [6] and scientific publishing at large [32,33].

Table 2
Geographical focus of studies, showing number of studies by cluster. Determined by screening of abstracts.

	User cluster	Exclusion cluster	Gender cluster	Policy cluster
	Search 1c = 59 documents	Search 2c = 107 documents	Search 3a variant ii. = 85	Search 4b = 108 documents
Africa	6	30	22	17
Asia	7	26	15	27
Europe	16	20	7	25
North America	11	3	5	12
South America	2	2	11	5
Australasia	1	0	1	1
Cross-regional	4	13	1	15
Excluded from sample[a]	10	13	23	6

[a] Studies are excluded if they do not specify an empirical context (e.g. conceptual papers, review studies, special issue introductions, entire books), or abstracts could not be accessed.

This analysis benefits from a reference point. Table 3 thus compares results to the research

on climate change and mitigation replicating (this was done on December 19, 2022) the searches using the gender + entry point (3a i and ii and 3b). This returns a comparatively higher number of hits for

Table 3
Comparison between gender + cluster for energy and climate research. Source: Scopus advanced search. 16 June and December 19, 2022.

Search nr	Search string	Number of hits (unfiltered)
3a i.	TITLE-ABS-KEY (gender OR feminist OR intersectionality OR ”women empowerment” OR queer OR LGBTQ AND electricity OR bioenergy OR "solar PV" OR "solar power" OR "renewable energy")	960
3a ii.	(TITLE-ABS-KEY (gender OR feminist OR intersectionality OR "women empowerment" OR queer OR lgbtq AND electricity OR bioenergy OR "solar PV" OR "solar power" OR "renewable energy")) AND (feminist)	85
	Compared with: TITLE-ABS-KEY (gender OR feminist OR intersectionality OR "women empowerment" OR queer OR LGBTQ AND "climate change")	2994
	(TITLE-ABS-KEY (gender OR feminist OR intersectionality OR "women empowerment" OR queer OR lgbtq AND "climate change")) AND (feminist)	778
3b i.	TITLE-ABS-KEY (gender OR feminist OR intersectionality OR ”women empowerment” OR queer OR LGBTQ AND “energy policy”)	174
	Compared with: TITLE-ABS-KEY (gender OR feminist OR intersectionality OR "women empowerment" OR queer OR LGBTQ AND "climate policy")	85

climate change, indicating the stronger presence of critical theory perspectives and gender analyses grounded in feminist theory and intersectionality. However, for climate policy, the search rather indicates less uptake of such perspectives than in the energy field.

4. Discussion

The landscape overview provided by this literature review illustrates both quantitatively and visually what topics, perspectives and voices that dominate research, thus answering the first research question: what is the state of scholarship on user-centred perspectives on energy policy, energy use and inclusive transitions to sustainable energy systems? In response to the second research question, the review shows a marginal position within the energy scholarship for work that adopts an explicit power lens and engages in depth with mechanisms of inclusion and exclusion in energy systems, despite such mechanism being explicitly exposed as a problem for the current energy transition. The results of this study begs the question if such exclusion—also mirrored in the realm of policy making—is one reason why the energy transition is not moving fast enough? Evidence for such a claim can be found in scholarship dealing with just transitions [34].

The combination of very broad and open search strings and a Power lens that captures concepts from critical theory approaches shows a stark contrast between the dominating–thus mainstream–perspectives that do not unpack, but rather take for granted, social categories of difference, and those that care to investigate relations of power, mechanisms of exclusion, and diversity and richness within or beyond a label like “gender”. When present, gender is typically understood in binary terms or as the equivalent of “women” as biological sex. “Income level” has over time replaced “class” in a discussion on poverty that is strikingly technical.

Whereas a focus on income offers easier routes to quantitative measures than a fuzzy and charged concept such as “class”, it fails to do justice to the multi-dimensionality of poverty [35] which qualitative and critical theory based analyses of energy poverty manage to capture [13,36]. There is, same as in climate change research and policy, a risk that mainstream research, policy and practice reproduce simplistic understandings of who is vulnerable and a passive victim of energy poverty and who has agency and capacity to address it [37,38]. Statistical methods also have more to offer [39,40] and state of the art in gender sensitive statistical method is yet to find its way into energy studies. Currently, some of the most cited articles in this review are based on outdated methodology and their contribution to understanding how gender relations shape, and are shaped in, the energy sector is at best indicative.

Sorting the searches on citations and relevance show that these do not correlate well, especially not for the broader searches. Perspectives with a strong conceptual grounding in power theories, i.e. the critical theory approaches, receive limited attention and relatively few citations even in the two clusters on users and exclusion, where they should reasonably make an impact given their scientific relevance. Of course, “relevance” is a subjective quality, also in research despite beliefs to the contrary, working at the level of ontology and epistemology. The search is reflecting a framing that positions inclusion and exclusion of users at the centre of energy transitions, and it is from this position that this research make judgments around relevance.

4.1. Limitations and further research

This study has three limitations that could be addressed in future work: first, that it only includes the anglophone literature, which undermines the ambition to explore the state-of-the-art with a global scope. Second, the use of Scopus rather than other data bases. Using the Web of Science or Google Scholar would likely yield different numbers and without a comparison one may not know whether the relative sizes of different bodies of work—that is the overall pattern—would be the same. Third, this study operationalised a Power lens based on critical theory. This choice means that work in political economy or political science that do pay explicit attention to power relations can be caught in the broad searches but not be identified among the core body of work—unless these studies use terms like gender, feminist or class.

Reflecting on knowledge gaps highlighted by this study, it is shown that conceptual perspectives and methodological approaches that explicitly deal with power relations are marginal, even in debates that label themselves as dealing with justice or exclusion. There is no substantial body of evidence to draw from in quantitative terms, even for understanding intersecting relations of gender and class, two of the most used social categories. This study sees a great opportunity and need for new research to enrich and substantiate the knowledge base—both in terms of theoretical and methodological possibilities to think through intersecting relationships of power that shape and get reshaped in energy transitions.

A promising avenues for work is further studies that unpack taken-for-granted social categories like “gender”, “users” or “households”. To illustrate, what constitutes a household is highly contextual and dynamic—pre-defined methodological categorizations that are static regarding size or composition, or based on traditional heteronormative ideals of husband, wife and children impose simplicity where there is diversity [41]. If the methodology misrepresents people’s ways of life it will, by extension, misinterpret their energy uses. To revisit standardized social categories used in quantitative tools for measuring energy poverty is especially important in a time when policymakers are looking towards research for help with designing interventions to lessen the impact of energy crises on their publics. Feminist theories have much to offer here. Queer and Lesbian, gay, bisexual, and transgender + perspectives have yet to be mobilized analytically and the search only found two examples of work that engages briefly with the concept of masculinities [42,43]. Research around masculinities could additionally help shed light on prominent norms in this male-dominated sector and their reproduction in technological designs [44,45].

Research on energy transitions from a user-oriented perspective would also benefit from studies that address global justice of coloniality in questions of land and control over physical resources, and the consequences of extraction, construction and pollution from energy

production and use. This theme is more prominent in work on energy positioned in political ecology and human geography [46,47], which indicates a fruitful research frontier. Beyond the empirical contributions, decolonial perspectives provide an ontological and epistemological challenge to mainstream energy research in how they forefront epistemic injustice, positionality and knowledge making.

The geographical analysis of where scholars are based in relationship to what countries are studied confirms a pattern of inequity that is well established for energy studies more broadly as well as other fields [6,32,33]. The researchers involved in this study are scholars based in a European institution, a common situation. To set a "global scope" does not address the mechanisms by which colonial legacies marginalise good work from institutions and scholars in the academic periphery. This may be better done in qualitative content-oriented reviews. Also, one must query if our categories and terminology around energy use come with underlying assumptions that represent particularistic (rather than universal), dualist and techno-oriented views [37].

There is clear scope to draw on and learn from work in the climate change and climate policy fields, where critical perspectives are more prominently used. Based on experience, the neigbouring fields of climate justice, energy justice and environmental justice are still largely separate despite closely interrelated thematics. Further exchanges are likely to bring valuable insights. Finally, this research hopes for work that mobilizes more-than-human perspectives to the nexus of interest. It is missing, probably because user-centred analyses foreground human needs and interests, thus adopting anthropocentric framings unless care is taken to work with broader ecologies [for an exception see [48]].

5. Conclusion

This quantitative review of literature oriented around users' place in transitions to sustainable energy systems has offered an overview of the scholarly landscape. The mapping has revealed how work that builds on critical theory approaches and deals explicitly and in depth with relationships of power still occupy marginal positions even in bodies of work that are labelled as being about justice and exclusion.

Standing in the middle of a combined crisis of biodiversity loss, renewable energy shortage and effects from climate change, it comes as a surprise that the energy scholarship broadly has not paid more attention to these approaches and drawn to a larger extent on the vast research that is available in nearby fields (e.g. in human geography, science and technology studies, political ecology and development studies). In addition, increasing interest in issues of user perspectives and equity in policy circles and funding agencies over the past years, indicates that nuanced and in depth analyses of these issues are sought after by policy makers in the energy realm. For example, understanding the power structures and contexts that energy users act within is of central importance for EU countries who will need to enact the revised EU Energy Efficiency Directive (EU/2023/1791) from October 2023, which includes binding aims to decrease energy consumption while also empowering consumers and alleviating energy poverty.

In light of this, this research argues that even if there are other traditions to build from—e.g. in the political science realm—that also deal explicitly with power, critical theory approaches offer a vast repository for studying exclusion and oppression with an eye to social transformation. These are an underused resource within the energy field. As shown by other studies, one explanation for this is the historical and disciplinary grounding of energy studies with its main focus on technologies and finance, which results in a somewhat uncomfortable relation to "the social scientist" [49,50]. While the interdisciplinary exchanges have vastly improved in the last two decades, there remains a gap by training and terminology between research from the different traditions. Future cross-disciplinary studies that bridge this gap are crucial to develop the knowledge needed to carry out the policy and practice interventions needed for assuring both socially and environmentally sustainable energy transitions.

Another, more worrisome explanation is that the focus on the speed and urgency of socio-technical energy transitions pushes other concerns aside and leads to secondary considerations for questions of equity and justice [51]. The financial flows that accompany a big shift in energy production systems are intertwined with ownership and control, which means that down prioritizing equity concerns in the interest of fast emission cuts will be, as it is already, accompanied by dispossession of people from their lands, disregard for human and animal well-being and continued epistemic injustice [47,52]. When developing policies for a just energy transition, the elements of justice, inclusion and power need to be well understood, based on context-specific knowledge and integrated in the planning and inception phase of projects and programs.

In the context of emerging energy transitions, the landscape view here presented helps visualise the trends and development within energy scholarship. In the face of rapid changes in energy landscapes, this work can potentially enable research, policy and practice to make informed choices on research domains to ensure that emerging energy transitions not only achieve decarbonization goals but also actively contribute to a more just and equitable global energy future.

CRediT authorship contribution statement

Helene Ahlborg: Conceptualization, Methodology, Formal analysis, Validation, Visualization, Writing – original draft, Writing – review & editing, Funding acquisition. **Kavya Michael:** Methodology, Formal analysis, Validation, Visualization, Writing – review & editing. **Samuel John Unsworth:** Methodology, Formal analysis, Validation, Visualization, Writing – review & editing. **Sylvère Hategekimana:** Formal analysis, Validation, writing—review. **Olufolahan Osunmuyiwa:** Methodology, Writing – review & editing. **Anna Åberg:** Conceptualization, Methodology, Writing – review & editing, Funding acquisition, Project administration. **Martin Hultman:** Conceptualization, Methodology, Writing – review & editing, Funding acquisition.

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.

Data availability

No data was used for the research described in the article.

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References

[1] Sultana F. Critical climate justice. Geogr J Mar. 2022;188(1):118–24. https://doi.org/10.1111/GEOJ.12417.

[2] Brown B, Spiegel SJ. Coal, climate justice, and the cultural politics of energy transition. Global Environ Polit Jan. 2019;19(2):149–68. https://doi.org/10.1162/GLEP_A_00501.

[3] Sovacool BK. Who are the victims of low-carbon transitions? Towards a political ecology of climate change mitigation. Energy Res Social Sci Mar. 2021;73:101916. https://doi.org/10.1016/J.ERSS.2021.101916.

[4] Carley S, Konisky DM. The justice and equity implications of the clean energy transition. Nature Energy 2020;5(8):569–77. https://www.nature.com/articles/s41560-020-0641-6.

[5] Kanger L, Schot J. Deep transitions: theorizing the long-term patterns of socio-technical change. Environ Innov Soc Transit Sep. 2019;32:7–21. https://doi.org/10.1016/J.EIST.2018.07.006.

[6] Ali M, Couto LC, Unsworth S, Debnath R. Bridging the divide in energy policy research: empirical evidence from global collaborative networks. Energy Pol 2023;173(Feb). https://doi.org/10.1016/j.enpol.2022.113380.

[7] Cecelski E. Energy and rural women's work: crisis response and policy alternatives. Int Lab Rev 1987;126(1):41.

[8] Aria M, Cuccurullo C. bibliometrix: an R-tool for comprehensive science mapping analysis. J Informetr Nov. 2017;11(4):959–75. https://doi.org/10.1016/J.JOI.2017.08.007.

[9] Casillas CE, Kammen DM. Environment and development. The energy-poverty-climate nexus. Science Nov. 2010;330(6008):1181–2. https://doi.org/10.1126/SCIENCE.1197412.

[10] Siksnelyte-butkiene I. A systematic literature review of indices for energy poverty assessment: a household perspective. Sustainability 2021;13:10900. https://doi.org/10.3390/SU131910900. vol. 13, no. 19, p. 10900, Sep. 2021.

[11] Herrero ST. 7. Energy poverty indicators: a critical review of methods, vol. 26; Aug. 2017. p. 1018–31. https://doi.org/10.1177/1420326X17718054.

[12] Shahzad U, Gupta M, Sharma GD, Rao A, Chopra R. Resolving energy poverty for social change: research directions and agenda. Technol Forecast Soc Change 2022;181(Aug). https://doi.org/10.1016/j.techfore.2022.121777.

[13] Listo and Romy. Gender myths in energy poverty literature: a critical discourse analysis. Energy Res Social Sci Apr. 2018;38:9–18. https://doi.org/10.1016/J.ERSS.2018.01.010.

[14] Pachauri S, Rao ND. Gender impacts and determinants of energy poverty: are we asking the right questions? Curr Opin Environ Sustain Jun. 2013;5(2):205–15. https://doi.org/10.1016/J.COSUST.2013.04.006.

[15] Sovacool BK, Clarke S, Johnson K, Crafton M, Eidsness J, Zoppo D. The energy-enterprise-gender nexus: lessons from the multifunctional platform (MFP) in Mali. Renew Energy Feb. 2013;50:115–25. https://doi.org/10.1016/j.renene.2012.06.024.

[16] Mohideen SR. The implications of renewable energy development for gender relations in poor communities in South Asia. http://hdl.handle.net/11343/43162. [Accessed 13 December 2023].

[17] Ahlborg H. Towards a conceptualization of power in energy transitions. Environ Innov Soc Transit Dec. 2017;25:122–41. https://doi.org/10.1016/J.EIST.2017.01.004.

[18] Sunikka-Blank M, Galvin R. Single parents in cold homes in Europe: how intersecting personal and national characteristics drive up the numbers of these vulnerable households. Energy Pol Mar. 2021;150:112134. https://doi.org/10.1016/J.ENPOL.2021.112134.

[19] Sunikka-Blank M, Bardhan R, Haque AN. Gender, domestic energy and design of inclusive low-income habitats: a case of slum rehabilitation housing in Mumbai, India. Energy Res Social Sci Mar. 2019;49:53–67. https://doi.org/10.1016/J.ERSS.2018.10.020.

[20] MacEwen M, Evensen D. Mind the gap: accounting for equitable participation and energy democracy in Kenya. Energy Res Social Sci Jan. 2021;71:101843. https://doi.org/10.1016/J.ERSS.2020.101843.

[21] Winther T, Ulsrud K, Saini A. Solar powered electricity access: implications for women's empowerment in rural Kenya. Energy Res Social Sci Oct. 2018;44:61–74. https://doi.org/10.1016/J.ERSS.2018.04.017.

[22] Parikh J. Hardships and health impacts on women due to traditional cooking fuels: a case study of Himachal Pradesh, India. Energy Pol Dec. 2011;39(12):7587–94. https://doi.org/10.1016/j.enpol.2011.05.055.

[23] Räty R, Carlsson-Kanyama A. Energy consumption by gender in some European countries. Energy Pol Jan. 2010;38(1):646–9. https://doi.org/10.1016/J.ENPOL.2009.08.010.

[24] Joshi G, Yenneti K. Community solar energy initiatives in India: a pathway for addressing energy poverty and sustainability? Energy Build Mar. 2020;210:109736. https://doi.org/10.1016/J.ENBUILD.2019.109736.

[25] Feenstra M, Özerol G. Energy justice as a search light for gender-energy nexus: towards a conceptual framework. Renew Sustain Energy Rev Mar. 2021;138:110668. https://doi.org/10.1016/J.RSER.2020.110668.

[26] Burney J, et al. Impact of a rural solar electrification project on the level and structure of women's empowerment. ERL Sep. 2017;12(9):095007. https://doi.org/10.1088/1748-9326/AA7F38.

[27] Halder P, Pietarinen J, Havu-Nuutinen S, Pelkonen P. Young citizens' knowledge and perceptions of bioenergy and future policy implications. Energy Pol 2010;38(6):3058–66 [Online]. Available: https://ideas.repec.org/a/eee/enepol/v38y2010i6p3058-3066.html. [Accessed 13 December 2023].

[28] Sovacool BK. Confronting energy poverty behind the bamboo curtain: a review of challenges and solutions for Myanmar (Burma). Energy for Sustainable Development 2013;17(4):305–14. https://doi.org/10.1016/J.ESD.2013.03.010.

[29] Lacey-Barnacle M, Robison R, Foulds C. Energy justice in the developing world: a review of theoretical frameworks, key research themes and policy implications. Energy for Sustainable Development Apr. 2020;55:122–38. https://doi.org/10.1016/J.ESD.2020.01.010.

[30] Cynthia Neudoerffer R., Malhotra P., Venkata Ramana P. Participatory rural energy planning in India – a policy context. Energy Pol 2001;29(5):371–381. [Online]. Available: https://ideas.repec.org/a/eee/enepol/v29y2001i5p371-381.html. [Accessed 13 December 2023].

[31] Cecelski EW. From Rio to Beijing: Engendering the energy debate. Energy Pol Jun. 1995;23(6):561–75. https://doi.org/10.1016/0301-4215(95)91241-4.

[32] Karlsson S, Srebotnjak T, Gonzales P. Understanding the North–South knowledge divide and its implications for policy: a quantitative analysis of the generation of scientific knowledge in the environmental sciences. Environ Sci Pol Nov. 2007;7–8(10):668–84. https://doi.org/10.1016/J.ENVSCI.2007.04.001.

[33] Nielsen MW, Andersen JP. Global citation inequality is on the rise. Proc Natl Acad Sci U S A Feb. 2021;118(7):e2012208118. https://doi.org/10.1073/PNAS.2012208118/SUPPL_FILE/PNAS.2012208118.SAPP.PDF.

[34] McCauley D, Heffron R. Just transition: integrating climate, energy and environmental justice. Energy Pol Aug. 2018;119:1–7. https://doi.org/10.1016/J.ENPOL.2018.04.014.

[35] Chambers R. What is poverty? Who asks? Who answers? UNDP International Poverty Centre (IPC); 2006.

[36] Middlemiss L, et al. Energy poverty and social relations: a capabilities approach. Energy Res Social Sci Sep. 2019;55:227–35. https://doi.org/10.1016/J.ERSS.2019.05.002.

[37] Tuana N. Gendering climate knowledge for justice: catalyzing a new research agenda. Research, Action and Policy: Addressing the Gendered Impacts of Climate Change Jan. 2013:17–31. https://doi.org/10.1007/978-94-007-5518-5_2.

[38] Arora-Jonsson S. Virtue and vulnerability: discourses on women, gender and climate change. Global Environ Change May 2011;21(2):744–51. https://doi.org/10.1016/J.GLOENVCHA.2011.01.005.

[39] Westbrook L, Saperstein A. New categories are not enough: rethinking the measurement of sex and gender in social surveys. Gend Soc Aug. 2015;29(4):534–60. https://doi.org/10.1177/0891243215584758.

[40] Magliozzi D, Saperstein A, Westbrook L. Scaling up: representing gender diversity in survey research. Socius 2016;2(Jan). https://doi.org/10.1177/2378023116664352/ASSET/IMAGES/LARGE/10.1177_2378023116664352-FIG2.JPEG.

[41] Campbell B, Cloke J, Brown E. Communities of energy. Economic Anthropology Jan. 2016;3(1):133–44. https://doi.org/10.1002/SEA2.12050.

[42] Tsagkari M. The need for gender-based approach in the assessment of local energy projects. Energy for Sustainable Development Jun. 2022;68:40–9. https://doi.org/10.1016/J.ESD.2022.03.001.

[43] Bell SE, Daggett C, Labuski C. Toward feminist energy systems: why adding women and solar panels is not enough. Energy Res Social Sci 2020;68:101557. https://doi.org/10.1016/J.ERSS.2020.101557. Oct.

[44] Hultman M, Pulé P. Ecological masculinities : a response to the Manthropocene question? Routledge International Handbook of Masculinity Studies; Nov. 2019. p. 477–87. https://doi.org/10.4324/9781315165165-47.

[45] Anshelm J, Hultman M. A green fatwā? Climate change as a threat to the masculinity of industrial modernity. Norma Int J Masc Stud 2014;9(2):84–96. https://doi.org/10.1080/18902138.2014.908627.

[46] Backhouse M, Lehmann R. New 'renewable' frontiers: contested palm oil plantations and wind energy projects in Brazil and Mexico. J Land Use Sci May 2020;15(2–3):373–88. https://doi.org/10.1080/1747423X.2019.1648577.

[47] McCarthy J, Thatcher J. Visualizing new political ecologies: a critical data studies analysis of the world bank's renewable energy resource mapping initiative. Geoforum Jan. 2017;102:242–54. https://doi.org/10.1016/j.geoforum.2017.03.025.

[48] Siamanta ZC. Conceptualizing alternatives to contemporary renewable energy development: community Renewable Energy Ecologies (Cree). J Polit Ecol Mar. 2021;28(1):47–69. https://doi.org/10.2458/JPE.2297.

[49] Sovacool BK. What are we doing here? Analyzing fifteen years of energy scholarship and proposing a social science research agenda. Energy Res Social Sci Mar. 2014;1:1–29. https://doi.org/10.1016/J.ERSS.2014.02.003.

[50] Lutzenhiser L, Shove E, Lutzenhiser L, Shove E. Contracting knowledge: the organizational limits to interdisciplinary energy efficiency research and development in the US and the UK. Energy Pol 1999;27(4):217–27 [Online]. Available: https://EconPapers.repec.org/RePEc:eee:enepol:v:27:y:1999:i:4:p:217-227. [Accessed 13 December 2023].

[51] Priebe J, Mårald E, Nordin A. Narrow pasts and futures: how frames of sustainability transformation limit societal change. J Environ Stud Sci Mar. 2021;11(1):76–84. https://doi.org/10.1007/S13412-020-00636-3/FIGURES/1.

[52] Stock R, Birkenholtz T. Photons vs. firewood: female (dis)empowerment by solar power in India. Gend Place Cult Sep. 2020;27(11):1628–51. https://doi.org/10.1080/0966369X.2020.1811208.