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REVIEW

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# Gender-based opportunity structure in the energy sector: a literature review on women's networking and mentoring

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## Abstract

**Background** While the energy system is recognized as the largest contributor to climate disruption, the bulk of the sustainability-oriented interventions are made through technologies rather than employment equity and social justice issues. Emergent research points to the critical role of increasing the number of women and other minoritized groups in the energy sector, which could have a cultural, economic, and environmental impact. Nevertheless, how inclusion and diversity in the sector are to be achieved is not clear.

**Main text** This article is a result of a structured literature review of earlier research focusing on gender in professional networks and mentoring programs within the energy sector. Professional networks and mentoring have been identified as some of the tools employed for increasing gender diversity in the sector. We seek to understand how gender has been integrated, what the main barriers and enablers for women are, and what strategies organizations have applied to achieve gender balance so that men and women face equal opportunities to partake in and influence decisions concerning the energy system.

**Conclusion** We found that women's exclusion is not recognized as a problem that needs to be acknowledged, monitored, or addressed by the energy sector or policymakers. Professional mentoring and networking have largely been employed to fill the career advancement and diversity gaps left untackled by the energy sector or policymakers. Opportunities for women to be meaningfully included in energy systems decision-making are still limited and fragmented. Furthermore, this lack of recognition is mirrored in energy research. We identified a concerning lack of evidence-based findings on the topic of women's networking and mentoring in the energy sector. We thus call for in-depth, qualitative, and critical examinations of how opportunities for women and other minoritized groups are generated on both the policy and practice level.

**Keywords** Energy sector, Gender, Mentor, Network, Inclusion, Diversity

## Background

The energy system is the largest contributor to climate disruption, generating upwards of 80% of greenhouse gasses globally [1]. Central to proposed measures to reduce carbon emissions is a transition from fossil fuel-based energy systems to renewable-based energy generation, which promises to mitigate climate change, as well as create more equitable, localized, and democratic energy systems [2, 3]. Inequality and a failure to include a diversity of actors in decision-making processes in energy systems are increasingly recognized as a barrier to inducing change [1, 4]. Deeper understandings have also emerged from research, policymaking, and professionals, demonstrating that gender dynamics determine who

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participates in decision-making about energy systems and how to respond to climate change [2]. Nevertheless, in industrialized countries, much attention has been paid to the technologies and the financing of renewables rather than employment equity and the social justice potential of the expansion of renewables [5, 6]. In this literature review article, we consider employment in the energy sector as a platform wherein a lack of diversity and inclusion can be contested and negotiated. As we will go on to motivate, professional networking and mentoring will be examined as two possible tools for achieving these goals. The contributions of this research are situated at the nexus of gender and energy. Our contributions lie in the problematization of the forementioned tools, which we will show lays the responsibility on the women that are meant to be benefitting. We further underline their limitations, such as being submitted to gendered structures that play into already existing inequalities in the sector or wider society.

From a research perspective, the examination of the nexus of gender and energy is a budding field. The seminal work by Clancy and Roehr [7], where they astutely argue that gender inequality is left unaddressed in the north, thus obscuring power relationships, paved the way for contemporary engagements with gender and energy. Recent accounts have examined the gendered use of energy in everyday lives, social relations, and practices therein [8–10]. Researchers have also looked past the household to view the gendering, or lack thereof, of energy policy [11], as well as begun to address the experiences of women as employees in the energy sector [2, 6, 12], which represents the empirical focus of this article. Our previous research on women's experiences in energy communities in Sweden and Japan [13, 14] examined which practices might improve and increase gender diversity and equality in grassroots renewable energy engagement. Informants from these two studies, situated in two different cultural and socio-economic contexts, pointed to the role of mentoring and networking as key to enabling and sustaining their engagement in those initiatives. Thus, the findings from those projects [13, 14] motivated the research team to further examine the potential that lay within networking and mentoring activities in the energy sector. Professional network dynamics are crucial in determining how not only people's careers are shaped but ultimately what impact they have on how the energy system develops and is designed. The role of gender in networking and mentoring in achieving a gender balance among employees and professionals in the energy sector is, however, rather unexplored. Professional networks function as complex webs of relationships that promote cooperation, mentoring, and easy access to vital resources [15]. The experience from these professional networks differs, however, between groups in society, and it is crucial to understand, for example, men and women's different experiences with these networks. It is essential to incorporate a gender perspective into the examination of professional networks and mentoring opportunities to have a thorough grasp of the energy sector as a field for professional actuation and equal opportunity.

Gender is a crucial aspect of human identity that has a significant impact on how, among other aspects of daily life, professional networks are formed, organized, and function. Gender differences have historically had a significant impact on career paths, power dynamics, and opportunity availability in the workplace [13, 16]. A review of earlier research on gender differences within the circular economy showed that women have higher environmental concerns and ambitions and often act more sustainably compared to men but are often undermined in decision-making [17]. Nevertheless, an appreciation of women's greater capacity to act on environmental concerns and harbor ambitions, as reported by the review study, should not disregard the possibility that these might be rooted in an unequal division of labor and entrenched social roles and social norms. In other words, their sustainability-oriented behavior might be rooted in the care labor that women are disproportionately expected to perform within families, communities or places of employment, and not necessarily a choice they take freely. The gender dimension is neglected within both policy and practice in the science, technology, engineering, and mathematics (STEM) fields, of which the energy sector is a part [18]. The male dominance and norms are continuously reproduced, and women and other minoritized social groups have restricted access to men's decision-making arenas. Necessary changes in the energy sector will not be achieved through technocratic solutions alone but through deeper engagement with what power is and who gets to use it [1, 16]. Researchers and social movements have recognized these wicked problems as calls for feminist, anti-racist leadership on climate and energy, one with an explicit commitment to racial, social, and economic justice [1, 19]. To successfully transition energy systems to mitigate climate disruption, we must access a wider talent pool, including gender and other types of diversity [1, 6].

Increasing the number of women in the energy sector could enhance environmental, economic, and cultural aspects through their increased environmental concerns and willingness to act on them, their capacity to increase corporate performance, and their inclusive group work [6, 12, 20, 21]. There are also benefits for the women themselves, who are able to work in STEM-related jobs; women in STEM jobs earn 33% more than those in non-STEM jobs, with the gender wage gap being 14% as

compared to 21% for non-STEM jobs in North America [5]. The energy sector has, nevertheless, taken longer than other sectors to mainstream gender. Although, as Clancy and Mohlakoana note, there are signs of change as reflected by the United Nations Sustainable Development Goals (SDGs), which have been aiming to assure, among other issues, women's empowerment and decision-making since 2015 [22]. SDG 5 on gender equality, while formulated to safeguard gender equality and women's rights, cannot be understood as standing alone but is interdependent with the other SDGs, such as SDG 7 on affordable and clean energy [23]. This line of reasoning highlights that gender equality cannot be achieved without access to affordable and clean energy (as well as access to employment within its workforce), and conversely, affordable, clean energy cannot be achieved without safeguarding gender equality [23].

The review article takes a broad approach to the energy sector, including an examination of actions toward diversity and inclusion in both the fossil fuel and the renewable energy (RE) sectors. This is due to women being underrepresented in both the fossil fuel and the RE sector [5]. While findings examining gender equality in the energy sector indicate that the RE sector is more gender diverse than the fossil fuel industry, the RE sector has not picked up the pace with other sectors of the economy that have similar demands on training and experience [12]. Women hold 32% of the renewable energy jobs and 22% in oil and gas [5].

This literature review has been conducted to examine earlier research where gender within the energy sector has been analyzed to discuss key findings and their implications for advancing equity and cultivating more varied and inclusive professional networks therein. More specifically, the article aims to review earlier research focusing on gender in professional networks and mentoring programs within the energy sector. We seek to understand how gender has been integrated, what the main barriers and enablers are for women, and what strategies organizations have applied to achieve gender balance so that men and women face equal opportunities to partake in and influence decisions concerning the energy system.

From a theoretical perspective, we analyze the findings through the prism of energy justice, which grapples with issues of decision-making and participation in the energy systems, with its three dimensions of recognition, procedure, and distribution [24]. Particularly, we address recognition and procedural justice. Recognition justice refers to acknowledging the legitimate concerns and interests of individuals and groups of individuals, along with their viewpoints, arguments, and beliefs. It also includes acknowledging the responsibility of groups as well as their vulnerability. Recognition justice highlights questions such as which values and actors can influence a process, and which cannot, as well as which groups are constantly dominant and which ones are marginalized [25, 26]. Procedural justice refers to the degree of perceived fairness in a process concerning which actors and groups are officially included, but also their meaningful and equitable influence over the outcome. Procedural justice relates to the right to be heard, to participate in decision-making, and to be represented in situations when the choice could have an impact on oneself [27].

## Methods

The article represents the results of a structured literature review, consisting of acquiring articles for analysis through a database search at Scopus and Web of Science (WoS). The search was limited to the period between 2013 and 2023 and was conducted in August 2023. The reason for the limitation was to capture contemporary trends and developments in the energy sector. The following search strings were employed:

*"energy AND sector AND diversity AND inclusion"*
*"energy AND sector AND gender AND mentor"*
*"energy AND sector AND gender AND network"*

The search amounted to 75 articles to select from. An initial exclusion based on an abstract and keyword review was conducted, excluding those that did not address women or gender in the energy sector, after which authors had 30 remaining for full-text screening. Of the 30, 10 were duplicates. Thus, 20 articles were taken further for full-text analysis. After the reading, seven more were excluded for different reasons, such as being behind a paywall or only addressing gender, networking or mentoring as words found in the abstract or reference list rather than as analytical categories, for example, treating 'network' as a distribution network rather than a social practice. A total of 13 articles were included in this review (see Additional file 1 for listed articles). While the number of the articles is, indeed, limited, they represented a relatively diverse geographic spread (Africa: Kenya, Senegal, Tanzania, Nigeria, Kenya, Uganda, Ghana, and Egypt; Americas: Canada, Brazil, and the USA; Asia: Nepal, Indonesia, Thailand, India, and Brunei; Europe: France, The Netherlands, the UK, Russia, Portugal, Greece, and Germany). Solely three were single case analyses, with Canada ($n=2$) and France as empirical locations for those studies.

Data analysis was conducted through a manual thematic analysis conducted by the authors. The analysis was organized in the first step by examining the empirical focus, method, theory, actors, geography, boundaries for women, main conclusions about mentoring/networking, and aspects gender inclusion brings to the energy sector.

We then examined the coding to find themes that are presented in the findings section.

We have only included peer-reviewed literature. This can be considered a limitation, as it excludes the numerous grey literature that addresses women's networking and mentoring in the energy sector. Nevertheless, while valuable, it is difficult to guarantee the quality of the data in grey literature, and the review aimed to focus on what is known from systematically conducted research with a peer-review process, including the various critical points that emerge from that. A further limitation is that there is not much research conducted on this topic, which has consequences in terms of our capacity to go into depth and nuance the findings, such as the fact that certain aspects we herein highlight as enabling women in the energy sector might constrain them in a different context [5]. In response, we have tried to discuss the tenuous boundary between an opportunity and a barrier in the findings. Another limitation is thus that, in this review, gender is addressed in a binary fashion, hence overlapping with biological sex, which is not necessarily people's lived reality. This is due to the kind of articles we had access to as our data. The research in its turn suffers from the limited access to data with regard to identity markers and employment in the energy sector, but despite these limitations, we argue that it is important to summarize the existing knowledge base regarding the prerequisites for women in the energy sector to highlight what is known and where evidence-based knowledge is lacking.

## Findings

We have divided the findings into nine recurrent themes: lack of data; lack of policy and institutional commitment; marginalized groups, grouped as one—for the benefit of the powerful; women's need to have their roles and contributions recognized; sociocultural ideas about gender; disjuncture between companies' rhetoric of inclusiveness and everyday practice; traditional energy actors and energy entrepreneurs as male; strength is in networks; and mentoring as sharing power. While mentoring and networking are the analytical focus of this review, the energy sector and policy makers are often invoked. This is an effect of, as we argue, the limited powers of these networking and mentoring initiatives. While we acknowledge their potentials, they often grapple with limited resources, or limited spheres of influence, when dealing with, for example, socio-economic inequalities, unequal educational opportunities, socio-culturally ascribed gender roles and stereotypes, limited or lacking gender-disaggregated employment, etc. Invoking the energy sector and policymakers is a call to action for actors with greater resources or spheres of influence.

Before the findings are presented, an overview of the central concepts used in this review is provided. Mentoring is here understood as a development-oriented relationship where a person with more experience in a particular role (mentor) shares their experiences with a less-experienced person (mentee) in a structured and goal-oriented fashion. Networking is understood as the establishment and maintenance of profession-based relationships where the goal is mutual learning and career advancement. A prominent network that provides such opportunities, also addressed in this review, is, for example, ENERGIA, the international network on gender and sustainable energy. Unlike mentoring, networking implies relationships that run along horizontal and vertical power lines. In line with Hoicka, diversity is understood as the employee composition of workplaces that is representative of a wide range of races, ethnicities, genders, disabilities, sexual orientations, religions, age, socio-economic backgrounds, and other identity factors [1]. Inclusion is understood as the provision of respect and valuing of an individual's diverse contributions and skill sets in decision-making and design processes [1].

### Lack of data

One problem for the analysis of gender in the energy sector, as well as for intervening in gender gaps, seems to be a lack of data. Several researchers addressed the lack of gender-disaggregated data for employment patterns in the energy sector, as well as data that would measure the existence (or lack thereof) of other types of diversity [1, 5, 12, 22]. It can be derived that there is a lack of clear indicators regarding the extent of the problem. Nevertheless, it is not clear if improving statistics would improve the access to employment for excluded groups or improve the quality of work life for those within the sector. Statistics do not necessarily address existing power imbalances [1], but they help to highlight if and how it is a potential problem and show the scale of the problem. Organizations promoting gender equity in Canada are found to focus their early activities on public education, professional development, and networking activities and have increasingly come to engage with research and policy-making in gender equality [5]. Such organizations have great potential, according to these scholars, as they can collect and disseminate employment-related data based on membership in a strategic manner and inform with nuanced data [5].

### Lack of policy and institutional commitment

The institutional commitment by employers to address gender gaps is fragmented [22]. The lack of attention to gender extends beyond individual employers to energy policy. This lack of attention is found to be a result of

two primary factors: i) a lack of knowledge about the significance of the gender dimension in the energy sector, and ii) uncertainties about how to integrate gender into energy projects and policies [22]. Clancy and Mohlakoana welcome all actions that bring change to organizational behavior and increase gender awareness, such as employment policies and equity-oriented implementation practices [22].

Equity in employment needs to be planned and proactively implemented: in the transition to green energy, one needs to avoid inequality being replicated in the labor force [5]. Based on research on Indigenous women's employment in natural resource industries in Canada, Baruah and Biskupski-Mujanovic argue that enabling Indigenous women access to skilled and well-paid employment should be addressed on a holistic level [28]. They write that it needs to be a priority for governments, resource development companies, industry associations, and gender equity advocacy associations. These scholars further point to the important roles that Indigenous community-based recruiters, liaison officers, and human resources personnel could play in securing better training and employment opportunities for women [28]. Baruah and Biskupski-Mujanovic recommend including targets for Indigenous women in professional, technical, and senior administrative positions; enabling associations that work with Indigenous populations to serve as information and employment conduits to industry associations and employers; and creating access to quality employment opportunities for women who live remotely [28].

While 'meaningful' inclusion or participation is a popular narrative, who can influence the results of such procedures still needs to be probed. This line of questioning can enable collective and alternative visions to affect outcomes [29]. When increasingly shaped and controlled by powerful actors, transformative potential can be limited, as institutionalization can preserve the status quo [29]. Furthermore, neoliberal economic policies make it difficult for one group of people (women and Indigenous people, for example) to secure gains for themselves without creating the misperception that it is setting another group of people (men, non-Indigenous people) back [28].

Findings indicate that these inequalities can be tackled through more hands-on public sector involvement. Baruah and Gaudet point to Brazil as a positive example and world leader in RE, which has enabled women's increased participation in science, technology, and engineering through progressive social policies that include state-funded tuitions and scholarships at the undergraduate and graduate level [5]. However, policies toward gender equality are generally found to be linear and positivist and do not seek to correct historical and current injustices and inequalities [5].

#### Marginalized groups are grouped as one—for the benefit of the powerful

Concerns for racialized, gendered, Indigenous, and otherwise excluded groups are often clustered [29]. The consequence of this is the erasure of intersectional and divergent viewpoints and the continued dominance of majority groups. Research indicates that the difficulties and barriers that Indigenous women face in Canada's natural resource employment are similar to those faced by non-Indigenous women, such as glass ceilings and lack of mentors [28]. Indigenous women, however, experience the added barriers of racism as well as limited employment opportunities due to geographic location [28]. As Baruah and Biskupski-Mujanovic point out, it is important to consider the intersections of gender, culture, ethnicity/race, language, and class to respond to the challenges women experience at their places of employment [28]. Thus, the one-size-fits-all approaches to inclusivity, exemplified by 'fair treatment for all', are inappropriate as they do not address the racialized, patriarchal, and militarized political-economic patterns of controlled access to resources [29]. Centering power and material differences between classes, genders, races, abilities, forms of work, and ways of life is required if a change is to happen [29].

#### Women need to have their roles and contributions recognized

Women need more than assurances of jobs and professional training: they need to have their prominent roles in the home, the environment, the public sector, and energy democracy organizations recognized and acknowledged [29]. Women spend a disproportionate amount of time on household tasks, which limits their capacity to engage in entrepreneurial endeavors [30], including in the traditional energy sector. According to Clancy and Feenstra [31], women are held back from expanding their domain of decision-making due to time poverty. They write that approximately 50% of working women spend one hour a day on caring activities compared to approximately 33% of men in the European Union (EU), with these inequalities growing in at least 12 EU Member States [31]. Both the RE sector and fossil fuel industry can demand travel, which might be a problem for those with caregiving responsibilities, which tends to be women as they globally spend a disproportionate amount of time on it [5]. While women and minorities must gain easier access and support for technical education and training, the double standard of women being socialized in gendered systems

that press upon them caregiving roles both in the home and at work needs to be addressed [12].

### Sociocultural ideas about gender

Societal gender resources are reinforced by the type of work men and women are being hired to perform [28]. Sociocultural ideas about gender diminish women's career prospects in technical fields, but according to findings with employees from the RE sector, qualifications for jobs in RE were less rigid than expected [12]. Baruah and Biskupski-Mujanovic write that opportunities available to Indigenous women are particularly influenced by gendered and racialized misperceptions about skills and levels of education [28]. Indigenous women are tokenized both for being women and for being Indigenous [28]. Likewise, boundaries can be both a combination of societal perceptions, and women's self-perceptions, thus external and internalized. A prominent and hindering view is that women are unfit for technical occupations [5]. Gathering studies from the Global North and South, Baruah and Gaudet point out that women in non-traditional and male-dominated fields are perceived as less competent than men, even when possessing the same or superior qualifications [5].

There are also misperceptions about the kind of work involved in technical fields, which might falsely represent these fields as solely comprising technology-related tasks [5]. Technical fields might also be perceived as potentially socially isolating hence repelling many women [5]. Women may experience a sense of low status in business networking, as they are more often judged on prior performance, while men are judged on potential competence [30]. Furthermore, employees can experience resistance to gender integration through unwelcoming work conditions and a hostile atmosphere when female employees are present, made apparent through loud and aggressive behaviors and sexualized banter [12]. Challenging norms and the 'gender comfort level' is found to upset some male colleagues [12]. There is also the phenomenon of 'benevolent sexism', implying that male-biased hiring norms and workplace cultures would lead to women not being offered work in difficult or dangerous working conditions but fast tracked into feminized occupations such as in administrative and support services within the sector [5]. Moreover, in their findings, Baruah and Biskupski-Mujanovic [28] highlight that verbal sexual harassment tends to be disregarded by management [28]. Day-to-day interactions are essential for work–life satisfaction, as people need to feel valued, have career advancement opportunities, have a healthy work–life balance, and not experience any type of unwarranted behaviors or harassment [28].

### The disjuncture between companies' rhetoric of inclusiveness and everyday practice

While calls for greater diversity and inclusion can be found in the rhetoric of energy companies and policy documents, they need not be reflected in practice. Elements like culture, race, and gender, according to Wilgosh et al. [29], can be mentioned as buzzwords but left unaddressed through appropriate recruitment, retention or advancement actions and strategies. While a company can have explicit rhetoric aiming to attract diversity and be inclusive in their recruitment practices, research has shown that talent identification practices, for example, may conflict with an organization's public stance toward inclusiveness, ultimately leading to less diverse talent pools [32]. Particularly, Peterson et al. note that 'ambiguity in advancement practices' and 'support from hidden networks' were frequently identified as main sources attributing to perceptions of organizational justice, or a lack thereof, among their informants [32]. They also mentioned frequent gender discrimination and added that the effectiveness of a person's network in assuming a new position or receiving recognition was an advantage, with men often having more chances to create and nurture well-developed networks. The effect of hidden networks, according to these scholars, tends to work in men's favor while women face obstacles [32]. The bulk of the reviewed articles lumped companies together, with companies addressed in plural or as a sector. Further research could provide greater understanding if and how, for example, different types of energy companies engage with diversity and inclusion in rhetoric and practice.

### Traditional energy actors and energy entrepreneurs as male

Based on research with women solar entrepreneurs partaking in *Solar Sister*, an Africa-wide network, women's livelihoods, and communities are found to be improved through such activities [33]. Nevertheless, women experience challenges in performing their tasks in energy entrepreneurship, as entrepreneurship is commonly viewed as a male endeavor, and women face issues with lacking legitimacy and status [30]. These scholars further state that this is not different from the traditional energy sector, where energy-related businesses tend to be founded and led by men [30]. Possessing an effective mix of economic, social, and cultural capital may not be enough to overcome the social and institutional barriers that are ubiquitously present in society [30]. Wilgosh et al. have also recognized the need for an approach that acknowledges the conditions of workers beyond formalized positions, such as informal work, as well as peripheral and precarious labor, arguing that it follows the lines

of intersectional marginalization [29]. For example, in the findings of Baruah and Biskupski-Mujanovic, Indigenous women are overrepresented in the lowest-paid and most feminized occupations in the energy, mining, and forest sectors [28]. Access to financing has also been identified as a boundary in setting up an enterprise [34]. Women might struggle with access to formal credit, or access to bank accounts in rural areas lacking bank branches [34]. Bankers might also lack the knowledge on renewables, or the trust in women-led enterprises [34]. From these perspectives, we can see that women are either kept outside of energy entrepreneurship or occupy the least desirable and lowest paid occupations.

#### Strength is in networks

Increasing the number of women entrepreneurs in the energy sector is argued to support the dual goals of energy access and empowering women [30]. Aiding women entrepreneurs' access to industry-relevant networks may help them overcome some of the foremen-tioned challenges related to access to business financing, through pooling funds, for example [30]. Furthermore, through these networks, the women might experience greater solidarity with peers, gain greater financial independence, and greater respect in their communities [30]. Access to networking activities can constitute sources of knowledge, social support, and legitimacy for women entrepreneurs [30]. The benefits from networking for female entrepreneurs, especially within resource-poor settings can be challenged by the lack of access to mentors and networks, as women entrepreneurs often have less effective business networks compared to men entrepreneurs due to gendered family roles [30]. Under such conditions, financial capital is not enough to provide the needed new information, resource acquisition, and social support from other entrepreneurs that networks can provide [30]. Access to coaches, mentors, and networks is thus identified as an essential field in need of support [30]. It is optimal if the networking activities provide some kind of regularity and stretch through time. Recurring networking can help female entrepreneurs maintain a useful network, which would be their platform to: (a) address business challenges; (b) learn best practices from other entrepreneurs; and (c) expand their reach and share resources with their peers and communities [30]. Engaging men in programs targeted toward women's economic empowerment can also improve their impacts, with effective strategies such as capacity-building activities encouraging men to adopt gender-equitable masculinities, promoting the benefits that men will gain from women's economic empowerment, encouraging men's roles in care work, engaging men in training targeting women, and identifying and supporting gender champions [30]. Clancy and Mohlakoana have also found that working with men toward gender inclusion can positively contribute to women's influence on decision-making [22].

Alisson et al.'s findings confirmed that networking is important to women's careers [12]. They affirmed that these networking organizations had both individual and collective value [12]. Networks are found to play a role in transferring knowledge and helping shape discourse [22], where networking and collaboration are seen as a platform that creates the space for dialogue between stakeholders [35]. Allison et al. support industry-based findings that advise firms to engage with professional networking organizations throughout the hiring process (recruitment, interviewing, hiring, and retention) and through the development of more inclusive company cultures [12]. While women have limited access to influential people, these organizations provide access to other women who have succeeded [12]. Their informants stated that one must 'sell oneself' but that women might lack the social opportunities to build relationships, where men perhaps have such access through gendered (sports) activities [12]. Networking behavior is also gendered [12], and women benefit less from networking than men do [12]. Women lack the institutional resources to convert a network into a promotion [12] since they do not want to be pushy to capitalize on networks due to the social stereotypes inhibiting it [12].

Women's networks, considered as social capital, have also been found to benefit their employers, or professional spaces for actuation. Research on female board members in the energy sector who have a background in community leadership, such as political parties or social organizations, rather than the 'usual' industry-based expertise, indicates that they can provide resources such as connections to important stakeholders, social position, reputation, and legitimacy [36]. They can thereby be viewed as sources of social capital and provide trustworthiness, openness, and improved communication with other board members and external partners [36]. This might benefit their employers by enabling better resource acquisition, greater monitoring, different perspectives, and varied orientations toward more social and environmental challenges [36]. Including such women will, therefore, contribute non-business viewpoints and methods to the decision-making process in addition to the influence, external connections, and expertise they gained by working with major groups in the community [36]. While increasing women and minorities' networking opportunities are to be recommended, increasing diversity and inclusion needs involvement on multiple levels.

Likewise, greater focus needs to be given to attracting females and minoritized groups earlier in their

educational or life trajectories. Baruah and Biskupski-Mujanovic write that careers in STEM-fields are less often presented by career counselors or student employment advisers as options for these groups [37–39]. Furthermore, these scholars have suggested that we consider women's personal networks in enabling their interest and motivation to work in STEM-fields. Their informants have reported that they have 'stumbled' into their jobs, and as informal networks are often the way by which job opportunities are communicated and have tended to favor men, mainstreaming needs to be introduced to provide equity in access to employment information [37]. Baruah and Biskupski-Mujanovic identify different types of internships as enabling access, but this assumes that these types of programs can also be a source of free labor, which threatens the positions of more permanent staff [37].

### Mentoring as sharing power

Coaching and mentoring are the most used types of social support programming provided to individual energy entrepreneurs [30]. These approaches are, likewise, found to be important for individuals in setting and achieving their learning goals in workplaces in the traditional energy sector [40]. Margaryan's research revealed that most respondents, whether novice or expert, tended to draw upon their personal networks for problem-solving when facing problems or insecurities regarding new tasks [40]. Mentors played a role by providing advice on skills assessment and learning needs, and by helping identify formal and informal learning opportunities [40]. Interestingly, research also indicates that experts are better than novices at seeking help, as they have the experience of being more selective, adaptive, and self-initiated in drawing upon 'significant others' to assist them in learning [40]. Furthermore, their findings suggest that professionals, specifically novices, may not always know how to self-reflect in a way that is conducive to learning. Hence, they recommend that organizations consider supporting individuals in the development of their reflection skills to analyze their learning and development, so that they can best profit from the learning opportunities that mentorship, for example, can provide [40].

In the case of energy entrepreneurs, mentors with at least two types of skills are found to be beneficial, namely skills in general business development and the technological aspects of the energy product [30]. In Dutta's findings, mentoring is found to consist of customized support from trained mentors, who help mentees on an ongoing basis. Their help can be sought to identify new market opportunities, develop marketing strategies, interact with suppliers and government authorities, prepare business plans, and negotiate with financial institutions [41], where the mentor's role is to demystify 'business' [41]. Based on findings from ENERGIA's WEE program, Dutta writes that mentorship can be a one-to-one relationship, in which an expert provides sustained support to a less-experienced person [41]. The program also contains group mentorship where various mentees with similar needs can be grouped in clusters where they can learn from each other's experiences [41]. The mentoring consists of setting time-bound goals and action planning. Dutta further adds that mentoring is best viewed as a dynamic process, in which the needs of the mentees will change; hence, the mentoring inputs must evolve accordingly [41]. As this mentorship is focused on female entrepreneurs who distribute energy technologies, the mentoring comprises both business and technical aspects. With time, the business mentorship takes precedence over the technology mentorship [41].

The wage gap and unequal access to career advancement are what drives highly ranked women to serve as mentors, according to Allison et al.'s findings [12]. The practice they describe enhancing is the more conventional sense of sharing knowledge, resources, and advice, in addition to role models [12]. Alisson et al. confirm the *Solar Industry*'s diversity study's findings that mentoring is critical to including individual and industry-wide benefits to reduce discrimination against intersectional identities [12]. The study included mentoring and networking as some of the most important factors leading to career success for US solar energy employees [12], and according to these scholars, mentoring practices have increased women's employment in the solar industry by 10% since 2013 [12]. Importantly, mentoring needs to work in combination with state, national, industry-wide, and firm-level initiatives to advance women's and minorities' advancement [12].

An example of women's constructive mentoring can, as in the case regarding energy highlighted by Hoicka, include bringing accountability, reciprocity, and transparency to meetings by contributing to the shared agenda, showing up, sharing ongoing work, providing and receiving constructive feedback, and then following up with an email of action items [1]. Hoicka, in their role as supervisor and mentor, notes that they cannot devolve power per se but can help to unpack hierarchy so that it is more transparent. This way, the people they work with can become more aware of the power that they have [1].

## Discussion: the way forward

In Table 1 shown below, we highlight the barriers, as well as the enabling opportunities for women in the energy sector identified in the themes.

Several of the themes presented in this review (e.g., lack of data, marginalized groups being grouped as one,

**Table 1** Summary of the findings on barriers and enabling opportunities for women in the energy sector

| Theme | Barrier | Enabling opportunities |
|---|---|---|
| Lack of data | Maintains the status quo | None identified |
| Lack of policy and institutional commitment | Inequality is replicated in the labor force;<br>institutionalization can preserve the status quo;<br>neoliberal economic policies pit groups against each other;<br>historical and current injustices and inequalities not corrected | None identified |
| Marginalized groups are grouped as one—at the benefit of the powerful | Erasure of divergent viewpoints;<br>the continued dominance of majority groups | None identified |
| Women need to have their roles and contributions recognized | Time poverty affects the capacity to multiply spheres of decision-making;<br>gender systems press care-giving roles both in the home and at work upon women | None identified |
| Sociocultural ideas about gender | Reduced career and employment opportunities in technical fields;<br>tokenism;<br>women are perceived as less competent than men;<br>women self-exclude based on preconceptions about the content of jobs;<br>women often judged on prior performance, while men are judged on potential competence;<br>unwelcoming work conditions and atmosphere;<br>the 'gender comfort level';<br>'benevolent sexism' | None identified |
| The disjuncture between companies' rhetoric of inclusiveness and everyday practice | Unable to access diverse talent pools;<br>hidden networks tend to work in men's favor | None identified |
| Traditional energy actors and energy entrepreneurs as male | Women lack legitimacy and status;<br>conditions of workers beyond formalized positions follow lines of intersectional marginalization | None identified |
| Strength is in networks | Gendered family roles amount to women having less efficient networks than men;<br>difficulties in assuring continuity networking behavior is gendered;<br>women lack the institutional resources to convert a network into a promotion;<br>stereotypes about the inappropriateness of women's networking;<br>externalizes responsibility for women's advancement to networking opportunities | Enables energy entrepreneurs to pool funds;<br>provide sources of knowledge, social support, and legitimacy;<br>help address business challenges, learn best practices from other entrepreneurs, expand their reach;<br>helps shape discourse;<br>creates the space for dialogue between actors;<br>provides access to other women who have succeeded;<br>source of social capital, and can provide trustworthiness, openness, and improved communication |
| Mentoring as sharing power | Lacking access to mentors might keep individuals and groups in the status quo;<br>lacking or fragmented quality assurance of mentoring;<br>externalizes responsibility for women's advancement to mentoring opportunities | Enables setting and achieving learning goals;<br>demystifies 'business' and aids in interacting with relevant actors (e.g., market, government authorities, other businesses);<br>supports time-bound goal setting and action planning;<br>provides a greater comprehension of business and technical aspects<br>enables sharing knowledge, resources and advice;<br>reduces the discrimination against intersectional identities;<br>increased women's employment;<br>can help to unpack hierarchy and power |

women needing to have their roles and recognitions recognized, and sociocultural ideas about gender) speak to the fact that women's and other minoritized groups' exclusion is not recognized as a problem that needs to be acknowledged, monitored, and addressed. This further exacerbates marginalization. From the perspective

of recognition justice [25–27], the absence of data on women's participation in the energy sector confirms that it is not viewed as a legitimate concern and that women or other minoritized groups' possible inputs are not valued enough to be included. In extension, their values, viewpoints, arguments, and beliefs are excluded from the design and practice of energy value chains. As aforementioned, there is much to be gained from recognizing that women's exclusion is a problem. Recognizing and addressing women's exclusion would signal the openness of the sector towards harvesting the positive benefits of women's presence, such as their cultural, economic, and environmental impact [6]. There thus needs to be access to more transparent and sex-disaggregated data on employment in the energy sector so that the sector becomes aware of the scope of the problem. As this is currently insufficient, analysis and comparison are made difficult [5]. Without empirical evidence, there is no visibility, and without that, no policy priority [5, 6]. While the aforementioned enhancements induced by women certainly hold promise for the transition required of the energy sector, there is much to learn about what is needed to integrate women's concerns and capacities in the male-dominated culture of the energy sector and policymaking.

From the perspective of procedural justice, in our findings, multiple themes spoke to the limited capacity for women to be meaningfully included in energy systems decision-making (e.g., a lack of policy and institutional commitment, sociocultural ideas about gender, the disjuncture between companies' rhetoric of inclusiveness and everyday practice, traditional energy actors and energy entrepreneurs as male, strength in networking, mentoring as sharing power), even in cases when opportunities, albeit fragmented, were made available. Procedural justice is not merely about, as Bell et al. [42] astutely wrote, just adding more women and solar panels. Procedural justice demands that actors are included through transparency and justice of process, and have the space to make a meaningful impact on the outcome of the matters that they partake in [27]. It is essential to be meaningfully included as socially constructed gender roles shape climate change vulnerabilities, as well as how society responds to them [2]. The findings from the review confirm that gender equity and social justice as political goals have not permeated public or policy consciousness regarding, for example, green transitions' need to be inclusive [5]. The mainstream energy transition pathways still represent the dominant male perspective while other perspectives are left out, thus shaping energy pathways that are disconnected from local realities, lack public buy-in, and slow down a sustainable energy transition [16]. Women's capacity for environmental action is thus kept in the privacy of homes rather than in public demonstrations [12] such as political and industrial spheres of decision-making.

Our engagement with recognition and procedural justice further increased our concerns with the practices that are highlighted by researchers as having the potential to generate opportunities for women in the energy sector, namely networking and mentoring. While networking and mentoring can surely, to a certain extent, grapple with issues of increasing women's representation, as well as providing some opportunities for procedural inclusion, applying focus solely on these practices frames women as neoliberal subjects, responsible for catering to their own advancement. While mentoring and networks can benefit from their relative informality, since they can be embedded in external organizations and assembled and operationalized quicker than state-level policy intervention, little pressure is placed on the energy sector and actors therein as responsible employers, or on policymakers themselves. Many of the researchers included here affirm the role of mentoring and networking, but we suggest for careful optimism, as externalized responsibility will at best accrue fragmented success and empowerment of the groups in need. Both mentoring and networking are strategies that address the individuals that have already established themselves in the sector; hence, they work best for employee retention, rather than diversification of the workplace, or make that workplace more receptive to changing its modus operandi. As Allison et al. note [12], networking, and we add mentoring, are gendered behaviors, with naturalized dimensions of how, when, where, and by whom they are practiced. The actual relational labor involved in networking and mentoring, implying that they are relationships that require resources to be maintained, has also been left unaddressed. The time poverty mentioned earlier, and the sociocultural norms and stereotypes that police women's behavior, limit who can partake in their benefits, thus indicating that they may well be options for those who have access to certain privileges, and leaving those most marginalized behind.

What then can be done about structural inequality? Who takes responsibility for working with histories of injustice and deeply entrenched power relationships? We have gathered that much more needs to be done for knowledge on gender and other types of inequalities to be better disseminated and integrated into different levels of the energy sector and policymaking. A particular focus needs to be placed, according to Dutta, on the enabling environment, including the policies and resources available [41]. Governments must play a stronger role in implementing employment equity policies to motivate the energy sector [5]. These must ensure that structural barriers that create bias against women within policy are

overcome [41]. Considerations of challenges for women and minoritized groups need to be made at all stages of a career: attraction, selection, retention, interruption, reentry and advancement [37, 38]. Likewise, according to Hoicka, it is not only the energy sector that suffers from diversity or inclusion but also academia, as well as sustainable energy research [1]. These are also forums in need of diversification. This is not only in terms of representation, but also in terms of which topics are discussed and in which ways they are represented. Both the energy sector, as well as our backyard of energy and sustainability research, need to find strategies to better advance gender, as well as racial and ethnic minorities, LGBTQ2+, persons with disabilities, and other underrepresented groups [1].

## Conclusions

### What networking and mentoring can do for women

The findings of this review confirm that women's networking and mentoring in the energy sector can be utilized as tools for their individual career advancement. They are found to be beneficial for both women employed within the traditional energy sector and those working as RE entrepreneurs. The activities they engage in, and the relationships they gain access to, enhance their social capital, which they can use as leverage to transcend some of the practical, social, and cultural barriers that a woman or minority person might experience in a male-dominated technical field.

### What women should not be expected to do for themselves and each other

We point out that mentoring and networking are not, nor should not be, the only tools for increased inclusion and diversity in any sector. We welcome engagement on a policy, research, and practice level, with different approaches towards gender mainstreaming, such as auditing, budgeting, quotas, et cetera.

### What are the barriers

While these strategies promise to ameliorate their professional options and career growth once they have entered the energy sector, we still lack deeper engagement with the significant barriers that minoritized groups would still face, or that keep other groups on the outside. As shown in the discussion, women's exclusion is not recognized as a problem in need of being acknowledged, monitored, and addressed (thus failing from the perceptive of recognition justice); moreover, the opportunities for women to be meaningfully included in energy systems decision-making are still limited and fragmented (thus failing in procedural justice).

### The contribution of this research

We have contributed by highlighting the need for a gender perspective on formal opportunities in the energy sector, thus adding to what is scantily addressed in energy research and by policymakers or those within the sector. We further critically engaged the limited number of existing research articles on the topic and problematized the highlighted solutions, with mentoring and networking as gendered and limiting in their own right. We have also highlighted the neoliberal and individualizing qualities of mentoring and professional networking, as they can place the responsibility for increased diversity and inclusion in the energy sector back to the groups that need it the most. This deflects responsibility away from actors with greater spheres of influence, such as the employers themselves or policymakers.

### Call for further research

Considering the limited number of articles we have been able to identify and include in the review, we find it essential to point out the concerning lack of evidence-based findings on the topic of women's networking and mentoring in the energy sector. We found that the most detailed and qualitative descriptions of what constitutes these practices came from the Global South. Indeed, this makes Clancy and Roehr's [7] call to engage with gender, energy, and power relationships still timely. Opportunities for women in the energy sector in the Global North and South, or the lack thereof, run across gendered lines as do the tools we use to get ahead: mentoring and networking being but a few of them. We thus call for in-depth, qualitative, practice-near, and critical examinations of how opportunities for women and other minoritized groups are generated, both on the policy as well as industrial/practice level globally. We invite researchers to examine what women's networking and mentoring (or other diversity and inclusion tools) are in the energy sector, what kind of practices they entail, how they are experienced by those they aim to address, what the gendered and intersectional dimensions of having the capacity or lack thereof to meaningfully participate in opportunities looks like, and how they can be tackled. This approach would provide us with greater insight into mentoring and networking as power relationships in their own right. Through this knowledge, we can envision more ways in which subjects with less power could question and transform more established positions. Inclusion and diversity are not matters of mere reproduction, but of the potential to transform the world as we know it. Furthermore, if mentoring and networking are acts of care, they are also acts of labor. We know little, if anything, of what the cost of that labor is, and who can perform it. Finally, we invite

for research on how dominant groups in the energy sector view or experience issues of diversity and inclusion at work. We thus call for greater research on the topic, as well as practice-based approaches that can provide dominant groups with insights on how to be better allies and contribute to an inclusive work culture.

**Abbreviations**

| | |
|---|---|
| *EU* | European Union |
| *RE* | Renewable energy |
| *STEM* | Science, technology, engineering and mathematics |
| *SDG* | Sustainable Development Goals |
| *UNESCO* | The United Nations Educational, Scientific and Cultural Organization |

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**Author contributions**
DL: conception and design of the work; acquisition, analysis, and interpretation of data; has drafted the work and substantively revised it. JP: analysis, and interpretation of data; has drafted the work and substantively revised it. Prepared Table 1. ARK: has drafted the work and substantively revised it. All authors have reviewed and approved the submitted version and agree to be personally accountable for any issues being investigated, resolved, and the resolution documented.

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**Competing interests**
The authors declare no competing interests.

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## Publisher's Note