

Literature review on gender and energy

Introduction

This literature review has been prepared as part of the H2020 project DIALOGUES, with the primary goal to inform project participants on the gender aspects of energy insofar they are relevant for the project.

61 recent publications have been reviewed, and clustered along the following topics:

- ▶ Energy poverty: papers focusing on how women are more affected by energy poverty;
- ▶ Gender roles & technology: papers focusing on roles of gender in the context of prosumerism and renewable energies. Men tend to 1) take the decision on investments in renewables 2) monitor energy consumption 3) install renewable energy systems 4) have more interest in technology. Women become involved once it affects their household duties;
- ▶ Gendered energy consumption: gender as a determinant of domestic energy use (laundry, cooking, cleaning etc.);
- ▶ Gender-responsive energy policy: papers focusing on tools/methods/solutions to make energy policies gender-responsive;
- ▶ Intersectionality: papers analyse intersectional aspects of the energy sector and energy transition;
- ▶ Just Transition: papers focusing on how just transition for the energy sector needs to look like, with a gender focus;
- ▶ Representation in renewable energy cooperatives (REC): papers on the (under)representation of WLINTA* (women, lesbians, inter, non-binary, trans, agender people) in renewable energy cooperatives (REC), local energy initiatives (LEI) and community-based energy (CBE);
- ▶ Data on gender: papers that use gender as a variable or cite findings of different papers.

In the past, GenderCC has prepared literature reviews on gender and energy which are part of two publications, available only in German, except for an English summary (Röhr et al., 2018; Rückert-John et al., 2021). References that have been reviewed for these publications are not included in this paper.

We kept this initial version quite brief, in order to give everybody a chance to get a quick overview, and some motivation to take a closer look at the collected gender articles.

Please note that this is a draft version, and comments and recommendations are very welcome.

Energy Poverty

Concerning gender aspects of energy poverty multiple research papers stress that energy poverty is gendered. Research for the Global North (Mort, 2019) and the EU (Clancy et al., 2017) find that women are at higher risk of energy poverty, due to lower overall income. Within the EU elderly women with a high life expectancy and low pensions, as well as lone-female headed households are particularly affected by energy poverty (EIGE, 2016). Energy poverty has severe consequences, connected to age it can lead to the loss of home and independence and for young people it can be a barrier to employment and education (Dunphy et al., 2017). (Campos and Marín-González, 2020) and (WECF and ZE, 2018) argue that gender justice within and around energy cooperatives is one possible way to overcome energy poverty, by addressing the issue and placing gender needs at the core of cooperatives' political agenda.

Gender roles & technology

Gender roles and attitudes towards technology and renewable energies differ on multiple levels. Women are often seen as more environmentally responsible and interested in sustainability (Comeau et al., 2015), which is

explained by their motivation to protect their children, as well as the community (Allen et al., 2019). This is supported by a UK project to monitor energy use at household level, where mainly women represented the household and were engaged in monitoring consumption (Burchell et al., 2016). Women's engagement is explained by the connection of the monitoring project to the local primary school and women being more inclined to join the project because of the connection to their children. However, (Mort, 2019) and (Mang-Benza, 2021) find the attitude of women in the Global North to be ambiguous towards renewable energy resources, however surveys in Germany repeatedly show that women tend to be more in favour of renewable energies than men (Belz et al., 2022; Rubik et al., 2019). The resistance of women towards nuclear power is commonly observed over time and among all countries in the Global North (Mort, 2019).

Although, women are perceived as environmentally concerned, they are not impelling or even object investment in renewable energy systems for their household. In Germany typical investors in renewable energy for their house are male, high income, higher education, strong pro-environmental beliefs and live more rurally (Schall, 2020). Women are generally interested in socially responsible investment (Schall, 2020) but are reluctant to invest into renewable energies for their house, fearing it would come at the expense of other investments (Standal et al., 2020). The same study found for Norway and UK households that men are putting prosumerism forward (Standal et al., 2020), whereas women were less likely to become prosumers (Mort, 2019). Smart technology is catering to the existing gender roles and developed to tailor to male consumers and their interests (Gram-Hanssen et al., 2017). In this context the term 'energy citizenship' has also been criticized for traditionally addressing men. On the one hand, women were historically denied rights of and not seen as citizens and on the other hand, for citizenship exclusively referring to the public sphere, from which women were and still are excluded, ignoring energy use and its importance at the household (Lennon et al., 2020).

Gender roles and responsibilities are one way of explaining differences in attitudes and behaviours towards renewable energy transitions (EIGE, 2016). Division of labour in households follows categorizations into supposedly technological (typically male) and non-technological (typically female) tasks and responsibilities are set according to these gender scripts (Mort, 2019). Solar energy technology as well as prosumerism are seen as the male domain (Standal et al., 2020) (Mort, 2019). Women are often described as less interested in renewable energies and lacking expertise (Standal et al., 2020). Looking closer at the issue, differences in access to resources and structural barriers, such as lack of skills, social networks and financial capital, can explain fewer engagement of women in renewable energy technologies as well as their attitude (Buechler et al., 2020; Comeau et al., 2015; Standal et al., 2020). However, people also reinforce and try to fit into their gender roles. In Canada women were more insecure to answer questions about the energy transition and in Norway and the UK women even downplayed their expertise on technology (Comeau et al., 2015; Standal et al., 2020).

In addition, gender emerged as an important factor in an anthropological study on energy renovation in Denmark (Tjørring, 2016). The division of tasks within a household between men and women place energy renovation in the male sphere due to cultural and gender norms. The findings of the research showed the underlying reason for women's limited engagement with energy renovation is because it is associated with house maintenance which appeals mostly to men whereas the opposite seems to apply to the protection of nature. The study proposes to engage more women by disconnecting the cultural association between energy renovation and house maintenance (Tjørring, 2016).

Home climate change solutions in a case study in U.S. households were found to potentially exacerbate the gender 'climate gap' as they are traditionally performed by women (Thoyre, 2020). An example of that is compact fluorescent lamp (CFLs) which are considered an easy and accessible climate action, yet they may involve additional gendered work which affects the climate gap due to traditional gender roles. The devaluing of the labour around the use of CFLs is likely to reproduce inequalities not only between the binary but they can be extended in larger discourses between women of the Global South and the Global North (Thoyre, 2020). On a similar note, a study conducted in Sweden notes that the extra workload related to energy efficiency

affects women in a disproportional way and argues for a gender perspective in future intervention programmes (Carlsson-Kanyama and Lindén, 2007).

Gendered Energy Consumption

To analyse gender differences in energy consumption at household level, many studies look at how household work is divided among men and women. Studies in the Global North all find that women spend considerable more time doing household chores than men (Dunphy et al., 2017; EIGE, 2016; Grünewald and Diakonova, 2020; Mort, 2019; Standal et al., 2020), with largest time gaps for laundry and cleaning (Dunphy et al., 2017; Standal et al., 2020). The time gap for cooking is much smaller between single household men and women, in comparison to when women live with their partner and/or children (Dunphy et al., 2017). Also for the rural Global South heating and cooking are traditionally female responsibilities with negative health effects due to high indoor pollution from fire wood (Clancy et al., 2007; Wilhite, 2017). Similar adverse health effects even exist in the EU (EIGE, 2016). Electrification in the rural Global South and Europe frees up time for women (Sahakian et al., 2021) and can lead to higher income and education, although this relationship might not be causal (Wilhite, 2017).

Energy use at household level is, as a result of the division of household labour, seen to be influenced much more by women than men (EIGE, 2016; Gram-Hanssen and Georg, 2018; Lennon et al., 2020; Wilhite, 2017). The hypothesis that women therefore would also use more energy at household level only manifests for female-headed households having higher energy use, due to higher ambient temperature needs, older houses, energy intensive activities and cleanliness (Clancy et al., 2017; Mort, 2019). This is however, contradicted when looking at single households: single men use more energy than single women (Mort, 2019). Other findings also point in the direction of women being more sustainable consumers than men (EIGE, 2016). Men in the UK have been shown to have a 13% higher electricity demand connected to the use of electric vehicles and fewer gas boilers, whereas women use less electricity overall (Grünewald and Diakonova, 2020). Although women are responsible for high energy chores (such as laundry), they use less electricity than men performing the same tasks and often during off-peak demand times (Grünewald and Diakonova, 2020).

Working on the energy transition at household level, men in the Global North are initiators to reduce energy use turning to technological solutions, while women are more willing to change their behaviour to save on energy (Mort, 2019; Standal et al., 2020). This is also referred to the feminization of energy transition, mostly burdening women to change their behaviour to reduce energy (Gram-Hanssen et al., 2017; Mort, 2019; Standal et al., 2020).

A study showed that gendered relations and roles act as organising principles and based on that, household dynamics influence how energy is consumed by men and women respectively (Bell et al., 2015). In addition, one should consider that a household consists of different family members who correspond to different gender roles (e.g., women tend to be responsible for laundry and cooking and men for house maintenance) (Tjørring et al., 2018). Thus, electricity consumption is affected by the relationship of the members and their level of responsibility towards a specific household task (Tjørring et al., 2018).

Participation in REC

Participation of women in renewable energy cooperatives (REC) and renewable energy projects, concerning investment, (board) membership and active participation, is much lower than men (Łapniewska, 2019a). Research on members and shareholders of RECs shows that women are highly underrepresented as members, with the highest imbalance in Belgium (81% male) (Bauwens and Eyre, 2017), followed by Germany (71-80% male) (Drewing and Glanz, 2020; Łapniewska, 2019b) and Japan (79.5%) (Karl et al., 2021). For smaller RECs (n>40 members) the imbalance was even more prominent with only 7% female members. Looking at the staff of prosumer initiatives, women are largely underrepresented: EU average were 72% male employees with the highest imbalance in Germany (80% male employees), with inequalities exacerbating at management levels

and decision-making bodies of RECs (Fraune, 2015; Karl et al., 2021). Spain and Portugal with 40% male staff and half of the management being female are exceptions. Only in 17% of the RECs in Europe women were more active than men (Horstink et al., 2020). In Denmark men had a 10% greater willingness to invest in wind farms (Johansen and Emborg, 2018) and in Germany men were 1.3 times more likely than women to participate in public energy projects (Ernst and Shamon, 2020). Which is why people participating in European RECs are a very homogenous group: male, retired, high income, high electricity consumption and high educational level (Bauwens and Eyre, 2017; Drawing and Glanz, 2020; Karl et al., 2021; Łapniewska, 2019b; Schall, 2020).

Reasons for the low participation of women in RECs is associated with 1) underrepresentation of women in the energy sector 2) women's risk-aversion 3) foundation of RECs and new recruitment 4) REC's lack of knowledge or willingness to include women 5) women's time constraints 6) gender wealth gap and 7) formal structures of RECs. The most common explanation given by studies to explain the female absence in participation at RECs was the underrepresentation of women in the energy sector and the gender imbalances in STEM fields (Drawing and Glanz, 2020; Fraune, 2015; Łapniewska, 2019a; Lazoroska et al., 2021; Mort, 2019). Women working in the energy sector are not in decision-making positions and if so are having comparatively less influence on decisions and are otherwise occupying low-qualified and non-technical jobs (EIGE, 2016; Mang-Benza, 2021; Wilhite, 2017). A gender gap in STEM education persists (Gender and energy, 2016), as well as gender-based discrimination along the energy value chain (WECE and BBE, 2020).

Women's risk aversion is given as the second most common explanation for their absence in RECs. Johansen and Emborg (2018) explain the lack of female willingness to invest in Danish windparks with their risk aversion and Fraune (2015) and Karl et al. (2021) show that women are more likely to get involved in RECs with legal structures reducing personal liability. The foundation of RECs as well as the recruitment of new members and active participants are the third most observed explanations for gender disparities in RECs. Some of the German RECs established out of existing male dominated networks (Karl et al., 2021) and in Sweden RECs retreated to look for board members with experience, which favored male candidates (Lazoroska et al., 2021). A lot of the recruitment of new members for RECs is tied to personal contacts, via-via contacts and information stands (Fraune, 2015; Karl et al., 2021), leading to further homogenization of the membership base.

Ranking fourth, multiple studies find the **lack of knowledge or willingness to include women in RECs** to be critical for women abstaining to join RECs (Fraune, 2015). Among EU and German RECs the vast majority does not mention the issue of gender imbalance among their members and are not planning any activities to recruit women (Campos and Marín-González, 2020; Karl et al., 2021). Gender equality was not even among the shared values of the initiatives, except for some RECs in Spain, who had feminism as one of their core values (Campos and Marín-González, 2020). In Sweden the naïve assumption that RECs are open for everyone is leading to solar RECs neglecting to address diversity of their members entirely (Lazoroska et al., 2021). The few women involved in RECs are experiencing pressure to justify their participation (Drawing and Glanz, 2020).

Two of the reviewed studies also name **lack of time** as a reason for women to participate less in REC (Drawing and Glanz, 2020; Karl et al., 2021). Fraune (2015) refers to the **gender wealth gap** as one of the reasons of absent female investment in RECs due to lack of financial resources. Mean investment per capita of women in RECs is lower than men's however, not statistically significant (Fraune, 2015). Lastly, Fraune (2018) argues that women tend to be more active in informal structures. The reasons given for gender imbalances of RECs in Germany differ between men and women (Karl et al., 2021). Women's most common reasons are lack of financial resources, lack of openness of RECs for women and lack of time. While men also mention the lack of openness of REC as a major reason, the second most common assumption is that RECs are too technical for women, which is much less echoed by female respondents.

A lot of research has come up with recommendations to diversify for RECs. In order to make participation in RECs fair and open, RECs should specifically reach out to marginalized groups (Haf and Robinson, 2020; Horstink et al., 2020). One successful way of doing that, specifically tackling gender imbalances, is recruiting

women through existing female members and female role models (Fraune, 2015; Karl et al., 2021; Łapniewska, 2019b, 2019a; Lazoroska et al., 2021). More broadly addressing the issue, Łapniewska (2019a) suggests for RECs to follow a less technical outreach, use gender mainstreaming, gender training and sharing best practice ideas for recruiting women. Clancy et al. (2007) pleads for renewable energy projects to identify 1) clear gender goals and gender assessments 2) gender problems and challenges 3) opportunities for women to participate 4) if the gender goals were reached in the end. This includes a gender planning framework for energy projects, acknowledging women as a specific target group and centering projects around women's reproductive and productive needs and their social and political position (Clancy et al., 2007).

Involving more women in RECs bears advantages (Mort, 2019). Gender just renewable energy projects leave a larger positive impact and are more effective (WECF and BBEEn, 2020). In Mexico and the USA, women's participation in energy projects leads to increased autonomy (Buechler et al., 2020). WECF and ZEZ (2018) even find a connection between women's involvement in RECs and energy poverty reduction and rural development, as well as the potential of RECs to advance a gender just energy policy. The concept of intersectionality goes beyond looking at individual groups excluded in the energy transition but tries to address societal discrimination patterns and how they intersect with each other (Castán Broto and Neves Alves, 2018). Energy projects and RECs alone are not able to bring about gender and social equity as they fail to address structural dynamics (Johnson et al., 2020). RECs that do not specifically address intersecting discriminations are at danger to merely shift inequalities or worse, replicate and manifest them (Johnson et al., 2020).

Research on the electricity-gender-entrepreneurship nexus showed that it cannot be understood out of context as contextual factors (e.g., social, cultural and political context) can enable women through empowerment to be involved in male-dominated spheres or they can be exclusive in less progressive contexts. This is relevant when one aims to design sustainable electricity in a gender sensitive manner (Osunmuyiwa and Ahlborg, 2019).

Gender-responsive energy policy

Currently, energy policy is not gender neutral and at the same time negligent in addressing gender imbalances, further contributing to gender inequality (Clancy et al., 2007; EIGE, 2016; Gram-Hanssen et al., 2017). One way of highlighting gendered issues in the energy transition has been through the concept of energy justice. Centring energy policies around energy justice makes them more gender-responsive and pays attention to gender justice (Feenstra and Ozerol, 2021; Haf and Robinson, 2020). At the same time these just climate and energy policies are shown to be more sustainable (Mort, 2019). Another way to make energy policy gender-responsive is through accounting for women's larger share of household work and by making sure that women are not the only gender burdened with the reduction of energy consumption (Gram-Hanssen et al., 2017; Mort, 2019).

For the EU, implementing energy policies on 1) enhancing women's representation in decision-making processes and management positions 2) gender mainstreaming 3) awareness raising through education and training 4) promoting female entrepreneurship are recommended (EIGE, 2016). Similarly for Nigeria, Abdullahi (2017) drafts policy recommendations that enhance women's participation along the entire energy value chain, women's leadership in communities and foster an increase of women in STEM careers.

Just Transition

In the past, transitions away from fossil fuels affected women much more than men (Walk et al., 2021). The few women employed in the coal industry were the first ones laid off. Compensating the income loss of the family, women entered the labour market, while still performing the majority of the household work, which meant a double burden. The jobs women took up were mostly in lower paid service sectors and often precarious. The resulting unemployment of many men led to an increase in domestic conflicts, such as gender-based violence (Walk et al., 2021).

Currently just transition in the energy sector oftentimes refers to people working in the fossil fuel industry losing their jobs, thereby reproducing patriarchal norms by focusing on a heavily male-dominated industry (Piggot et al., 2019; Walk et al., 2021). Many studies argue that this approach falls short of really addressing justice issues in the energy transition. (Piggot et al., 2019) demands a just energy transitions to aim at improving lives of people now marginalized by the energy system. The authors argue that it needs to be based on the analysis of current distributions of harm and benefits the energy system enforces and how these will change when transitioning from fossil fuels. Putting marginalized groups at the centre, they become change makers and have an active role in participation, recognition and decision-making in the just transition (Lieu et al., 2020). Just transition policies are predicted to be more socially and politically accepted, are agreed upon faster and easier to successfully put in place (Piggot et al., 2019). The challenge to design and implement just transition policies is to divert from current patriarchal technology-oriented norms (Lieu et al., 2020)

Focusing on a gender just transition, multiple studies highlight that measures have to go beyond just representation of women and rather embed gender knowledge in decision-making processes (Mang-Benza, 2021; Walk et al., 2021). Gender mainstreaming as a tool fails at bringing in diverse perspectives and falls short in leading to multi-layered change (Bell et al., 2020). A gender just transition should disregard the hope for technological advancement to spare people from having to perform boring, dirty and risky tasks, the authors find, as well as throwing one-size-fits-all approaches and the idea of economic growth over board. Bell et al. (2020) declare that a feminist energy system in the future should be 1) in political terms: democratic, decolonial, decentralized, pluralist, publicly owned 2) in economic terms: put humans well-being and biodiversity at its centre, focus on community economics and pink-collar jobs 3) in socio-ecologic terms: relationships over individuality, care-culture and fighting violence of energy production 4) in technological terms: decentralization (WECF and BBE, 2020), publicly governed, diverse sources. Gonda (2019) lays out a gender just transition by looking at four fields 1) emotions 2) subjectivities 3) knowledges and 4) policies. For emotions, the author explains that manipulation and fear hinder a just transition and that positive emotions are needed. Subjectivities refers to self-perception and the focus of women being victims, whereas for a gender just transition women have to see themselves as active agents and change makers (Gonda, 2019). In the fourth field knowledge, Gonda (2019) declares knowledge as a tool of oppression and for a gender just transition a powerful weapon to shape the future. The author lastly suggests policies to centre around the feminist idea of reproduction. Mang-Benza (2021) advises women to politically organize themselves around NGOs, talk about their own experiences in the energy field and come up with their own strategies for a gender just transition.

Data on gender

Many papers include gender as a variable when analysing aspects of the energy transition but find no gender aspects in their results or ignore looking at gender in the energy transition altogether. Most of the studies highlight the importance of having a gender balance among their participants for interviews or questionnaires on aspects of the energy transition (Axon and Morrissey, 2020; Bartiaux et al., 2018; Komendantova et al., 2021; Lennon et al., 2019; Ruostetsaari, 2020; Stikvoort et al., 2020). Proudlove et al. (2020) for their study on willingness to invest in RECs in Australia find that women as respondents to their questionnaire are underrepresented but do not offer any analysis as to the reasons why. Pohjolainen et al. (2021) include gender as a variable in their regression to analyse factors for partaking in energy citizenship in the EU but do not investigate gender any further. For the study on Dutch willingness to join citizen participation in the local energy systems, gender as a factor was statistically insignificant, yet this finding is not further assessed (Koirala et al., 2018). Two papers of the literature review cite other papers mentioning gender aspects of the energy transition however; do not advance research on gender with their studies (Ryghaug et al., 2018; van Bommel and Höffken, 2021).

Research Gaps

Gaps on gender and energy identified by research include missing gendered data, in particular in-depth qualitative data on women's opinion on the energy transition (Lieu et al., 2020). WECF and BBE (2020) criticize that coherent gender policies across all fields are still missing. Other authors highlight the lack of applying gender just energy policy frameworks to all energy policies (Feenstra and Ozerol, 2021).

Our own preliminary conclusion in terms of gaps are, for example, the lack of inclusion of questions on gender and energy into surveys, and the binarity of data, only including women and men and therefore, thereby concealing perspectives, vulnerabilities and responses of non-binary, gender non-conforming people. Moreover, contradictory results on gendered domestic energy consumption have not been resolved yet. One factor for this might be, that gender differentiations made in almost all studies do not include the actual role an individual plays at household level, i.e. who is mainly responsible for family care work. In general, intra-household dynamics seem to be underexplored.

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