User-Centred Energy Systems

Empowering All:

Battling exclusion in energy transitions

September 2025

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https://doi.org/10.47568/7XR148

User-Centred Energy Systems

The Users TCP's mission is to provide policy-relevant evidence on factors influencing energy use, including technology acceptance, and their impact on society. Its objective is to provide impartial, reliable and authoritative research, guidelines and recommended practices to public and private decision makers and implementers based on international evidence.

Participating countries in the Users TCP: Austria, Belgium, Canada, Finland, Ireland, Italy, Republic of Korea, the Netherlands, New Zealand, Norway, Sweden, Switzerland, United Kingdom and the United States of America.

Further information on the Users TCP is available from: www.userstcp.org

Acknowledgements

We want to extend our gratitude to the funders of the task research and travel: the Swedish Energy Agency, the Austrian Federal Ministry of Innovation, Mobility and Infrastructure, the Netherlands Enterprise Agency, and the Sustainable Energy Authority of Ireland. We also want to thank the members of the Users TCP exco for their constructive comments over the years of this task work. We especially want to thank the exco members of the countries participating in the task for their continued support and valuable input: Helena Karresand, Réka Andersson, Gerdien de Weger, Franka Beijers, Tara Esterl, Sabine Mitter, Josephine Maguire, Hannah Julienne, Ciarán Lavin, Tony Fullelove and Iain MacGill.
We also want to thank Samuel Thomas for support as well as careful and critical review, and Vikki Searancke for administrative guidance. A special thank you to Helene Johansson for her communication work.

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Executive summary

The User-Centred Energy Systems mission is to provide policy-relevant evidence on factors influencing energy use, including technology acceptance, and their impact on society. In this report we highlight how current energy systems exclude users and explore the role of gender and social perspectives for equitable, effective energy transitions. Examining the systems and power structures affecting energy transitions, we identify interlinked key drivers of exclusion and provide recommendations for policy makers and technology developers on how to counter them, supported by examples of good practice from different geographical contexts.

Energy transitions are leading to a decentralization of energy system resources. However, power structures remain highly centralized and supply-side focused, often leading to local resistance to change and the exclusion of end user groups. Despite these challenges, grassroots initiatives and innovative partnerships all over the world offer alternative visions for equitable energy transitions. However, such efforts, in particular from low-income countries, often remain invisible and under-researched.

The recommendations and examples are based on the common work in the Empowering All task phase 1, including new research from task researchers, good practice examples gathered during our research, and the aggregated knowledge of current state of the art research within the energy field.

KEY FINDINGS:

Exclusion from the energy system happens in a plethora of ways in different spaces. Three main identified spaces are:

1. Exclusion from view: misrepresentation of users

Dominant understandings of energy users on the part of the energy industry and policy makers generally misrepresent the diversity of energy users, relying on stereotypes that shape inefficient policies and technologies, obscuring and homogenising user needs. This leads to technological and policy solutions that do not achieve their aims.

2. Exclusion from energy services

Energy poverty and exclusion from energy services still remain widespread even though the characteristics and effects vary in different social and geographical contexts. Such exclusion prevents individuals from meeting basic energy needs and maintaining well-being, leading to health risks, social isolation, and restricted economic participation.

3. Exclusion from centrally-driven energy transitions

Many currently promoted measures to ensure energy transitions are centralised, top-down approaches that often ignore local realities and exclude users from decisions affecting their household energy use. Policy interventions, subsidies, and technological solutions often favour wealthier groups, while lower-income households, tenants, and marginalized communities struggle with housing-related issues of health and wellbeing as well as to access renewable energy solutions.

DRIVERS OF EXCLUSION

The literature as well as our task work identifies several systemic drivers that perpetuate user exclusion within the energy system, and that need to be addressed if the above exclusions are to be mitigated. We outline these drivers along with targeted recommendations and examples of effective responses.

Driver 1. Lack of equality and diversity in the energy sector

Issue: The energy sector, which remains homogenous and dominated by male professionals and techno-economic approaches, struggles to develop user-centered, cross-disciplinary solutions essential for inclusive energy transitions. Despite efforts to diversify, perspectives from marginalized groups, non-Western contexts, and non-technical fields remain underrepresented. Diverse teams are proven to foster better designs and innovation, yet sector norms limit true inclusion.

Recommendations for countermeasures:

- **Diversify the energy sector through addressing sector norms**
  Beyond increasing workforce diversity, the energy sector needs to adapt its culture if it is to retain diverse talent and embrace innovative solutions, even these challenge or modify taken for granted norms and conventional practice. To increase diversity and facilitate knowledge exchange from other sectors, senior professionals that enter the energy sector later in their career or mid-career coming from another sector and who bring valuable insights and experience (switchers) especially from underrepresented groups, should be better supported.

- **Ensure broad engagement in changing norms**
  To lead to change, equality work should involve all genders, including men, with leadership playing an active role. Gender and social inclusion should address the broader spectrum of social hierarchies, recognizing the role of both masculine and feminine norms in both hindering and advancing equitable green transitions.

Driver 2. Lack of nuanced and disaggregated data

Issue: The current lack of nuanced and disaggregated data is a known contributor to the misrepresentation of diverse energy users, as well as a key problem when conducting research on gender and social inclusion issues. . Current data collection often aggregates diverse user experiences, overlooking complex household dynamics, social intersections like gender, class, and location, which leads to user misrepresentation. In addition, overreliance

on quantitative data in assessment practices fails to capture important aspects of user activity.

Recommendations for countermeasures:

- **Develop nuanced tools for quantitative data collection**
  Improving quantitative surveys to gather intersectional, disaggregated data beyond traditional household models would enable the representation of diverse sets of users. Moving beyond binary gender classifications especially in countries that acknowledge the human right to freely choose sexual orientation and gender identity would better reflect diverse realities. The energy industry could take on a more prominent role in nuancing data collection, provided they consider user integrity.

- **Open up the concept of the household**
  Redefining the concept of the household to methodologically capture a variety of family and living arrangements and avoid imposing on traditional family unit stereotypes in data collection would enable more dynamic and rich understanding of household energy use. Importantly, the relational aspect of energy use must be highlighted. Regardless of household composition, energy use happens in a context of relations between individuals, as well as in a dynamic context of shared norms and routines, and data gathering needs to take this into account, as opposed to the current focus on individualised users.

- **Adopt mixed methods to counter the overreliance on quantitative data**
  Current user framing often builds on an overreliance on quantitative data which is not complemented with qualitative data. Using mixed methods that balance quantitative data with qualitative insights through new approaches like sandbox experiments, deep local studies, time studies, and action-research would capture experiential and relational knowledge. Such mixed methods could for example be promoted by funding institutions.

- **Develop new assessment practices**
  Integrating social impact evaluations into all project phases, focusing not just on installed units and similar quantitative results, but on deeper community effects, and local realities would enable policy makers to better understand take-up, use, acceeptance and impacts of energy transition technologies.

Driver 3. User needs are not being considered in technology design

Issue: The energy sector is dominated by technology-driven rather than needs-driven processes. This leads to technology development that fails to respond to user needs or desires and therefore also fails in terms of uptake and use. Typically, technology developers tend to neither account for household dynamics such as gender roles, age and the practicalities and nuances of household work, nor cater to low-income users. In addition,

technology-centred approaches tend to cater to individuals that are already tech-savvy and interested, thus focusing on a narrow demography.

Recommendations for countermeasures:

- **Empower users through user-centred and needs-driven design**
  Proponents of user-centred design propose the following strategies to address exclusion from energy technologies and service provision:
  (a) Demystifying and de-centring technology through education and centring user and bottom-up perspectives.
  (b) Using iterative design processes to find out not only stated needs but actual motivations for adoption.
  (c) Prioritising user goals and contexts, acknowledging users as experts of their own energy use and local context, and then adapt technologies to meet these objectives.
  (d) Giving users adequate support over time and securing maintenance for household systems (sometimes throughout the lifetime of a technology).
  (e) Prioritising user-friendliness, rather than focusing solely on high-tech innovation. This means that "lower-tech" and social and behavioural solutions should also be considered.
  (f) Moving from individualistic to community-based approaches to avoid knowledge and agency being limited to one person in the household and ensuring energy literacy for more people. This aims to make households more resilient both to technical issues as well as personal crises.

- **Develop new, and use existing, inclusive GESI (Gender and Social Inclusion) aware design methods**
  Use and expand participatory and co-creation practices that start from everyday household life, not just energy management, integrating successful models already proven in other sectors.

Driver 4. Siloing between energy and the social in energy projects and policy

Issue: Energy issues and social issues tend to be separated in energy policy and projects, resulting in missed opportunities to use the energy transition to address inequalities and leverage synergies with education, healthcare, and economic development. Overcoming siloing in policy and practice has been done within other fields, such as health care and climate change policy. Energy policy is falling behind and could benefit from looking to examples of successful policy integration and organisational innovation processes that address these longstanding challenges.

Recommendations for countermeasures:

- **Integrate gender and social inclusion concerns into energy transition projects**
  Embed gender and social inclusion throughout project design and implementation using multi-sectoral advisory teams with GESI expertise, backed by mandates and training. Joint budgeting between agencies can enhance coordination at planning stages.

- **Foster Inter-Departmental Coordination**
  Enhance coordination between Energy Ministries and those related to for example gender, health, and welfare. This approach has been implemented in several countries, such as for example Rwanda, Nigeria, Sweden, and Indonesia. While these countries have instituted structures to integrate gender equality into all policy areas, their effectiveness varies, and they do not always function as intended in all aspects. However, changing institutional and government practice takes time and requires ongoing evaluation and adaptation to achieve objectives. Improved collaboration can help integrate diverse perspectives into energy policy, leading to more comprehensive and equitable solutions.

- **Centring GESI issues in energy policy development**
  Policy should reflect users' lived experiences and socio-economic contexts. Broaden participation through bottom-up input from consumer organizations and local initiatives.

- **Utilise gender aware policy tools for planning and assessment**
  Employ existing tools for making gender-related social issues visible in planning and policy. These tools, many available for many decades, are usable at various levels of policy-making and project planning and ensure that practical needs, productive needs, and empowerment needs are met. Examples from the gender field include Gender Aware Policy assessment, Gender Budgeting, and Gender Mainstreaming.

Driver 5. Lack of middle actors and institutions between policy makers, utilities, and users

Issue: Exclusion drivers in the decision-making and implementation of new energy solutions exist on all governance levels, necessitating multi-level support to address and mitigate these issues. A significant gap often exists at the mid-level, where there may be insufficient actors to bridge the macro-level policy decisions and practical user engagements. This absence of intermediaries to connect users, utilities, and policymakers hampers inclusive communication and user participation and can lead to ineffective policy implementation, as well as heightened distrust and confusion over responsibility allocation between governance levels and utilities.

Recommendations for countermeasures:

- **Empower local communities and diverse groups of users and listen to them**
  Policy makers wishing to speed up energy transitions can do so by actively supporting and empowering local communities and diverse groups and by providing resources, education, and opportunities for participation in energy governance. This approach shifts the focus from placing the burden on individuals, to enabling collective action and ensuring that the needs and voices of various demographics are considered. Such empowerment methods need to include true listening and action, so that users who engage can trust that their voices are heard. Participatory processes also need to acknowledge the power structures that they happen within.

Energy citizenship can be a starting point to empower users and offer various engagement pathways in the energy system, reinforcing their roles and contributions to energy transitions. This includes activating innovative energy citizenship practices both at city and municipal levels and within the home.

- **Strengthen existing intermediary organisations and actors**
  Develop and equip organizations that mediate between governance and users, especially for marginalized groups. These may include schools, unions, housing companies, consumer groups, and local energy advisors. Context-specific strategies are needed to identify and support effective intermediaries.

CONCLUSION

While these challenges are well-documented, research struggles to keep pace with ongoing energy transition projects worldwide. The dominant energy systems model is rooted in entrenched knowledge systems that often exclude diverse perspectives, limiting innovation. A more inclusive, user-centred approach—tailored to specific socio-political contexts—has been shown to be a success in isolated cases. However, large-scale statistical validation of these strategies remains difficult due to their context-specific nature. This points to the crucial importance of being attentive to user realities and local contexts when designing new solutions, as well as the need for mixed methods to ensure high quality research.

This period of energy transitions presents an opportunity in many countries to design energy systems that are sustainable, equitable, and adaptable. Cross-regional collaboration and diverse user engagement can help integrate technical goals with local lived experiences. However, for user inclusion to be effective, it needs to go beyond token gestures; trust-building requires valuing diverse expertise and ensuring a commitment to just transitions. Addressing funding disparities between social sciences and STEM fields, as well as between high- and low-income countries, is critical for fostering interdisciplinary learning and localized solutions.

Finally, policy makers wishing to accelerate action to mitigate climate change, with concerns for intergenerational fairness and slowing biodiversity loss, should not ignore present day social justice issues. Doing so can lead to resistance, lower acceptance and backlash. Acknowledging this as a key consideration in energy transitions is essential for creating sustainable and widely accepted reforms.

1 Introduction

1.1 Relevance

According to the IPCC, residential energy is currently one of the largest sectors of total final energy consumption, and in some geographic areas, it is the largest, and thus a major contributor to global energy-related greenhouse gas emissions (IPCC, 2022; OECD, 2023a) Meanwhile, construction of new energy infrastructures as well as implementations of new technical and policy solutions are dependent on user acceptance for efficiency and success. Thus, a focus on end use is central to the energy transition processes that are currently in the making. Historically, when new energy systems have been introduced, this has deeply impacted the every-day life of users in different contexts, both negatively and positively. The ongoing transitions will be no exception. As an example, the 2022-23 energy crisis in Europe, set off by Russia's large scale invasion of Ukraine, led to spikes in electricity and fuel prices with severe negative impact on households, political crisis response, but also significant reduction in demand and emissions, as energy users scrambled to reduce their use and associated cost (IEA, 2023). This illustrated both the vulnerability of energy systems in high-income European countries and the potential for lowering demand.

Whether the ongoing energy transitions will achieve the challenge of reducing CO2 emissions while ensuring equal access and energy security, will depend on the degree to which systems are construed to meet the needs of users, as well as how they align with or disrupts existing power structures and inequalities that have trailed previous energy systems (Stoddard et al., 2021). Energy sectors worldwide are under pressure to rapidly reduce greenhouse gas emissions in line with commitments made in international climate negotiations. Yet, the current highly centralised and predominantly large-scale model of energy production and supply struggles with multi-dimensional inertia and difficulty to change at the pace required. One of the key challenges is the sector's supply-side orientation and standard mode of operating, which often fails to mobilise or cater to the needs of domestic energy users (Bouzarovski, 2022; Peacock et al., 2017). Furthermore, both technological and policy solutions tend to be formulated and implemented in a top-down fashion, leaving little scope for users to influence energy services which are a central part of their everyday lives (Deumling et al., 2019; Johnson et al., 2020; Peacock et al., 2017). This power dynamic between users and producers, in turn, leads to gendered and social consequences (Bouzarovski, 2022; Johnson et al., 2020). As both historical and contemporary research has demonstrated, existing power dynamics will continue and be exacerbated if they are not openly addressed or remain unmediated during the formulation of new policy and technology (Ahlborg et al., 2024; Hultman et al., 2021). In addition, when users' realities are not taken into account, envisaged solutions are less likely to efficiently scale up, since they do not fit into specific user contexts. In some contexts, users opt out of existing grid services as these do not meet their needs, which creates a challenge for incumbent utilities (Hojckova et al., 2020).

On the other hand, the work of this task shows that there are numerous initiatives emerging at the grassroot level and innovative partnerships that demonstrate alternative visions of just and gender aware energy transitions. However, these initiatives, especially those emerging from low-income countries, often remain invisible and understudied.

The User-Centred Energy Systems mission is to provide policy-relevant evidence on factors influencing energy use, including technology acceptance, and their impact on society. In this report we highlight how current energy systems exclude users and explore the role of gender and social perspectives for equitable, effective energy transitions. Examining the systems and power structures affecting energy transitions, we identify interlinked key drivers of exclusion and provide recommendations for policy makers and technology developers on how to counter them, supported by examples of good practice from different geographical contexts.

1.2 Scope of research

The recommendations in this report are based on our common work in the Empowering All task phase one, also called the Gender and energy task, including new research from task researchers, good practice examples gathered during our research, and the aggregated knowledge of current state of the art research within the energy field. The geographical scope of the literature review is global, with studies from all continents. While the studies are methodologically and theoretically diverse, the base of evidence from respective context and topic is not always substantive enough to make certain claims and there are still important knowledge gaps. However, the research presented here echoes findings in other fields, including historical and contemporary gender studies, which gives a stronger base to our recommendations.

The first phase of the Empowering All Task has brought together researchers from the fields of gender and energy in a global network to analyse energy policies and technologies through a gender lens and to provide recommendations for policy design and implementation. The overarching aim of the Empowering All Task is to bring science-based evidence on how to formulate and implement clean, effective, and inclusive energy policy and technological interventions. This work has been carried out in three mutually reinforcing subtasks:

Subtask 1: Pathways to change: Learning across regions and best practices

The aim of Subtask 1 was to gather existing research on energy, gender, and use as well as identify good practice examples. Our extensive literature review has resulted in three articles mapping the current state of the art and knowledge gaps in the nexus of energy policy, users and exclusion by adopting a gender and power lens. One of these scoping articles is published (Ahlborg et al., 2024), and two others are being finalised, one focusing on user roles and representations (referenced in report as Ahlborg et al., forthcoming), and the other one mechanisms of exclusion (referenced in report as Michael et al., forthcoming). In addition, subtask participants have published one article focusing on granular power quality

and reliability (PQR) data to make energy inequalities in urban Sub-Saharan Africa visible (Osunmuyiwa et. al., 2025), and one report addressing solar electrification equity in rural Nigerian areas (IEA, 2024). We have also identified Barefoot College in Zanzibar as a good practice example and carried out and published a case study of this project (Michael & Ahlborg, 2024).

Subtask 2: Understanding and countering systematic inertias in the sociotechnical energy system hindering gender aware policies and interventions

The aim of Subtask 2 was to analyse the values and normative systems underlying energy policy making and planning. The work includes identifying how these norms and values create inertias in interventions coming both from the private and public spheres. This subtask has resulted in two case studies on the integrated energy and climate plans in Austria (Hausner & Badieijaryani, 2021) and Sweden (Michael & Hultman, 2021), as well as one case study on Energy poverty policy in the Netherlands (Clancy et. al. 2024) and one on Energy consulting in Austria (Hausner et al. 2023). Two MA theses outlining Dutch case studies on municipal workers views on battling energy poverty (Krueger, 2023) and gender inequality in energy organisations (Nijland, 2023) have also been written in relation to the project. In addition, a gender just energy policy framework (Feenstra, 2021b) has been developed and presented in a policy brief (Feenstra, 2025) to support the formulation of gender-aware user policies. The framework has also inspired an executive boardroom game. The work of the has been A paper synthesising the results (Clancy, 2025) of this subtask is available Subtask participants have also contributed task work to policy reports from the European commission on the gender dimensions and impact of the FITfor55 package (Clancy et. al., 2022), as well as on the gender balance in the R&I field to improve the role of women in the energy transition(European Commission, 2024).

Subtask 3: Designing inclusive and efficient technological interventions

The aim of Subtask 3 was to develop guidelines and prototypes for more gender-aware and efficient technologies and interventions, including methods for collecting user data and user engagement. This was achieved using case studies as well as workshops with technology designers. Within this subtask, we have carried out one case study on two Dutch smart grid sites (Breukers et. al.2022), examining how users perceive and interact with the new technology, as well as one case study on smart grids in Austria (in German) (Hausner et. al. 2024). In terms of design support, one fact sheet (Hausner, 2022) was developed through workshops to support designers in creating energy technologies that are meaningful and usable for all, and another fact sheet for developing smart technologies (in German)(Hausner & Karner, 2024). The subtask work has also included the development of a household energy planner (Breukers et. al. 2023; Merl & Ekdahl, 2024) using norm creative design. Researchers from Subtasks 1 and 3 have further worked together developing best practices for collecting user data. Task members have supported the development of the latest OECD EPIC household survey (OECD, 2023a), with a particular focus on issues of gender and power and how these could be effectively captured in the survey, and co-authored one of the survey reports (OECD, 2023b). As a follow up to this

survey, our Austrian task members have developed a new survey tool which will be tested in phase 2 of the task.

In addition to this, our task members have done extensive outreach work, liaising with stakeholders, policymakers, technology designers and users. Information about our work and our publications can be found here.

1.3 Note on using a gender and power lens

Much research within the gender and energy field, particularly in high income countries, has focused on how to increase the number of women working in the energy sector. While this is an important part of achieving just transitions, the aim of our research has instead been to apply a gender lens to user roles in the energy system. By doing so, we place ourselves within a long tradition of critical literature stemming from the field of gender studies as well as gender and energy research. Gender is one of several critical intersections through which power hierarchies are created, upheld and questioned. Feminist contributions to understanding power hierarchies and exercise, along with empirical investigations of gender relations across many fields of study, have been profoundly important for advancing both philosophical and practical understandings of power (Allen, 2014; Crenshaw, 1989; Nightingale, 2006). In energy research, gender and energy scholars have pushed the research frontier for the past 40 years (Agrawal, 1983; Cecelski, 1987; Clancy et al., 2007; Clancy et al., 2003; Parikh, 1995), and this body of scholarship is finally starting to make a significant impact, both quantitatively, in terms of numbers of publications, and qualitatively, judged by the impact on policy making. Important contributions come from non-Western scholars and contexts. There is increasing recognition of possibilities for learning from experiences in research and practice from different parts of the world and from other fields. Our literature reviews show that analyses of energy users in low-income countries represent a vast literature, including studies on transitions to new energy sources and areas of use. In this literature, the user has historically taken on a more active role, compared to literature focusing on high-income countries. In high-income countries, research on energy users has been less extensive, and often focusing on energy poverty in certain countries such as the UK, while being almost entirely absent in others, such as Sweden (von Platten, 2022). The so-called “access gap” has also been a central theme and, more recently, the gendered dimensions of energy poverty have received attention in both high and low-income countries (Michael et al., forthcoming).

Importantly, there has been a significant shift in energy research over the past two decades, moving from analyses of gender only, towards acknowledging plural and intersecting synergies. This includes not only binary gender*, but also age, ethnicity, socio-economic status, geographical space etc., mirroring a more general trend in the social sciences and humanities (Ahlborg et al., 2024). However, our global research overview shows that even literature explicitly addressing just energy transitions and exclusion often lacks an in-depth analysis of relationships of power. Furthermore, in terms of interdisciplinary and social science research, the energy field still lags behind other areas, such as climate research (Ahlborg et al., 2024).

Our work aims to continue and develop the growing interdisciplinary and intersectional tradition, while maintaining a clear focus on a critical analysis of power, and how power hierarchies affect the inclusion and exclusion of users within the energy system.

We view energy system change as inherently political, shaped by complex power relations. This change is multi-dimensional, encompassing behavioural and cultural shifts, technological adoption, and the acquisition of new skills. However, amidst these shifts, there is a continuous struggle between empowering users, giving them greater autonomy, and simultaneously exerting control over them. For instance, while new technologies can improve energy access and offer cleaner energy solutions for users, the manner in which they are rolled out and the technological training required may limit users' autonomy and decision-making power (Ahlborg, 2017; Ahlborg et al., forthcoming; Boekelo et al., 2022; Lennon & Dunphy, 2023). In addition, existing power relations and gender roles will affect how and by whom new technologies are used, while these technologies and interventions can also change power and gender dynamics at multiple levels.

*The evidence base gathered in this report is limited to socially constructed and biologically based gendered differences between males and females, since our literature reviews show that significant data and research on other genders related to energy systems is currently lacking.

1.4 Structure of the report

If we are to avoid the exclusion of diverse and marginalised populations during the energy systems transitions and in particular if we want them to be a part of the solutions that are proposed to aid these transitions, we need to examine not only who is being excluded, but also what and where users are being excluded from and the different mechanisms driving their exclusion (IPBES, 2022; IPCC, 2023). Our literature review shows that exclusion can happen to many types of users and comes in many forms, though it disproportionately impacts those with fewer resources or limited access to decision-making processes (Ahlborg et al., forthcoming; Michael et al., forthcoming; Osunmuyiwa et al., 2025). Several spaces of exclusion have been identified in the literature, which are described in Section 2. These spaces of exclusion appear across geographical contexts, although their characteristics may be locally different. However, there is conclusive evidence that gender and class drivers are of central importance. In Section 3, we delve deeper into the multiple drivers of different forms of exclusion, as well as give recommendations on how to counter them. Many of these drivers impacts several forms of exclusion, leading to some overlap between different types of exclusions, their drivers and corresponding recommendations. This overlap is inevitable, considering the interconnectedness of the processes that we have been studying. For each of the drivers and recommendations we also list good practice examples from our task work as well as other cases worth highlighting. Finally, in Section 4, we present our conclusions, where we emphasize that exclusions from energy transitions exist on multiple levels of policies, technologies and interventions, and need to be broadly understood and addressed

by policy makers wanting to achieve just and efficient transitions. We further highlight the need to not let climate urgency displace the need to address social justice issues. Instead, equity and social inclusion can be addressed alongside climate goals to achieve sustainable and widely accepted reforms..

2 Spaces of exclusion

Key Findings

- Exclusion from the energy system happens in a plethora of ways in different spaces.

  The three main identified spaces are:
  - Exclusion from view: misrepresentation of users
  - Exclusion from energy service
  - Exclusion from centrally-driven energy transitions

2.1 Exclusion from view: misrepresentation of users

Our original research and review of the literature reveal a generic and significant gap in the dominant understanding of users, with current user models based on implicit social hierarchies, including gendered ones, that fail to reflect the actual diversity of users. The conventional approach to data collection in the sector renders such diversity invisible, in contrast to qualitative studies that show a great deal of heterogeneity. Simplistic representations remain the basis for most policy and practice. It affects all users but has a particular impact on marginalised groups and may hinder effective user-centred policy and technical solutions (Ahlborg et al., 2024). Two ways of misrepresenting users have been identified in our literature review: Homogenisation and stereotyping (Ahlborg et al., forthcoming).

The **homogenisation** of users happens in four principal ways:

1. A fictitious ideal user is assumed to represent reality, typically portrayed as someone with the economic, social, and knowledge resources to make rational economic choices, access technology, and modify their homes and behaviours.
2. Differences in group-level behaviours and needs are overlooked, including specific needs of certain groups and the influence of both masculine and feminine norms on current energy use patterns.
3. User roles and needs are assumed to be static, ignoring the emergence of new types of user roles and agency beyond mere purchasing power.
4. Users' relationship with energy systems are seen as merely transactional, not multidimensional.

All these assumptions are falsified by studies that adopt more fine-grained empirical methods, evidencing diversity among users, differently shaped by factors such as gender, age, education, socioeconomic status, cultural, and other context-specific power hierarchies.

Regarding **stereotyping**, the gender issue in energy has been understood as a binary relationship between women and men, where women are perceived as subordinated and in

need of empowerment through access to energy services (to reduce the household work burden) and by increasing women's decision-making power (Ahlborg et al., forthcoming). While unequal access and decision making are important issues, the gendered dimensions are more dynamic and diverse and necessitate an analysis of masculine and feminine norms. Households are predominantly stereotyped as heteronormative units of cooperation with similar family structures, disregarding the diversity of family configurations and communities across different countries. Scholars also identify stereotyping of energy users and contexts that reproduce broader colonial and racist views, where women from the Global South are depicted as passive victims (Arora-Jonsson, 2011; Mohanty, 1991; Wågström & Michael, 2023), while Western women are encouraged towards individual responsibility. In both contexts, the assumption that women's energy use is delimited to the home ignores wider roles and activities in the public and commercial sphere (Ahlborg et al., forthcoming; Osunmuyiwa & Ahlborg, 2022).

Another assumption that works to exclude user diversity and agency from view is the prevailing understanding of users as providers of value to the grid, rather than the energy system serving the users (Boekelo, 2022). This lack of recognition of user agency and needs has consequences for the design and implementation phases of energy solutions, often compromising user needs and comforts, as well as their ability to help drive transitions. The prioritisation of the supplier is evident in the development of smart homes and energy hubs, where concepts like flexibility are framed as win-win solutions but often have negative, uneven impacts on users in different economic and social contexts (Fjellså et al., 2021; Hausner et al., 2024; Johnson, 2020; Libertson, 2024). Even in visions of decentralized energy networks, such as regional smart grids, focus remains on adapting user behaviour to fit technology, rather than designing solutions that enhance people's lives (Breukers et al., 2022; Breukers et al., 2023; Hausner et al., 2024).

In addition, the capacity of different groups to respond to calls for their participation is rarely accounted for. In the FITfor55 work, citizens were consulted, but no data was gathered to analyse the demographics of the respondents, and thus, the extent to which different groups actually contributed to policy formulation cannot be studied (Clancy et al., 2022).

Lack of nuanced data is a main reason why users continue to be misrepresented or excluded from view (Idem et al., 2024). For example, the current use of aggregated data renders both gendered and other intra-household dynamics invisible. This lack of dis-aggregated data has been highlighted by several researchers and is an important part of mitigating exclusion that we will return to in section 3.1 (Clancy, 2022; Clancy & Feenstra, 2019; Winther et al., 2017). Our Dutch case study reports data from the Netherlands study where they were unable to account for approximately 900,000 households (13% of all Dutch households) attributed to the nature of their residence (e.g., students, or people living in unusual dwellings, such as houseboats, or multi-occupancy dwellings), leaving no insights into these households living conditions (Middelkoop et al., 2018). Studies on European statistics, particularly regarding Hard-To-Reach energy users, have further revealed that there is a lack of data from Eurostat. There is insufficient data on both the most vulnerable groups (for example people with low income, ill health, and disabilities), and the wealthiest

groups. Additionally, for certain groups, including homeless individuals, as well as nomadic and travelling communities, there are no data at all (Sequeira et al., 2024).

2.2 Exclusion from energy services

Exclusion from energy services leads to users lacking the energy provisions necessary to meet their basic needs and ensure their well-being. For example, deprivation of energy services leads to numerous health issues, including the inability to adequately heat or cool your home, indoor air pollution, and mould, along with psychological and social problems related to shame and isolation (Charlier & Legendre, 2023; Liddell & Morris, 2010; Mei & Seo, 2024; Robinson, 2019). In addition, lack of energy services (such as electricity) negatively impacts on the possibility to "participate in the lifestyles, customs and activities that define membership of society" (Bouzarovski & Petrova, 2015, p. 33). Energy service deprivation also restricts the possibility for users (including owners of small and medium sized businesses that are often tenants or might operate from the home) to access other services, as well as carry out work.

The exclusion from services is a problem with historical origin, resulting from the production centred dominant model and its institutions, shaping the market regulations, infrastructure projects, and planning processes. While studies adopt different methodological approaches to study energy deprivation and thus ask the questions differently, gender, economic poverty, and rurality are significant group-level drivers of exclusion from energy services in both the global North and South (Abbas et al., 2020; Bouzarovski et al., 2024; Commission, 2008; Osunmuyiwa & Ahlborg, 2019; Sansonetti & Davern, 2021). In high-income countries, studies of exclusion from energy services have focused on understanding how affordability, inadequate infrastructure, and social inequalities contribute to energy poverty (or primarily fuel poverty) even within energy-rich societies (Bouzarovski & Petrova, 2015; Michael et al., forthcoming). Energy poverty has long been recognized as a problem in some EU countries (as well as in low-income countries) but is now gaining attention in other countries, such as Sweden, where it has not been on the agenda before (von Platten, 2022).

Traditionally, energy poverty has been defined in a static manner by policy institutions in many EU countries, often based on the percentage of income used for energy services. Recent years has brought a shift in perspective and some studies view both the determinants of energy poverty and its consequences as multi-dimensional and context-specific issues where many factors combine to produce deprivation (Bouzarovski & Petrova, 2015; Szczygieł et al., 2024), and where those in marginalised positions are more vulnerable to experiencing lack of access (Bouzarovski & Thomson, 2018). This can manifest as having access to certain energy forms, such as coal and peat, while lacking access to others, such as electricity. The complexity and diversity within larger social groups is further demonstrated in explicitly spatial approaches to energy poverty that unpack both individual gendered energy poverty; and household, rather than neighbourhood, vulnerabilities (Robinson, 2019; Robinson et al., 2019). The latter suggests that energy poverty is highly regionalised and locally specific, suggesting such context-specific knowledge can inform targeted policy interventions.

Electricity access was previously understood in binary terms of being connected or not, but is now commonly defined using the Multi-tier framework (ESMAP, n.d.). This highlights that the quality and reliability of access varies, with many domestic users around the world having electricity connections but experiencing such unreliable and poor-quality services that in practice, their use is severely hampered. While this is a step forward, it renders access a technical issue rather than a political question of how access to energy services is dynamic and can be gained, controlled, maintained and lost (Ahlborg, 2018), influenced by existing power dynamics and vulnerabilities, both intra-household and external (Bouzarovski & Petrova, 2015). Specifically, for sex and gender, Pachauri and Rao (2013) observe that the evidence points in different directions and that many studies do not disaggregate for sex. Findings are shaped by methodology *and* context, as illustrated by Abbas et al. (2020) whose study from South Asia shows that female-headed households and increased age correlate with higher vulnerability to energy poverty. Similarly, Clancy et al. (2017) highlight that gendered exclusion from services is influenced by socio-economic contexts as well as social and power dynamics within and outside the home. Robinson (2019) provides a relevant critique of the assumption that gender can simply be included among other variables in existing frameworks, and the assumption that gender inequality equals energy poverty.

With methodological development and experimentation, these issues are explored also in quantitative terms. Robinson (2019) provides an analysis of socio-spatial inequalities that give rise to energy poverty, using data at the neighbourhood scale for England. Chaudhry and Shafiullah (2021) develop a statistical approach to explore cultural dimensions of energy poverty and find that masculine national cultures worsen the conditions of energy poverty across their country sample. Osunmuyiwa et al, (2025) develop more nuanced metrics of power quality and reliability (PQR) in urban settings in Sub-Saharan Africa. The study reveals how ageing infrastructure disproportionately affects marginalized urban communities and shows how poor access to electricity aggravates economic disparities, undermines household capabilities and limits participation in key socio-economic activities.

2.3 Exclusion from centrally-driven energy transitions

The current push for a rapid energy sector transition comes with an unequal distribution of benefits and burdens. Users are commonly excluded from the decision-making spaces that steer the centralised and top-down processes but organise and drive transitions at the grassroots and community level (Späth & Scolobig, 2017). While policy making can enable a greater role for users as agents and participants in shaping the energy transition, our review indicates that this is not a prioritised policy area, with for example many regulations working against establishment of energy communities and decentralised energy system (Clancy et al., 2022;Wierling et. al.2018). Instead, studies show that users are largely excluded from centralised policy making and the design of interventions that target the domestic sector or specific user groups, and that this results in ineffective programs but also skewed and detrimental effects on some users (Genus & Iskandarova, 2019; Kaufmann et al., 2023).

In today's visions of green energy transitions, policy and technological solutions are often portrayed as a win-win situation for users and utilities, and they are considered to benefit different groups equally, including different genders. Case studies of households instead evidence that technological solutions often favour populations already skilled or confident in handling new technologies, and those with the time and interest to invest in learning them (Breukers et al., 2022; Hausner et al., 2024; Powells & Fell, 2019; Strengers, 2014; Tjørring, 2016). Research also indicates that energy system transitions driven by top-down policy approaches are predominantly unjust, leading to a "Matthew effect," where the wealthy become wealthier, and the poor become poorer (Feenstra, 2021a). The recent OECD EPIC household survey shows that a significant number of the respondents cannot make investments needed either due to them renting their housing or being unable to afford investments (OECD, 2023b). According to the survey, the uptake of solar panels, heat pumps and battery storage remains low on average, although certain countries have higher uptake of some of these technologies. The cheaper and easy-to-apply solutions to improve energy efficiency, on the other hand, such as changing light bulbs, and buying energy efficient appliances have the highest uptake (OECD, 2023).

Many current policy solutions, such as subsidies, typically benefit those who can afford investments in new technologies like solar panels and retrofitting, which disproportionately advantages high-income individuals and homeowners, whereas other parts of the populations, such as tenants or those receiving social welfare rarely get targeted subsidies. Given the persistent gender pay gap, women are underrepresented in the last two groups globally with the situation becoming worse as women reach retirement age. This and other evidence lead scholars to criticise current policies and technological innovations as mischaracterized as gender and socially neutral when in reality they are gender-blind—and based on our own review, also socially-blind—failing to consider their varied impacts on diverse populations (Breukers et al., 2022; Clancy et al., 2022; Feenstra & Clancy, 2020).

Another consequence of top-down policy making is that programs intended to benefit marginalised groups are largely ineffective. An example of this is LPG introduction in India, through the Prime Ministers Ujjwala Yojana (PMUY) project aiming to address energy issues for poor marginalised women, However, due to the fact that the targeted women were not involved in the formulation and implementation of the project, it failed to lead to sustained LPG use, and expected benefits to health and women's empowerment were not achieved as women simply could not afford the cost of further refills of LPG cylinders (Michael, 2023). Similarly, team members' research on smart home technologies reveals that many current technical approaches often lack "household-management-literacy", thereby disregarding the complex realities of most users' lives, which impedes adoption (Breukers et al., 2022; Diamond, 2024; Skjølsvold et al., 2017). In the case of energy communities in Germany, despite existing EU framework to support the inclusion of vulnerable groups, most energy communities struggle to reach for example low-income groups (Hanke & Guyet, 2023).

Finally large investments into new energy infrastructure projects, including renewable energy technologies (RETs), often fail to benefit local users affected by their construction. Large-scale projects are particularly problematic in how these cater to demand from industry and urban centres while underserved populations are left out. Worse, a growing number of

studies document dispossession and displacement of communities around the world (Sovacool, 2021). Historically, such dispossessions were observed in extractive energy industries, often disproportionally affecting colonised people and indigenous populations. Forced dispossession is now evident in many RET projects and climate mitigation initiatives (Avila et al., 2022; Knuth et al., 2022; McCarthy & Thatcher, 2019). These experiences have fostered deep-seated and well-earned distrust within many communities towards energy infrastructure projects, especially those implemented top-down by the state or large international companies (Avila et al., 2022; Narayan et al., 2023; Sareen & Shokrgozar, 2022).

3 Drivers of exclusion and possible countermeasures

Key Findings

Identified drivers of exclusion:

3.1 Lack of equality and diversity in the energy sector
3.2 Lack of nuanced and disaggregated data
3.3 Users' needs not being met/considered in technology design
3.4 Siloing between energy and the social in energy projects and policy
3.5 Lack of middle actors and institutions between policy makers, utilities and users

In the previous section, we have mapped spaces of exclusion identified in the literature. Our research overview has identified several main drivers of this exclusion on different levels of the energy system: **3.1** Lack of equality and diversity in the energy sector. **3.2** Lack of nuanced data**. 3.3** Users' needs not being considered in technology design. **3.4** Siloing between energy and the social in energy projects and policy, and, finally, **3.5** Lack of middle actors and institutions between policy makers, utilities and users. These drivers reinforce each other, and countermeasures therefore needs to be adapted both to each of these separately and in relation to each other. Below we will delve deeper into the drivers of exclusion that have been identified in our literature review, as well in the research done within the Task. Furthermore, these drivers will each be presented with recommendations for policy makers on how to counter them, as well as examples of good practices from different geographical contexts.

3.1 Lack of equality and diversity in the energy sector

Driver 1. Lack of equality and diversity in the energy sector

- Recommendations for countermeasures:
    - Diversify the energy sector through addressing sector norms
    - Ensure broad engagement in changing norms

Actors in energy policy and projects that are interested in improving efficiency and adoption of new solutions for the green energy transitions, while simultaneously considering inclusion and energy justice, will need to envision, support and develop cross-disciplinary and innovative solutions that reach outside of the current proverbial energy sector "box". This

may include new ways of gathering data, assessing solutions, developing needs-driven rather than technology-driven solutions and economic models, and innovative public-private partnerships, to mention some of the good practice examples you will find in this report.

Recent reports on diversity in business show that the relationship between gender and cultural diversity on an executive level and financial performance has strengthened over time (McKinsey, 2023). In terms of gender, there is now robust evidence that a more gender-balanced workforce has positive effects on organisations in terms of performance, for example on certain KPI's such as financial return and productivity (McKinsey, 2020; McKinsey, 2023; EHRC, 2021, European Commission, 2024) The relationship between diversity and innovation has been less comprehensively studied, however, existing studies so far do show a relationship, with diversity positively impacting innovation capacity (Talke et al. 2010; Hewlett et al, 2013; Dillon & Bourke, 2016; Mayer et al. 2018; Ju & Kim, 2025). A study of 7 600 London firms shows that firms with diverse leader groups were more likely to introduce new product innovations that those with homogenous leader teams, and in a Spanish case, gender diversity in R&D teams was positively related to radical innovation (Nathan & Lee, 2013; Díaz-García, et al. 2013). Within the business sector, the relationship has been observed statistically as well as through company experiences. A recent Deloitte report shows that a diversity of experiences ensures not only a higher innovative capacity but also allows businesses to cater to diverse customer groups and reduces risks, since a certain risk or opportunity that might have been missed in a homogenous group, can be more easily identified in a diverse group (Dillon & Bourke, 2016). The heightened ability to customise products for a diverse customer-base has also been highlighted by business analysts (Clark, 2023; Bryan, 2018). BCG has further shown that companies with more diverse leaderships report a higher innovation revenue (Lorenzo et al. 2017). While more detailed research is needed, the current literature and business analyses thus show a relation between diverse teams and leadership and innovation capacity. This is important both to ensure the development of new and innovative solutions, and for being attentive to diverse user groups.

Meanwhile, the extractive and productive energy sector has historically been homogenous, and male dominated. While the renewable energy technology sector aims to improve women's representation, their overall presence in the energy sector remains low, and the new EU Commission report "Gender Balance in the R&I Field to Improve the Role of Women in the Energy Transition" concludes that "women's representation in renewable energy is not higher than in traditional sectors" (C3E, 2024; Froehlicher et al., 2021; WEF, 2016; Wierling et al., 2018). In addition, women tend to be employed in the so called "soft" parts of the organisation, such as HR and administration. For example, an overview of the Canadian electricity and renewable sector, 12% of women in executive roles worked in operations and "other", 12% were presidents or CEOs, and the remaining 76% worked in IT, HR, Law, Finance, or Marketing/PR (EHRC, 2021).

Furthermore, cultural norms in the industry and in STEM fields as a whole, have previously been shown to often prioritize masculine ideals and undermine the perceived value of women's contributions, particularly in technical or leadership roles (Clancy & Roehr, 2003;

Mechlenborg & GramHanssen, 2022; Mehrabi et al., 2024; Michael & Ahlborg, 2024; Miller, 2004; Stephens, 2020). These structural factors are well-known barriers that significantly influence access to knowledge and expertise, shaping career pathways and participation in sectors like energy and STEM, as Stephens (2020) demonstrates. These dynamics contribute to the underrepresentation of women and low-income groups (IRENA, 2019; Listo, 2018, European Commission, 2024). Consequently, the energy sector, in particular the technical and operational side, is dominated by a homogeneous group of men with engineering or economic expertise. This results in dominance of techno-economic worldviews and practices, which are also reflected in energy research as a whole (Shove & Walker, 2014; Sovacool, 2014; Offenberger & Nentwich, 2010). This aggregated underrepresentation of women, non-technical professionals, and minority groups risks excluding crucial perspectives, needs, and interests from decision-making processes that can help energy transitions and improve innovative capacity (Clancy et al., 2017; Clancy & Feenstra, 2019; McIvor, 2024).

In addition, the field is dominated by research emanating from Western academic institutions while researchers in low-income countries are currently severely underfunded in comparison to those in high income countries (Ahlborg et al., 2024; Muez et al., 2023). This imbalance often leads to the exclusion of diverse perspectives, particularly non-Western and non-technical insights, and include specific views on the roles of users, the organisation of the energy system, and the types of knowledge deemed important for the energy sector and its transitions, as described in section 2 (Brooks & Wingard, 2024; Kendrick & Nagel, 2020; Letourneau et al., 2024; Rossiter & Wood, 2016). Meanwhile, innovations such as mobile banking from African countries, frugal innovation from India, and the solidarity economy from South America exemplify valuable non-Western approaches that can inform the energy sector in terms of new economic models for energy systems. The solidarity economy, for instance, emphasises collective ownership and reciprocity rather than competition and private ownership (Calvo Martínez et al., 2019; Saguier & Brent, 2017). In terms of energy and women's enterprises, there is also extensive research in non-western contexts (Osunmuyiwa & Ahlborg, 2022), while research is lacking in western context.

Thus, changing norms and promoting diversity in the energy sector can contribute to promoting its innovative capacity and financial stability as well as ensuring that important user perspectives that have historically been ignored, will not be so in the future. Diversifying the energy sector cannot, however, be only a numbers' game. Instead, changing prevalent norms in regard to which kinds of knowledges and which types of solutions that are considered feasible needs to be addressed also through other means. While promoting diversity is a part of such a process, there is reason to caution against looking blindly at diversity in terms of numbers, since changing norms is not necessarily correlated to equal numbers of for example men and women or heightened cultural diversity (Hewlett et al. 2013; Mort, 2019; McKinsey, 2020). In addition, promoting diversity is not a one-fits-all solution. How norms are changed and diversity promoted needs to be tailored according to a certain business or organisation (Ju & Kim, 2025). In short, numbers and norms need to be addressed in parallel and according to context when doing diversity work.

Recommendations:

- **Diversify the energy sector through addressing sector norms**
  To enable a diverse workforce to enact change, the energy sector needs to open up for new solutions that lie outside of their traditional framings listed above. Much work has been done both within energy companies and in STEM educations to diversify the workforce in the energy sector (WEF, 2025). However, our research shows that while diversity in numbers is important, more work is needed on how to make the energy sector accommodate and retain this diverse workforce as well as listen to them, i.e. to strengthen its innovative capacity. To increase diversity and facilitate knowledge exchange from other sectors, senior professionals that enter the energy sector later in their career or mid-career coming from another sector and who bring valuable insights and experience (switchers) could also be better supported and facilitated, in particular those from underrepresented groups.

- **Ensure broad engagement in changing norms**
  To enact change in the workforce, sector leadership, including men, needs to provide long-term support to and be actively involved in changing sector norms. In order to legitimize equality measures, and engagement in social issues they have to engage all genders, and not be relegated to being “women’s issues”. Masculinity research has shown that addressing norms of both masculinity and femininity are vital to addressing green transitions (Hultman & Anshelm, 2017; Mechlenborg & GramHanssen, 2022). Solutions addressing gender and social inclusion thus need to recognise the interplay between them as well as other social hierarchies.

Good practice examples:

- In Michael and Ahlborg’s (2024) **case study** on the Solar Mamas Program of Barefoot College Zanzibar, where socially and economically marginalised women are trained as solar engineers, empowerment extends beyond the individual women to encompass their male partners and the entire community, fostering a collaborative environment where knowledge sharing and sustainable practices empower all users to actively participate in and benefit from the transition to solar energy. This holistic approach ensures that empowerment is seen not as a singular achievement and not only about women’s empowerment, but as a collective effort towards economic resilience, gender equality, environmental stewardship, as well as inclusive and just energy transitions, that includes the whole community. (Se box “Solar Mamas – Barefoot college Zanzibar”)

Solar Mamas – Barefoot College Zanzibar
The Solar Mamas Program, developed by Barefoot College International and adapted in Zanzibar by Barefoot College Zanzibar, empowers socially and economically marginalized women by training them as solar engineers. A key innovation is the ENRICHE module, central to the program's success, which focuses not only on financial literacy, entrepreneurship, and critical thinking but critically on unlearning restrictive gender norms. This transformational focus enables the Solar Mamas to thrive as professionals in deeply patriarchal settings. Community involvement is woven into the process from the start: male partners, family members, and village leaders participate in the selection of candidates, fostering broader acceptance and support for the Solar Mamas' new roles.
The program also incorporates a peer-to-peer model where trained Solar Mamas visit other villages to monitor and evaluate project outcomes, reinforcing local ownership and knowledge sharing. Barefoot College Zanzibar acts as a deliberative space where Solar Mamas regularly convene to reflect, support each other, and address ongoing challenges. Through this holistic approach, Solar Mamas not only gain technical skills and income but also catalyze community-wide change.

- The Maldives' POISED project offers a strong example of how gender and social inclusion can be successfully embedded into national energy transitions. Through early community engagement, local ownership strategies, and a Gender Action Plan promoting women's participation, the project has led to the employment of over 1,300 women in technical and operational roles, creating new economic opportunities linked to decentralized renewable energy systems. (See Box: Maldives POISED Project – Gender and Energy Integration.)

Maldives POISED Project – Gender and Energy Integration

The Preparing Outer Islands for Sustainable Energy Development (POISED) project in the Maldives integrates gender equality and social inclusion (GESI) into national energy transition strategies. Recognizing the need for local ownership of renewable energy projects, POISED established a Gender Action Plan (GAP) to promote women's participation through technical training, employment, and support for women-led microenterprises. A key strategy is the early involvement of Women Development Councils and local communities to tailor solutions to user realities. The GAP also set a target for at least 33% women's participation in public consultations, reinforcing inclusive governance structures. The project's gender-sensitive design ensures that women are not only beneficiaries but active agents of change in the energy transition. POISED also contributes to the Maldives' broader goal of achieving net-zero emissions by 2030, demonstrating how gender mainstreaming can be successfully embedded into national climate and energy strategies. Through this approach, POISED builds long-term resilience, promotes just energy transitions, and strengthens community empowerment across the country. (Mohideen & Kolantharaj, 2024)

- The Energizing Education Programme (EEP) was launched in 2019 as a Rural Electrification Strategy and Implementation Plan (RESIP), where women's training in solar technologies is considered a key instrument. The program addresses the underrepresentation of women in the energy sector. By equipping women with technical skills and promoting their participation in renewable energy projects, the EEP contributes to creating a more inclusive workforce (Clean Energy Innovation

Policies in Emerging and Developing Economies, 2024, Osunmuiwa & Nwadiaru, chapter 11)

- Task member Mariëlle Feenstra has co-founded 75inQ. 75inQ engages actively in coaching for career transitions into the renewable energy sector through an online platform for networking and sharing job opportunities, as well as through a partnership with the recruitment bureau Sustainable Talent. 75inQ has a growing community of 1000 female energy professionals. Engaging women in energy transition work is an important equality aspect, since many of the new jobs created in the green energy field as a way to replace old fossil jobs are in the construction sector, a sector where women are currently severely underrepresented (Clancy, 2024).

3.2 Lack of nuanced and disaggregated data

Driver 2. Lack of nuanced and disaggregated data

- Recommendations for countermeasures:
  - Develop nuanced and context–specific tools for quantitative data collection
  - Open up the concept of the household
  - Adopt mixed methods to counter the overreliance on quantitative data
  - Develop new assessment practices

Observations for policy makers

The current lack of nuanced and disaggregated data is a known contributor to the misrepresentation of diverse energy users, as well as a key problem when conducting research on gender and social inclusion issues. As mentioned in section 2.1, although research into gender and energy has increased, there remains a significant data gap, particularly in obtaining nuanced insights into heterogenous users and their practices, power relationships, and households that do not fit the norm. There is still need for more comprehensive and gender-disaggregated quantitative data to shed further light on new insights generated in qualitative studies (Ahlborg et al., forthcoming; Clancy et al., 2022; Idem et al., 2024; Michael et al., forthcoming) as well as further qualitative studies to ensure continued progress in a field that is lagging behind nearby research field theoretically and methodologically.

Whereas there has been a lot of progress in how e.g. class, ethnicity, and religion are understood and measured in surveys/questionnaires, comparatively little has happened in treatment of sex and gender. These are still predominantly understood as a binary, static category, and sex and gender are typically conflated. The language used tends to reproduce gender stereotypes and gender is typically assumed as a given and as such there is little transparency as to how gender categories are assigned to respondents. These methodological aspects exemplify a source of misrepresentation of diverse users. Scholars

currently advocate a more nuanced metrics rather than a gender neutral one as there may be patterns that we still do not know exist and that can be discovered with better methodology (Magliozzi et al., 2016).

In addition, the household being the primary data point for energy utilities to access users, many technical and economic solutions still lack a relational perspective. For example, residential smart energy systems and the related appliances such as energy management systems and interfaces, e.g. smart energy interventions, tend to approach households as unitary actors, thereby misrecognising the diverse roles that householders may have, as well as the differences in their ability to act upon these interventions and the impact that has on their day-to-day wellbeing and mental burden (Breukers et al., 2023; Diamond et al., 2024).

Our literature review also highlights an overreliance on quantitative data in assessment practices. For instance, using the number of installed photovoltaic (PV) systems to measure program success overlooks critical aspects such as location, ownership, actual functioning over time, and who are the beneficiaries of the installations, leading to unequal outcomes (Johnson, 2020) Definitions of flexibility, efficiency, and energy poverty are similarly based on quantitative measures that, alone, fail to capture underlying inequalities (Bergman & Foxon, 2020; Herrero, 2017; Johnson, 2020).

Recommendations:

- **Develop nuanced and context–specific tools for quantitative data collection**
  In order to better capture the diverse experience of users, surveys and other quantitative data collection tools need to, start from their lived reality as well as reflect power imbalances and include more detailed descriptions of various household types. For example, in countries that acknowledge the human right to freely choose sexual orientation and gender identity, statistics need to go beyond binary gender. Even if only a small percentage of respondents identify outside the male/female binary and may not provide statistically significant data for certain analyses, changing the language and framework away from binary gender helps to shift norms and avoid reinforcing stereotypes. Incentives should be created to encourage the energy industry to collect and share comprehensive data about user experience, while considering user integrity.

- **Open up the concept of the household**
  Redefining the concept of the household to encompass a variety of family and living arrangements would enable a more diverse data collection. Importantly, the relational aspect of energy use needs to be highlighted. Regardless of household composition, energy use happens in a context of relationships between individuals, as well as in a dynamic context of shared norms and routines, and data gathering needs to take this into account, as opposed to the current focus on individualised users. In addition to adding new questions and diverse multiple-choice answers that capture a broader relational context, this can also be achieved by employing the concepts focusing on other types of relationships within the household. One example

is the concept of Hard-To-Reach energy users, which focuses on understanding users based on how and which spaces they are excluded from, rather than relying only on traditional family unit stereotypes.

- **Adopt mixed methods to counter the overreliance on quantitative data**
  The current user framing often builds on an overreliance on quantitative data which is not complemented with qualitative data. To ensure a nuanced view of users, new methodological approaches need to be employed, incorporating intersectional perspectives. Methods for both quantitative and qualitative studies as well as innovative methods including sandbox and policy experiments, deep local studies, time studies, and life stories can be employed to gather comprehensive qualitative insights. Action-research, whereby learning takes place in (inter)action, can be used to allow for more space for tacit, experiential, and situated knowledge to feed into the energy transition processes. Funders can also work to promote mixed methods. E.g. EU programmes can be restructured to enable a better integration of both technical and qualitative social science work. One example is the Swedish Energy Agency, that has worked with a long-term strategy to fund gender and energy research since 2013. In current funding calls they promote mixed methods, sometimes demanding that the project includes both social sciences and STEM perspectives, as well as user perspectives to get funding.

- **Develop new assessment practices**
  To enable policy makers to better understand uptake, use, acceptance and impacts of energy transition technologies, a combination of quantitative and qualitative methods needs to be used throughout project processes, from initiation to assessment. This includes evaluation, with a focus on addressing power dynamics and social issues through local knowledge. Assessment needs to focus on social impact, instead of only numbers of installed units or similar quantitative measures (Winther et al., 2017).

Good Practice examples

Data collection

- Nepal serves as a good practice of collecting heterogeneous disaggregated data. The GESI-disaggregated data from the governmental body Alternative Energy Promotion Centre (AEPC) enables a deeper understanding of which technologies best support marginalized groups, for example targeted subsidies for small-scale hydropower plants that have been shown to benefit women in mountainous areas by reducing their workload and improving their opportunities for economic activity (Mohideen, 2018).
- Mohideen (2018) proposes a pilot project to test a gender-inclusive reference energy system in South Asian communities where there are weak or non-existent grid connections, designed to integrate GESI criteria into energy solutions. The pilot project emphasizes collecting and coordinating inclusive and integrated technical

data, to ensure that technical solutions are adapted to local needs. It also highlights the recommendation to share technical data between relevant actors, such as small power producers, to optimise operations and improve energy services (Mohideen, 2018).

- Osunmuyiwa et al., (2025) combine a granular power quality and reliability (PQR) data with justice, capability and MPI frameworks to unpack urban electricity inequities in sub-Saharan Africa, driven by ageing grids. Going beyond simply quantifying PQR differences in the over 219 million data points collected in Accra, Ghana, in 2023, the study not only identifies significant differences in power quality across areas but shows how poor power quality and irregular access to electricity reinforce socio-economic marginalization, and how energy poverty affects households' daily capabilities and opportunities for participation in socio-economic activities.
- Palm and Ellegård visualize energy use in relation to people's everyday lives by analysing time diaries of 3244 participants in Sweden, challenging simplistic images of the typical household. Divided into 10-minute intervals, participants recorded their activities, including use of specific appliances or energy sources, over two days (one weekday and one weekend day) providing insights into the needs and practices of different user groups and the power realities that shape them (Palm & Ellegård, 2017).
- The OECD EPIC survey with data collected in 2022 (Household Surveys (EPIC) - OECD) was designed tapping into recent survey design research, ensuring that the survey applied self-identification of biological sex and gender identity, and avoided stereotyping energy users or households (see i.e. Westbrook & Saperstein, 2015). For the household composition, the survey allowed respondents to define their household and offered options that did not presume family relationships between householders. Team members from the Empowering All task (Helene Ahlborg and Olufolahan Osunmuyiwa) supported this redesign work.
- Team members from the Empowering All task (Azadeh Badieijaryani, Janne Wanner, and Beatrix Hausner, in consultation with Helene Ahlborg and Kavya Michael) has built on the OECD EPIC survey to design a survey tool to better capture Austrian residential energy use, behaviours, and norms. The revised survey incorporates a more nuanced understanding of sex and gender as well as a more nuanced understanding of the household by placing greater emphasis on household power dynamics, task distribution, care work, and decision-making processes. The survey was developed during phase one of the Empowering All task and will be launched during phase 2 of the Task.
- The Master's thesis on energy poverty in the Netherlands written within the task by Hanna Kreuger uses Q-methodology in order to capture the mindsets of municipal workers dealing with energy poverty issues (Kreuger, 2023).

Assessment and action research

- The Solar Mamas initiative applies a peer-to-peer monitoring model, where trained Solar Mamas visit other villages to assess program outcomes and strengthen knowledge exchange. This approach supports sustainable empowerment at both

individual and community levels. (See Box: Solar Mamas – Barefoot College Zanzibar.).

- The Hard-To-Reach task members used follow-up interviews when deploying the Whãnau Heat Kit, in order to assess behavioural change rather than only the number of kits borrowed from the libraries, which was earlier the case. The Whãnau Heat Kits contained easy-to-use tools such as infrared thermometers, digital hygrometers, shower timers etc. to educate families in both their own energy-using behaviours, and their home's energy performance The follow-up interviews allowed for a deeper understanding of the impact of the heat kits for different user groups (Rotmann, 2023).
- An action research project for rural electricity access described by Ulsrud et al. (2015) was implemented in Kenya through a participatory process of needs driven, gender sensitive and user-centred design, with continuous evaluation and adjustment to the system setup as the challenges unfolded. Sensitive to the context and involving a multi-disciplinary team of researchers and practitioners, the resulting village energy centre established a unique model to deliver decentralised services in a low-income community, with affordability and service quality as central.

3.3 User needs not being considered in technology design

Driver 3. User needs not being met/considered in technology design

- Recommendations for countermeasures:
  - Empower users through user-centred and needs driven design
  - Develop new and use existing inclusive GESI aware design methods

Observations for policy makers

Social scientists have established that the energy sector is dominated by technology-driven rather than needs-driven design processes (Schillebeeckx et al., 2012; Strengers, 2014; Wilkins, 2002; Murphy, 2001). Technologies that fail to respond to user needs or desires also typically fail in terms of uptake and adoption (Rogers, 2003; Smale et al., 2018; Wilkins, 2002). Large-scale roll out of new technologies is not enough as users may ignore or rapidly stop using technologies, as evidence by "improved" cookstoves, and smart housing that does not cater to user needs (Lindgren, 2020; Smale et al., 2018; Thacker et al., 2018). A lack of understanding of user needs has been observed in examples of DSM technologies that do not take into account household dynamics such as gender roles, age, and the practicalities and nuances of household work (Breukers et al., 2023; Carlsson-Kanyama & Lindén, 2007; Diamond, 2024; Hausner et al., 2024; Johnson, 2020; Skjølsvold et al., 2017; Smale et al., 2018). While gender dynamics and household practices change according to cultural, geographic and socio-economic contexts, and DSM technologies have been shown

to both reinforce and redistribute gender roles, these cases show that technology developers need to pay attention to both the practicalities and social norms of everyday life (Aagaard, 2023; Aagaard & Madsen, 2022). Our review of the user-centred literature identifies simplistic representations and lack of considerations of user realities, as well as users not being perceived as experts on their own energy use and local context, as reasons why technology design caters only to a narrow demography (Ahlborg et al., forthcoming).

As discussed in section 2.2, low-income households are also generally not catered to in current DSM solutions and household experiments to achieve more efficient energy use. Solbu et al. (2024) have found, however, that these households often are actively engaged in multiple “low-tech” tinkering and activities to lower energy-use which might be harnessed as more general solutions to lower energy use. However, experimentation around such practices needs to be conducted responsibly so as to avoid exploitation (Solbu et al., 2024). Interestingly, a Sacramento case has shown that the 10% of energy users with the lowest use had all economic demographics represented in that group (Deumling et al., 2019). Low energy use and low income are thus two separate issues, albeit overlapping. Self-reported quality of life of these 10% did not differ from the population as a whole. Here, as in the case of Solbu et al. (2024), the low-use group engaged in a number of creative strategies to keep comfort while lowering energy use (Deumling et al., 2019).

Another contributing factor to user exclusion is that technology-driven design processes are often black-boxed, focusing on new technology development, and relying on abstract measures, such as number of KwH. This makes it harder for users who do not already have a high level of knowledge and feel at ease with new technologies, as well as lack the time to learn, and the money to invest, to engage with them (Vindegg & Julsrud, 2025). Focus on techno-economic factors of household energy use is a blunt instrument for understanding the practices of energy use, and how these practices are negotiated between inhabitants of a certain space (Skjølsvold et al., 2017; Throndsen & Ryghaug, 2015). In addition, the focus on technological solutions may hamper innovations in other areas, such as economic models or behavioural science, as well as the leveraging of existing technologies and practices that can be seen in the cases of low energy users (Deumling et al., 2019; Shove, 2018; Solbu et al., 2024).

Examples from smart grids and PV installations show that responsibility for the technical system often falls on one person in the household, leading to other members of the household engaging less in the technology in the case of PV systems, and feeling a lack of control in the case of residential smart housing (Breukers et al., 2022; Mechlenborg & Gram Hanssen, 2022). In case studies on household technologies in Europe carried out in our task and in the Social License to automate 2.0 task, as well as in Australian studies on smart technologies, gender and age clearly influence the division of responsibility for these technologies with men generally taking the role of being responsible for system installation and running, including partaking in surveys and interviews for these studies (Breukers et al., 2022; Diamond, 2024; Hausner et al., 2024; Skjølsvold et al., 2017; Strengers & Nicholls, 2018). In these cases, women, children, and elderly are to a higher degree represented among the household members that experience less control, less engagement, and less representation in research data. Gendered norms that affect access and engagement in

technology, as described in section 3.1, is one driver to these exclusions. However they can be exacerbated by the fact that many DSM technologies are aimed at individuals, such as apps on individual mobile phones and information aimed at only one person in the household (Aagaard & Madsen, 2022; Breukers et al., 2023; Diamond, 2024; Govindan et al., 2023; Powells et al., 2014).

Another issue for users in the long term is maintenance and technical support in case of failure. In our case on smart housing, Breukers et al. (2022) show that knowing where to turn in case of failure was a problem for the residents, and repeated malfunctioning led to decreased trust in the system (Breukers et al., 2022). Cases from the Social License to automate 2.0 task also show malfunctions and badly designed apps leading to users engaging less in technology platforms (Diamond, 2024).

Considering this, researchers highlight the need to take intra-household dynamics as a starting point for changes in energy management (e.g. in smart energy interventions) rather than imposing it in a top-down manner, and to ensure that knowledge of new technological solutions is distributed among several household members (Breukers et al., 2022; Diamond, 2024; Palm & Ellegård, 2017). Shifting to needs-driven and user-centred design in this context means, among other things, seeing energy management as a part of household management rather than the other way around. It also means taking into account gender- and socio-economic dynamics of households and other contexts, as well as considering the ease-of-use of new technologies and offering support in accordance with user needs.

While there are not that many examples of good practices in terms of user-friendly and socially aware technologies, research indicates that well-conceived technologies, standards, social innovations, and governance models can both facilitate the adoption of sustainable energy technologies and transform gender roles and cultural norms (Michael & Ahlborg, 2024; Mohideen et al., 2022). However, addressing power imbalances and marginalisation through user-oriented approaches requires significant time and funding to ensure that it does not just end in window-dressing processes, where user-participation does not result in impact. In addition, maintenance and long-term sustainability of energy technologies are often underfunded and need to be centred in funding processes (Ahlborg, 2018).

Recommendations

- **Empower users through user-centred and needs driven design**
  Proponents of user-centred design propose the following strategies to address exclusion from energy technologies and service provision: (a) Demystifying and de-centring technology through education, and centring user and bottom-up perspectives. (b) Using iterative design processes to find out not only stated needs but actual motivations for adoption. (c) Prioritising user goals, acknowledging users as experts of their own energy use and local context, and then adapt technologies to meet these objectives. (d) Giving users adequate support over time and securing maintenance for household systems (sometimes throughout the lifetime of a technology). (e) Prioritising user-friendliness, rather than focusing solely on high-tech

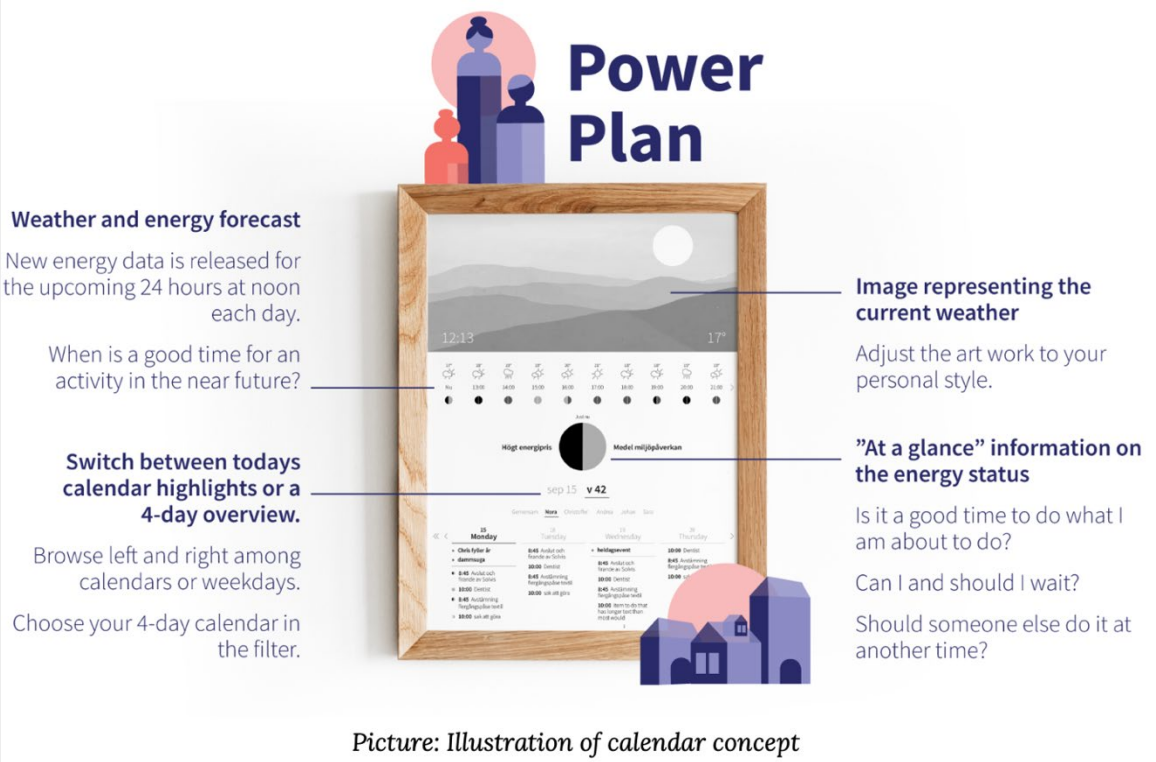
innovation. This means that “low-tech” and social and behavioural solutions should be considered. (f) Moving from individualistic to community-based approaches to avoid knowledge and agency being limited to one person in the household and ensuring higher energy literacy for more people. This aims to make households more resilient both to technical issues as well as personal crises.

- **Develop new, and use existing, inclusive GESI aware design methods**
  These methods can be informed by successful examples of service co-production and local user practices that prioritise everyday life and household management as starting points, rather than purely energy management. There are existing methods already used in different innovation processes and participatory design that could be promoted within the energy sector as well (see list of good practice below).

Good practice examples

Prototypes and practice

- Using Norm-creative design methods, task participants from Boid AB have developed an energy household energy planner that incorporates perspectives from gender research (Merl & Ekdahl, 2024). The methodology combines norm-critical analysis with participatory processes, such as co-creation workshops, to effectively address users' needs. The prototype differs from current approaches by focusing on energy planning over energy monitoring. The proposed energy planner challenges the current techno-centric and individualistic interpretation of households' contribution to sustainable energy use by focusing on everyday household activities and people's use of electricity, rather than technical upgrades and data. The solution is low-tech and aims to be easy to use for all members of a household, centring around the relational aspects of energy. Using daily activities as a starting point for discussion about energy use, the aim is to involve all household members in so called household energy management. (Merl & Ekdahl, 2024).



BOID AB's Household energy planner (Merl & Ekdahl, 2024, p. 22)

- The Whãnau Heat Kit uses existing technologies as well as libraries to make energy efficiency accessible for Hard-To-Reach (HTR) and underserved energy users (Rotmann, 2023). The HEAT Kits empower users by involving them directly in the co-design process, creating simple tools and activities tailored to the specific needs of vulnerable households. By training trusted community navigators and using culturally appropriate materials, the project reduces knowledge exclusion, helping participants understand energy efficiency in their own homes. This hands-on, user-focused approach equips undeserved and magrginalised groups with the skills and confidence needed to manage their energy use effectively (Rotmann, 2023).
- Developing standards-based solutions for gender-equal technology processes is a new way to address the mismatch between users and technology development. The IEEE Gender and Social Inclusion (GESI) standards work stream, headed by task NE Reihana Mohideen, is working to develop standards for technology development addressing gender and social inclusion issues, to ensure that new technology development within the electricity sector enables rather than prevents gender equality (Mohideen et al., 2022).

Tools and educational materials

- Our task participants from ÖGUT have developed two fact sheets for technology developers. The first one is aimed at energy developers and can be used to incorporate intersectional gendered concerns in technology design, and to avoid the pitfalls of the norms and framings outlined in this report (Hausner, 2022). The second

factsheet focuses on smart grids and aims to integrate different user perspectives into the design and development of new energy systems.

- Within the SCCALE 20 30 50 Inclusivity project (2023), a comprehensive guidebook has been designed to support energy communities in becoming more inclusive. The guide offers a range of tools and strategies, illustrated with real-world examples, to promote participation and equitable sharing of the benefits of the energy transition, as well as to create a culture of respect and value for diversity within these communities (REScoop.eu, 2023).
- A handbook has been developed by the research project Sun for Everyone - Solar from a Gender and Service Design Perspective, which looked at how to increase the long-term social sustainability of solar power and broaden the solar power deployment in Sweden by increasing the proportion of female house owners who invest in solar power. The handbook presents guidelines aimed at the solar power industry, specifically how to reach out to and help women to become solar customers (Lööf et al., 2022).
- The NOVA methodology is a deck of cards with tools and tactics for norm-creative innovation. These methods are inclusive, accessible, and sustainable and can be used by anyone, without any particular design background or similar. This material supports the solution developer in finding and understanding needs of a diverse group of humans and translating this knowledge into actual solutions. The NOVA cards specifically target discriminating norms and can be helpful in any innovation project.
- The Intersectional Design Cards are designed to help innovators explore intersectionality when designing various solutions. Similarly to the NOVA cards, this methodology is used during the design process, either during the early-stage generation of ideas, or when testing or critiquing the finished solution. The intersecting social factors are useful to take into consideration when developing just solutions. The cards can be used in any industry or on any topic.

3.4 Siloing between energy and the social in energy projects and policy

Driver 4. Siloing between energy and the social in energy projects and policy

- Recommendations for countermeasures:
  - Integrate gender and social inclusion concerns into energy transition projects
  - Foster Inter-Departmental Coordination
  - Centring GESI issues in energy policy development
  - Utilise gender aware policy tools for planning and assessment

Observations for policy makers

The current organisation of the centralised and large-scale Western resource model with its close alignment between energy, industrial, and mining policy is historically established during the 20th century and first and second World Wars (Dunphy & Lennon, 2024; Dahmén, 1989; Johnstone & McLeish, 2020; Kander et al., 2013; Smil, 2017; Zomers, 2001). A significant issue related to this historical model focusing on production and industry use in many countries is that energy issues often are separate from social issues in policies and practice. This separation is a pervasive problem across many countries and must be addressed to develop socially-aware, efficient, and sustainable energy solutions. Even as energy sectors shift towards renewable energy sources, the gap between energy policy and socially and environmentally oriented policy areas causes missed opportunities for positive synergies (Shrivastava et al., 2023).

As Parikh established in the 1990's, a gender perspective was largely missing in energy policy (Parikh, 1995). Since then, a lot of the work on inclusiveness centred upon gender. But depending on context, other power relationships and social hierarchies that lead to exclusion—such as caste, religious belonging, ethnicity or race—may be equally or more prominent socially and politically and require adapted approaches and strategies. One of the consequences of policy siloing, which affects the effectiveness of energy infrastructure projects, is that energy projects are planned without coordination with the sectors that will be primary users. A consequence seen in African countries is that public services in health and education cannot fully harness new opportunities coming with improved energy service access (Peters et al., 2009; Sovacool et al., 2013).

Overcoming siloing in policy and practice has been done within other fields, such as health care and climate change policy. Energy policy is falling behind and could benefit from looking to examples of successful policy integration and organisational innovation processes that address these longstanding challenges (Rana et al., 2022; Steinbach et al., 2016).

Recommendations

- **Integrate gender and social inclusion concerns into energy transition projects** Energy projects should address power dynamics and social inclusion at all stages of planning and implementation. This can be achieved by establishing multi-professional and multi-sectoral advisory teams with strong GESI competence to consult and supervise these processes and train involved actors. The teams should have a strong mandate to inform project discussions with best practices and practical experiences. Gender mainstreaming has emerged as an attempt to address the common practice of including gender concerns as an afterthought or add-on (Moser, 1993). Policy makers and financial institutions may ensure integration between policy areas by demanding joint budgeting processes between public service agencies during planning stages of new energy infrastructure projects.

- **Foster Inter-Departmental Coordination**

Enhance coordination between Energy Ministries and those related to for example gender, health, and welfare. This approach has been implemented in several countries, such as for example Rwanda, Nigeria, Sweden, and Indonesia. While these countries have instituted structures to integrate gender equality into all policy areas, their effectiveness varies, and they do not always function as intended in all aspects. However, changing institutional and government practice takes time and requires ongoing evaluation, and adaptation to achieve objectives. Improved collaboration can help integrate diverse perspectives into energy policy, leading to more comprehensive and equitable solutions.

- **Centring GESI issues in energy policy development**
  Research on public perception of climate policy across countries shows that perceived (un)fairness is a strong predictor of acceptance for new policy, even more so than perceived effectiveness, environmental concern, or personal values (Isaacson et.al, 2024; Lindvall et. al.,2024 refs). This means that people are more willing to accept policies that may affect them personally in a negative way if the policy is perceived as (contextually) fair.
  For new energy policy, this means that in order to design measures that are acceptable to users, policy makers must understand user perceptions of fairness, the lived reality of everyday life and socio-economic contexts, including gendered and other power relationships. To achieve this, distributive justice should be considered imperative. More groups need to be included in policy design, through different kinds of participatory processes. This can include inputs from consumer organisations and other bottom-up action and transformative initiatives feeding into policy processes across scales.

- **Utilise gender aware policy tools for planning and assessment**
  Employ existing tools for making gender-related social issues visible in planning and policy. These tools, many available for many decades, are usable at various levels of policy-making and project planning. The tools ensure that practical needs, productive needs, and empowerment needs are met (Moser, 1993). Examples from the gender field include Gender Aware Policy assessment, Gender Budgeting and Gender Mainstreaming.

Good practice examples

Integrate gender and social inclusion concerns into energy transition projects

- Michael and Ahlborg's (2024) **case study** on the Solar Mamas Program highlights how addressing gendered care norms and technical exclusion together can promote transformative social outcomes in energy access. (See Box: Solar Mamas – Barefoot College Zanzibar.)
- The POISED project provides a strong example of gender-responsive energy planning, using a Gender Action Plan and inclusive consultation processes to support sustainable transitions. (See Box: Maldives POISED Project – Gender and Energy Integration.)

Inter-departmental coordination

- Some countries have instituted Gender offices that overcome policy siloing through inter-departmental and inter-ministerial collaboration: For example, Rwanda's Gender Monitoring Office (gmo.gov.rw) has the mandate to monitor "the respect and compliance of gender related commitments across public, private, non-governmental and religious institutions" which includes the right to have opinions on draft laws in all policy areas. While the Office is relatively small and limited in staff capacity as compared to its large responsibility, Rwanda has acted on its ambition by putting in place a gender mainstreamed infrastructure strategy (2017) that sets ambitious targets and was developed through cross-sectoral and cross-level consultations.
- By applying inclusive bottom-up strategies and a cross-cutting, multi-sectoral approach, Nepal has developed a National Adaptation Plan (NAP) to strengthen climate preparedness and integrate climate-inclusive planning across sectors. The plan involved nine thematic working groups led by relevant ministries, ensuring inter-sectoral coordination. The Multi-Stakeholder Climate Change Initiative Coordination Committee (MCCICC) further enhanced collaboration by bringing together government bodies, NGOs, the private sector, and local communities to advance inclusive climate adaptation ((GIZ), 2019).
- Sweden has a Gender Equality Agency with inter-ministerial working groups that work to ensure gender mainstreaming in climate and energy policies. By relying on sex-disaggregated data, gender-specific impacts and opportunities can be made visible in energy and climate policies, thereby supporting gender equality initiatives and promoting a just energy transition. Furthermore, Sweden is scaling up capacity building initiatives through training of policy makers to mainstream gender equality in energy and climate strategies, including mandatory gender analyses for energy policies and projects (Weber et al., 2024).

Centring GESI issues in energy policy development

- In its net-zero emission plan towards 2060, Indonesia is committing to a gender just transition policy within its Just Energy Transition Partnership (JETP), and focuses among other things on a just and inclusive transition away from fossil fuels. The policy plan also includes standards and principles to promote gender equality and empower women in the energy sector.
- A historical example of how energy policy and welfare policy can be combined, is the example of warm rent in Sweden (and Finland) becoming prevalent and regulated by law. It moved responsibility of heating from the tenant to the house-owner in an effort to both protect tenants from price fluctuations and encourage building-owners to invest in energy efficiency. However, warm rent is currently questioned on an EU level, since it does not encourage individual households to lower their heating in response to market changes (von Platten, 2022).
- The NGO 74inQ, aims at gender just energy policy through contract research and policy advice. They have contributed to energy policy making by the Dutch national government, the European Parliament and have been invited as NGO representative of the Dutch delegation of the United Nations Commission on the Status of Women.

- Through user-centred participatory processes, ENERGIA ensures that energy policies and interventions address the unique needs of women and marginalized groups. By empowering 7,300 women entrepreneurs, fostering 97 partnerships to promote gender equality and producing 56 research reports and policy briefs, ENERGIA has contributed to the development of inclusive energy policies (ENERGIA, 2024).

Tools

- Within our task, Mariëlle Feenstra has developed a policy assessment tool that integrates gender justice and energy justice principles into energy policy design and evaluation (Feenstra, 2021b). The tool combines gender policy approaches with energy justice principles. It can be used to identify and analyse gender-related inequalities in energy policies and serve as an assurance framework for implementing inclusive and equitable measures (Feenstra, 2021b)
- Osunmuyiwa and Ahlborg (Osunmuyiwa & Ahlborg, 2019) provides a framework to be used to plan, design, and evaluate renewable energy projects, for the extent to which these are progressive or reproduce unequal opportunities for male and female entrepreneurs. It further identifies points of intervention that can support gender-equal outcomes.
  Energy Ministries can carry out a Gender Impact Assessment and develop a GAP for formulating and implementing gender-responsive policies. GAP is a recognised toolkit for political institutions, developed by the European Institute for Gender Equality (EIGE), for implementing a gender mainstreaming strategy (Clancy, 2024; EIGE, 2016). (also used in the earlier mentioned POISED-project)
- Gender Impact assessment Toolkit from the European Institute for Gender Equality. The GIA assessment is implemented to assist civil servants in evaluating gender implications of legislation. Note however that implementation has been less successful than anticipated due to lack of involvement of gender experts and the absence of sex disaggregated data collection. This example emphasises the fact that effective assessment needs to go beyond the initial policy implementation and extend to collecting robust data for the assessment.
- Sweden and Austria apply gender budgeting to mainstream gender equality in their budget processes and ensure that resources are allocated in a way that promotes gender equality. In Austria, gender budgeting is a legal requirement for all ministries. and officials are trained on how to develop gender equality objectives, measures, and indicators as part of budgeting. In Sweden, the government has been working with gender budgeting since the 2000s by integrating the gender equality perspective throughout the budget process. Sweden has introduced a five-step tool, BUDGe, which is provided to decision-makers and public bodies. Furthermore, Sweden applies gender budgeting in its international development co-operation (Clancy, 2025)
- The Deep transitions project has developed the Transformative investment lab, a tool designed for companies and policy makers to change investment thinking away from

a case-by-case focus that favours system optimisation and instead stretch investment portfolios to contribute to systems change by targeting the rules that underpin our current systems. This directs energy transitions investments towards the root causes of unsustainable practices that increase social inequality. Lab (transformativeinvestment.net)

- For the Clean Energy Solutions Center, Morris, Greene and Healey (2019) have developed a *Blueprint Guide for Creating Gender-Sensitive Energy Policies*, through a step-by-step guide to integrating gender perspectives into energy policies. With practical examples from the ECOWAS region, the guide offers suggested tools and methods to ensure that policies address social inclusion and gender equality (Morris et al., 2019).

3.5 Lack of middle actors and institutions between policy makers, utilities and users

Driver 5. Lack of middle actors and institutions between policy makers, utilities and users

- Recommendations for countermeasures:
  - Empower local communities and diverse groups of users and listen to them
  - Strengthen existing intermediary organisations and actors

Observations for policy makers

Exclusion drivers in the decision-making and implementation of new energy solutions exist on all governance levels, necessitating multi-level support to address and mitigate these issues. A significant gap often exists at the mid-level, where there may be insufficient actors to bridge the macro-level policy decisions and practical user engagements (Parag & Janda, 2014). Specifically, on the municipal level, many countries lack designated actors for energy issues, as energy policy is typically centralised at the national level (Feenstra et al., 2021). Such centralisation exacerbates the disconnect between state energy policies and local residents, including municipal politicians. One example is Tanzania, where the district and region did not (as late as 2020) have an energy office responsible for planning, coordination or implementation. This resulted (Ahlborg & Hammar, 2014) in them being unable to plan for a new grid while coordinating that schools and health centres receive a budget for paying for electricity. It could take a year or more for them to include these new budget items after electrification, thus delaying service provision. On the other hand, decentralising energy policy and energy infrastructures could also lead to spatial injustice, since different policies could be acted out in different municipalities (Clancy et al., 2024).

It is important to note that decentralised energy systems do not automatically lead to greater trust and higher social sustainability, if users are still left to fend for themselves. At the distributional level, the withdrawal of governance authorities should ideally be compensated

by utilities. However, the current framing of users by the energy sector hinders effective user communication and the interaction between users and utilities remains largely one-sided, leaving users to navigate individual solutions (Breukers et al., 2023). This scenario results in confusion over responsibility allocation between governance levels and utilities. Users often face basic issues, such as not knowing whom to contact for a smart house system malfunction (Breukers et al., 2022).

Trust is a central issue that relates to this situation. While studies in some contexts point to distrust of both governments and energy utilities from the users' side, in particular from marginalised groups, which needs to be overcome for a project take shape at all (Rotmann et al., 2024; Sequeira et al., 2021), in some demographics and contexts trust seems to be of less importance than, for example, user-friendliness (Diamond, 2024). A Dutch residential smart grid case showed that face-to-face meetings during the initial phase of the project enhanced trust, while when providers and developers became more invisible and withdrew over time, trust was lost, and this affected continued use (Smale and al 2018). Other cases show that maintaining user trust takes continuous trust building, which is helped by face-to-face engagement (de Wilde & Spaargaren, 2019; Späth & Scolobig, 2017; Verkade & Höffken, 2018).

To overcome issues of trust and responsibility, mid-level actors can be of importance, and recent case studies have shown that existing mid-level actors such as local organisations are willing to engage, given that they have the time and resources (Sequiera et al, 2024). For example, energy coaches, and advisors, have the potential to address gender and social issues effectively, if they are given adequate support through education, mandate, and funding, something which is now lacking. This education needs to include social elements, and not only technical ones (Hausner et al., 2023).

Worth noting is that participatory processes and research are resource heavy, and diverse actors need support to be able to engage in a meaningful way in policy and technology development. For example, to maximise the effectiveness of mid-level actors as recommended below, policy changes need to ensure that incentives for addressing social issues and promoting user engagement are embedded within funding and procurement processes (Creusen et al., 2023; Feenstra, 2021a).

Recommendations

- **Empower local communities and diverse groups of users and listen to them**
  Policy makers wishing to speed up energy transitions can do so by actively supporting and empowering local communities and diverse groups by providing resources, education, and opportunities for participation in energy governance. This approach shifts the focus from placing the burden on individuals, to enabling collective action and ensuring that the needs and voices of various demographics are considered. Such empowerment methods need to include true listening and action, so that users who engage can trust that their voices are heard. As in the case of technology design, user expertise has to be valued and acted upon by involved institutions. If listening and action does not happen, then trust-building will also not

happen (Rotmann et al., 2024). Participatory processes also need to acknowledge the power structures that they happen within. Energy citizenship can be a starting point to empower users and offer various engagement pathways in the energy system, reinforcing their roles and contributions to energy transitions. This includes activating innovative energy citizenship practices both at city and municipal levels and within the home (Dunphy et al., 2023).

- **Strengthen existing intermediary organisations and actors**
  Develop and support intermediary organisations and infrastructures that bridge the gap between macro-level governance and micro-level user experiences and who can build relationships of trust. These organisations should be equipped with the necessary resources, recognition and the mandate to facilitate effective communication and action between higher-level decision-makers and individual users, including marginalised groups and HTR energy users. Examples of actors and organisations that could be important agents for building relationships and trust can be schools, universities, unions, energy and climate advisors, municipal and private housing companies, and consumer organisations. Different types of mid-level actors will be of value in different contexts, and services from mid-level actors such as energy advisors should ideally benefit people living in different housing conditions, for example both tenants and homeowners. More work is needed by researchers, policy makers and energy utilities to identify a broad array of such actors in their respective contexts.

Good practice examples

Empower local communities and diverse groups of users

- In working to reach users in underserved and HTR groups living in energy poverty, four themes have been identified as crucial to enabling meaningful participation from society. These themes are Trust, Community Voice, Stick to Your Role, and Develop Mana[1]-Enhancing Practices. By listening, showing care, and building long-term relationships, while respectfully supporting the expertise of communities without overburdening them, the foundation for trust is established, creating the conditions to develop processes that enhance mana and address real needs. These themes serve as guiding principles for the energy industry in engaging with underserved and marginalised users and addressing energy hardship (Rotmann et al., 2024).
- Energy citizenship is an increasingly applied term across policy cycles and academic discourses (Dunphy et al., 2025). Our task NE's Niall Dunphy, Breffni Lennon, and Alexandra Revez (UC Cork) have participated in the Horizon-funded project ENCLUDE, one of three sister-projects exploring the concept of energy citizenship. The insights from these projects have been gathered in a policy platform where policymakers and citizens can find examples of and models for energy citizenship engagement in the energy transition.

[1] mana - Te Aka Māori Dictionary

- Within our task we have translated educational materials for energy users developed in Sweden, including tenants and house-owners associations, discussing masculinity norms in energy transition processes. These materials aim to have an impact on bottom-up community organisations, such as energy communities and tenant organisations. They can be built upon to expand to other contexts.

Strengthen existing intermediary organizations and actors

- Gothenburg city (Sweden) uses energy pedagogues that primarily support pre-schools, schools, and residences for elderly to reduce their energy use or become more energy efficient. They work directly with students, kitchen staff, janitors etc., and not only the school management. An example of their work is the program "Vi kan påverka" which translates to "We can influence".
- Energy and climate advisors exist in several countries. In Sweden, they operate on a municipal level, and their service is free, impartial and locally adapted to the municipality you live in. Their service is for private households, small and medium-businesses, condominium associations, private apartment building owners and associations. A positive example includes Swedish municipalities opening up hotlines with free energy consultations for users on how to reduce cost and energy use (Energimyndigheten, 2024). However, more work is needed to build knowledge about how to meet the needs of vulnerable households, as well as funding and incentive to follow up on initial visits.
- In the Australian Capital Territory (ACT), the regional government has instated a renters' home energy program, which provides renters with advice on low-cost ways to improve the energy efficiency of their homes. For low-income renters, practical support—such as draught proofing, curtains, and sealing cracks—is available through community service providers. To enable these upgrades, ACT rental laws allow renters to make these minor changes themselves if the landlord does not act after being informed of the need.
- The Maldives case shows an example of state-non-state partnership within the POISED project, where the Women Development Councils and local community organisations were important actors for the project's implementation, design, acceptance and local anchoring to improve gender inclusion in decision-making. The local actors play a key role in the continued operation and maintenance of the new energy sources (Mohideen & Kolantharaj, 2024).
- The Solar Mamas programme and the Barefoot College are also a good example of government-non-government collaboration, combining innovative governance with grassroots empowerment. The programme's partnership with the government facilitated the training of women as solar engineers and addressed patriarchal norms. The approach strengthened local acceptance and ownership (Michael & Ahlborg, 2024).
- The SCCALE guidebook by REScoop.eu (2023) provides support to intermediary actors and organisations, such as energy cooperatives, to strengthen the capacity of these actors to provide a platform for mediation between users, policy makers, and utility companies (REScoop.eu, 2023).

- An example of an alternative vision for a sustainable community-based energy system has been proposed by Zoi Cristina Ziamantha, who has developed the notion of Community Renewable Energy Ecologies (CREE). CREE signify community economies involved in small-scale RE prosumption (production and consumption), or medium-scale RE prosumption and sale of energy and adopt alternative economic models for ownership, production, exchange, and circulation. Ziamantha also proposes a model for collective decision making “directed towards more 'thriving' and egalitarian socio-ecological futures” (Siamanta, 2021).

4 Conclusion: Transition challenges and social challenges in tandem.

In both scientific literature and political discourse, there is frustration that transitions to sustainable energy systems are not proceeding at the pace needed to meet climate policy goals and, above all, to prevent widespread loss of life, the huge socio-economic costs, ecosystem collapse, and large refugee flows that accompany accelerating warming. In 2023, researchers estimated the cost of extreme weather damage from 2000-2019 to average around 143 billion USD (Newman & Roy, 2023). The National Centers for Environmental Information estimates the cost of weather and climate disasters in the US to 187 billion USD for 2024 alone (NCEI, 2025).

Carrying out timely energy transitions is also about reducing inefficient infrastructure programmes and wasted investments, which our literature reviews show are common across the globe as infrastructure investments regularly fail due to poor maintenance and financial sustainability, low uptake by users, and resistance at the local level. In addition, the literature shows that centralised, top-down implemented large-scale initiatives often exacerbate the situation of socially and economically marginalised groups and, in too many cases, lead to people seeing their living environment polluted (e.g. through increased mining) or being displaced (dispossession). The problems are relatively well researched in the sense that there is strong evidence on the nature and severity of the problems. However, research does not keep pace with the large number of countries and specific cases where energy transition initiatives are underway.

As shown in our literature overviews, exclusion in most cases doesn’t happen by pure chance, but by socially unaware design. This ranges from design of policy to program interventions, projects and funding schemes, down to specific artefacts, consumer contracts, services, and technical systems (Michael et al, forthcoming). In this report we have pointed out these challenges as well as given examples of good practices, where initiatives in policy, sectoral practice, or among actors at local level are working on inclusion in different ways. As demonstrated in the report, valuable innovations and inclusive practices are often being piloted in countries of the Global South—yet these remain under-recognized in global debates. Learnings from these contexts can offer critical insights for energy transitions elsewhere, including in the Global North, where inclusion remains an ongoing challenge.

Meanwhile, as there are relatively few cases studied and evaluated according to their effects on social inclusion specifically, it is not possible to draw strong conclusions about the general effectiveness of these strategies. It is also not possible to validate the effectiveness of inclusion strategies in a statistical sense, as one of the main characteristics of successful examples is that they are adapted to the unique social and political context. Their tailor-made and user-centred approach, as well as flexible and adaptable ways of working, is what appears to be the recipe for success in contrast to the supply-side oriented, one-size-fits-all approach that is currently the dominant and traditional way of working in the energy sector.

We recognize our current period of burgeoning energy transitions as a pivotal period of experimentation. This experimentation phase provides a unique opportunity to reimagine and construct energy systems that are inclusive, equitable, and sustainable. By fostering diverse forms of user engagement and cross-regional collaboration we can build systems that not only meet technical and environmental goals but also reflect and integrate the lived experiences, cultural contexts, and aspirations of varied communities. This dual process of transition and experimentation allows us to embed resilience and adaptability into the very fabric of our future energy systems, ensuring they are better equipped to meet global and local challenges. However, for this to happen, including users cannot only be window-dressing. For trust-building to occur, users of different genders and social groups need to see that their expertise is valued and that actions are taken to ensure more just transitions. To help support these interventions, qualitative research perspectives are more important than ever. One major issue that needs to be addressed in order to design fitting policy and technology interventions that considers social aspects is unbalanced funding distribution. This includes the disparity between social sciences and STEM fields, as well as between low-income and high-income countries. Additionally, uneven impacts within countries, in terms of who benefits both from funding and how technology is designed, planned, and implemented must be addressed. These changes are essential to ensure both learning across fields and regions, and locally anchored solutions for the green energy transitions.

Our work in this report has focused on finding leverage points for change processes in the current dominant energy system. However, we acknowledge that this energy system embodies entrenched knowledge systems and worldviews that may exclude diverse perspectives, particularly non-Western and non-technical insights, and thus hinder innovation capacity. These knowledge systems include specific views on the roles of users, the organisation of the energy system, and the types of knowledge deemed important for the energy sector and its transitions. When facing today's challenges, we need to look broadly for knowledge, experience, and user engagement. In particular, there is a growing need to lift knowledge systems from the Global South into global energy dialogue, and to integrate indigenous and community-based knowledge frameworks that are often overlooked in dominant energy modelling and policy-making. In response, Phase 2 of the *Empowering All* Task (2025–2027) places stronger emphasis on co-production of knowledge across global regions, including more explicit integration of indigenous perspectives and local knowledge systems. This includes recognizing the value of indigenous worldviews, particularly in contexts where extractive energy activities threaten traditional livelihoods, and where relational understandings of energy—rather than individualistic or technocratic framings—can provide pathways for more equitable transitions.

Finally, policy makers wishing to accelerate action to urgently mitigate climate change, with concerns such as intergenerational fairness and slowing biodiversity loss, should not ignore present day social justice issues. Climate change is a grave threat that is already affecting in particular, marginalised groups globally, but there is no quick fix for an inclusive and equitable energy transition. On the contrary, applying quick technocratic and top-down fixes has been shown to lead to resistance, lower acceptance and backlash (Devine-Wright, 2012; Steg et. al., 2005; Steg et.al., 2006). Acknowledging this as a key consideration in energy transitions is essential for creating sustainable and widely accepted reforms.

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