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Perspective

Extending energy access assessment: The added value of taking a gender perspective

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ABSTRACT

Measurement methodologies are increasingly being deployed to monitor energy poverty or energy access, and to provide insights for policy development, both in the South and more recently also in the North. However, care should be taken with interpretation and use of the data, particularly if a gender perspective is lacking. This paper argues that taking a gender perspective is vital to understanding energy access and outcomes related to interventions, through consideration of gendered user differences in energy needs, access to energy services and gendered outcome pathways. We show that the standard practice of focusing on numbers of energy connections, availability and quality of supply, is insufficient to provide insights relevant to realising gender equal access and benefits. It is a political decision about what is measured and who decides on what is measured. Based on the literature, we discuss key elements of the use of gender approaches in the assessment of energy access and energy poverty. We show that by including gender approaches in the design and execution of qualitative and quantitative data collection and analysis, there is the potential to contribute to more equitable outcomes from improved energy access.

1. Introduction

In 2012, a strong signal for the need for action in the energy sector was given by stressing universal access to affordable, reliable and modern energy services as one of the Sustainable Development Goals (SDG 7.1). In the SDG Framework, gender goals (formulated in SDG 5) are explicitly linked to other goals including SDG 7.1. More recently at the global level policy level, the UN General Assembly [1] outlined the opportunities for women in the energy sector and emphasized the need for full and equal access to sustainable energy to enhance economic and social empowerment.

At regional and national levels, an increase in the recognition of gender as a dimension of energy policy has taken place since 2000. The European Parliament resolved in 2016 that a gender dimension must be included in EU energy policies and policy implementations [2]. The gender and energy link was strengthened in 2018 within the package "Clean Energy for All Europeans", as part of the EU's commitment to the Paris Agreement [3]. Similarly, since 2017, ECOWAS in West Africa has goals to mainstream gender in the energy sector which are currently being translated into national strategies, work plans and legislation [4].

Despite progress in raising awareness about the gender and energy nexus, gender considerations are still not typically prominent in energy sector agendas [5]. At national levels, gender is not considered to be a standard issue in energy frameworks. Rojas and Prebble [6] point out that, as of 2017, gendered terms were used in only 32 % of 192 energy frameworks in 137 countries with significant differences between regions, from a relatively high use in sub-Saharan Africa energy frameworks to a low occurrence in OECD countries. Higher levels of awareness and commitment to gender issues in energy are exemplified by countries such as Rwanda, where the National Energy policy includes gender mainstreaming [7], and the Ministry of Energy in Kenya which has a Gender Policy supported by an annual allocation of funds towards gender mainstreaming and by 'a gender unit, a gender officer and an operational Ministerial Gender Committee' [8].

As part of mainstreaming strategy for including gender issues in energy policy, combining SDGs 5 and 7 can provide an important impetus. Such a combination of goals draws attention to the transition to sustainable energy systems being not only about the need to increase access to modern energy services, but also that the transition must deal with socio-culturally differentiated gender biases to avoid the creation

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of new injustices [9].

Taking a gender perspective implies consideration of gendered aspects of access, gendered needs for energy services, and gendered benefits. The supply of sustainable energy access itself benefits from taking into account gendered social and economic issues - women experience the same barriers to energy access as their male peers, but with additional gendered encumbrances which add to their access problems. These encumbrances include lower incomes, energy-related traditions, the burden of household chores and access to cash, and limited decision-making powers meaning that women in all countries across the globe are disadvantaged in accessing energy services to meet their needs.

The single gendered energy service which receives the most attention from policy makers in the context of the Global South is cooking. This focus is deemed to be a powerful step towards meeting urgent priority energy services for all. However, unlike access to electricity, creating access to clean cooking is not on track - by 2030, if current trends continue, only 72 % of the population worldwide will have access to clean cooking fuels and technologies [10]. The emphasis on domestic cooking overshadows the need for energy for small-scale production, which is the level of activity where many women are involved in (informal) income generating activities situated in the family home [11]. It also overshadows another household requirement: access to clean water, which is also the responsibility of women to provide for their family needs. The time and physical energy required is also demanding. In Europe, the focus in gendered energy services is on space heating and cooling [12].

Progress in achieving the SDGs is currently tracked through established measurable international targets. This draws attention to the issues of the quality, typology and quantity of data required to monitor progress. The applicability of collected data is the key in formulating policy by defining the nature of the problem to be addressed and how it can be resolved. "*Better data will assist in the design of policies that encourage uptake and sustained use of clean household fuels and technologies*" [13]. The implication of this statement is that what is measured and who decides on what is measured are political decisions, [14,15]. If gender considerations are not included in the measurements, it is likely they will be left out of policy design and interventions.

The data referred to in the previous paragraph are usually quantitative. The advantages of quantitative data for policy makers are that they provide overviews and allow for comparison as well as the methodological advantage of repeatability and generalisation. Designing quantitative methods requires careful consideration of what can and cannot be measured and how to measure them. However, when it comes to deciding how to measure gender issues, reliance on quantitative methods is inherently difficult and precarious, since many causes and effects of gender inequality are specific to intrahousehold dynamics and are related to local context. It is here that qualitative methods can support quantitative data by creating an understanding of gender issues hidden in the data and by informing the decisions on what to measure.

This paper looks at how gender is included in assessments for energy sector targets and achievements and discusses current approaches and their limitations to measurement with recommendations on how data collection can be improved to increase achieving targets. In Section 2 we define our concepts. Section 3 describes how a range of agencies incorporate gender into energy access assessments. Based on the literature discussing the inclusion of gender in energy access measurement, Section 4 reviews different practical elements of incorporating a gender approach into energy access assessment.

2. Defining scope and concepts to include gender in assessments of energy access

Insights into gender inequality in access to energy and in the benefits of access can only emerge if the scope and perspectives of analysis are defined to allow assessment of such differences. As the common terminology and scope used in the energy sector is sometimes inappropriate to the identification of gender issues, for this paper we define four aspects of scope and concepts that are needed to allow explicit assessment of gender issues across the perspectives of needs, access and outcomes of energy policy: i) energy needs for households and income generation, including in the informal sector which is a particularly important sector for women, ii) access to energy services, iii) outcomes or benefits from energy supply, and iv) equal opportunities for men and women in decision making, as a cross-cutting issue.

i) On the topic of energy needs, the scope goes beyond cooking to other culturally-distinct gendered patterns in assessment frameworks and methods. Examples may include pumping water, services linked to household chores such as washing clothes or differences in energy needs for income generation and family care. We also go beyond the household by including the informal production and service sector which plays a critical, but often overlooked, role in many economies providing 52 % employment to workers aged 15 and above globally and 81 % in low-income economies. In low-income economies, more women than men are involved in the informal sector: 85 % of female and 78 % of male workers [16].

ii) We use the term access as it applies to *energy services,* by distinction from the term access to supply. Access in the energy sector is typically defined related to supply and assessed in terms of numbers of households with connections to the grid or with off-grid energy supply technologies in place. This hides the many gender issues and inequalities that manifest themselves at the level of the actual energy services. We include within access to energy services the take up of a connection and ability to use an appropriate energy supply and appliances linked to the provision of domestic and business services such as cooking, heating and lighting. Access to energy services is also more likely to be considered in the Global North where access to supply is not seen as a significant issue.

iii) To understand how outcomes or benefits from energy supply are effectuated and who benefits requires taking a gender perspective. Outcomes are overwhelmingly influenced by gendered household roles and the division of labour, gendered differences in assets and gender norms stimulating or inhibiting changes. Outcomes are also influenced by the way men and women engage in the planning and realisation of energy access.

iv) Finally, gender equality in decision making is considered by looking at involvement of women in energy supply in terms of employment and their contribution to decision making on energy supply and use of energy services.

3. How is gender included in energy access assessments?

To provide an overview of how gender is included in international and national frameworks for energy access and energy poverty, this section presents an assessment of key frameworks at different levels: i) at the level of global targets expressed in the Sustainable Development Goals, ii) by the International Energy Agency as developer of influential reports for policy makers in the energy sector, iii) the EU and iv) ECOWAS as regional governance institutions guiding and steering national energy policies, v) national level frameworks and vi) the Multi-Tier Framework (MTF) as framework for the assessment of energy access at national level. We pay special attention to the MTF, as it has considerable influence over the standardisation of assessment of energy access in the Global South.

3.1. Gender assessment in the energy progress report/global tracking framework

The Energy Progress Report, formerly The Global Tracking Framework, is the key platform for the assessment of progress towards the SDG7 target, including energy access (target 7.1). Reports on progress are updated annually by the IEA, IRENA, UNSD, World Bank and WHO from a range of sources including national household surveys, census data and regional database surveys.

In the 2020 Energy Progress Report [13], gender is mentioned as a relevant topic for further consideration. The report provides a short description of gender issues based on a range of studies, including case studies and mixed methods research; access to training and skills development programs are identified as a key measure to improve women's engagement in deploying renewables for energy access. The report also gives examples of the productive use of electricity and women's economic empowerment, for instance through studies in Tanzania and Ghana showing that the use of electrical appliances allowed for diversification in products for sale and helped female entrepreneurs attract more customers [16,18].

In the 2021 Energy Progress report [10] gender is related to a range of topics: affordability of electricity services, gender-based violence in refugee camps that could be reduced by access to sustainable electricity, access to finance in Kenya's electrification programmes, the occurrence of girls living in extremely poor households being higher than that of boys, women's involvement as professionals in the energy sector, employment gains for women following electrification, the disproportionate toll on women of the negative effects of the use of polluting stoves, and women as change agents in reducing both poverty and inequality.

The data collection framework newly developed by World Bank and World Health Organization [19] can be slotted into national surveys such as Living Standards surveys or national censuses. The framework provides a transparent and detailed approach that at a minimum, provides more in-depth insight than the standard binary approaches to energy access and benefits, and includes essential questions that are highly relevant to gender access and impacts through building an understanding of the actual use of energy services, as well as a module with recommended questions to inform analysis of gender dynamics for energy related roles and responsibilities in the household.

3.2. The world energy outlook

The World Energy Outlook (WEO), the annual report of the International Energy Agency (IEA) provides key trends and priorities in the energy sector based on national level statistics. However, gender has not been among the mainstream issues reported on, although attention to gender issues was given in the report on energy access in 2017 [20] and elaborated in a text box in the 2018 WEO [21].

The IEA Users Technology Cooperation Programme established a gender and energy research programme in 2020 [22], although the focus is primarily on European countries. The research programme has contributed to the design of the OECD's forthcoming large-scale household survey, which includes energy use, ensuring incorporation of gender and social inclusion issues.

3.3. ECOWAS

As was mentioned earlier ECOWAS has a policy for gender in the energy sector, now being translated into national level institution building and legislation within member states of West Africa [4]. The national level focus is on capacity development among decision makers for identifying and understanding gender issues for inclusion in policy, the inclusion of girls in STEM education, the inclusion of female staff in the energy sector and a do-no-harm principle for large scale infrastructure projects. ECOWAS is also being urged by the UN to support the role of women as key economic actors in the regional informal sector [23].

3.4. The European Union

In the European Union (EU) policies and monitoring frameworks, the term energy poverty is central to the understanding of energy access. Energy is considered to be one of the essential services in the principles for social rights [24], where access to affordable space heating/cooling has been the main concern. However, the signficant increase in energy prices in 2022, has raised the prospect of an escalation of energy poverty in EU countries which requires responses from policy makers.

Both in current national emergency measures, and in EU monitoring tools, including for the SDGs [24], the concept of energy poverty is linked mainly to expenditures at the household level and building quality (correlated with the impacts on energy efficiency). At different national levels, SDG terms and goals are contextualised, linked to differences in the way problems are conceptualised and approaches to solving them.

However, lack of EU Member State data hinders monitoring of progress on energy poverty; current data focuses on consumer vulnerability and are largely qualitative and not sex-disaggregated [25]. Nonetheless, there are indicators that energy poverty has a gender dimension, as distinguishing vulnerable groups show that such groups include women above pension age, and women-headed households who are often tenants of a private landlord and dominate in single-parent households.

New monitoring guidelines for local governments in the EU by the Energy Poverty Advisory Hub [26] advise to include not only the technical and financial aspects (income, energy prices, energy efficiency of buildings) in the diagnosis of energy poverty, but also to pay attention to vulnerability factors. The Covenant of Mayors for Climate and Energy Europe includes in its reporting guidelines on energy poverty the need to disaggregate data about vulnerability across a wide range of social characteristics including women and girls [27].

3.5. National level data

Although most countries collect statistics on energy as well as statistics on gender, data or analysis of issues addressing the gender and energy nexus is very limited. At a national level energy data tends to focus on energy supply with only a few indicators addressing issues of energy access or energy poverty.

In gender and energy country briefs for Kenya [8], Rwanda [7], Uganda [28] and Tanzania [29], assessments were made of data on energy access, gender issues, and the gender and energy nexus, with a strong focus on cooking in combination with another topic, the involvement of women in the energy sector. In Rwanda, the Multi-Tiered Framework (MTF) provides more detailed information on differences in electricity access for grid and off-grid solutions between male- and female-headed households. (See next section for more detailed discussion of the MTF).

Meanwhile, a lack of gender disaggregated data is a challenge that hinders gender mainstreaming in Kenya, which might support the effective implementation of gendered energy policy in the country [8]. In Uganda energy data are available at household level, but data on gender issues in energy projects and gender impact studies are lacking [28]. Gender disaggregated information is considered important in Tanzania for decision making, accountability and planning, however availability and capacity of staff for data collection and analysis is an inhibiting factor [29].

In the EU, currently, no member states specifically include gender as a characteristic of energy poverty or consumer vulnerability. In the UK, while survey data on energy poverty[1] is not presented distinguishing the sex of the household head, other social indicators, such as age and ethnicity, are used.

3.6. Gender assessment in the multi-tier framework (MTF) country reports

The MTF (developed by the World Bank to address the data gaps on energy access goals) is a key framework-entailing methodology,

[1] The UK uses the term ‘fuel poverty’.

developing indicators for the standardisation of understanding of energy access at national level [30]. It characterises energy access according to five tiers related to potential usefulness of energy supply. The MTF assesses household energy with separate tiers for access to electricity and access to cooking; access in Tier 1 is sufficient for 4 hours of lighting a day, while Tier 5 access envisages potential use of electric household appliances with electricity supply available at least 23 hours a day. The methodology, focussing on quantifying and qualifying access, does not include outcomes or benefits of access, but does entail data collection for the understanding of a number of common inequalities in outcomes and benefits, including gendered differences. The methodology has been used for the development of MTF household surveys, and is similar to that used in other national frameworks such as that of India.

Energy access diagnostic reports based on MTF household surveys are currently available for 12 countries (Bangladesh, Cambodia, Ethiopia, Honduras, Kenya, Myanmar, Nepal, Niger, Nigeria, Rwanda, Sao Tome and Principe and Zambia). Gender aspects related to energy access are included in these reports although the aspects and extent differ. In 11 of the 12 reports, the gender of the household head is one dimension across which the data at household level in these reports are presented, next to the location (urban or rural) and income quintiles.[2] For the MTF reports this means that differences in access to the different Tiers of electricity access are specified according to the gender of household heads.

A section on gender also describes male and female headed households according to urban/rural location, level of attended education of the household head, occurrence of widows/widowers and representation in expenditure quintiles, as well as cooking insights. Next to the household level data, specific information was collected for male and female respondents on selected topics in most countries. The most prominent within-household issue, presented in all reports except Nigeria, is time spent by men and women related to cooking but not fuel collection which is generally more time consuming than cooking.

The depth of analysis on gender issues differs per MTF country study. On differentiated access, the Cambodia study for example [59] cites differences in not being connected to the grid as 9.4 % for male headed and 14.3 % for female headed households (the percentage for both groups is based on those who have submitted an application), where the authors suggest that gender-based cultural and education barriers add to the difficulties to connecting to the grid. The MTF Honduras [60] identified a gender issue related to tenancy: 18.7 % of female-headed households but only 3.1 % of male-headed households stated that the final decision to connect to the grid belongs to the landlord.

On decision making, the Rwanda MTF study [61] examined male/female differences in decision-making for purchasing different types of stove or other energy appliances. Relevant gender findings were that women made the decision for 49.7 % of cookstove purchases, including 85.6 % of clean fuel stove purchases; the same report suggested that female-headed households are less willing to pay for an improved cookstove (ICS) than male-headed households and men are more willing to pay upfront. For appliances, it was the refigerator in which the highest percentage of women were involved in making the decision to buy either alone or as a joint decision.

In the Kenya MTF report [62], gender differences in purchase decisions indicated lower willingness to pay for electricity access in female headed households than in male headed households in the case of grid connections, but more strongly in the case of off-grid solutions (solar PV). The report provides several potential contributing factors, such as differences in access to education and access to finance.

In the Ethiopia MTF study, Scott et al. [31] found a complex interaction between cooking and indicators of female empowerment: women able to go out on their own (a female empowerment indicator used in MTF studies) tend to spend more (sic) time cooking, while women who are income earners and bank account holders tend to spend less time cooking. They also find that women who cook exclusively with electricity are more likely to be involved in income generation. This is a good example of where, for the interpretation of these correlations, further investigation would be needed and qualitative data would be revelatory.

The MTF approach allows for a gender perspective but does not systematically mainstream it which may be linked to a failure to use national gender experts. In the 12 country studies, local expertise that informed the adaptation of surveys to national circumstances and priorities was often related to energy markets and national statistics, and not on gender issues, while international experts from the WHO were consulted for the aspects of the survey related to cooking. As standard practice in the MTF studies, local expertise was used to inform data collection methods to increase response rates and also to allow greater responses by females.

4. Taking a gendered approach to energy access assessment

How and to what extent gender is taken into account in different energy assessment frameworks defines which insights are gained and how relevant assessments are for actionable inputs to address gender inequalities. In this section, we discuss characteristics of gender approaches and energy access that are pertinent to decision-making on scope, method and indicator development in the assessment of gender issues in energy access and energy poverty.

4.1. Quantitative and qualitative data

Measurement tools for energy access and the reduction of energy poverty typically reflect technical and economical perspectives. This emphasis acts as a bias towards quantitative methods in surveys on assessments of energy access, which allow the advantage of easy presentation and comparison. Quantitative analysis can also take place using qualitative data (based on categorisation of information from open questions, observations or perceptions, for instance), but this is rare in large scale surveys.

It follows that a reliance on quantitative indicators can be reductive when complex processes are reduced to mere numbers. Collecting quantitative data can miss crucial gender issues related to energy access and distribution of benefits when they become too standardised or focussed on immediate measurability [32]. By including qualitative methods, it is possible to include intrahousehold tensions and power relations in respect of energy choices which provides a more nuanced understanding about household choices of energy access. This understanding aids policy making in identifying who to target with policy messages and the form that message should take to motivate purchases or behavioural change.

Reliance only on quantitative data has other consequences. As Nelson [33] and Kooijman [32] show, by focussing on numbers, the discussion tends to move away from issues of inclusion and exclusion of impacts. A typical example is the counting the numbers of women and men participating in a village development project rather than analysing their contributions and influence towards decision making [34] Cloke [35] suggests holistic data gathering related to issues of agency and ownership, by paying attention to processes of exclusion relating to culture, socio-economic environment and the politics of energy generation, distribution and use. The introduction of qualitative methods invites a re-examination of findings from quantitative methods because this provides a more nuanced understanding of household energy decision making.

A gendered approach to energy access assessment would combine quantitative and qualitative approaches which allows for sensitivity to context, including intrahousehold dynamics, decision making on aspects to be included in energy access and use of energy services, an approach elaborated below.

[2] The Nigeria report does not present any specific gender analysis.

4.2. Household level data and intra-household data

Household level information is useful for the identification of gender issues as they relate to access to cooking fuels, according (for instance) to income groups or rural/urban location of households. This selection of data is often used due to availability in national level databases, but household data have limitations in assessing gender inequalities in energy services and benefits, both between and within households, and in the understanding of what influences the effectuation of outcomes.

Firstly, household definitions and indicators may not cover the realities that shape both energy needs and access to energy services. A household in reality is a complex, fluid entity, the composition of which is both culturally and time dependent [36]. This issue implies differential outcomes from gendered energy complexities, illustrated by envisaging differences in needs for energy services according to family member roles in household tasks as well as difference in capacity to pay arising from employment opportunities and power to influence decisions.

Time dependency and fluidity of household composition can also depend on migration, where one or several members of a household are away for some time, sending remittances and altering gendered decision-making roles and the financial situation of the household. Also, in many low-income countries informal businesses are home-based, with inseparable private and business tasks with their associated energy needs, making a distinction between household and business energy needs problematic.

Secondly, structural gender differences within households remain unevidenced if information is collected only at the aggregate household level. As shown by Bradshaw [37], intrahousehold data are required to uncover intrahousehold inequalities of access to energy services and any associated benefits/outcomes. This type of data would take into account how gendered relations, roles, norms and agency influence energy needs and also whose needs for energy services are prioritised within a household. A gender approach to analysing intrahousehold dynamics does not assume standard definitions or functioning in a household; researchers recognise that the roles and needs of people are differentiated across a range of social characteristics such as age, ethnicity, religion, civilian status and class.

4.3. Gender disaggregation

Disaggregation of data is a first necessary step to understanding issues and thereby identifying pathways to mitigating energy poverty and/or improving energy access. Such issues are typically defined specific to socio-cultural situations, for example, how gender intersects with other social characteristics such as age, ethnicity, religion, civilian status and income level.

Examples of insights from gender disaggregation show that this is relevant not only to energy access issues (as discussed for low-income countries) but also to issues of energy poverty occurring in high income countries. In Bulgaria in one-person households there is a 45 % risk of income poverty, which is correlated with energy poverty, with an overwhelmingly gender issue since this group is dominated by single, usually older, women [38]. In Spain, energy poverty is 10 % higher among women than among men and a wave of house repossession after 2008 has been linked to exacerbating energy poverty [38].

In the UK, disaggregation also helps identify social groups recognised to be vulnerable to negative outcomes of insufficient heating, including the elderly, disabled, the youngest and the terminally ill [39]. These groups also have other energy service needs such as additional warm water for washing [40]. Taking a gendered intersectional approach highlights differences between and within groups, which may require specific targeted forms of action rather than generic policy instruments.

4.4. Gender analysis of male and female-headed households

Gender disaggregated data often compares male- and female-headed households, a relevant gender issue given that globally 18.2 % of the population live in female-headed households. Women in single female-headed households with dependent children are a specific group vulnerable to income poverty [41]. However, a categorisation of households by gender of the head of household is prone to the diversity of definitions and unreliability or inaccuracy of data. Therefore, most recent reports by the World Bank and United Nations no longer use the term household head but instead look at income earners. The number of dependents per income earner is then the typical unit of measurement. The UK has also stopped using the term and since 2001 has used the concept of the 'household reference person' [42].

The UN Department of Economic and Social Affairs Statistics Division [43] in their study on methodological issues of gender measurement, identifies the following household level data misconceptions in identifying gender issues:

- A lack of explicit criteria in identifying the household head.
- The traditional notion of head of household typically counts households in which there is a male adult based assuming that one person has primary authority and is also its chief economic support.
- Household level information based only on consumption does not assess a range of differences between men and women within a household such as intra-household poverty and inequality.

These arguments by a UN agency indicate a positive step towards presenting gender disaggregated data without using the term household head. However, in order to promote gender equitable energy access there is a need for including a contextual understanding of power relationships and how they influence livelihoods, which is discussed in the following sections.

4.5. Including energy services to understand energy access and energy poverty

Currently assessments of progress with energy access tend to use binary indicators. However, it is increasingly recognised that a multidimensional approach is necessary, due to the shortcomings of indicators that are in use [44] some of which we have indicated above. Binary indicators tend to overestimate access [45], failing to account for the quality of supply and user circumstances determining the value of energy supply. Furthermore, current approaches typically do not include the benefits of community services, such as health centres, energy for productive uses or decent living standards in contributing to poverty reduction. From a gender perspective, recognizing multidimensional aspects of energy access is a critical step in a gender approach for the quantification of inequalities and the identification of factors that influence inequalities.

Multidimensional approaches such as the World Bank MTF [30] and the Alternative Framework [45] presented by Pachauri and Rao seek data sets that relate available 'usable' energy at household level to the needs for energy services and characteristics at the space of interaction between supply and users (affordability and costs of energy services and appliances, income levels and organization of payment). These approaches try to balance accuracy of results, costs of data collection and opportunities to use existing large-scale surveys.

In areas or countries with high access (connections), definitions of energy poverty are used, typically primary income-based metrics that assume that a higher percentage of income spent on energy indicates that a household is energy poor [46]. These income-based metrics may lead to false conclusions, for instance when households adapt behaviour to reduce energy expenditure or cannot afford certain appliances that would be required to meet demands for energy services. They also do not reflect the differences that energy efficiency of appliances or the

insulation of homes can make in the measurement but also in the experience of energy poverty.

A focus on energy services is therefore needed to provide evidence for links between supply and supply outcomes, for instance through appliances [47]. This is not a simple exercise, as a selection of which energy services to be included is precarious in all methods that predefine the scope of data collection. A separate complication is that much information is lost if energy access measurements aggregate averages of characteristics of energy services which are used for different purposes. Multi-tier and multi-dimensional approaches attempt to tackle this issue by distinguishing categories of energy use such as households, productive uses and community services. By allowing for context specific priorities for energy services, sets of indicators can be selected, for example the priority given to space heating or cooling and which spaces in a household need to be defined, or the requirements of energy supply for context specific forms of household-based income generation such as in cooking or tailoring enterprises.

4.6. Gender norms are context specific and norms shift

We need to be careful not to assume universal or static truths about particular energy needs since gender inequality manifests itself in different ways for example in the gendered division of labour and gendered access to and control over resources, and changes over time (both towards and away from gender equality). A gender approach therefore requires accurate knowledge of gendered practices and processes, and of possible variations between different population groups such as those based on age or ethnicity.

The multidimensional frameworks which do not use a gender approach to define their methodology risk omitting issues that may well be a priority for meeting women's energy needs, for example, water collection compared to fuel collection. Varied gendered role divisions and time expenditures mentioned above have been evidenced in Sub Saharan countries from different studies. This provides an example of an assumed universal truth – fuelwood collection is women's work [48]. For instance, research in Uganda found that in rural areas men spend more time collecting fuelwood than women, while in urban areas women spend more time on this task.

4.7. Collecting data

A gender sensitive approach also pays attention to the way that data are collected. Firstly, speaking with women may require culturally sensitive approaches such as involving female enumerators or the use of researchers who are locally trusted [49] and speak the local language. Secondly, assurance that female responses are not influenced by males (such as often occurs when husbands are nearby or respond), especially where information is required about the appliances women use. Thirdly, to have a comprehensive understanding, for many issues it is relevant to collect both male and female responses within the same household.

4.8. Who takes part in decision making on what is measured

Women have more limited access to political processes which influence the policy agenda on energy, such as deciding on energy goals and indicators. However, if there is no engagement with stakeholders, such as women's groups, during these processes, then there is a risk that there will be no recognition of the relevance of gender inequality related to energy issues. These political processes operate at different levels which allows a range of institutions such as the World Bank, ECOWAS and international NGO's to have a significant worldwide influence on gender inclusion in policy [50] – for example, recognizing the value of women's work within the household as part of the economy has contributed to an increased appreciation of cooking in energy frameworks [50,51]. Increasing the political transparency in decision-making about what is measured can reduce the risk of missing the interests of groups [32]. As an example, in India the inclusion of gender issues in the country energy policy is attributed to the electoral weight of rural women in elections [52]. Feenstra and Özerol [53] see a gap between the concept of energy justice developed in the 2010s and gendered approaches and posit that what is required is a 'gender just energy policy framework'. Further, the inclusion of local gender experts in the development and adaptation of frameworks might allow for a selection of topics and indicators relevant to national priorities and context which potentially reduces resistance to the incorporation of gender into energy planning [5].

In the literature on energy for development projects, engagement and participation by women and men is often prioritised but in practice it does not happen. There is also a need for a further disaggregation reflecting that women and men are not homogenous groups but are intersectionality constructed, however, this is rarely mentioned. Future energy access for low-income households will be largely realised through decentralised energy systems- in which the manner of engagement will structurally influence the level of useful or desired access across all groups.

4.9. Including topics urgent to gender equality on the agenda

Topics urgent to gender equality entail including other energy services than cooking, identifying and addressing the real (positive or negative) outcomes of energy interventions rather than assuming them, and the potential to change gender norms through energy interventions.

Looking at influential international and national frameworks for gendered energy access, often cooking is the only energy service explicitly included, although restrictive gender relations may be embedded in the availability of a range of energy services. Little data is available for gendered energy needs such as refrigeration or laundry or in the Global North space heating/cooling and even less attention is given to gender differentiation of business-related energy needs or leisure and relaxation.

Positive changes in people's lives due to energy interventions are often assumed, but this does not always reflect reality. The potential positive effects of energy access may or may not happen in practice, and when they do, they may or may not lead to positive changes. Although increased access to affordable supply of energy services, including the appliances which provide the services, can lead to improvements in the quality of life, the evidence to demonstrate the correlation is unsufficiently robust and frequently anecdotal. Of the potential effects, time savings is the most reported indicator, especially related to benefits for women. Modern energy services have the potential to save time in many (frequently unpaid) household care tasks with a typically strong gender dimension - fuel collection, cooking, water collection, food processing, washing clothes.

However, efficient appliances do not automatically lead to reduced 'time poverty' or to time for income generation, although such assumptions have been observed. For instance, with washing machines a part of time savings can be undone by increased frequency of washing clothes since social standards of cleanliness change [2]. Even where outcomes are given, the experienced value of access to energy services can be both positive and negative. Where lighting is concerned, women report the flexibility to shift tasks to different times, however the same opportunity to continue work into the night may also increase the burden of women and worsen other gender inequalities.

Increasing the involvement of women in energy supply and decision making is also accepted as an indicator in data on gender in energy; typically this is related to improving equal opportunities to quality jobs and decision making. Very little data is available on the effects of increasing the presence of women in energy supply and decision making. While the evidence in general indicates that women in positions of influence are no more likely to represent women's interests then men are [54], evidence from South Africa and Uganda indicates that when women held senior posts in ministries of energy, gender issues have

tended to receive more attention [55].

A key aspect of gender equality that is nevertheless rarely evidenced is the potential for modern energy services to shift gender norms in a positive or negative direction towards gender equality at work and in the household. Research in India and Nepal for instance has shown that modern energy helps overcome gender norms related to reducing the need for physical strength in the traditional operation of water pumps and farm machinery after which norms shifted as to which jobs are appropriate for women [17].

It is also highly probable that shifting from the unpaid burden of women to payment-based modern energy services will have an effect on household gender roles. There is evidence that the manner in which energy service supply is set up involving women can lead to changing norms, such as in the examples of women selling PV systems [56] and women owning and managing services offered by the multifunctional platforms in Mali [57] in which the programmes explicitly ensure roles for women that they may not have been able to take without the intervention. This is in contrast to programmes that purely reflect gender roles and thereby often reinforce gender roles and gender inequalities in society [17].

5. Reflections and conclusions

Terms such as lack of access to sustainable appropriate energy services and energy poverty have a very real meaning, in low income and in high income countries. A gendered perspective is essential to ensure that interventions reach men and women equitably in improving energy access. A starting point is the understanding that energy services have gendered patterns of use linked to the gendered division of labour and roles in society which lead to different requirements on energy supply and appliances. This in turn entails the need to address gender-related energy barriers and differences in opportunity to act upon provision of supply.

To improve assessment of gender issues in energy access we recommend a structural combination of qualitative and quantitative methods taking a gender sensitive approach as discussed above. While the increasing level of attention for gender issues in energy policy and in data collection is a positive development, the focus on household level data and standardisation of approaches still risks lack of relevance to informing actions to support gender equitable change.

An informed, transparent and participatory process using qualitative approaches to identify issues also within households, reflecting the interests of men and women in different social and economic groups, age groups, from different communities and locations is needed for the definition and selection of relevant indicators and issues. A gender sensitive framework development can then form the basis of quantitative multidimensional data collection and the application of frameworks to a country context, and in order to develop effective policies and programmes, qualitative gender sensitive approaches may also be needed for interpretation of quantitative findings. Detailed qualitative reporting on case studies provides a wide scope to understand people's perceptions and valuation of outcomes by learning from case studies which have good distribution within a country reflecting different contextual factors. It is good news in this respect that the evidence base on gender related issues related to energy access is increasing, in both the Global South and the Global North.

Data which build an understanding of gender issues should be inseparable from the mainstream focus on technical and financial aspects of energy supply to support development of policy and actions to benefit improvements for both men and women. By providing data on gendered differences, the case can be made for actions to truly reach energy access for all and further to reduce gender inequalities through access to energy services.

Declaration of competing interest

All authors have declared that they have no competing interests.

Data availability

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

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