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Working Group 2 - Implementation: Developing an operational energy poverty framework

Moving beyond the state of the art in energy poverty measurement

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Table of contents

1. Resolving the complex challenges of energy poverty metrics (by Siddharth Sareen)

Research has made notable strides on the measurement of energy poverty during the late 2010s. Increasingly, policymakers in European countries agree that the topic merits attention. Many have mobilised metrics to measure it. This report is intended as a ready reckoner that captures these trends and identifies useful future avenues for advancing energy poverty measurement.

From a policy perspective, a single definition across European Union countries may be undesirable given the multidimensional nature of energy poverty. For the sake of consistency, our report coheres around a generic understanding of energy poverty as a condition whereby people are unable to secure adequate levels of energy services in the home (Bouzarovski and Petrova 2015). We are conscious that the report comes at a moment when energy poverty indicators are continuing to emerge rather than having crystallised. Ongoing work within our research group reflects on the dynamics of energy poverty metrology and informs the framing here: we acknowledge existing measurements in multiple national contexts, identify promising new approaches at multiple scales, and remain mindful of the tensions between the uptake of novel metrics and the ability to collect and systematise data (Sareen et al., in review). Consequently, we include the mention of notable gaps, where sufficient energy poverty measures have not yet come about, despite recognition of clearly relevant phenomena.

The report comprises six sections. This introduction is followed by Section 2 on prevalent approaches, which succinctly draws on and extends this working group's contribution on the state-of-the-art in energy poverty measurement in the ENGAGER Policy Brief 1.[1] Next, Section 3 provides a handy overview of four emerging approaches. These span harnessing big data sources such as smart meters and building energy certificates; employing data on vulnerable users such as electricity disconnection events and unpaid bills; using geo-spatial data through open source mapping to visualise factors like energy potential; and monitoring energy poverty through the lived experience of vulnerable users.

[1] http://www.engager-energy.net/wp-content/uploads/2019/01/Engager-Brief-1.pdf, pp. 9-13.

Section 4 comprises an action-centric overview of policy levers to operationalise energy poverty measurement through governance. It zooms in from the global to the European level, and then dwells on some trends in the National Energy and Climate Plans of the European Union member states. Section 5 takes up four major and relatively urgent gaps in energy poverty measurement. It bookmarks the need for: gender-disaggregated data on energy poverty; preemptive citizen-centric monitoring for disaster resilience; complaint service metrics; and an approach to measuring transport energy poverty that can navigate the tensions of transcending the space of the household. Section 6 concludes with key reflections on the way forward for energy poverty metrics and offers key takeaways for energy service providers, applied researchers, policymakers, and citizen groups.

2. Prevalent approaches (by Harriet Thomson)

Dominant approaches to measuring energy poverty in Europe are shaped by traditional definitions that emerged from the UK and Ireland, countries that have a long tradition of academic scholarship, practice-based responses and policy frameworks to address the issue. In particular, many measurement approaches focus on household income, energy pricing, and energy efficiency – a triad that arose from Boardman's earlier work (1991), and the first official definition of fuel poverty in the UK. This classified a household as fuel poor if it needed "to spend more than 10% of its income on all fuel use and to heat its home to an adequate standard of warmth" (Department of Trade and Industry, 2001: 6).

From this context, three main overarching approaches have developed:

1. **Expenditure approach** – this is one of the most commonly used methods, in which the energy costs faced by households against absolute or relative thresholds provide a proxy for estimating energy poverty. Among the most enduring energy poverty thresholds are the 10% and twice-national median lines, typically calculated using expenditure data from Household Budget Surveys (HBS) (Thomson *et al*. (2017).

2. **Consensual approach** – given some of the difficulties associated with the expenditure approach, particularly in terms of data coverage, a popular alternative is the use of self-reported assessments of indoor housing conditions, and the ability to attain certain necessities relative to the society in which a household resides. Typically, this has involved asking households whether they can afford to heat their home, pay utility bills on time, and live in a damp and rot free home, using EU Statistics on Income and Living Conditions (SILC).

3. **Direct measurement** – this is an increasingly applied approach where the level of energy services (such as heating, cooling, and lighting) achieved in the home is directly measured and compared to a set standard. This has usually involved taking internal temperature readings to determine if households are attaining 'adequate' levels of warmth, however, smart metering and the Internet of Things offers broader potential for this approach.

Until recently, there has been a lack of universally accepted indicators for measuring energy poverty, and subsequently a diversity of approaches and methods. However, work by the EU Energy Poverty Observatory (EPOV) – initiated by the European Commission and led by ENGAGER team members Professor Stefan Bouzarovski and Dr Harriet Thomson – is bringing about substantial changes in that regard. EPOV posits energy poverty as a multi-dimensional concept that cannot be adequately captured with a single indicator. It argues that each indicator signifies a different aspect, thus a combination of metrics should be applied to the phenomenon of energy poverty, and has proposed a suite of four indicators that exist on a pan-European basis:

1. **High share of energy expenditure in income (2M)** – part of population with share of energy expenditure in income >2x the national median. Source: HBS.

2. **Low share of energy expenditure in income (M/2)** – part of population whose absolute energy expenditure is <1/2 the national median. Source: HBS.

3. **Inability to keep home adequately warm (Keep warm)** – based on self-reported thermal discomfort. Source: SILC.

4. **Arrears on utility bills (Arrears)** – based on households' self-reported inability to pay utility bills on time in the last 12 months. Source: SILC.

These indicators were selected based on factors such as geographical and time series coverage, and relevance as proxies of energy poverty. However, it should be noted that a broad range of relevant indicators is available to stakeholders at the European level, covering themes such as housing quality, energy expenditure, household income and more. Rademaekers *et al.* (2016) provide a comprehensive list of primary and supporting indicators across Europe in their report for the European Commission. Furthermore, as can be seen across this report, a wider range of approaches has developed across Europe, sensitive to regional contexts, as well as to gender, climatic characteristics, and individual behaviour.

3. Emerging approaches

3.1 Innovative data sources: potential for big data and the Internet of Things (by João Pedro Gouveia and Pedro Palma)

Just as the number of different approaches to assess energy poverty at different levels and scales has increased in recent years, so too has the variety of datasets and data sources used to improve the quality of these assessments and refine the identification of vulnerable population. Big data could further improve data collection quality and mechanisms for energy poverty assessment (Hassani et al. 2019).

Energy poverty can be addressed and analyzed through a diversity of indicators, e.g. climatic, energy consumption related, building stock characteristics, social and economic determinants. As it pertains to the approaches that rely on building stock energy performance indicators, several authors (e.g., Gouveia et al. 2019) have generally based their approach on the use of national statistics on building characteristics, collected in the context of national census or other periodic official surveys or studies. Other authors are starting to resort to different building data sources such as energy performance certificates (EPC), either directly using their classes as a proxy of building energy performance (Fabbri 2015) or using the EPC raw data in their methodology to identify representative building typologies and estimate energy poverty vulnerability (Horta et al 2019). EPCs provide buildings data that are more detailed and often more updated than national building statistics, thus improving the quality of building stock characterization, and subsequently, energy poverty assessment. Heating and cooling degree-days are the most commonly used climate indicators in energy poverty studies (cf. Llera-Sastresa et al. 2017). Data stemming from modelled future climate scenarios is likely to be utilized to estimate future vulnerability to energy poverty in further studies.

Smart meters registries are another source of increasingly available data that can assume a relevant role in energy poverty assessment studies, particularly since the roll-out of this type of equipment is underway across Europe in line with EU legislation. Several authors have used smart meters to study electricity consumption patterns and consumer profiles, as well as their determinants (e.g., Seo and Hong 2014). The information and insights that can be obtain from this data are starting to be analyzed through the lens of energy vulnerability and energy poverty allowing us to understand different levels of consumption and its daily and seasonal patterns (e.g., Gouveia et al.

2018). As smart meter data becomes more available, and since energy consumption is an important and widely used indicator to assess energy poverty, it is expected that we will see more frequent integration of this kind of data in assessment studies, offering a greater level of detail and resolution compared to energy consumption statistics at larger scale. ICT and IoT are also tools already being applied to study, manage and predict building occupants' patterns of behaviour relating to energy consumption. IoT and ICT devices can provide useful updatable data on building energy management and future energy needs that could subsequently support energy poverty studies, and be particularly significant to policy-making on the issue.

Non-scientific and non-governmental organizations, such as civil societies, activists and even the general population, are also an important emerging source of data for future energy poverty studies. These groups often collect data and perform studies that can be useful to understand local realities, analyze different particularities and perspectives, or to fill gaps in the available statistics. This source of unconventional data, frequently referred as citizen science, despite not always complying with random sampling and statistical representativeness criteria, has potential to add new relevant information to the energy poverty landscape

3.2 Assessing the safeguarding of vulnerable consumers at risk of disconnection (by Audrey Dobbins)

Households across the EU are increasingly struggling to meet their basic energy needs due to increasing energy prices, and sometimes inefficient buildings and appliances (Pye et al. 2015). Those factors can lead to energy poverty and sometimes disconnection to electricity and heating provision. With the recent efforts to progress the European energy transition, the liberalised market system increasingly rules the way retailers and consumers interact with each other. Regulated prices and energy subsidies to households are being gradually removed in all EU countries. An open energy market has advantages in terms of competition and overall costs; however it might risk leaving behind some of the most vulnerable consumers. European legislation outlines protective measures for supporting vulnerable energy consumers to avoid energy disconnections in the EU. However this hinges on the way member states define vulnerable consumers as these will be the consumers qualifying for protection, but it also requires the active participation of energy suppliers to provide support to households and in particular to offer debt advice and payment plans (European Commission 2019).

Disconnection rates and procedures for electricity and gas differ substantially across member states, partly due to differences in economic situation, but also to large difference in measures applied to protect consumers from disconnections. Figure 1 shows, where data is reported, the share of population with electricity and gas disconnections together with the share of population in arrears on utility bills (CEER 2017, ACER/CEER 2018, Eurostat 2016). While there is no direct relationship between the share of population in arrears on utility bills and the share of disconnections, comparing this can give an indication of the overall economic situation of households and compare the potential effectiveness protective measures may have in mitigating energy disconnections. Portugal, Cyprus, Italy and Greece feature the highest shares of electricity disconnections and corresponding arrears on utility bills, followed by Spain, Poland and Slovakia. The UK, Belgium, Luxembourg and Ireland report lower shares of customers disconnected, but also exhibit higher incidences of pre-paid meters. Energy supply disconnections can be used as leverage against consumers to pay outstanding debts. Most member states have legislated procedures to disconnect consumers ensuring a notice of disconnection before the disconnection takes place, varying from two to 200 working days (Dobbins et al. 2016). The impact of the notification period is that consumers would then ideally have adequate time to make use of protective measures in place to negotiate payment plans, get budget advice or advocate for support.

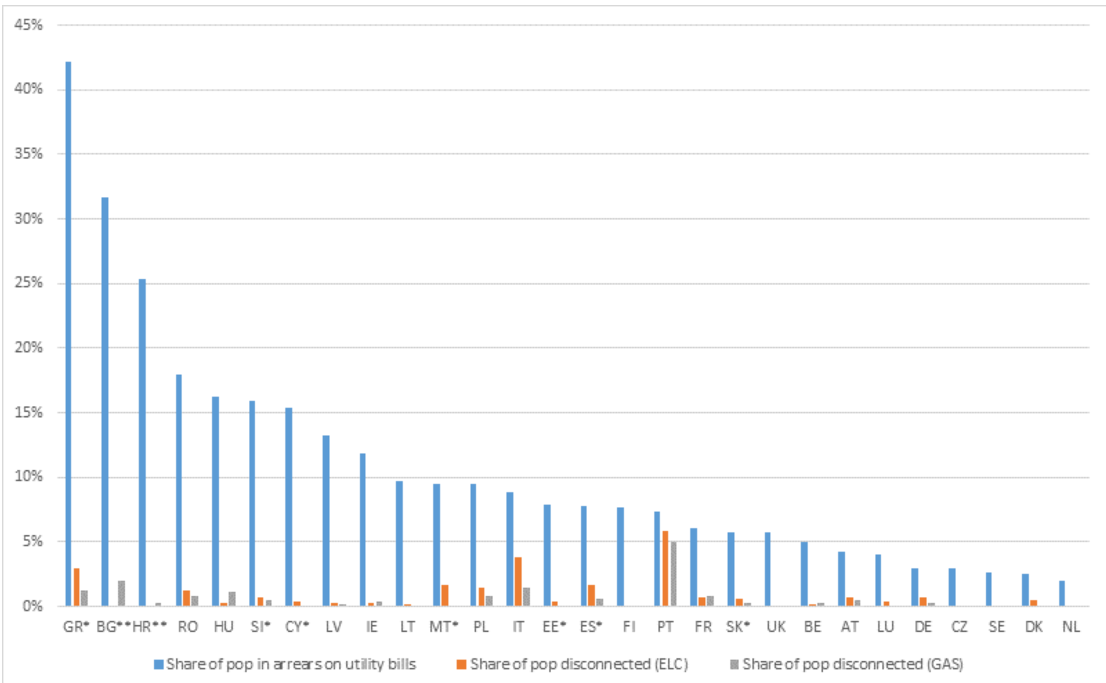

Figure 1: Share of population disconnected from gas and electricity (2016) and in arrears on utility bills (2016). Sources: CEER 2017, ACER/CEER 2018,

EUROSTAT 2016, own calculations. * Data reported for 2015 and 2017, so the value given here is interpolated. ** Data only reported for 2017.

The majority of member states have implemented a range of disconnection safeguards, including:

- Disconnection prohibition (10 member states provide seasonal or consumer group specific prohibition on either electricity, gas or both)
- Debt management (18 member states allow for payment plans, delayed payment responsibility or financial grants to assist with costs, or include the instalment of prepaid meters to manage debt);
- And/or customer engagement (15 member states ensure suppliers actively engage with consumers about the reason for non-payment before the disconnection takes place).

However, the complementarity of the protective measures is not always captured through the implementation, e.g., offering an extended notification period in conjunction with debt counselling or consumer engagement. The role of legislation around protective measures should provide a basis for facilitating the energy welfare of consumers, especially vulnerable consumers, and are a crucial foundation of support to households. How vulnerable consumers are defined will be critical to enabling adequate protection is made available to those who really need it (Dobbins et al 2019).

3.3 Visualising energy poverty: Geographical Information Systems and open mapping (by Ioanna Kyprianou)

Geographic information systems (GIS) are regularly used in research because they offer compelling visual output. One map can contain multiple layers of data and statistical enquiries, allowing researchers to convey their messages in a vivid manner, unburdening of copious analyses and processes. One of the most commonplace limitations of research is the unavailability of high quality temporal and spatial data. Open source databases are crucial and that is why, in the field of energy poverty, the European Energy Poverty Observatory (EPOV) constitutes a major accomplishment of the EU, disseminating knowledge and resources to the wider public. Another framework of particular note is the Nomenclature of Territorial Units of Statistics (NUTS) system, which in many occasions has allowed in-depth analysis of energy vulnerabilities in regional studies. It has also been employed in national studies presenting demographic and statistical information. This system was launched in the 1970s and serves as a geographic basis for investigations in a variety of subjects. There are three tiers of administrative units, based on demographic thresholds. NUTS 1 includes all areas with populations between 3 and 7 million, NUTS 2 contains “provinces” between 800,000 and 3 million, and NUTS 3 refers to smaller departments ranging from 150,000 to 800,000 in population. Adopting NUTS therefore ensures some level of harmonised statistical information. That is possibly its most attractive feature, rendering it suitable for use in a range of studies.

In the field of energy, these include exploring the potential of biomass towards electricity production, developing roadmaps towards achieving the EU 2020 goals in shares of renewable energy and greenhouse gas reduction and investigating the carbon footprints of EU regions (Ivanova et al. 2017). Furthermore, the NUTS system was used to identify strategic regional hotspots of excess heat in Europe, examining the potential for large-scale implementation of district heating. Additionally, area-specific human poverty has been estimated by constructing a composite index using different indicators available at that level (Węziak-Białowolska 2015). In another recent study, Chaton and Lacroix (2018) examined the fuel poverty trap in France and employed the NUTS classification to investigate multiple aspects related to dwellings. A multitude of studies have dealt with the energy potential of buildings. GIS applications serve a variety of topics, whether that relates to renewable resources, energy retrofits or socioeconomic issues. Datasets available freely and based on NUTS regions in Europe allow for regional dimensions across this range of topics and in various EU member states, while ensuring statistical uniformity.

Nevertheless, its most attractive feature renders the NUTS system unsuitable for a different array of cases. The EU includes countries of different demographic and territorial scales. From France, which covers almost 650,000km^2, with more than 67 million in population, to Cyprus, with a total land cover of less than 6,000km^2 and its population not yet reaching 1 million, the range is highly contrasting. Due to its small scale, Cyprus is represented by a single NUTS category, for all levels of classification. Data therefore exists only at the national level – something that contradicts the purpose of the different NUTS levels. In essence, this results in a lack of differentiation among the distinct climatic regions of the island, and disregards the urban-rural dichotomy. While the limitations of the NUTS system are clearly illustrated in this case, it does not mean that such discrepancies are lacking in other member states. The limits of statistical significance that are already in place cannot possibly reflect the variance encountered in countries where climatic and demographic conditions fluctuate drastically.

A composite indicator can be constructed to examine specific aspects of energy poverty. For instance, the sub-population exposed to risk of poverty and social exclusion can be weighted and combined with the sub-population with severe material deprivation to produce a single visual output that conveys a multitude of messages, as in Figure 2. Whereas monetary poverty is related to energy poverty, severe material deprivation includes nine categories of unaffordability; including paying rent, mortgage or utility bills, and keeping the home adequately warm, factors that are often directly related to energy poverty. Creating a time series for such maps for multiple countries could reveal comparative national spatio-temporal patterns of vulnerability. Such information would inform policy strategies in different territories and enable assessments of interventions.

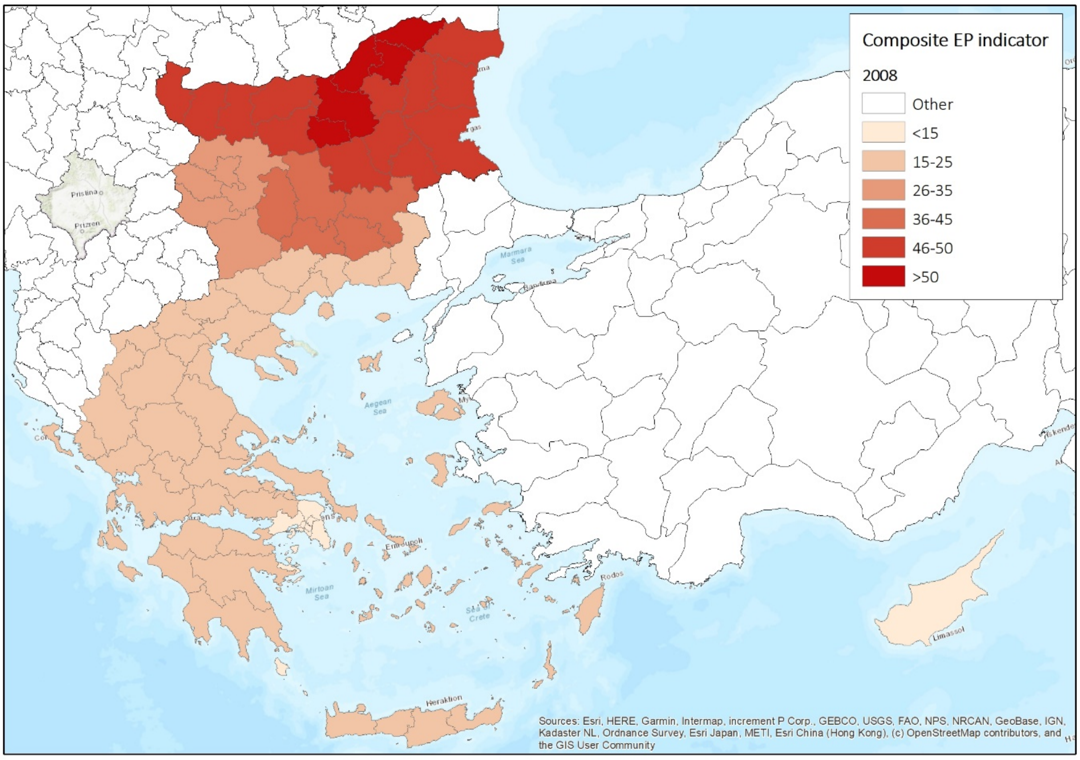

Figure 2. Spatial vulnerabilities in Bulgaria, Greece and Cyprus using a composite indicator. Source: Eurostat, created with ArcMap 10.3.

The lack of detailed databases in small-scale member states renders their position disadvantaged. Moreover, available information comes with limitations: underlying map data may only be fully available at relatively aggregate scales, like NUTS 3 rather than NUTS 2, and lead to inconsistencies of subdivisions. Despite these limitations of data consistency and applicability across EU member states, mapping open source data through GIS approaches renders scientific output accessible to a range of stakeholders. It can furnish evidence that generates awareness for the wider public on urgent matters by appealing to their sense of belonging in a geographic landscape of vulnerability. Compelling visualisation of evidence can shape policy and inform action at multiple scales.

3.4 Monitoring energy poverty through the lived experience (by Lucie Middlemiss)

There is a growing trend in understanding energy poverty through the lived experience: through the lives of the people who experience it every day (Middlemiss and Gillard, 2015). Lived experience research uses qualitative methods, often interviews, and documents people's experiences in the face of reduced access to energy services. It offers insights into how people learn to cope with this reduced access, what kinds of trade-offs they make, how different policies impact on their lives, and how their experience is affected by intersecting challenges. For researchers working in this space, the lived experience is a key site for monitoring this problem: it is the only place where the full effects of diverse policies that impact on energy poverty can be seen. It also offers unique opportunities for policymakers: to understand the unintended consequences of (energy) policy and other forms of intervention.

The monitoring of the lived experience is grounded in a systemic understanding of energy poverty: one which sees energy poverty as being affected by a range of drivers, outcomes and potential solutions, which are interconnected, and which form a web of causation that incorporates feedback loops, unintended consequences, and multiplier effects between variables (Middlemiss, 2019, Middlemiss et al., 2019). A systemic understanding also recognises that energy poverty is produced by the ways in which energy, welfare, housing, employment and health systems function: people's experiences vary in different locations and times as a result, and policy across these systems has, as yet, poorly understood, impacts on the energy poor. By talking to people about their experiences of energy poverty in the home, we get a sense of the way in which these are shaped: by their relationships with family and friends, their treatment by the property owner, the specific failures of insulation or energy efficiency, and the challenges they face in switching supplier. These interactions often change our perceptions of how and why people act as they do, and result in us finding different policy solutions to energy poverty problems.

To give an example: many policy initiatives around the energy market focus on informing people about how they can switch supplier. The assumption here is that people do not understand how to act (insufficient information), or perhaps that people cannot be bothered to act in their own interest: that there are barriers to them acting rationally in this market. When we talk to people in detail about this, we find that the energy poor are acutely aware of how much energy costs, to the extent that they can tell us the price of running one washing machine cycle, for instance. Their resistance to switching is not always rational (they do not understand), indeed, for those that have the IT skills, more often than not it is relational: it is based on their previous experiences with the energy provider, the level of trust they have in the supplier, friends and families experiences with switching, and the perceived risk this entails. Once we understand this, we can see why informing people about the possibility of switching is unlikely to have a substantial impact. An alternative approach would involve approaching people through trusted intermediaries to give them the confidence to switch supplier. Or, more radically, to create markets which do not require people to switch to get the best price.

Lived experience research is mainly undertaken by academics. The logical extension of this work is to involve people experiencing energy poverty in designing and monitoring policy. This could include talking to people experiencing energy poverty about specific policies before implementation (something that is being done in Scotland), and there is potential for effective ways of engaging the energy poor in policy design. After policy is implemented, there are also opportunities: given the lived experience is a site in which we can closely monitor the effects of policy on households. There is potential for government to monitor policy in the lived experience directly: by setting up qualitative panel studies, with a cohort of households selected for diversity, and undertaking longitudinal interview processes to understand policy impacts over time. There may also be the possibility to use such work as a means of monitoring poverty more generally – to share the costs of such monitoring between departments.

4. Policy levers for EP governance

4.1 Global and European policy levers for energy poverty governance overview (by Caitlin Robinson, Tareq Abuhamed and Raúl Castaño)

Global energy poverty frameworks

Domestic energy-related inequalities share a common feature: an inability to access the energy that is compatible with a decent standard of living (Bazilian and Pielke, 2013). An increasing number of global, trans-national and regional policy-frameworks have been developed to understand domestic energy-related inequality, including most prominently the concepts of energy poverty and energy access.

Energy poverty: Widely used in many global contexts (Simcock et al. 2017; Li et al. 2014), the concept of energy poverty is closely aligned with poverty and deprivation debates. Energy poverty draws attention to the negative outcomes that being without sufficient energy services can have for a person's health and wellbeing.

Energy access: Especially common in debates in the so-called Global South, energy access focuses upon new energy-related infrastructures and the ways in which they can increase access to energy (Bhattacharyya, 2012), including for example rural electrification through extensions of grid network and the introduction of modern, less-polluting cooking fuels (Singh, et al. 2015).

European policy action and legislation

Despite significant support from civil society, academia, and various policy institutions for a common definition of energy poverty across the EU, this element of the European Commission's recent legislative proposal for a Clean Energy Package for All Europeans was rejected during trilogue negotiations with the European Council and the European Parliament. As such, there is no official definition of energy poverty in the EU. At the national-level, only the UK, Slovakia, Ireland, Cyprus, France, and more recently Spain, have an official definition of energy poverty. However, the final Clean Energy Package - consisting of various directives to enhance the EU transition toward the use of cleaner energy and reduction of greenhouse gas emissions – does represent a significant step forward for governing and reducing energy poverty. This energy rulebook seeks to not only bring benefits from an economic and environmental perspective, but also from a consumer perspective. In this respect, the Clean Energy Package obligates European countries to recognise the prevalence of energy poverty and define a set of measures to address this issue, leading to different implications of each directive.

Electricity market design: This requires electricity markets to adapt to changing realities and in-build more flexibility for customers. In this respect, energy suppliers should notify vulnerable users who have accumulated debt about alternatives to disconnections, which include financial support, payment plans, debt management, and even a disconnection moratorium without extra costs.

Energy efficiency: Member states are obligated to develop their energy-efficiency policies from the perspective of households in energy poverty and social housing. This establishes energy poverty alleviation as a priority. Energy efficiency should be considered a priority in investment decisions on energy infrastructures, mobilising investments, removing barriers and facilitating access to the most affordable and low-carbon energy services for all people, including the most vulnerable. Furthermore, users are to be provided assistance in reducing energy use and improving the efficiency of appliances, combined with the availability of low-carbon transport modes integrated with public transport and cycling.

Energy performance in buildings: Each member state is required to include relevant national actions that contribute to the alleviation of energy poverty in their long-term building renovation strategies; greater energy efficiency leads to savings for users of buildings. In this respect, clear guidelines are to be provided and equal access to funding promoted for retrofitting buildings. To this end, energy poverty measures that identify vulnerable people and assess the effectiveness of proposed energy policies must be developed.

Governance regulation: In their integrated national energy and climate progress report, member states are required to include: (a) information on mechanisms and progress to reduce the number of energy poor households; and (b) quantitative information on the number of affected households and, where available, on policies and measures to address energy poverty. The European Commission will share qualitative and quantitative data with the EU Energy Poverty Observatory to monitor the effectiveness of these policies and develop new ones.

Renewable energy – Energy communities: Member states are required to address the accessibility of renewables for all final users, including those in low-income or otherwise vulnerable households. In this respect, financial mechanisms to guarantee that energy poor households can cover the costs of building retrofits to install renewable energy systems is to be defined.

Overall, the Clean Energy Package can thus be considered a tool to empower and protect vulnerable consumers, subject to meaningful implementation by member states.

In what ways can Europe leverage and contribute towards global policy-frameworks?

Embedded within global policy-frameworks: Energy poverty and energy access are uniquely global issues that cannot be separated from wider global markets, trends and histories. Growing global recognition of these issues is evident in the United Nations Sustainable Development Goal of ensuring everyone has access to "Affordable and clean energy" by 2030. It is therefore important to consider the ways in which European energy-related policies can be embedded within, and learn from, these global frameworks. One of the key strengths of these global debates is the way in which they begin to highlight the role of structural inequalities in energy poverty and energy access, including unequal processes of globalisation, urbanization, colonialism and patriarchy.

Developing locally-specific measurement approaches: Whilst overarching global frameworks are useful for elevating the issue onto international policy agendas, policy-makers tackling energy poverty in Europe should also continue to adopt different ways of defining and measuring the phenomenon in specific local contexts. This is due to the lack of a universal definition of energy poverty and energy access, the wide range of geographically-specific drivers, and the difference in data availability and collection. The gathering of context-specific disaggregated data should be encouraged across European member states to inform such locally-specific understandings (Broto et al. 2017).

4.2 Energy poverty in National Energy and Climate Plans (by Ana Stojilovska)

As part of the above-mentioned Clean Energy Package, member states are required to produce National Energy and Climate Plans (NECPs) to report on the five dimensions of the Energy Union – namely energy security, the internal energy market, energy efficiency, decarbonisation of the economy, and research, innovation and competitiveness. Objectives to address energy poverty come under the section on the internal energy market. To represent countries with both high (Bulgaria, Croatia, Ireland and Hungary) and low levels of energy poverty (Austria, Finland, Denmark and the Netherlands), eight member states are discussed briefly. This characterisation is based on the literature about the prevalence of energy poverty in the EU, which states that Southern and Central Eastern Europe (Bouzarovski 2014; Bouzarovski and Tirado Herrero 2015; Thomson and Snell 2013) and Ireland and the UK (Bouzarovski 2014) are more affected than Western and Northern Europe (Bouzarovski and Tirado Herrero 2015). This section analyses the energy poverty related content of the draft NECPs submitted by each member state in early 2019. The aim is to see if the degree of relevance of energy poverty alleviation policies in a country is related with its prevalence of energy poverty. The treatment includes consideration of three categories: definition, indicators or study/programme/strategy on energy poverty; energy poverty consideration in the context of the energy transition and climate change policies; and the type of measures to address energy poverty.

Definition, indicators or study/programme/strategy: Some countries with lower energy poverty have defined it, assessed its size and conducted studies on it, such as Austria (Government of Austria 2018) and Finland. Among countries with a higher incidence of energy poverty, Bulgaria lacks a definition, whereas Ireland has a strategy to combat energy poverty (Government of Ireland 2018) and Croatia has a programme for energy poverty reduction. Austria, with a lower share of energy poverty, has considered social affordability to be an integral part of its climate and energy strategy (Government of Austria 2018).

Situating energy poverty within energy policies: Among countries with high energy poverty rates, Ireland plans to integrate actions to combat energy poverty with decarbonisation and renewable energy support schemes (Government of Ireland 2018). Bulgaria, which is still in the process of electricity market liberalisation, plans to protect vulnerable users by ensuring year-round cover for minimum electricity needs other than heating needs.

Types of measures to address energy poverty: Among countries with lower rates of energy poverty, energy poverty is treated as part of their general social policy, as in Finland, the Netherlands and Denmark, but also in Bulgaria. In Hungary, energy use comes within the scope of universal services through fixed universal service tariffs since the early 2010s. Austria, Denmark, Finland, Croatia and Ireland envisage combating energy poverty through energy efficiency. Austria and Bulgaria combine the subject/income or profile-based and object/property-based support in some measures (Government of Austria 2018).

This analysis does not show any clear lines of division between countries with high and low levels of energy poverty in their efforts to define it, ways of measuring it, and its linking with climate and energy plans. Countries with high and low energy poverty rates alike have diverse measures to combat energy poverty. Thus, countries with higher energy poverty rates do not necessarily have more developed energy poverty programmes than those with lower rates.

5. Major/urgent gaps

5.1 Gender-disaggregated data (by Carmen Sánchez-Guevara and Ana Sanz Fernández)

The relationship between poverty and women has a long story in economics, social and gender studies, where one can discern the so-called 'feminisation of poverty'. With increasing interest and a number of studies on energy poverty in recent years, gender perspectives are starting to be addressed through analyses of the *feminisation of energy poverty* (Clancy and Feenstra 2019).

Some of these studies point out strong limitations in current statistics to evaluate the condition of women, which is a crucial gap given gender inequality related to who experiences energy poverty (Pijuan 2017). The use of households as the reference element or unit of measurement for poverty, inequality and home economics conceals gender inequalities within this unit. In most countries, women tend to be responsible for caregiving tasks and have higher rates of unemployment or part-time jobs (CEDAW 2014). This makes them spend more hours at home. They are therefore exposed to inadequate temperatures when a household experiences energy poverty. Current statistics do not represent these intra-household inequalities in time spent at home and in paid-hour conditions for women, which impedes analysis of the genderisation of energy poverty. Notably, households led by women can be characterised by using data regarding the gender of the main breadwinner (Sánchez-Guevara et al 2019).

In order to effectively address the *feminisation of energy poverty*, it should be analysed not only in households headed by women but in all types of households. This might allow the assessment of intra-household inequalities that affect women and make them more prone to experience energy poverty. For this purpose, disaggregated data regarding topics such as employment situation, income level, caregiving responsibilities and time spent at home by different household members should be included in official statistical sources. In addition to broader knowledge of energy poverty, a relevant outcome of this approach would be an improvement in gender mainstreaming in public policies.

5.2 Preemptive disaster-resilience citizen-centric services (by Carmen Sánchez-Guevara and Miguel Núñez-Peiró)

Climate change is recognised as one of the main challenges cities must face. Projections for Europe for the end of the 21st century foresee temperatures to warm substantially. Heat waves are expected to increase in frequency and duration, and cold temperature extremes are expected to change in frequency and spatial distribution.

72% of the EU-28's population live in urban areas and 41% live in cities. In these densely populated areas, temperature rise are exacerbated by the urban heat island effect, leading to warmer temperatures in city centres (Sanchez-Guevara et al. 2019). Energy poor households will have to cope not only with cold season but with an increase in summer severity. Mediterranean and Southern European households are already facing summer energy poverty conditions, and their circumstances are expected to worsen (Thomson et al. 2019).

Pre-emptive resilience plans thus need to be designed and implemented. Energy poverty interventions have traditionally coped with heating demand aspects and the lack of adequate temperatures during winter. However, cooling strategies must be put into action. Increasing the use of air conditioning may be protective during heat waves, but it is a maladaptive strategy in the long run. The challenge is to keep indoor temperatures low in the most efficient and passive way rather than increasing cooling energy consumption.

While cold temperatures can be fought by means of housing insulation, maintaining lower indoor temperatures during hot spells is closely linked with the surrounding micro-climatic outdoor conditions and the need for a cold source, such as in cooling through night-time ventilation. Thus, housing interventions must be coordinated with urban adaptation and mitigation strategies, such as greening streets and using urban surfaces with lower absorption capacity. Housing interventions should acquire such perspectives, as potential benefits can be obtained by greening rooftops or patios (Sánchez and Reames 2019). Other urgent experiences, such as cooling centres, have already been implemented to reduce the impact of heat events in cities, with uneven results. Here, community-based initiatives, such as building storey and block captains, or intergenerational exchanges, could play an important role by providing social support and citizen-centric perspectives (Sampson et al. 2013).

5.3 Complaint service metrics (by Marine Cornelis, Christian Gill and Naomi Creutzfeldt)

Analysing consumer complaints is one of the best ways to monitor a given market and assess any innovation to identify and address its shortcomings. Trust in the energy sector is low in all European countries (European Commission 2018). This translates into a higher proportion of disputes and higher detriment score on the Consumer Markets Scoreboards. Data collected by energy consumer dispute-resolution services and ombudsmen[2] confirm these trends: overall, in Europe, most registered complaints are related to invoicing and billing, followed by metering and meter-related issues. Complaints related to payment problems and commercial practices are on the rise, as are misleading and unfair practices in doorstep-selling, especially in France and Belgium.

These data suggest a strong correlation with the (financial) well-being of the people, their energy expenditures and behaviour. Bills are a direct tool for companies to communicate with their customers, and therefore the primary way for citizens to engage with their energy consumption. It is thus critical to design and present billing information to users in user-friendly ways.

The number of consumer complaints received by regulatory authorities, suppliers, distributors or other entities (such as ombudsmen) in electricity and gas continues to vary enormously across member states. This is mainly due to differences in handling and reporting procedures in member states, without prejudice to the quality standards for the service.[3]

Research on users of alternative dispute resolution (ADR) uncovered that a typical complainant is male, middle-aged, white (according to the UK statistics) and educated.[4] This is the same demographic that arguably has access to, and can confidently navigate, the legal system. What about others whom ADR is also supposed to help – those who are vulnerable, those who have trouble understanding the system, and those who are excluded from knowing where to turn for help? This is a massive gap that ADR does not cover enough at present.

The ESRC Just Energy project (http://esrcjustenergy.wordpress.com) investigates if and how vulnerable and energy-poor people access justice. Focused on ADR in EU member states as a means of helping users resolve their issues with businesses, it has found that vulnerable and energy poor consumers do not access ADR. One of the reasons is that the problems they

[2] http://www.neon-ombudsman.org
[3] https://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/MMR%202017%20-%20CONSUMER%20PROTECTION.pdf
[4] https://www.law.ox.ac.uk/sites/files/oxlaw/uk_report_final.pdf

face start much before a complaint can be made to an ADR provider. Support (access to information, advice, support) is usually provided by local and non-governmental organisations, and community initiatives.

As an illustrative example, 'Ombudsman Services: Energy' (OSE) is the UK's energy ombudsman. It deals with complaints from consumers who remain dissatisfied after complaining to their energy supplier. In 2018, it received 108,349 contacts, of which 45,667 were complaints. 50% of complaints fell outside OSE's term of reference. The top 3 subjects of complaints were billing (59%), service quality (9%), and contract issues (9%). Ofgem (the UK energy regulator) requires energy suppliers to report complaints information quarterly in a standard format. In quarter 2 of 2019, the UK's six large energy firms received an average of 2023 complaints per 100,000 customers. As an example, the top 5 subjects of complaints received by British Gas in that quarter were: billing (21%), payments (21%), customer service (16%), metering (13%), and communication (6%). According to a survey of complaint handling commissioned by Ofgem in 2018, 30% of complaints to energy suppliers were made by consumers identified as being in vulnerable circumstances. Ombudsman Services Consumer Action Monitor Report 2019 noted that 70% of vulnerable consumers were suffering in silence rather than complaining (compared to 47% of the rest of the population). Vulnerable consumers do not know where to begin the complaint process (compared to 44% of the rest of the population).

According to the Institute of Customer Service, 74.3% of consumers in 2018 were satisfied with their energy supplier, with 12.7% experiencing a problem. Utility providers have one of the lowest overall rates of customer satisfaction (coming penultimate out of 13 industry sectors). Gaps in relation to complaints data include: limited demographic information on those who raise complaints; lack of detailed reporting on the subject matter of complaints; and lack of information regarding the impact of poor energy supplier performance on fuel poverty.

5.4 Transport energy poverty: Prospects and pitfalls of expanding energy poverty beyond the household (by Giulio Mattioli and Mari Martiskainen)

Early approaches to energy poverty (or 'fuel poverty') had a relatively narrow focus on the definition of a single empirical indicator (e.g., Boardman's ten per cent of household income fuel spending ratio) and on a limited set of factors that influence affordability (i.e., the 'triad' of income, prices and energy efficiency). Over time, though, research in this area has moved towards a broader conceptualisation of energy poverty as a multidimensional phenomenon, to be apprehended with a variety of methods (including qualitative) and indicators.

Within transport studies, the tradition of research on 'transport poverty' has somehow followed the opposite trajectory. Perhaps because of the complexities associated with the topic, transport poverty research has traditionally emphasised the multi-faceted, multi-scalar nature of the problem, and the need for empirical and measurement approaches that are equally varied and diverse. It is only more recently that quantitative indicators for the measurement of transport energy affordability have been proposed, sometimes adapting metrics developed in research on domestic energy poverty.

Current energy poverty definitions and metrics focus overwhelmingly on energy service consumption within the home. This reflects the origins of energy poverty as a sectoral issue but has led to an overlooking of similar problems in the transport sector. In 2016, transport (both freight and passenger) accounted for 33% of final energy consumption in the EU-28[5] (as compared to 26% for households), and for 79% of petroleum consumption. It also accounted for 13% of EU household expenditure in 2017 (second only to housing),[6] with values of over 10% in 27 member states. The average share of household expenditure on the 'operation of personal transport equipment' is higher than that on 'electricity, gas and other fuels' within the home in the EU-28 (6.5% vs. 3.9%) as well as in most member states. A considerable amount of research demonstrates the essential role of transport for access to essential services and opportunities (such as employment) and thus for well-being, social inclusion and human need satisfaction. Currently, however, France is the only member state with an official indicator of 'transport energy poverty' – and estimates its incidence at 10.2% of households (vs. 14.6% for domestic EP)[7].

Expanding the scope of energy poverty to include transport might be perceived as a challenge by thematic researchers and practitioners with a background in the housing sector. It could also be argued that it risks making the energy poverty agenda less focused, and could result in more comprehensive but less clear concepts and measurement approaches. There are indeed key conceptual and practical differences between domestic and transport energy consumption, with important implications for how to

[5] https://www.eea.europa.eu/data-and-maps/indicators/final-energy-consumption-by-sector-9/assessment-4
[6] https://ec.europa.eu/eurostat/statistics-explained/index.php/Household_consumption_by_purpose
[7] http://www.donnees.statistiques.developpement-durable.gouv.fr/lesessentiels/indicateurs/e36.html

conceptualise, measure and tackle transport energy poverty (for a fuller discussion, see Mattioli et al. 2017).

We would argue, however, that these concerns are more than outweighed by the risk of continued neglect of transport issues – in particular as we move towards more electrified transport systems. Energy poverty indicators based on the French *Phébus* survey suggest that transport energy poverty affects a greater number of households (21%) than domestic EP (18%) (Berry 2018). Events such as the 2018-2019 Yellow Vests movement in France, and their resonance abroad, show that issues of transport affordability loom large in the public debate in the EU. Given that climate mitigation measures, such as carbon pricing, impact energy costs on both transport and the domestic side, it seems ill-advised to limit ourselves to measuring energy poverty in a single sector. Also, in household daily life, expenditures on transport and domestic energy are traded off against each other, and there is evidence of a 'double vulnerability' phenomenon, whereby, e.g., high expenditure on motor fuel can lead households to restrain their consumption of domestic energy. From a policy perspective, an exclusive focus on domestic energy poverty might have perverse or self-defeating effects, such as the development of energy-efficient housing in car-dependent areas.

In terms of measurement, crude approaches such as merely adding together household expenditure on domestic and transport energy into a metric of 'overall' cost burden must be avoided, as they may obscure more than they reveal. A step-wise approach should be adopted instead: i) develop distinct (sets of) transport energy poverty indicators that are informed by the state-of-the-art of domestic energy poverty measurement, but consider the specificity of transport; ii) collect the information required for domestic and transport energy poverty indicators, whenever possible with the same instruments (e.g. with bespoke surveys such as the French *Phébus* survey, or through the inclusion of ad-hoc modules in future waves of EU-SILC); iii) investigate the overlaps and trade-offs between the two types of energy poverty (e.g. issues of 'double vulnerability'). A number of studies carried out in France (and to a lesser extent, the UK) in recent years can provide a blueprint here. Some of these issues will be explored further in the upcoming research project 'Fuel and transport poverty in the UK's energy transition' (FAIR - https://www.creds.ac.uk/fair/).

The transport energy poverty indicators proposed in EU-based studies can be classed in three categories: (i) adaptations of existing domestic energy poverty indicators for use in the transport sector; (ii) composite indicators to capture the multidimensionality of transport energy poverty, including indicators of vulnerability to fuel price increases based on exposure, sensitivity and adaptive capacity; and (iii) 'forced car ownership' indicators to identify households who own and use cars despite being in poverty or deprivation. Other distinctions that can be made relate to whether the indicators are based on survey, census or modelled data (or combinations thereof); and whether the unit of analysis is households/individuals and/or spatial units, or member states.

When measuring transport energy poverty, there are some important issues and potential risks to keep in mind:

1. 'Transport poverty' is broader than transport energy poverty: not all transport poverty problems have energy implications (see Lucas et al., 2016).
2. Transport energy poverty is multidimensional – so it would be ill advised to suggest that it could be measured with a single indicator. When a single metric is used or proposed, it is important to be clear about which aspects of it are covered and which are not.
3. 'Car dependence' (i.e. the forced reliance on cars for daily mobility) is key to understanding transport energy poverty – so indicators should assess this aspect either directly or indirectly (see e.g. Berry et al., 2016; Berry 2018).
4. Not all affordability problems have to do with the car, so the affordability of public transport must be assessed as well (see OpenExp, 2019). Expensive public transport can be a factor in pushing low-income households towards 'forced car ownership', which leaves them more vulnerable to fuel price increases. However, the relationship between energy costs and public transport costs is less straightforward.
5. The issue of transport energy poverty among higher income households needs to be approached with care. On the one hand, household transport expenditure is less regressively distributed than domestic energy expenditure. This makes it important to deliberately exclude higher income households from transport energy poverty definitions (see Mattioli et al., 2017). On the other hand, there may be real issues of *vulnerability* to fuel price increases for middle-higher income households/areas due to high cost burden of fuel, ownership of inefficient, larger vehicles and lack of modal alternatives (Berry, 2018).

6. Conclusion (by the editors)

Entering 2020, Europe is poised at a definitive moment for advancing energy poverty metrics. Up until recently, most member states lacked recognition that energy poverty must be measured through context-specific indicators, and lacked metrics to robustly capture its multidimensional nature. These states have begun to demonstrate an appetite to leverage existing metrics and innovate new ones, thus the stock-take offered by this report takes on momentous importance. Practitioners and researchers must now address the lacunae left by various path dependencies in energy sector metrics. This entails both monitoring under-attended aspects of energy poverty like complaint service metrics and transport energy poverty, and also aspects that are harder to capture through indicators, such as gender-disaggregated data and preemptive resilience.

Policy and regulatory support by governments at multiple scales can render data collection efforts particularly meaningful by incorporating attention to energy poverty into the modalities of multiple sectors. Thus, cross-sectoral coordination will be key going forward, as we see new energy sources and patterns of demand linked with heating and cooling services and electricity. Energy transitions come with new geographies of energy, and a focus on monitoring energy poverty can help hold the energy futures that these low-carbon energy transitions aim to create accountable to socially equitable outcomes. Hence it is particularly significant that the National Energy and Climate Plans of member states diverge in their degree and manner of attending to (and to a limited extent measuring) energy poverty and integrating it with systemic shifts to low-carbon energy systems.

Greater coherence at disaggregated scales is desirable. For instance, this means harnessing what regulations at building and block level can yield in terms of increased energy efficiency, and simultaneously expanding the ability to monitor aspects of energy poverty through smart meters and building energy certification schemes. At the regional scale, systematic open source mapping of building energy potential can enable identification of retrofitting needs and renewable energy capacity. It can also democratise knowledge and better involve citizens in planning and monitoring, helping target vulnerable users.

A vital point is that the measurement of energy poverty can be characterised by overlapping domains of authority and control over infrastructure, including data infrastructure. Hence, data are selectively available to certain actors in specific forms based on particular decisions. For example, data on disconnection events, when prominently publicised, can draw attention to energy poverty as a phenomenon, as can very low energy efficiency of buildings in poor residential neighbourhoods. Yet these data rarely find their way into systematic statistics and energy poverty metrics. This situation has begun to change due to the efforts of actors at multiple scales, including the local and urban, besides the traditional more aggregate scales such as the regional and national. Policymakers and service providers must recognise the role of diverse actors in measuring energy poverty, and proactively facilitate access and seek to harness their insights and inputs. Responsive regulations can be attentive to such opportunities and institutionalise such requirements. They can thus empower a wide range of actors who are positioned to assist in procuring and processing metrics on vulnerable energy users at disaggregated scales down to households.

We conclude with an overall observation: there is reason to take heart as we progress on measuring energy poverty in multi-dimensional, contextualised ways. These efforts equip us to tackle this issue at suitable scales in a timely and customised manner. Yet there is a continuing and urgent need to advance emerging efforts along discrete lines as briefly laid out in this report, and elaborated in a rich body of emerging applied scholarship. These efforts require a range of actors – service providers, applied researchers, policymakers and citizen groups – to take distinct responsibilities, as outlined in this report. Together, we can transcend the state-of-the-art on energy poverty metrics!

Table 1. Prioritisation and key takeaways

For energy service providers	**For researchers**
Continue integrating smart metering and Internet of Things for direct measurement of energy poverty.	Recognise the lived experience as a key site for understanding and monitoring varieties of energy poverty.
Collect better quality information on disconnections to address large gaps in data reporting on electricity and gas disconnections.	Look beyond national statistics and official surveys, with greater utilisation of alternative sources such as Energy Performance Certificates raw data.
Show leadership by creating ethical codes of conduct that safeguard user rights such as data access and use.	Address energy poverty in relation to cross-sectoral and multi-scalar issues like low-carbon energy transitions.

For policymakers	For citizen groups
Ensure definitions of vulnerable consumers are adequate to enact effective protective measures.	Demand and engage with citizen science initiatives to generate new knowledge and inform energy policies.
Move towards gender mainstreaming in energy policies by providing gender-disaggregated data.	Seek out opportunities to involve the people who experience energy poverty in policy design and monitoring.
Establish new data instruments to address key gaps in provision, such as qualitative panel studies to monitor the lived experience of energy poverty.	Identify and document instances of energy poverty in various forms and hold local political representatives accountable to address these issues.

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