EnergyMeasures

Tailored measures supporting energy vulnerable households

D1.1

Review of Methods of Identifying Energy Poor Households

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About EnergyMeasures

EnergyMEASURES is working to address energy poverty in seven European countries, namely: Belgium, Bulgaria, Ireland, Netherlands, North Macedonia, Poland and the United Kingdom. The project comprises two complementary and synergistic strands of work.

The first strand involves working with energy poor households to improve their energy efficiency through a combination of low-cost measures, and changes in energy-related behaviours and practices. Recruited householders will be provided with low-cost energy measures and empowered to change their energy-related behaviours and practices through an approach that takes account of existing housing conditions and is reflective of their lived experience.

The second strand comprises working with municipalities, energy authorities, housing associations and other relevant actors to assess how current multi-level institutional contexts affect efforts to alleviate energy vulnerability in the participating countries. This knowledge will be used to develop and support the implementation of policy and practice measures which will address structural issues that combine to trap households in energy poverty.

Through this work the project contributes to reducing participants' vulnerability to energy poverty, while at the same time cutting household energy consumption and associated GHG emissions.

For more information see **http://www.energymeasures.eu**

Description of the deliverable and its purpose

This deliverable explores the range of methods forwarded for the identification of energy poor households across Europe. The report examines a number of approaches to the measurement of energy poverty, including indicators of energy poverty and so-called supporting indicators. While a great deal of effort is expended on analysing energy poverty at the macro-, or the meso-, level there remains a gap in our collective understanding of how best to identify and engage with energy poor households at the local level. It explores approaches to identifying energy poor households, considering practices reported in literature, those used in cognate projects, and the experiences of some practitioners active 'in the field'.

Glossary

DoA	Description of Action
EP	Energy Poverty
EPOV	EU Energy Poverty Observatory
EU-SILC	European Union Statistics on Income and Living Conditions
hEP	Hidden energy poverty
LIHC	Low income, high costs
mEP	Measured energy poverty
WHO	World Health Organisation
WP	Work Package

1 Introduction

Energy poverty is a condition predicated upon a combination of high energy prices, low household incomes, inefficient buildings and appliances, and specific household energy needs (Bouzarovski, 2014). While income level is an important factor, not all those who suffer from monetary poverty are energy poor and indeed not all those in energy poverty are necessarily income poor[1,2] (Palmer, Macinnes and Kenqay, 2008). Energy poor households are faced with the choice of using an above-average portion of their income on heat, light, cooling, cooking and appliance use; or going without these essentials, resulting in a cold and uncomfortable home and reduced living standards. The consequences include significant deteriorations in people's physical health and mental well-being, along with premature death related to severe winter conditions, as well as more restricted lifestyles and social exclusion (Thomson, Snell and Liddell, 2016).

Dubois (2012, p. 107) rightly observes that difficulties in identifying those suffering from energy poverty can be a '*major obstacle to an efficient implementation of fuel poverty policies'*. However, the variable causes of energy poverty[3] mean the identification of energy poor households is very challenging. Baker (2011, p. 15), for example, suggests that '(i)t is not possible to identify individual fuel poor households without obtaining information on both their income and housing circumstances'. The overarching objective of the EnergyMeasures project is engage with, and assist energy poor households. It is no surprise then that identifying energy poor households is a key element of the project.

The first work package of the project is designed to undertake the planning and preparatory work required for the project's activities, including the multi-stakeholder engagement to assess and improve the institutional context, and for the household level engagements of targeted segments of energy poor. In this context, Task 1.1 aimed to explore the most appropriate methods to be used for identifying energy poor households for the planned engagements. The task constituted a review of current best practice, academic discourse and new thinking, from *e.g.,* the European Energy Poverty Observatory (EPOV), as a means of identifying potential methods for use in the different locations[4]. This deliverable represents the outcome of this work, and comprises a review of identification methods for energy poor households – which is of such relevance to realising the EnergyMeasures' objectives.

There are five sections in this report, this first section offers an introduction and background to the report. The second comprises a brief treatment of the issue of energy poverty providing context to the report. The third section examines a number of approaches to the measurement of energy poverty, including indicators of energy poverty and so-called supporting indicators. The next section comprises the focus of the report looking at approaches to identifying energy poor households – this fourth section considers practices reported in literature, explores practices used in cognate projects, and engaging practitioners to present

[1] Palmer, MacInnes and Kenway (2008) note that rising energy costs weaken the link between energy poverty and income poverty

[2] Castaño-Rosa, Solís-Guzmán and Marrero (2020) also observe that there is not a direct link between energy poverty and the energy (in)efficiency of buildings - further emphasising the multi-dimensional nature of the phenomenon.

[3] including *e.g.,* low income, poor quality of housing stock, social contexts, market conditions and individual financial circumstances

[4] Within Task 2.2, different candidate methods will be tried by the partners based on local specificities (and considering the reality of the Covid-19 pandemic on the ground in the different partner locations).

some 'thoughts from the field' on the subject. The final section considers some lessons taken from the identification methods review and draws conclusions pertinent to the realisation of EnergyMeasures.

2 Energy Poverty

Energy Poverty is typically described as a 'a situation where individuals or households are not able to adequately heat or provide other required energy services in their homes at affordable cost' (Pye *et al.*, 2015). Brenda Boardman's (2010) explanation of a decade ago summarises the condition quite well: describing it as where households have insufficient income to meet the most basic levels of energy needed to provide home heating, lighting, cooking and appliance use. Healy (2003) distinguishes between energy poverty and general economic poverty, or 'income poverty', and argues that while income poverty can be overcome with income support that energy poverty also requires addressing the energy efficiency of buildings. It is only relatively recently that there has been mainstream acceptance of this distinction[5], and by extension of the need for different responses. Indeed, Bouzarovski (2014, p. 277) suggests that the initial acknowledgement (within the UK) of energy poverty – fuel poverty as it was then referred[6,7,8] – as a distinct phenomenon in academic and policy-discourse was a 'pioneering achievement'[9].

Healy (2003, p. 2) suggests that '(f)uel poverty is caused by a complex interaction between low income and domestic energy inefficiency' (Healy, 2003: 2). Similarly, Thomson, Snell and Liddell (2016, p. 5) observe that energy poverty is often caused by a combination of poor building fabric (and inefficient equipment), high energy costs, and low household income. Pachauri and Spreng (2011, p. 7499) concur noting the complexity of energy poverty factors '… *including lack of physical availability of certain energy types, lack of income and high costs associated with using energy, among others*.' Interestingly, considering the focus of EnergyMeasures on energy-related behaviour and practices, Thomson and Bouzarocski (2018, p. 6) see 'the manner in which energy is used in the home also playing a role' in energy poverty.

Energy poverty can manifest in a number of ways '… *from excessive energy expenses, which can result in energy debts or to the reduction of other budgets like the food budget, to a rationing of energy consumption and cold homes, with possible effects on health, quality of life and on the quality of buildings*' (Dubois, 2012, p. 107). Appreciating the multi-faceted and complex nature of energy poverty is key to understanding the problem and working towards addressing it. Income support, usually administered by means of social security mechanisms, has proven to effectively help alleviate income poverty. However, because domestic energy efficiency levels directly influence energy poverty (Healy and Clinch, 1999), resolving it requires a

[5] Bouzarovski (2014, p. 276) notes until recently '*(t)he United Kingdom and the Republic of Ireland were the only two EU states where the material existence and political voice of the 'fuel poor' were widely recognized in public debates, policies, and research*.'

[6] Thomson *et al.* (2016) observe that there is inconsistency in the use of the terms 'fuel poverty' and 'energy poverty' – while sometimes treated as quite distinct, they are increasingly seen as interchangeable terms describing the same phenomenon.

[7] This report takes the approach that the phrases 'fuel poverty' and 'energy poverty' can be used interchangeably, and agree with Bouzarovski and Petrova's (2015, p. 37) argument that the term '*fuel poverty incorrectly places an emphasis on the supply of energy carriers to the home'.* The term energy poverty has therefore been selected as the more appropriate term to use.

[8] Précarité énergétique (energy precariousness) being the preferred term in France.

[9] Following on the instrumental work of Boardman (1991)

more considered engagement involving improvements to the housing and changes in energy-related practices in addition to income support. The complex nature of addressing energy poverty is also highlighted by its intersection with concerns about climate change and energy security, which are indirect factors in the rise of energy poverty in the home, since efforts to move towards low carbon or domestically procured sources of energy supply may drive up the cost of services supplied to households (Bouzarovski, 2014, p. 277). In Europe, the problem is widespread, with (depending on the metric used) an estimated 50-125 million in energy poverty (BPIE, 2014).

There is, however, no doubt that energy poverty is on the agenda of the European Union, Sánchez-Guevara Sánchez *et al.*, (2020) report '*a growing interest in energy poverty within the European Union. Member States are being urged to establish energy poverty thresholds and improve living conditions in deprived households'.* The support on this topic is exemlified by the development of the ENGAGER Cost Action in 2017 and in particular the establishment of the EU Energy Poverty Observatory (EPOV) in 2018[10], which are seen as seminal moments for the advancement of a policy agenda addressing this societal challenge within the European Union (Middlemiss *et al.*, 2018). Moreover, this support is also demonstrated through the funding of multiple IEE/H2020 projects to address energy vulnerabaility (see *e.g.,* projects listed in Section 4.2), including of course EnergyMeasures.

A core part of the EnergyMeasures project is engaging with energy poor households, this involves working with them to devise an appropriate suite of low-cost measures to be deployed in their dwelling, and a behavior change plan tailored to the way they live their lives. Measuring the incidence of energy poverty, and identifying those suffering from it are of course key to the success of initiatives such as EnergyMeasures. The following section explores how energy poverty is measured, it looks at a number of different approaches, and discusses both direct indictors of energy poverty and supporting indicators.

3 Measuring energy poverty

Measuring energy poverty is not easy, Thomson, Bouzarovski and Snell (2017, p. 882) note '*(i)t is a private condition, being confined to the home, it varies over time and by place, and it is a multi-dimensional concept that is culturally sensitive*.' The most straightforward means of identifying energy poor would be through a comprehensive income, energy expenditure, and property assessment of all households, this would provide all the data required to measure level of energy poverty, appreciate its severity, and to identify individual energy poor houses for support. However, as Hills (2012, p. 70) observes such a programme '*would be prohibitively expensive – and intrusive – to carry out*'.

If it is accepted that not all households can be comprehensively assessed, determining the number of, and which type of, households fall within the established thresholds for energy poverty would in principle require 'a detailed household and building sample survey followed by sophisticated modelling work' (Hills, 2012, p. 70). However, the more detailed the survey, the higher the administrative burden. Dubois (2012, p. 108) notes the administrative overhead associated with precise targeting of energy poor households, and suggests 'targeting is a necessary step but, as it is also costly, being as precise as possible is not necessarily optimal'.

[10] EPOV is an initiative financed by the European Commission to help combat energy poverty, through improving the measuring, monitoring and sharing of knowledge and best practice on energy poverty. https://www.energypoverty.eu

Hills (2012) points out that many of those working to address energy poverty directly use less complicated proxy indicators to identify households that may be in need of assistance. The following two sections provide an overview of the indicators used for understanding the prevalence of energy poverty and the type of supporting indicators, which can help with prioritising support 'on the ground'.

3.1 Energy poverty indicators

Energy poverty may be measured in a number of different ways. Three principal methods are evidenced by the literature – these may be summarised as expenditure-based (absolute or relative energy expenditure thresholds); subjective-based (self-reporting of living conditions and financial distress); and needs-based (direct measurement of energy use compared to a set standard) measurements (Bouzarovski *et al.*, 2020; Thema and Vondung, 2020). Of these, metrics based on expenditure predominate[11], with relative thresholds used as proxies for energy deprivation (Waddams Price, Brazier and Wang, 2012, p. 35). Rademaekers *et al.,* (2014, p. 25) discuss three types of expenditure-based metrics for defining and measuring energy poverty, namely:

(i) high share of energy costs: proportion of income spent of energy above an established threshold *i.e.,* those who spend too much. The Belgium energy poverty barometer for example sets its threshold for measured energy poverty (mEP) at twice the median expenditure of equivalent households (Meyer *et al.*, 2018);

(ii) low income, high costs (LIHC): income after energy costs below established threshold, *i.e.,* high energy expenditure and/or insufficient income. Hill (2011, p. 9) for instance suggests that the LIHC threshold should be a combination of expenditure over the median level, and residual income less than official poverty line;

(iii) insufficient energy spending: absolute energy spending below established threshold *i.e.,* those who self-restrain, the hidden energy poverty (hEP). The threshold set for hEP in Belgium is set at half the median expenditure of equivalent households[12] (Meyer *et al.*, 2018).

The second, subjective approach is based on self-reporting of inability to heat one's home sufficiently (so-called 'consensual' data). Thomson and Snell (2014) suggest that such reporting is often more about the consequences of energy poverty, (*e.g.,* presence of damp, arrears), rather than the causes of energy poverty (*e.g.*, high costs, specific demands). However, they do agree that they provide '*an insight into the perceived affordability of heating homes across the EU*' (Thomson and Snell, 2013, p. 567). While such approaches are often criticised for their subjectivity and basis in householders' perceptions – it could be argued that this is exactly the point.

Arguably, expenditure-based measures and self-reporting of energy poverty do not distinguish those households that really need to consume the energy used (to provide for basic household needs) and those

[11] With the pre-eminence of expenditure-based measures is typically explained by the perceived superiority and objectivity of such data compared to self-reporting (Sareen et al., 2020)

[12] As Rademaekers *et al.* (2014, p. 50) note that absolute monetary expenditure must be used to measure hEP, rather than the proportion of income spent on energy – otherwise higher income households would inadvertently be classified as energy poor, having a (very) low share of income expended on energy.

that do not. This can be resolved by use of a needs-assessment modelling approach. The Irish Government's 2016 review of residential energy is an example of such an approach (SEAI, 2018, p. 37). Data from national household budget surveys and the official building energy rating database, were incorporated into a bespoke residential building stock model. This was used to compare household income to theoretical energy spend required to keep houses heated to WHO recommended norms. The emphasis is not on actual expenditure incurred, but rather on that expenditure that would be required to achieve acceptable levels of warmth.

Meyer *et al.,* (2018, p. 280) observe that there are '*people feeling energy poor who cannot be detected by neither (sic) forms of objective measurement*' (*i.e.,* measured energy poverty mEP or hidden energy poverty hEP), and argue that this demonstrates the value of subjective measurements of energy poverty. Fahmy *et al.* (2011, p. 4371) agree, noting that there is little overlap in households identified as energy poor using expenditure-based, subjective-based, or needs-based measurements, highlighting the advisability of using multiple complementary measures. Bouzarovski et al. (2020, p. 41) observe that '*Energy poverty is a culturally sensitive, multi-dimensional concept that varies over time and by place and is thus not easily captured by a single indicator'* and accordingly they advise using a suite of consensual and expenditure-based indicators, which they consider should be viewed and used in combination. Agreeing with the preference of using multiple energy poverty indicators, Sokołowski *et al.*, (2020) for example, forward a multidimensional energy poverty index – including both consensual and expenditure-based indicators – meeting two out of the index's five criteria[13] of energy deprivation indicates an energy poor dwelling.

Building on the work of Sareen *et al.,* (2020) the EU Energy Poverty Observatory (EPOV) selected four primary indicators of energy poverty as shown in Box 1 below.

1. **High share of energy expenditure in income** (2M) – those households with share of energy expenditure in income >2x the national median.
2. **Low share of energy expenditure in income** (M/2) – those households whose absolute energy expenditure is <1/2 the national median.
3. **Inability to keep home adequately warm** (Keep warm) – based on self-reported thermal discomfort.
4. **Arrears on utility bills** (Arrears) – based on households' self-reported inability to pay utility bills on time in the last 12 months.

Box 1: Primary indicators of energy poverty used by EU Energy Poverty Observatory (Bouzarovski *et al.*, 2020, p. 41)

3.2 Supporting indicators

Rademaekers *et al.* (2014, pp. 38–39) report that energy poverty indicators such as those discussed above are complemented by supporting indicators, which measure factors that contribute to the social experience of energy poverty. They suggest that such additional indicators enrich understandings of energy poverty and could help provide a focus for policy action. Hills (2012, p. 82) comments that '*(u)nderstanding the characteristics of fuel poor households is a first step to identifying them on the ground*'.

[13] Sokołowski *et al's*, (2020) index comprises five indicators of energy poverty: Two objective measures: Low income, high costs; high share of energy expenditure in income. Three self-reported measures: Inability to keep home adequately warm; presence of leaks, damp, or rot; difficulties in paying utility bills.

Examples of supporting indicators include:

- Demographic factors – households with vulnerable members *e.g.,* young children, elderly (especially those living alone), those with health issues, *etc*., are more energy vulnerable;
- Energy prices – differential pricing may apply in many cases (for reasons of *e.g.,* geography, bill arrears consumption level, service bundling) meaning that householders will not have equal access to tariffs;
- Income levels – lower income households are more likely to be energy poverty, no matter which way it is measured;
- Household composition – the make-up of the household may render it more susceptible to 'financial problems in general and energy poverty particularly' (Rademaekers *et al.*, 2014, p. 38);
- Heating system – what type and condition? inadequate and inefficient heating systems will provide poor heating at a higher cost;
- Supply choice – due to lack of choice (*e.g.,* due to geographical[14] and/or socio-political considerations[15]) or supply lock in (such as with district heating systems[16], or tenancy agreements);
- Building efficiency – age and technical characteristics of a building directly influence its energy performance, householders of poor performing buildings are inherently more prone to energy poverty;
- Level of social supports – the amount of social security support in a household is an indicator of its vulnerability to financial shocks, which could manifest itself as, or intensify existing, energy poverty;
- Tenure (and security of tenure) – Different forms of tenure (*e.g.,* ownership, long-term leasehold, monthly rental, *etc*.) are associated with varying levels of control and influence in decision-making and 'may limit the energy efficiency interventions and fuel switching measures' that can be implemented (Bouzarovski, 2014, p. 280).

3.3 Indicators or identifiers

Energy poverty indicators such as those discussed in Section 3.1 are essential to quantifying the amount of energy poor households, and helping to understand the depth of energy poverty which they endure. This information is essential to appropriately target policy measures ensuring their efficacy and efficiency in supporting energy poor households. While the collection and analysis of additional data would result in more precise modelling of energy poverty, a larger data set directly increases the administrative burden associated with the targeting. Indeed, Hills (2012, p. 71) commenting on the use of proxy indicators, argues against the

[14] The lack of choice in rural areas is well documented, where typically natural gas is not an option, there will likely be fewer electricity suppliers, and there will be a disproportionate dependence on fuel oil heating systems, or even solid fuels from a rather limited number of suppliers. This lack of choice can also be found in urban and peri-urban areas, where for legacy (often socio-economic) reasons, choice of energy sources and suppliers may also be restricted.
[15] Even when there are multiple energy suppliers, they may be equally available to all households. Requirements around a variety of issues (including: credit scores, minimum purchases, tenure status, contract length, payment methods, *etc.*) often combine to restrict actual choice for the less economically privileged.
[16] See *e.g.,* Bouzarovski *et al.,* (2016) examination of embeddedness of energy poverty in post-communist Hungary.

use of strict thresholds, the application of which he posits would do more harm than good, suggesting 'imprecision in targeting may be desirable rather than undesirable'[17].

The use of these indicators greatly contributes to understanding who are the people suffering from energy poverty, and the supporting indicators offer insight into the characteristics energy poor households are likely to exhibit. This enables targeting of policy measures to support the identified groups. In a lot of discourse, the use of these indicators for such targeting is conflated with the actual identification of energy poor households (*i.e.,* actual dwellings suffering energy poverty)[18]. Of course, if the available data was detailed enough, the use of such indicators could contribute to the identification of specific energy poor dwellings[19]. However, it should be remember that the adaption and use of indicators does not on its own constitute a method for identifying (specific) energy poor households. Dubois (2012, p. 108) suggests a systematic three-step model of addressing energy poverty involving targeting (of policy), identification (of households) and implementation (of policy). It is this identification stage that remains somewhat unclear.

The following section considers this identification of energy poor households, presenting practices reported in literature, explores practices used in cognate projects, and using dialogues with practitioners presents some 'thoughts from the field' on the subject.

4 Approaches to identify energy poor households

This section takes a three-fold approach to exploring methods for the identification of energy-poor households. The first part, Section 4.1, presents examples of practices founded in the literature and provides a number of insights into the discourse about energy poor identification. The second part, Section 4.2, looks at a selection of project funded under both the Intelligent Energy Europe and Horizon 2020 programmes. The review of these projects, many of which share at least some objectives with EnergyMeasures, offers some insights into innovation in the field and lessons which can be drawn from their experiences. The final part, Section 4.3, draws on the findings from structured dialogues conducted with practitioners in each of the participating countries.

4.1 Practices reported in literature

Much of the discourse surrounding the identification of energy poverty focuses on defining what constitutes energy poverty, describing the characteristics of energy poor households, and macro- and meso-level data collection and analysis for monitoring and benchmarking of energy poverty. This work lends itself to such development of new knowledge, that is of primary interest to researchers, and the research journals which publish their work. The mundane activities associated with identifying specific households that are actually

[17] Hills (2012, p. 73) makes the point that having households who are not strictly identified as energy poor eligible for policies is not '*not necessarily undesirable since eligibility criteria which include households on the margins of fuel poverty are still likely to help address the problem of fuel poverty in the long term, either by helping those households whose energy costs are just below the threshold and who may become fuel poor over time, or by helping those who are just above the income threshold but who are still facing high costs*.'

[18] Dubois (2012, p. 108) notes that the literature on poverty policy often makes no clear distinction between targeting (of policies), identification (of energy poor households) and implementation (of policy).

[19] Thomson, Bouzarovski and Snell (2017, p. 880) consider that 'local-level household identification for specific policy implementation … would require detailed micro-data at the lowest geographical level. '.

suffering from energy poverty are not seen as new or interesting, this work often goes unreported, with the emphasis in reports and publications on household level work focusing more on the actual engagement activities rather that the identification step. However, there is not a complete dearth of publications addressing local-level identification of households. This section presents a selection of energy poor household identification practices proposed or reported in the literature – with a representative example of literature presented for each approach identified.

Table 1: Examples of energy poor household identification reported in the literature

Approach to identification	Example from the literature
National level data analysis and extrapolation	Sokołowski *et al.* (2020), building on work of researchers in developing countries[20] propose a multidimensional index with five dimensions of energy deprivation: two objective indicators: low income and high costs; high actual cost; three subjective indicators: insufficient warmth; building faults; difficulties in paying. Households are defined as energy poor if they display at least two forms of deprivation. They posit 'measures which account for both monetary and non- monetary indicators are better than single monetary indicators' (2020, p. 93). Data is sourced from national household budget survey. *Key Attribute*s: Useful for targeting, monitoring and comparison.
National socio-demographic data and local housing datasets combined	Morrison and Shortt (2008) report a GIS-based modelling approach used to predict areas where energy poverty is likely to be more prevalent. The method combines census data with locally available information of housing to derive energy poverty risk scores. Specifically, it involves obtaining individual dwelling level data[21], from housing service datasets as a means of identifying physical risk factors for energy poverty. Information on the social risk factors are sourced for census output areas from the national census returns, with the resultant risk score feeding into the individual dwelling analysis. This approach enables energy poverty risk ratings to be mapped onto individual dwellings combining the dwelling-level physical data and area level social data. *Key Attributes*: Combines area-level social data, with individual level housing data
Small area-based targeting	Walker *et al.* (2012) developed a small area energy poverty risk index using a range of environmental and socio-economic variables. The analysis is conducted at the level of census output areas (OA) level, following Morrison and Shortt (2008) and Fahmy *et al.* (2011). The index considers

[20] *e.g.,* Bhatia and Angelou (2015), Nussbaumer, Bazilian, Modi and Yumkella (2011)
[21] Such as property type, tenure, construction year, heating type.

Approach to identification	Example from the literature
	a number of factors: heating burden[22], built environmental vulnerability[23] and social vulnerability (determined by dependence on social security). This analysis allows for the assessment of energy poverty risks for small areas, at reasonably detailed level *i.e., c.* 125 dwellings. The authors suggest identification efforts could be targeted in areas of high risk, with households in other areas encouraged to self-refer for support. *Key Attributes*: Energy poverty risk index determined for small areas
Zonal approach	Liddell, Morris, and Lagdon (2011) describe a zonal approach undertaken in Kirklees (pop. c. 400,000) in the UK. Kirkless is amongst the 25% most deprived local authority areas in England. The local council developed an initiative (Kirklees Warm Zone Project) that offered loft and cavity wall insulation free-of-charge for every suitable household in Kirklees. This approach was intended to encourage take-up and minimise administrative overheads. The developed 'Zip-Up Method' for implementation is seen as an exemplar for local authorities tackling energy poverty. *Key Attributes*: zonal deployment, available to all, no charge. This approach negates the need to identify specific households
Smart meter data coupled with surveys	Gouveia and Seixas (2016) discuss an approach which involve the combination of daily electricity consumption data from smart meters combined with 110-question surveys for a cohort of 265 households in Évora, Portugal. The analysis of the combined quantitative and qualitative data enabled the authors to distinguish different groups of consumers, which they describe as '*three main groups of consumers: fuel poverty, standard comfort, and "fat energy" households*'. While this approach is not scalable for mass identification of energy poor households, a variation of the approach may have a role couple with appropriate targeting. *Key Attributes*: developed knowledge supports the design of measures and instruments to address the needs of each identified group,
Via energy advice centres	Fischer *et al.,* (2014) describe the work of energy advisory centres, and their role in identifying energy poverty. These NGOs and public bodies engage directly with the public through telephone help lines, drop-in face-to-face 'surgeries' held in community spaces, *etc*. They provide free and

[22] Calculated using datasets on heating demand (degree-days) and fuel costs. Note: over three-quarters of homes in Northern Ireland use fuel oil as their heating source with big variations in costs across the region (Walker *et al.*, 2012)
[23] In the absence of sufficient data on energy efficiency, dwelling size (floor space) was used as a very broad proxy for energy efficiency as it often captures several energy poverty risk factors simultaneously (e.g. high heating demand, under-occupancy, and older dwellings).

Approach to identification	Example from the literature
	accessible advice on energy consumption and conservation. When energy poverty is evident or suspected they will refer them for further assessment and support (which may be to other within their organisations) *Key Attributes*: the accessible nature of these organisations mean that the barriers to engagement are low
Social service referrals	Scarpellini *et al.,* (2017) discuss how a case study in the region of Aragón, in northern Spain where social workers were equipped to identify energy poverty in the houses they visited as part of their everyday work. Moreover, they were specifically trained, and charged with 'certifying' such energy poverty enabling the households to access public supports. *Key Attributes*: leverages the public trust and household access of existing public service providers. This new role, complements the existing mission of the social workers.
Public health referrals	Mohan (2021) refers to the *Warmth and Wellbeing Scheme*[24], an Irish scheme, which aims to improve the living conditions of vulnerable people living with chronic respiratory conditions. This pilot government scheme operates in designated areas of Dublin, households with members with a respiratory condition < 12 years or > 55 years of age are referred to the scheme by the public Health Service Executive. Subject to eligibility criteria households receive extensive energy efficiency upgrades free of charge. *Key Attributes*: public health and energy poverty in a very concrete and beneficial way
Delegated approach using local actors	Dubois (2012) reports on the French programme *Habiter Mieux*, which operates at the department level involving a mix of centralisation and decentralisation of tasks. The determination and communication of the characteristics of energy poor dwellings is centralised, whereas the actual household identification is decentralised utilising a variety of local actors (*e.g.,* medical and social centres, home-help assistance, credit unions, firefighters, fuel suppliers) which use their local knowledge and contacts to reach out to, and identify, energy poor households

[24] See also the small 'Boiler on Prescription' scheme in Sunderland, UK run by Gentoo in collaboration with the National Health Service. Through this scheme family doctors could 'prescribe energy efficiency (e.g., double glazing, boilers and insulation) to patients with Chronic Obstructive Pulmonary Disease exacerbated by living in cold, damp homes' (Sareen et al., 2020).

Approach to identification	Example from the literature
	Key Attributes: Takes advantage of the strengths of both central administration (coordination and communication) and local actors (in actual identification and engagement of households)
Use billing relationship with customers combined with multiple other data sources	Spiliotis *et al*. (2020) forward a framework to support utilities to identify potentially energy poor households based on certain estimations. Their approach uses: (i) open source weather data to determine heating and cooling degree days; (ii) national building standards to estimate energy needs of 'reference' houses for an area; (iii) actual energy consumption of specific households derived from the utilities' own billing databases; and (iv) area-level average data from national statistics to estimate household income. Using this data, they apply two rules to identify energy poor households: those whose energy expenditure is above 10% of household income, or those consuming less energy than the relevant reference household. They suggest, notwithstanding the assumptions made in their framework, that their approach provides comparable results to previous studies using objective indicator data. *Key Attributes*: Leverages utilities' relationship with customers and access to billing information, combined with multiple other data sources, including *e.g.,* area-level social data, housing profiles, weather data

4.2 Practices used in cognate projects

The projects included in this section represent a cohort of action-orientated projects[25], addressing domestic energy use (typically but not always energy vulnerable householders). The review projects were funded under two European Commission sponsored programmes: Intelligent Energy Europe (2003-13) and Horizon 2020 (2013 to date). The projects were identified through the IEE project database[26] and H2020 project listings on CORDIS[27]. Documents available for each project were then sourced including *e.g.,* project reports, publicly available deliverables, website content, published articles, and other dissemination material. These materials were review in order to ascertain the means by which the project identified and recruited households to join their initiative. A summary of the findings from this review is include as Table 2 below.

Table 2: Recruitment practices of projects involved in household engagement on energy

Project & funding source	Recruitment practices & reference
POWERPOOR (2020-23) H2020-SC3-EC2-2019	- Newly commenced project

[25] Coordination and support actions (CSA) in Horizon 2020 parlance
[26] Intelligent Energy Europe Project Database https://ec.europa.eu/energy/intelligent/projects/
[27] CORDIS: Community Research and Development Information Service https://cordis.europa.eu

Project & funding source	Recruitment practices & reference
Mitigating household energy poverty	- Identify energy-poor areas or groups through analysis of information from municipalities & open source data. This will be supplemented through surveys, phone calls, & visits. PowerPoor (2020)
ENPOR (2020-23) H2020-SC3-EC2-2019 Mitigating household energy poverty	- Newly commenced project, with membership consisting of research institutions, energy agencies and property owners. - Household recruitment appears to be planned via stakeholder engagement with relevant actors organised in regional groups IEECP (2020)
ComAct (2020-23) H2020-SC3-EC2-2019 Mitigating household energy poverty	- Newly commenced project, many of the consortium members are housing associations or municipalities - Expected that recruitment of energy poor households will come from membership's own tenants
STEP (2019-22) H2020-SC3-EC2-2018 Mitigating household energy poverty	- Consortium members mainly comprise consumer organisations which provide consumer advice at national level; - Use existing channels to reach energy-poor consumers, partnering with consumer groups and frontline organisations STEP (2020)
EmpowerMed (2019-23) H2020-SC3-EC2-2018 Mitigating household energy poverty	- Partnership with municipalities and utilities (*e.g.,* Pijuan and Herrero, 2020) - Working with trusted third-parties *e.g.,* social workers, local associations, social landlords, charities, *etc*. (*e.g.,* Gérard, 2020; Tkalec and Živčič, 2020)
SocialWatt (2019-22) H2020-SC3-EC2-2018 Mitigating household energy poverty	- Consortium members comprise energy suppliers; - Project developing ICT tool to help utilities and energy suppliers efficiently identify energy poor households. SocialWatt (2020) (see also Spiliotis *et al.*, 2020 in previous section)
STEP-IN (2018-20) H2020-EE-06-2017 Engaging private consumers towards sustainable energy	- Partnerships with local stakeholder and schemes; - Energy cafés, with presentations on benefits of participation; - Social media, website, advertisements. McCall (2019)

Project & funding source	Recruitment practices & reference
ASSIST (2017-20) H2020-EE-06-2016 Engaging private consumers towards sustainable energy	- Partner with utility to reach consumers - distributing promotional leaflet via meter readers, emailing consumer energy savings tips; - Partner with social welfare centre & Environmental NGO to provide energy workshops specified for needs of vulnerable customers Maggiore and Realini (2020)
SAVES2 (2017-20) H2020-EE-06-2016 Engaging private consumers towards sustainable energy	- Working through student unions and accommodation providers; - Flyers, posters, pledges, photo competition; - Student ambassadors, with incentives for participation. NUS-UK (2017)
Smart-up (2015-18) H2020-EE-10-2014 Consumer engagement for sustainable energy	- Working though stakeholders who already had established relationships with vulnerable energy consumers *e.g.,* social work departments and housing associations - In some regions also engaged with other stakeholder, including: energy suppliers and energy distributors/network operators; advocacy and campaigning organisations; researchers; *etc.* SMART-UP Project (2018)
FIESTA (2014-17) IEE Energy Efficiency Consumer and Products	- Media contributions (TV, radio, press releases); - Prize draws (of energy efficient goods) for participants; - Working with relevant key social stakeholders. Starec and Tomasi (2017)
TRIME (2014-17) IEE Energy Efficiency Consumer and Products	- Use local knowledge (*e.g.,* social housing organisations) to select target neighbourhoods to benefit from energy savings support; - Contact as many residents as possible to generate awareness and identify interest, and recruit. - Use multiple contact modes: postcard, social media, email, text *etc*. TRIME project (2017)
REACH (2014-17) IEE Energy Efficiency Consumer behaviour	- Engagement with local actors; - Local promotion campaigns for households (involving the use of various communication tools, leaflets, placards, vouchers, *etc.*); - Direct referrals from social advisors. Živčić *et al.* (2017)

Project & funding source	Recruitment practices & reference
SPIRIT (2014-16) IEE Energy Efficiency Consumer Behaviour	- Using faith-based communities and the peer to peer support found in such communities - Leveraging the values of such faiths and linking to energy savings UCL Energy Institute (2016)
EC-LINC (2011-14) IEE Energy Efficiency Consumer Behaviour	- Press releases and promotional material in relevant languages (including in one case, target immigrant groups) - Working with co-operative building company - Through a network of local social and environmental groups and via energy advisors' networks; - Referral from third parties such as local authorities, housing associations and citizen advice bureaux. EC-Link Project (2014)
ACHIEVE (2011-14) IEE Energy Efficiency Consumer behaviour	- Focus groups of local actors such as local authorities, social housing providers, social welfare and charity organisations, energy agencies and services, schools, and households; - Using local civic groups such as welfare associations or other non-profit organisations from the social sector *e.g.,* debt advisory service, social stores, *etc*. Dünnhoff, Eisenmann and Schäferbarthold (2010)[28]

4.3 Thoughts from the field

A short structured-dialogue with researchers and practitioners was conducted amongst selected informants working in the participating countries[29]. All of the respondents have a track record in identifying and engaging with vulnerable consumers. These countries range across Europe and experience a broad variation in both seasonal extremes in climate, and the socio-economic, political and organisational structures to cope with the challenges posed by energy poverty within their boundaries. To overcome the challenges inherent in reaching the energy poor, many respondents reported adopting a mixed-methods approach to identifying and engaging energy vulnerable households that is very much practice-based. While a number would use data-driven analysis, especially when reporting on their activities, the task of identifying and recruiting energy poor households is usually achieved through a combination of activities set out in Table 3 below.

[28] Originally prepared by ifeu- Institut für Energie- und Umweltforschung Heidelberg GmbH and Caritasband Frankfurt e.V.on On behalf of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and the Hans Böckler Foundation. Translated and updated for the ACHIEVE project.

[29] Belgium, Bulgaria, Ireland, Netherlands, Poland, North Macedonia, and the United Kingdom

Table 3 Successful identifying and recruitment activities suggested by practitioners

Mode	Description of activity	Purpose	Target audience
Marketing and advertising	Press releases, articles, news features in local newspapers, radio, parish and/or community bulletin boards, branded vehicle *etc.*	Maintain presence in local community, branding, and the promotion of new or existing services being pushed by the organisation.	Older people with established, more traditional networks and who might not engage with newer media.
Social Media	Combination of new content and promoting marketing material featured in traditional media outlets.	Maintain presence in local community, promote new and existing services.	Younger people, smartphone users.
Outreach work	Services advertised (printed material and through staff) at an organisation's drop-in facility in the target community or at bespoke promotional events.	Raise profile with target community and 'piggyback' on other activities both inhouse and through partner organisations.	Householder who may self-identify as being energy poor. Those already using organisation's services, or partner organisation's services.
Word of mouth	*Ad hoc* campaigning strategy whereby staff inform their friend and family networks of a new/existing service.	Inform potential clients about specific activities or services being organised. Help to build trust through staff members.	Those who may already be aware of the organisation, its services or staff working for the organisation.
Collaborative projects with other NGOs, state bodies *etc.*	Partnership projects where two or more organisations share resources on a specific campaign or service provision.	Leverage resources of two or more organisations to maximise effective engagement in target community.	Usually, those already engaged with one or more of the organisations involved.
Referrals from social bodies	Direct & indirect referrals from social services, medical professionals, and charitable organisations.	Enables referring organisation to assist with a problem, which although outside of their remit, impinges on their clients' social, medical and financial wellbeing	Social service providers, medical practitioners and charity groups operating in relevant areas

In addition to the above-mentioned practice-based methods, some respondents also mentioned using mapping and engagement material generated from a number of European Horizon 2020, and older FP7, projects as part of their toolkit. While none specifically mentioned using any of the European or national datasets for identifying energy poor households, a reliance on self-generated data (either from insights gleaned from staff or from the technical equipment deployed during existing household engagement activities) was alluded to and seen as being particularly useful. A lack of familiarity with the four key indicators mentioned in Box 1 above[30], or possibly only having a tangential understanding of them, has resulted in many organisations tasked with addressing energy poverty having to rely on mixed-methods approaches. While this is not in and of itself a negative, it does leave gaps whereby those in most need of support may not necessarily get access or are made aware of supports, even when they are available. Also, all the activities in Table 3 above require certain levels of basic, digital, financial, and civic/social literacy on the part of the citizen that they may not actually possess.

To overcome such barriers, there is a growing tendency amongst actors working on energy poverty to do more collaborative work with other local and state actors who might share a common goal. An example shared by an energy charity, operating in a west European country, described working with another charity whose remit cover topics other than energy. Together, they co-devised a scheme whereby participants were given vouchers to top-up their pre-payment electricity meters. While these vouchers were only given to households that engaged with their services, participants received the vouchers as part of a wider package that included other supports such as food parcels. Households were identified through local partners, government agencies, general practitioners, health and addiction services *etc*. This collaborative initiative resulted in new synergies developing between the charities and government bodies involved resulting in participants being able to receive assistance from multiple organisations through referrals and cooperation.

A respondent from another western European country described work they are currently doing on communicating with households using home meters to measure temperature and humidity. This information is collected and relayed to the occupant with clear, simple instructions on how to respond to adverse changes in temperature and humidity, usually through manual ventilation by either opening or closing windows *etc*. The identification of energy poor households is carried out in partnership with other energy charities through work with individual landlords and landlord associations, rather than with tenants. This model sees the first conversation with the landlord being crucial to the success of all future engagements. In this instance, the landlord occupies a pivotal role. What is often seen as less productive are scenarios where the tenant initiates the process. Very often the relationship between landlord and tenant can already be strained and the task of encouraging a landlord to make energy-efficient investments may prove too difficult for some tenants. The issue of trust is also key here, with tenants fixating on the performance of the landlord and the landlord fixating on the performance of the tenant. By engaging directly with the landlord, the respondent found it easier to bypass potentially disruptive relationships between landlords and tenants, and in the process shift the focus onto the actual condition of the property. Also, it was accepted by many of the respondents that the general public had a rather mixed response to general communication activities. Therefore, adopting a more tailored approach was accepted by most as the better option. For example, approaching potential

[30] See Section 2.1

recruits to their services with the question "how can we help you?", instead of appealing to people to contribute to national carbon reduction targets that may appear removed or separate to people's everyday experiences, garnered a more positive response from existing and potential clients.

Other activities that were seen by respondents as producing little in the way of tangible results in terms of identification (and ultimately recruitment) included the more traditional media-related activities such as newspaper advertisements. Respondents were not able to link the publication of this type of material to any significant uptake in households presenting themselves to an advertised service. Also, communication that relied heavily on technical language, or information that was too detailed[31], was seen more often than not as counterproductive. Instead, focusing on the potential 'wins' for the household (*e.g.* lower energy bills, a more comfortable living space *etc.*) proved to be more useful in attracting and keeping energy poor households engaged.

Table 4 Less successful identifying and recruitment activities suggested by practitioners

Types of activities deemed counterproductive	Reasons given for poorly performing outcomes
Detailed information packs emphasising behavioural change without additional financial and/or technical supports.	Information that is too detailed is often ignored. Also, difficult to expect behavioural change around energy from those who often lack agency to instigate change in other aspects of their lives.
Appealing to the common good, or on environmental grounds[32].	Seen as condescending, especially when not backed up with additional financial and technical supports.
Aligning with energy actors who may not be as trusted by those in energy poverty	*e.g.* an energy charity worked with an energy supplier to engage with energy consumers in 'fuel debt'. Despite considerable time and resources put into the initiative from both partners, the response rate from consumers was 8%. This was seen as a very disappointing outcome by the energy charity[33].

Another issue raised by a majority of respondents concerned the indicators used to signify whether a household can be considered vulnerable to being 'energy poor'. A clearer approach to this at a European level, that also translate to fit local contexts, was seen by a number of respondents to be particularly helpful in planning for which social groups to target around the topic or energy poverty.

[31] Examples given included the socio-economic dimensions to energy poverty, the technical solutions focused on poorly performing buildings, or indeed discussions on climate change or decarbonisation.

[32] This, and the previous example, feed into what Mullally, Dunphy and O'Connor (2018) describe as a paternalistic perspective, which sees that armed with the 'correct' knowledge and given the 'facts', people will be 'persuaded' to change their behaviour. This approach ignores how behaviour is often locked into the socio-technical systems and normative practices that individual citizens have little agency to change.

[33] It is worth noting that perspectives differed between the energy supplier and the energy charity here. The energy supplier, who was used to even lower response rates from the same cohort of consumers, saw the collaboration as a success with responses up from 3% which they would normally get.

5 Conclusion

A great deal of effort in analysing energy poverty is carried out at the macro-, or the meso- level. This form of analysis provides valuable information on the extent and features of energy poverty in the focal area. Such analysis provides the basis for characterising the problem, targeting measures and initiatives to combat it, monitoring changes, and comparing with other areas. It is perhaps no surprise that this mining and analysis of different datasets is the dominant focus of literature addressing the identification and measurement of energy poverty. It is entirely natural therefore that those who have been engaged in such analysis would see the challenge of identifying specific individual energy poor households as a simple extension of the analysis to the micro-level. As shown in Section 4.1, this is reflected number of approaches identified in the literature, which involved: national level data analyses; combination of multiple datasets; use of both qualitative & quantitative data, *etc*. This analysis enables the measurement of energy poverty rates within an area, and (depending on available data) can also be used to produce risk indices and determine the energy poverty risk for specific houses, or at least small groups of houses.

There is however a gap between the macro- and meso-level analysis and the identification of specific energy poor households, which is required by actions like the EnergyMeasaures project. While a number of EU-funded project have taken a data orientated approach (*e.g.,* SocialWatt, POWERPOOR), it is interesting to note (see Section 4.2) that the vast bulk of such projects have focused on other methods. The approach adopted by these projects tends to reflect the strengths of the types of organisations involved in each project's consortium. Reviewing the list of practices used by projects similar to EnergyMeasures in Section 4.2, there are a number of potential approaches that could prove beneficial, depending on local context. In particular, the advantages of engaging with organisations already working with households likely to be in energy poverty seems self-evident, and offer synergies. While the examples from the literature included seeking referrals from social workers (Scarpellini *et al.*, 2017) and health professionals (Mohan, 2021), the experience from other project illustrate other potential collaborations including: *e.g.,* debt advisors, social stores, housing associations, advice bureaux, consumer groups, NGOs, municipalities & utilities.

The practitioners engaged in the structured dialogue suggest a number of approaches to reach out to energy vulnerable households, and to identify those in energy poverty. These included a bottom-up approach inviting self-referrals through marketing and advertising, social media engagement, outreach events and word of mouth. They recommend working with NGOs, state bodies, *etc.* to share resources on specific campaigns or service provision. Lastly, they spoke about seeking referrals from social service providers, charitable organisations and similar. The feedback from the practitioners was very much in line with the experiences of projects similar to EnergyMeasures, which is not too surprising as they are engaged in similar activities. While the review of the literature was quite informative, the true value from this exercise comes from the experiences of cognate projects and from practitioners active in the field. The practical approaches forwarded (in Sections 4.2 & 4.3) may not win awards for novelty (although it must be acknowledged that they have innovative elements), but they offer a tried and tested means of engaging energy poor households, and one which can be adopted by, and specified to meet the needs of, EnergyMeasures and similar actions.

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