



European Energy Poverty: Agenda Co-Creation and Knowledge Innovation (ENGAGER 2017-2021)

Case study: Innovation and energy poverty policies

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1. Introduction

Energy poverty is a major challenge that may affect between 50 and 125 million people across Europe (EPEE, 2009). It can be understood as the inability of households to access adequate energy services up to a socially and materially necessitated level (Bouzarovski and Petrova, 2015), and has negative impacts on their well-being, health and social integration. The formulation of the problem (then called “fuel poverty”) had its origin in the United Kingdom after the first oil crisis of the 70s. Energy was considered a basic need, along with food, clothing and decent housing (Bradshaw and Hutton, 1983). Since then awareness of the problem has been growing and concepts such as the “right to energy”, “energy democracy” or “energy justice” have been developed. Recognition of the problem has increased across Europe, and the issue has been identified as a policy priority by a number of EU institutions. In recent years, an intense work on the subject has been done: researchers from many different disciplines, policy makers, civil rights associations and many other agents have approached the problem from different points of view, and also from different geographic locations, enriching the debate and offering diverse strategies for alleviating energy poverty, as it has been documented by the EU Energy Poverty Observatory¹.

The diversity of approaches, policies and measures that have been developed allow learning from the experiences of others and creating synergies. However, existing strategies come with different scopes and approaches. On the one hand, the differences are due to different national or local contexts where both drivers of energy poverty as well as policy frameworks of welfare states differ. On the other hand, policies differ in respect to their innovativeness. This is problematic due to the complexity of drivers contributing to energy poverty, as well as the multiple manifestations of it, and its different impacts. Moreover, considering that energy poverty goes beyond the problem of social inequalities, and includes dimensions related to the production and consumption of energy, new approaches to address it are needed. This is even more so due to the urgent need of tackling the challenges of climate change and the transition to sustainable energy systems. Indeed, strategies for alleviating energy poverty must also be in tune with the need of transforming current energy systems towards reducing carbon emissions, improving energy efficiency, and ensuring the security of supply. This huge challenge calls for integrated approaches and innovative solutions.

This document aims at contributing to the reflection of innovativeness of policies to alleviate energy poverty by providing a review of the literature that identifies and summarizes novel approaches and measures currently being implemented. This review is thus meant to offer a contribution to knowledge on the state-of-the-art concerning policies to tackle energy poverty, as well as a contribution to knowledge exchange across different contexts and disciplines on the most advanced strategies and solutions. In order to accomplish this, the review initially searched documents on energy poverty focused on innovation, according to a set of criteria for the selection of these documents. Yet, since it was found that there is a lack of research on what can be considered innovative or not in tackling energy poverty, a second method to assess innovation concerning this topic was

¹ <https://www.energypoverty.eu/policies-measures>



employed. A short survey was conducted among the international network of experts related to this COST Action. Based on the results of this survey, which identified approximately 60 policies considered innovative by the experts, a procedure was developed to evaluate their characteristics. The outcome of this “innovation check” is a matrix that identifies the dimensions and sub-dimensions that are common to innovative policies to alleviate energy poverty.

This review is a first effort conducted by Working Group 4 “Innovation – Introducing path-breaking perspectives to the understanding of energy poverty” to contribute to an innovation check of existing strategies. Taking this initial review as a first step, a more developed analysis has been conducted by one of the authors, Anaïs Varo, as part of her Short Term Scientific Mission at Ecofys, the Netherlands, and will soon be published as a journal article.

The document starts by describing the method and criteria used to conduct the literature review. In the following section, the outcomes of the review are outlined. The criteria for the innovation assessment are then presented, followed by the results of this procedure.

2. Information source review methodology

2.1 Selection criteria

The undertaken literature review relies on the adoption of the following main selection criteria considering its scope and limitations: 1) recent publications reflecting the current status quo of the investigated phenomena, 2) publications focussing on the specific topic of innovation in energy poverty policies, 3) diversity of information sources – academic articles, EU Energy Poverty Observatory engine publications, BUILD UP The European Portal for Energy Efficiency in Buildings engine publications, relevant EU funded project outputs, and strategic EU documents. These criteria are also in accordance with the goal of this review to outline the most recent directions of policy innovation in tackling energy poverty in the EU as well as the policy gaps to be specifically addressed in order to give the ground in formulating the innovation assessment criteria and policy selection procedure of the policy innovation check undertaken by WG4.

2.2 Review criteria

As a next step it is necessary to define review criteria as a basis for the review methodology. The word “innovation” is seemingly everywhere in policy-analysis; it is often seen as a way of addressing pressing public policy challenges, and governments are increasingly turning to new policies. Yet amidst all this enthusiasm for innovation, there is only limited understanding of what makes a policy or measure to tackle energy poverty innovative. For the policies described it is therefore crucial to start from this very general point of view.

Based on the analysis carried out it can be stated that the policy described in the literature on energy poverty is considered to be innovative when it fulfils two basic criteria:

- The literature should describe policy solutions which contain a new idea/problem area, solution, device or method to tackle energy poverty.
- The literature should describe policy solutions which promise to push the status quo in a positive direction, e.g. it should consist of policies that are more effective in mitigating energy poverty than previous approaches.

The second criterion is considered to be an important conditionality from a policy-making perspective because a new innovative solution to mitigate energy poverty needs to effectively meet its goals.

2.3 Analytical criteria

Based on the previous general definition of an “innovative policy intervention” outlined in chapter 2.2, a more detailed list of criteria can be applied to characterise the literature on a policy/framework conditions related to energy poverty policy as innovative. In order to provide a stringent approach for the literature review, the analytical criteria are divided into two sub-categories:

Criteria regarding the content of the literature


- *Mode of action:* Does the literature deal with a single-targeted action (e.g. mitigating energy poverty) or has it multiple goals (e.g. reducing GHG-emissions and energy poverty, improving living environment, improving public health)?
- *Framing:* Does the literature recognise new ways of framing energy poor households (e.g. anticipating new definitions of vulnerability, recognising different needs of vulnerable groups, or considering a broader view of injustice)?
- *Targeting:* Does the literature target groups which have not been (adequately) addressed by previous energy poverty policies (e.g. elderly unemployed, low-income household which do not receive social benefits)?
- *Participatory aspects:* Does the literature anticipate new ways of civil-society engagement (e.g. bottom-up vs. top-down)?
- *Anticipatory aspects:* Does the literature mention policies or measures which by design anticipate (negative) side-effects and co-benefits which might emerge from the implementation?

Criteria regarding the framework conditions mentioned in the literature

- *Funding:* Is the funding of measures to tackle energy poverty in the literature innovative (e.g. a public-private partnership)?
- *Implementation:* Does the literature mention an innovative way for the implementation of the policy (e.g. multi-stage process, new actors involved)?
- *Evaluation:* Does the literature deal with conditions for an innovative evaluation (e.g. integrated evaluation)?

2.4 Comparative analysis method

In order to perform a systematic bibliographic analysis, the comparative analysis of the bibliography sources was based on a set of standardised criteria. The topic of innovation has not been a main subject in the energy poverty literature. Because of that, some tools are necessary to detect sources of academic literature, policy documents and project outputs connected and to distinguish their level of impact on this research area. Therefore, the comparative analysis is based on two main criteria. The first one is a narrative or conceptual criterion, connected to the notion about what the experts and researchers consider innovative, given the inexistence of a common definition. The criterion is the existence of key-words related to “innovation” and their definitions or conceptualization. The terms included in the search are, primarily the term of “innovation” and its derivatives, but also its synonyms, such as: change, novelty, newness, transformational, ground-breaking. The reason for using these terms as keywords is based



on the little specific literature and research on energy poverty innovative policies. Although there is research on new measures and innovative solutions for energy poverty related situations, there is not research on the specific conditions to consider innovative or not a measure, and the context-impact on the innovative processes itself. The second criterion is more operative and pragmatic. It consists in detecting illustrative examples and cases of innovation in policies to tackle energy poverty, in order to develop a categorisation of innovative policies in this field.

3. Results: the innovation assessment criteria

3.1 Clustering innovative policies

The literature review on innovation in tackling energy poverty reveals five main areas of policy intervention in which innovative actions, approaches and tools are further developed. The emphasis is on the impact of technological and social innovations for alleviating the energy poverty consequences and improving human well-being.


Energy efficiency measures - reducing energy demand and household expenditure

This review analyses a plethora of information sources which focus on policies tackling energy poverty by the intervention on energy efficiency of existing buildings in deprived neighbourhoods. In accordance with the current EU policy framework and the provisions of the Clean Energy Package for all Europeans (last amended in 2018) the efforts to define the key areas of possible innovative policy interventions in tackling energy poverty are related to (1) interventions to improve the energy efficiency of dwellings and (2) education of households on behavioural changes to reduce energy consumption. The emphasis is on the low-cost energy efficiency measures to low-income households and the longer term, higher cost energy efficiency measures including renovation of housing. Furthermore, it becomes crucial to identify the main groups of drivers and barriers for successful innovative policy schemes – involvement of key institutions, interaction with the wider policy framework, nature and type of funding sources, expertise and skills required, type of support provided, situational characteristics of the household and its members, and method through which measures are delivered (Gancheva et al., 2016; Ntouros, 2017).

Low cost energy efficiency measures and renovation of housing

The current situation reveals the continuous shift from policies relying on funding utility bills to long-term policies supporting tailored energy efficiency renovation programmes of the Member States in their efforts to tackle the energy poverty problems (Marian, 2017; Renovate Europe, 2017). The overall process is characterized by a variety of approaches and solutions available to tackle the renovation challenge in terms of scale, financing, addressing non-technical barriers, level of ambition or achievement of social objectives. Looking from technological innovation point of view, a variety of already successful building renovation approaches could inspire the future development of renovation policies to deliver CO₂ savings and cut energy wastage (BPIE, 2015).

Most low income households in Europe are living in low energy performance buildings. This means that vulnerable population is in urgent need of energy refurbishment. The improvement of thermal quality may decrease energy poverty through lower energy consumption and running cost of buildings (Kolokotsa and Santamouris, 2015). As stated by Papaglastra (2017) the energy building renovation, forming one of the main focus points of the Clean Energy Package for all Europeans (last amended in 2018), and also systematically addressed at policy level at the Concerted Action on Energy Performance of Buildings Directive (last amended in 2018) and the Concerted Action on the Energy Efficiency Directive (last amended in 2016) is seen as main long-term policy tool to reduce



fuel poverty and contribute to EU energy security. According to Vasilakopoulou and Papaglastra (2017) an important policy direction is to use the capacity of new technologies and materials in the energy retrofit and to make their application plausible and cost-effective.

The undertaken review supports the findings of Bouzarovski and Herrero (2016) that the traditional division of EU states into three clusters is increasingly replaced by a relatively well-off 'core' group of countries in Northern and Western Europe, and a heterogeneous energy poverty 'periphery' in the South and East. It is important to emphasise that this energy poverty 'periphery' is highly heterogeneous as current condition due to the different inherent driving factors. Bouzarovski and Herrero (2016) also outline that there are substantial differences among the individual Member States of the periphery and this is the reason to go beyond the binary distinction because the national, regional and local conditions are of higher importance in this more disadvantaged cluster of EU countries. In this context, the region of South-East Europe is particularly vulnerable to energy poverty as a result of inefficient and deteriorated housing stock with poor access to adequate energy services and inefficient housing appliances (Robić, 2016). In this regard, the emphasis on technology innovations and investments in the whole range of energy efficiency solutions, ranging from simple low-cost energy efficiency measures to full retrofitting of buildings and improvement of heating systems, are of utmost importance for shaping the innovative policies in alleviating all aspects of energy poverty in this region (BPIE, 2014).

An important direction for policy innovation is to maximize the public funding for energy savings by the development of sustainable energy financing models, energy performance contracting, assisting public fund managers with structuring and deployment of financial instruments and a template for increasing the share of financial instruments under the European Structural and Investment Funds. As Erhorn-Kluttig (2017) points out the aim is to stimulate energy building renovation, certification schemes, upskilling of construction sector workers on energy efficiency and renewable energy technologies including digital skills, advanced technological products and processes by the continued support of the contractual private partnership.

In this regard, the innovation for optimisation of available financial instruments to fight energy poverty becomes a high societal requirement within the concerted policy effort to alleviate energy poverty. According to Hiteva and Sovacool (2017) innovation on business models with an energy justice perspective is needed and policy interventions should focus on creating supportive conditions for local pro-justice energy companies. Financial support policies for retrofit measures need to shift from general subsidies to a specific and better balanced targeting on "poor homeowners" representing one of the most complex and difficult to deal with phenomenon especially in countries from the heterogeneous energy poverty 'periphery' with high rates of homeownership on housing. An innovative policy model is the *Warmer homes scheme Ireland*: free insulation for long-term homeowners who are in receipt of certain welfare payments, or have a respiratory disease, at no cost to the homeowner (Sustainable Energy Authority of Ireland, 2015). This nationwide scheme funds energy efficiency improvements to the homes of vulnerable people in, or at risk of, energy poverty.

Indoor ambient approach: better comfort, better health

It is believed that improvement of thermal quality of homes will have a serious impact on ameliorating health conditions of vulnerable population living in cold homes or suffering from overheating.

Concerning the living environment in winter conditions, research shows that housing quality is associated with a range of health and psychosocial outcomes and that provision of adequate, affordable warmth can lead to health improvements. The energy efficiency upgrades of obsolete buildings raise indoor air temperatures and help households to reduce their energy use. Poortinga et al. (2018) admit that the greatest increases in indoor air temperatures are found in buildings with the lowest energy performance ratings before the energy efficiency interventions. Indoor air temperatures increase most in the evening and at night, as well as in the living room and main bedroom, suggest that the energy refurbishment makes the biggest difference when spaces are in use.


Energy poor households, living in inefficient buildings, are more vulnerable to local and global climate change and are more affected by heat waves. In summer conditions, future energy demands for cooling will be dramatically increased and Urban Heat Island (positive thermal balance in the city) increases the urban ambient temperature. As a result, this phenomenon has serious effect on the energy demand for cooling and impact on peak the total electricity demand, and thus increasing energy cost. A decrease of the effectiveness of passive cooling techniques is also observed due to the climate change and the consequent increase of the number of warm nights in summer. Santamouris (2016) points out its direct impact on energy poor households lacking the financial capability to install efficient cooling facilities.

In terms of urban planning, innovation in research for “cooling the cities” focuses on urban green infrastructure for shadows and evaporative cooling (Moss et al., 2018; Saaroni et al., 2018). The “cool coatings” research is also increasing in both applied and fundamental science fields since their capacity to improve energy efficiency and indoor comfort is clearly stated (Pisello, 2017).

Socio-economic aspects

Policy innovation is aimed to reach additional socio-economic benefits. Such interventions deal with energy efficiency market stimulation, which impacts the creation of labour opportunities that can be achieved locally in deprived neighbourhood’s refurbishment. As a result, an increase of rehabilitated homes value is observed in parallel with improvements of the social status of deprived zones. As stated by Kerr et al. (2018) the increased home value is being included in “holistic narratives” of the research on the benefits of energy retrofit, and it is considered that it could help to improve the social condition of low income homes. In addition, Santamouris (2016) draws the conclusions that lower energy costs generate independence from energy assistance programs in these areas.

Hrovatin and Zoric (2018) analyse the building energy retrofit in Slovenia by econometric models, detecting drivers and barriers in a partial and integral approach. Results call for strengthening the financial incentives, informing and educating the public through various



information sources, combined with the redesign of public Energy Advisory Network to increase the reach of residential building energy-efficiency policies.


Skumatz (2015) points out that “hard to measure” non-Energy Benefits (NEB) are increasingly being assessed in order to evaluate effectiveness of investment in energy efficiency by incorporating not only participants, but also the utilities, and society as a whole, into benefit–cost tests. Integrated utilities of the user’s benefit in aspects such as comfort, health and savings have also been approached (Martín-Consuegra et al., 2015), together with the mismatch between the findings of NEB research and policy, by analysing the empirical basis of such research. Safety, human health, environmental health, and process streamlining elements are frequent by products of energy efficiency programs. Free and Felder (2017) emphasise the need to improve the definitions, attribution, and quantification of the benefits and costs due to both non-energy efficiency and energy efficiency measures, but such efforts should not hinder ongoing efforts to improve the safety and quality of life for low-income households.

New technologies in building energy efficiency applied to energy poverty

Technological axes of innovation policies on energy efficiency in buildings target (1) minimizing energy consumption, (2) clean and renewable supply and (3) smart management. According to Schleich, (2019) the incorporation of new technologies in energy poor households meets a barrier because the vulnerable population, falling into the lowest income quartile, exhibit lower adoption propensity for all technologies. In addition, Wurtz and Delinchant (2017) emphasise the role of new ITC technologies to develop high energy efficiency “smart building” integrated in urban smart grids. A social “human in the loop” approach is necessary in order to incorporate them in deprived quarters. In addition, the formation of “smart users” as active and involved stakeholders is highly needed. According to McCabe et al. (2018) the incorporation of renewable energies in vulnerable areas, the user interface and potential barriers to technology integration suggest that this emphasis reflects a broader trend in applying socio-technical approaches in the field of energy research. Particularly where user engagement is not carried out sufficiently, the community involvement must be addressed in order to mitigate barriers to energy provision for low-income groups.

Geissler (2017) points out an important innovative policy trend that focuses on the interrelation between energy demand and supply and the capacity of smart technologies to influence the decrease of energy demand with a positive impact on alleviating energy poverty. The emphasis is on the need to empower the vulnerable consumers in a smart meter world. As also shown by EU funded SMART-UP (2017) project implementation the aim is to increase the active and effective use of smart meters and in-home displays (where fitted) by vulnerable consumers, to encourage them to change their energy-related behaviours in response to improved feedback information, to enable vulnerable consumers to make significant energy savings, to reduce their fuel bills and seize further opportunities that may be offered by demand-response services.

As stipulated by Gouveia et al. (2018) smart meters, surveys and buildings energy simulation are being used to track fuel poverty. In addition, innovative big data analytics methodologies are being used for neighbourhood-scale information assessment on the



thermal performance of building envelopes (Martín-Consuegra et al., 2018). The development of innovative products such as Phase Change Materials, cool coatings, High performance HVAC systems, innovative “thin film” technology and integrated PV in building materials have been reported (Santamouris, 2016), but no evidence of any positive influence on energy poor households has been found in the reviewed literature. Romero Rodríguez et al., (2018) investigate the capacity of the use of the PV surplus electricity that improves the thermal comfort of the occupants and reduces the comfort differences among dwellings in social housing in Seville (Spain) showing unbearable temperatures all year round.


The review also emphasises on the assessment process of the ongoing policy implementation in tackling energy poverty. It becomes clear that shaping and implementing the national policies in alleviating the energy poverty goes together with serious effort to critically assess the current national initiatives to reduce energy poverty in Europe. The EU funded ASSIST2GETHER (2017) project presents an elaborated methodology for critical assessment relying on indicators such as (1) outlined policy proposals for a better protection of vulnerable consumers & against energy poverty, (2) involved consumers' engaging strategies, (3) stimulated energy saving behavioural change, (4) provided services for (vulnerable) consumers/fuel poor; established networking, (5) provided training for energy information and advising, and (6) researched vulnerable consumers and energy poverty. The project outputs focuses on the critical assessment of national initiatives to reduce energy poverty and draws the potential fields of innovation in tackling energy poverty in Europe.

New measures which affect the available income for energy-related household's expenses

Gancheva et al. (2016) emphasize the capacity of low-cost energy efficiency measures for low-income households to save heat energy, power and water, providing energy savings, and the importance of combining different measures, reflecting the diversity of energy efficiency needs. As the author points out, these measures would be funded with different schemes, which can vary from direct funding with grants to energy saving advice. Enhorn-Klutting (2017) points out the importance of public funding for energy savings, and specifically underscores that public funding should be maximised by the development of sustainable financing schemes (i.e. energy performance contracting, among others).

Grassroots innovation, social innovation and participatory approach

At this point, we highlight social innovation literature and their contribution to this field. As Oosterlynck, Kazepov and Novy (2015) point out, social innovation has been studied in a variety of fields, amongst others local development studies, urban studies and studies of labour organization (Moulaert et al., 2013). However, the studies on social innovation from within the field of social policy and welfare studies are still rather scarce. Oosterlynck, Kazepov and Novy (2015, p 5.) note the importance of social innovation understood as a ‘wave of initiatives, driven by civil society actors, social entrepreneurs and local governments that respond to unmet social needs in innovative ways’. Sabato, Vanhercke and Verschraegen (2015) analyse the evolution of the European Union instruments promoting social innovation, and especially, how they are framed in the Europe 2020 anti-poverty toolkit. The authors outline that there has been a growing interest in social



innovation initiatives, but mostly associated with ‘the need to reform domestic social protection systems in order to ensure their adequacy, efficiency and sustainability in a context characterised by budget constraints’; they stress that other scholars have noted the risk of delegating the responsibility on the responses to social needs to third-party actors, as a mechanism to externalize social services to the market (Sabato et al., 2015; Grisolia and Ferragina, 2015).

Not directly connected to energy poverty literature, but as collateral contributions, we can outline the study of Garrone, Groppi and Nardi (2017) on experiences of social innovation to improve urban liveability. Also, Hölsgens, Lübke and Hasselkuß (2018) have developed their research in the field of social innovation in the German energy transition, analysing social rather than technological innovations. An additional contribution on grassroots innovation and community action as a solution to tackle energy poverty is made by Martiskainen, Heiskanen and Speciale (2018) through their research on the experience of the Energy Cafes as a community mechanism to tackle energy poverty.

Behaviour transformation from a holistic approach that includes habits and practices


Raising awareness is among the critical factors in alleviating the consequences of energy poverty, by identifying the existing practices and methods and building on them, developing a high quality educational approach which should address both the technical and the social sides of the phenomenon and also highlight the entrepreneurship possibilities in the area of energy advising. A value added to this policy tool is the development and implementation of innovative ICT tools to be used in education on energy poverty (IDEA, 2018).

Most of the innovative proposals are focused on the citizenship empowerment in energy saving and energy efficiency, in order to achieve a behavioural transformation through information and knowledge. Related to that, we find contributions connected with the idea of enabling citizens to become prosumers, in order to change to a green-behaviour (Kapsalaki, 2017) and improving the utilisation of smart technologies to change the energy conduct (SMART-UP, 2017). In addition, an educational approach is further promoted with emphasis on energy entrepreneurship (IDEA, 2018).

Other authors highlight the importance of the education of households on behavioural changes to reduce energy consumption (Gancheva et al., 2016) while focusing on the role of social workers (Scarpellini et al., 2017). Within the literature, this approach may be linked to the fairly new approaches to energy poverty from the perspective of the human rights paradigm (Bouzarovski et al., 2018).

Highlights & outcomes

As we can note, the major part of the information bibliography sources associated to policy innovation is centred on energy efficiency measures and renovation of buildings in order to reach a long-term solution to energy poverty. Thus, we observe a general view that innovative approaches to energy poverty have in common long-term, holistic, sustainable solutions and a move from the short-term solutions (blanket measures) or the emergency policies needed in severe energy poverty situations. This may entail redirecting funds from




subsidising the energy bills towards energy efficiency measures. In the course of time, EU-level policies tackling energy poverty show a clear shift from short-term boosts to household income through social welfare subsidies and regulation of energy prices, with potentially adverse effects, towards long-term energy efficiency and deep housing renovation as a long-lasting and sustainable solution to energy poverty (BPIE, 2016). The logic behind this shift is the understanding that direct payments deal with the consequences of the energy poverty while investing in energy efficiency reaches its causes.

In addition, the review points out that different climates, infrastructures and social practices (buildings, heating/cooling practices and systems available, etc.) require differentiated approaches to tackle energy poverty. This is a clear policy shift from policies relying on funding utility bills to policies supporting tailored energy efficiency renovation programmes under the EU Energy Efficiency Directive (last amended in 2016) and within the long-term renovation strategies in the EU Energy Performance of Buildings Directive (last amended in 2018).

Regarding the area of governance innovation, we can point out the contributions on social innovation and community practices to tackle energy poverty. Most of the innovative proposals are focused on the citizenship empowerment in energy saving and energy efficiency, in order to achieve a behavioural transformation through information. Another key outcome from the review is the emphasis on the current innovative policy trend to enable citizens to become prosumers and to gradually shift to an environmentally-aware behaviour by growing the usage of smart technologies to change their energy conduct. The review findings reveal that the core-periphery distinction is also reflected in the means employed to tackle energy poverty – the mix of social and technological innovation is predominantly present in the ‘core’ group of countries in Northern and Western Europe, while the countries from the heterogeneous energy poverty ‘periphery’ tend to put the emphasis on the energy efficiency as a long-term policy intervention in alleviating the grave energy poverty consequences.

As a general observation, we can note that previous work has been limited to a specific approach to innovativeness. A challenging area in the field of innovation in policies to tackle energy poverty is the technological innovation and how it interacts with other type of innovation in other fields, such as governance and organisational transformations. Technology related policy interventions still remain insufficiently linked to the social innovation and the bottom up community based practices to tackle energy poverty. The innovation check is the core work of the WG4 on this first stage, aligned with its main goal: developing and consolidating knowledge around innovative solutions and co-benefits for alleviating energy poverty. The products expected from this process are this case study on innovation and energy poverty policies, on the one hand, and a collective paper, on the other hand. The content and outcomes of the review support the preparation of the innovation policy check in the following section. We will now present the methodology developed for the innovation check and a list of policies we consider to be innovative based on the elaborated criteria.

3.2 The innovation check: initial steps



The innovation check has mainly consisted in analysing existing policies to tackle energy poverty on the basis of elaborated methodology and indicators in order to explore their contribution in terms of innovation. The objectives of the innovation check are:

- To analyse the framework conditions of the innovative policies;
- To cluster the policies in different innovation areas or categories;
- To detect gaps on the innovative initiatives addressing energy poverty.

3.3 The innovation assessment criteria

The case analysis has been performed applying an 'Innovation assessment criteria' using different sources and tools, such as documentary analysis of planning applications, news reports and community groups' websites supplemented with expert consultations. The building process of the Innovation assessment criteria has been inspired by the framework proposed by Geels et al. (2018). This research aims to construct a research map on the topic of energy demand reduction. In order to do that, the authors propose an innovative framework to analyse two elements: the technical change (in terms of incremental or radical transformation) and the grade of changing in social and user practices. This framework is aligned with previous research from a socio-technical transitions perspective (we highlight the contributions of Geels et al., 2017a; Sovacool and Hess, 2017; Geels et al., 2017b).

In order to analyse the selected policies, we have designed a set of criteria build on the basis of two main axes: governance and technology innovativeness also proved by the review outcomes. Each of the axes has dimensions and subdimensions based on the gaps detected during the literature review. By connecting the two axes, we seek to link our research with some of the broad discussions in the literature. Traditionally the technological innovation has been understood as a key component of economic progress, and in the last years this debate has been complemented with a discussion on innovation in the public sector.

An important distinction needs to be made between the governance and the technological axis: while the technological component cannot be relevant in certain policies (because of their objectives, design or other factors), the governance elements are more or less directly present.

The technological axis (a) includes the following dimensions: (a.1) Technology innovation, composed by information about the degree of newness in the technological means and process; (a.2) the replicability and applicability of this technological innovation in terms of efforts, resources and implementation costs, and (a.3) the impact on renewal and alternative energy sources development. In order to define the technological dimensions and subdimensions we have used the seminal definitions and indicators from the Oslo Manual, the first multinational study to collect technological innovation indicators and their interpretation, and the extensive review of Garcia (2002) on technological innovation typologies.

Regarding the governance or organisational axis, it's connected with the core of the policy change. Here it's needed to differentiate between the policy changing and the policy innovation. Innovation contains new behaviour and cultural patterns with numerous social

functions (Deutsch, 1985) and can influence social objectives and structures (Sinko, 2016). An important distinction need to be made between the governance and the technological axis: while the technological component cannot be relevant in certain policies (because of their objectives, design or other factors) the governance elements are more or less directly present.

The governance axis (b) is composed by 5 dimensions, fed by subdimensions. The first dimension connects with the mode of action of the measure (b.1) including the policy adequacy, the policy approach, the type of resources provided by the measure and, finally, the funding method of the policy. The second is the framing and policy design (b.2), composed with information about the social inclusiveness character of the policy or how the measure targets its potential beneficiaries. The third dimension includes aspects linked to the participation and empowerment of the affected groups (b.3) including the behaviour changing, accessibility, and the affected groups' empowerment. Finally, the two last dimensions refer to the cooperation between different actors (b.4) and the monitoring and evaluation capacity of the policy itself (b-5).

The analysis process consists in scoring the different subdimensions of each policy in a scale from -3 to +3 (similar to a Likert scale, establishing the central values as neutral or not relevant). Each subdimension would get 'points' in every dimension. Finally, each axis would be represented by an index (summing all the subdimensions' scores and dividing by the number of subdimensions). The final goal of this process is to build a matrix with the two composed indexes for the technological and governance innovativeness.

Axis	Dimension	Subdimension	Subdimension description
(A) Technological innovativeness	A.1 Technology innovation	A.1.1 Technological means	From a technological product perspective, does the policy involve fighting energy poverty through "usual/classical" technological elements or does it involve the implementation a new technologies?
		A.1.2 Technological process	From a technological process perspective, does the policy involve fighting energy poverty through "usual/classical" means or does it involve the implementation a new technological process?
	A.2 Replicability and applicability	A.2.1 Applicability	Is the technology easily applicable in local and specific contexts, without great effort?
		A.2.2 Replicability	Is the new technology implicated in the measure easily replicable in other contexts and places?
	A.3 Renewable and alternative energy sources	A.3.1 Renewable and alternative energy sources	Does the measure make an effort to step up progress towards using renewable-energy technologies?
	(B) Governance innovativeness	B.1 Mode of Action	B.1.1 Policy adequacy
B.1.2 Policy approach			Does the policy emphasize action at the grassroots level (action based on networking and cooperation among individuals)
B.1.3 Resources provided			What type of resources are provided by the policy?
B.1.4 Funding method			Does the policy incorporate an innovative funding method?
B.2 Framing		B.2.1 Social inclusiveness criterion	Is the policy focused on social inclusiveness?
		B.2.2 Targeting	Does the policy target groups which have not been (adequately) addressed by previous policies? (e.g. elderly unemployed, low-income household which do not receive social benefits)
B.3 Affected groups		B.3.1 Behaviour change	Does the policy aim to influence/change the behaviour of individuals in their households and within the community?
		B.3.2 Accessibility	Is it easily accessible for households?

involvement and participation	B.3.3 Affected groups empowerment	Does the policy promote and impulse the affected groups' empowerment?
B.4 Cooperation	B.4.1 Actors partnership	Does the policy aim to develop partnerships across multiple stakeholders/institutions?
B.5 Monitoring innovation	B.5.1 Monitoring and evaluation tools	Does the policy specify clear follow up, monitoring and measurement tools to ensure the effectiveness of the policy once implemented?

3.4 Policy selection procedure for the innovation check

To capture the diversity of the policies to tackle energy poverty, we've selected 18 policies across Europe (Table 1). The case selection has been based on the variable dependent, the innovative character of the policy, selecting cases that differ relatively little from each other with respect to the outcome (Ragin, 2004). In this paper we have focused on positive cases that are cases where the innovative character is present.

Regarding the case selection procedure, research experts have been recruited from different countries to select appropriate cases. The experts' recruitment was made through the research network ENGAGER, specialised in Energy poverty. On September 2018 an online form was sent receiving more than 30 contributions in two weeks. Twenty-four experts from 16 different countries participated with approximately 60 existing policies that they considered innovative. This procedure was selected after verifying the nonexistence of a common definition of innovative policies to tackle energy poverty. The aim of the expert consultation procedure was generating an innovative policy database to analyse their characteristics to obtain a common framework. After analysing all the proposals, we selected a final sample of 18 policies balancing the diversity of measures in terms of typology, territorial representation and impact. The provisional² policy sample can be consulted in the following table:

	POLICY	TERRITORY	SHORT DESCRIPTION
1	Mieterstrom-Modell	Germany	Decentralised electricity supply model.
2	"Clean Air"	Poland	Long-term programme of thermomodernisation of buildings, through a deduction in taxes on the condition that the money is spent on an effective (as confirmed by energy audits) thermo-modernization of their houses.
3	Coach Copro	France / Paris	Free digital platform for the coordination and assistance with thermal renovation of co-owned apartment buildings.
4	Servei d'assessorament energètic (Ecoserveis/Barcelona)	Spain / Barcelona	The Energy Advice Points (PAE) located in each of the city's districts are to offer the general public information on energy consumption and saving, as well as advice on self-production.
5	Energy Cafe	London/ UK	
6	Papillon - a rental model for energy saving appliances for people in EP	Belgium / West-Flanders / Westhoek Region (17 towns)	Rental model for energy-efficient household appliances in cooperation with BSH Home Appliances. Energy poor households would be able to rent energy-efficient appliances for 10 years. This way they immediately benefit from a low rental price of lower energy consumption and therefore also lower energy bills.
7	MAGE (Mesurer et Accompagner pour Garantir les Economies)	France	The program aims at the sustainable adoption of economical uses, especially during a change of context (relocation, renovation, FSL requests) through energy

² We are still incorporating new policies to the sample.

			coaching of modest households (private tenants or HLM, owners) combining collective actions but especially individual support with 3 home visits over 12 months and the measurement of energy consumption and comfort.
8	Energy Efficiency Financial Fund	Romania	Energy Efficiency Financial Fund dedicated to support the energy poverty (retrofit of envelopes and systems) in households and social buildings.
9	L'atelier solidaire	France / Toulouse	Workshop conducted by the neighbours, with the aim to reduce residents' energy and water costs, combat fuel poverty, and create neighbourhood-level social ties as part of the city's policy.
10	Cold home toolkits	UK / Cornwall	Online toolkits for local authorities and health trusts that provide practical resources for tackling energy poverty and poor health from cold homes to local authorities and health trusts
11	Tutor per l'Energia Domestica (TED), ASSIST 2GETHER, Consorzio europeo	Rome, Italy	This measure consists in training certain members of the community in order to give them the tools to change the energy behaviour
12	Energiesubsidiewijzer	Netherlands	This measure is a website that allows households to easily check what subsidies they can receive for energy savings.
13	Dampoort KnapT OP!	Belgium	This measure provided financial assistance to low-income owner-occupants that have bought a house that is poor quality. The grant was given in the form of a 'rolling fund', whereby the homeowner would need to pay back the additional value of the house if it would be sold again.
14	Bielefelder Klimabonus	Germany	This measure provides a premium for energy efficient housing for low-income households. The premium enables households who are on social benefits to rent energy efficient housing.
15	VERBUND-Stromhilfefonds	Austria	This measure provides households with energy audits to improve energy efficiency, as well as support with the replacement of household appliances. The measure also provides energy bill support for urgent situations.
16	Energy Company Obligation	United Kingdom	Energy suppliers are required to support the delivery of energy efficiency measures amongst low income and vulnerable households.
17	Home Energy Efficiency Programmes for Scotland (HEEPS)	Scotland	Includes area-based scheme to installing free energy efficiency measures in areas with high levels of energy poverty
18	RobinHood Energy	UK	Local public utility.
19	Tax credit for households expenses	Finland	The tax credit for household expenses relating to household work (such as renovations and installation of e.g. IT equipment, solar panels etc.) supports energy renovations in Finnish households

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4.3 EU Energy Poverty Observatory

Section on Policies and Measures: <https://www.energypoverty.eu/policies-measures>

4.4 Relevant project outputs

ACHIEVE: <https://ec.europa.eu/energy/intelligent/projects/en/projects/achieve>

ASSIST2GETHER, 2017: <https://www.assist2gether.eu/>

- Report on National and European measures addressing vulnerable consumers and energy poverty.
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- Report on Replicable Best Practice National and European measures.
[https://www.assist2gether.eu/documenti/risultati/report on replicable best practice national and european measures.pdf](https://www.assist2gether.eu/documenti/risultati/report%20on%20replicable%20best%20practice%20national%20and%20european%20measures.pdf)

COMBI: <http://www.combi-project.eu>

EC-LINC: <https://ec.europa.eu/energy/intelligent/projects/en/projects/ec-linc>

EnerSHIFT: <https://enershift.eu/>

EVALUATE: <http://www.urban-energy.org/evaluate>

E-SEAP: <http://www.e-seap.eu/>

FIESTA: <http://www.fiesta-audit.eu/en/learning/>

FinSH: <https://ec.europa.eu/energy/intelligent/projects/en/projects/finsh>

IDEA, 2018: <http://www.project-idea.eu/>

INSIGHT_E: <http://www.insightenergy.org/>

REACH: <http://reach-energy.eu/>

REELISH: <https://getwarmhomes.org/>

SAVES: <https://saves.nus.org.uk/>

SMART-UP, 2017: <https://www.smartup-project.eu/>

SMERGY: <http://www.smergy.eu/>

STEP-IN: <http://www.step-in-project.eu>

TRIME: <http://www.trime-eu.org/>

4.5 EU strategic documents

Clean Energy for All Europeans, 2018.

<https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/clean-energy-all-europeans>

Covenant of Mayors for Climate and Energy, 2016.

https://www.covenantofmayors.eu/index.php?option=com_attachments&task=download&id=78

Energy Performance of Buildings Directive, 2018.

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Energy Efficiency Directive, 2016.

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