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Energy Communities: A Significant Factor to alleviate Energy Poverty

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Abstract. At the end of the 20th century, one of the phenomena that affect humanity on a social, economic, political, and environmental level is the energy poverty, a concept that is still misunderstood. It is a distinct form of poverty associated with a range of adverse effects for people's health and wellbeing. Energy poverty is often described as the inability to keep homes adequately warm. In the late of 20th and especially in the early of 21st century, the protection of the environment and the developing capacity of economy, through sustainable development, set the vision for the innovation of distribution networks and production of energy, through renewable energy sources.

To optimize energy production and to reduce production costs, the socio-technological system envisages optimal results through decentralized systems, and smart grid cities. It offers to consumers the power to be producers of the energy that they consume. The new concept of prosumer (the ability to be both consumer and producer) involves the production of the energy from renewable sources and its consumption in a social context. This new institution is called "energy community" and constitutes the key to transition to a decarbonized economy and society and it is considered as a significant step in tackling climate change.

The aim of this research is to evaluate the intervention of energy communities in the efficiency of the energy consumption sector and their social impact, based on the subjective indicators of energy poverty.

Keywords: Sustainability, Energy Production, Energy Communities, Energy poverty, Prosumer

1. Introduction

The definition of "energy poverty" posits in a general context the level of energy that is being consumed and does not fulfill the basic energy requirements of a person (eg heating, cooling) or a household. The first reference to the definition was made by Boardman (1991) who based on household heating costs. The relevant issue arose from the rapid increase of energy consumption, with the biggest part of their production, relying on fossil fuels and its disproportionate distribution, in terms of access and consumption gap between developing and emerging economies.

European Union in the Treaty of Paris (2016/2814 (RSP)) sets legally binding targets for reducing global warming and committed to convert energy production channels by developing Renewable Energy Systems (RES) and to invest in energy efficiency. The purpose of this policy is one hand to reduce emissions and on the other hand coupled with the development of RES to strengthen the "energy security" and alleviate the "energy poverty".

The common framework for the advancement of energy production from renewable sources is established. For the first time a regulatory framework at financial level supporting the "self-consumption" of energy produced, the appropriation of RES energy in transport, heating and cooling systems, inter-Community framework for cooperation between Member States and third countries, administrative procedures, and sustainability criteria was initiated.

This paper examines the correlation between the phenomenon of energy poverty and the energy communities.

2. Energy Issue

2.1. Energy Poverty

The phenomenon of energy poverty is a social challenge (Bouzarovski and Petrova 2015). The data of the annual report of the International Energy Outlook (IEO 2019), indicate that an increase in energy consumption will reach to 50% from 2010 to 2050.

The concept of energy poverty is defined in various ways both in developed and developing world. In developing world is defined as a lack of access to electricity and energy services mainly (González-Eguino 2015).

On the contrary, energy poverty in developed countries is attributed to three factors (Legendre and Ricci 2015, BPIE 2014, Palmer et al. 2008, IEA 2011):

- The low household income
- The high cost of energy
- The low energy efficiency of the house

2.2 Energy Community

The European Parliament (Directive 2019/28/EC) established a common framework for the development of energy production from renewable sources, bringing to the fore the definition of "self-consumption" in the production, using energy from RES, in the field of the transport sector, heating, and cooling systems, with a view to the sustainable development of the Member States of the Union.

The concept of "self-consumption" in energy production causes constructive changes in the energy market as it refers to new productive activities that communities and citizens play an important role. The new enterprise model formulates socially oriented business function. Taking advantage of the technology, energy community provides the advantage of decentralized energy networks that contribute to a safer, more competitive, and sustainable economy (Gancheva et al. 2018). The new social and enterprise entities entitled Energy Communities (Klein and Coffey 2016) are local cooperatives in which citizens or legal entities can primarily operate in the energy sector, utilizing clean energy sources. The result is the formation of a hybrid model of consumer-producer in the energy market which in the international literature is defined as "prosumer".

3. How Energy Poverty is measured

Energy poverty, as a multidimensional phenomenon, could be approached:

• With a cost-based method, using an objective index (the conventional index, the official index based on required consumption, the Hills index, etc.) with national statistics or primary surveys.

• Using subjective indicators (one, two, or more indicators, (Bouzarovski 2011), with EU Statistics on Income and Living Conditions (EU-SILC) data or national statistics or primary surveys.

• With a combination of objective and subjective indicators (Lawson et al. 2015).

• Using, more holistic approaches, considering the broader concept of energy vulnerability (Bouzarovski 2014, Thomson et al. 2017)

4. Impact of Energy Communities on alleviating Energy Poverty

Energy communities could be considered as a social innovation and contribute to more socially equitable models of energy access. They strengthen the democratic decision-making of the citizens and spread the use of renewable energy sources (Walker and Devine-Wright 2008).

They promote energy efficiency at the household level and alleviate energy poverty by reducing consumption and supply tariffs. (Boon and Dieperink 2014). In addition, energy communities help citizens and local authorities to invest in renewable energy and to achieve energy efficiency. Citizen participation in renewable energy projects can also transcend social acceptance at the local level. (Hoffman and High-Pippert 2010)

Furthermore, they encourage citizens to fund community-owned projects with funds that increase local benefits – such as harnessing local renewables, increasing employment and reducing fuel poverty in the region. Greece is a pioneer in this field as according to legislative initiative (National Law N4513/ 2018) a part of the profits of an energy community must be allocated to combat the energy poverty.

Moreover, consumers are more willing to participate in the electricity markets, including citizens with low incomes who otherwise would be excluded (Huijben and Verbong 2013).

They are, in a broad sense, institutions that give priority to citizen participation, boost citizen evolvement in energy issues, and increase the acceptance of renewable energy sources.

Finally, the energy communities can have a determinative role in reducing energy poverty – removing barriers that prevent socially vulnerable groups from participating in distributed production as long as they supported by the following strategies:

1. Development of consulting services for the deployment of community ownership initiatives in the establishment of local cooperatives and the implementation of information and awareness campaigns to address poverty (Van der Horst D, 2008) like Energie Solidaire Enercoop in France.
2. Education of the community about the local benefits, and subjects on how to enhance the implementation of local sustainability projects and achieve energy independence while reducing carbon dioxide and fuel poverty, how to contribute to the local economy, creating local jobs and avoid the outflow of financial resources from the region. (Kunze and Becker 2014).

5. Correlation Between Energy Communities and subjective indicators of Energy Poverty

Eight EU countries (Belgium, Germany, Denmark, France, Spain, Poland, the Netherlands, and Sweden) including Greece are studied in order to identify the nexus between Energy Communities and Energy Poverty.

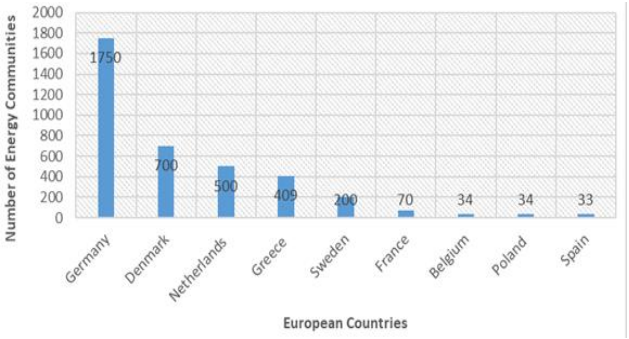

Figure 1. Number of Energy Communities in Europe (2019)

These EU Member States are selected according to their performance in the activation of energy communities

considering the total energy produced from renewable sources. Figure 1 shows the active energy communities in selected countries of the European Union.

The indicators used are subjective indicators of poverty energy. The subjective or indirect evaluation of energy poverty refers to personal assessment of households about the conditions that determine energy consumption in relation to the thermal comfort. Gathered data come from delayed bills and other information about

- Inability to keep home adequately warm
- Arrears on utility bills
- Dwelling with a leaking roof, damp walls, floors or foundation, or rot in window frames of floor

The nature of these subjective indicators at first glance does not clearly show any association to energy poverty, although they are utilized in many studies (Healy and Clinch 2002), with the significant advantage that they bring to the surface households that reduce energy requirements due to financial default (Dubois 2012).

Fahmy (2011) stated that the complexity of the officially accepted methodology of measuring energy poverty, misrepresent reality because of the overlap between the two different methods (objective-subjective measurement). Price et al. (2007), DECC (2009) argue that the connection between objective index and subjective indicators is weak.

However, Fahmy (2011) points out that further use of subjective indicators is required because these indicators verify the results of the objective indicators. When these indicators read together with other data, contribute to fill the gap of the required expenditure limit. In this approach, Price et al. (2012), Roberts et al. (2015) and Phimister et al. (2015) consider that subjective indicators could be useful for recording facets of energy poverty in the case that objective indicators cannot estimate. They urge that this combination equip them with tools for a holistic approach to the phenomenon.

According to Figure 2 the values based on population share of household (%) of subjective indicators for the year 2019 indicate that energy communities have a crucial role in alleviation of energy poverty.

The European average for:

Inability to keep home adequately warm equals: 6.9.

Arrears on utility bills equals: 6.2.

Dwelling with a leaking roof, damp walls, floors or foundation, or rot in window frames of floor equals: 12.7.

It is noted that the values of indicators of Greece exceed the average of the EU energy poverty indicators, despite the large number of established energy communities.

On the other hand, Spain, and Poland, despite the small number of energy communities, are close to European Union average. Germany, Denmark, and Sweden countries with established knowledge, projects and practice in renewable energy sources and high distribution of energy communities show incredibly low levels comparing to the average of subjective indicators of the EU.

France, Belgium, and the Netherlands are the countries in which a balance between the values of the subjective indicators and energy communities is noticed.

It is specified that in - almost all the countries of the study except for Sweden, the issue of maintenance and infrastructure of the households and the insulation of houses is a crucial concern.

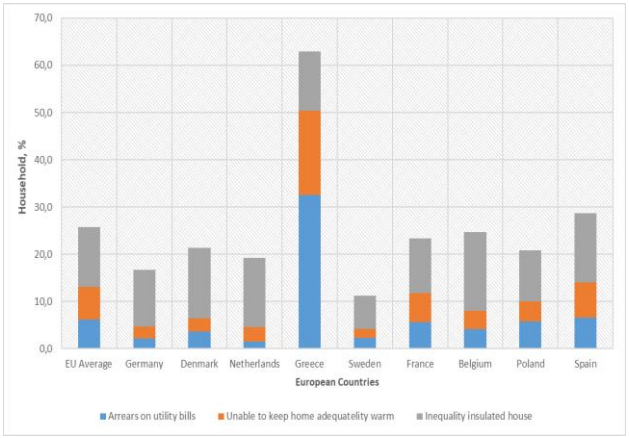

Figure 2. Subjective Indicators for Energy Poverty in 2019

6. Conclusions

The research aims of this study is to introduce a new consideration about energy communities and their contibution in the alleviation of energy poverty.

The number of established energy communities in a country is not the crucial factor (eg. Greece comparing to Spain and Poland).

In addition, energy communities can be seen as a useful tool for quantitative qualifier and correlation to the energy poverty, between objective and subjective indicators, in terms of estimating it in absolute terms

The energy community policy has to be holistic, including all the local stakeholders, in order to elaborate the energy ecosystem for the implemention of sustainable development strategies.

Subjective indicators of energy poverty can utilazed as indicators to assess the effectiveness of energy communities in the local community and its sustainability.

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