

1                    **Analysis of energy poverty intensity from the perspective of the**  
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3                    **regional administration: empirical evidence from households in Southern**  
4                    **Europe**

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26                  **Abstract**

27                  The current economic situation has increased the number of households in Europe  
28                  experiencing restrictions and/or limitations of affordability of energy services,  
29                  demonstrating the urgent need to intervene in those extreme cases in which households  
30                  suffer the daily consequences of what is internationally defined as energy poverty. In such a  
31                  context, this paper presents the results obtained in a case study characterising a sample of  
32                  615 households with demonstrated energy poverty in the region of Aragón (Spain). In  
33                  parallel, the intensity of energy poverty in the studied cases is examined by measuring the  
34                  percentage of energy expenditures with respect to income in the households that suffer it,  
35                  and a descriptive analysis of the main determinants of energy poverty in the homes studied  
36                  is presented as well as the policy implication at regional level.

53                  **Key word**

54                  Energy poverty - Regional Government - Empirical evidence – Correlations – Social  
55                  Services

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## 1. Introduction

The economic situation in Europe has increased the number of households with unexpected economic difficulties and situations of debt and insolvency. Among other negative consequences, the low income and the consequent household decapitalisation are significant limitations to accessing energy resources necessary for the home.

In many cases, housing is in fact one of the elements that Europeans use to reduce household spending in times of recession, causing an increase of extreme cases in which some suffer the daily consequences of what is internationally defined as energy or fuel poverty. Energy poverty is here understood as the economic inability of the home to meet its domestic energy needs, increasing as energy expenditures and their relative significance in relation to household income also rise

Spain has also been affected by this problem, and action has been taken by different institutions mainly to assess the problem at the local, regional, and national level and to define which actions ought to be taken and measures adopted. To do so, the Public Administration must identify the households that are most vulnerable to the problem and their main features to take concrete steps that are preventive in nature and suitable for every type of household. These steps would also be taken to avoid situations of consumer vulnerability that may lead to severe energy poverty in all the European countries, as Spain, located in the south of the European Union (EU), even though they have more favourable weather conditions than in northern Europe. Substantial differences among EU member states have in fact been detected, with Southern and Eastern European countries generally reporting a higher incidence of energy poverty (Tirado-Herrero and Bousarovsky 2014), and the highest incidences of fuel poverty in southern Europe include Portugal, Spain, Greece and Italy (Healy and Clinch 2002b).

1 As Bergasse et al. (2013) note, when homes must cover excessive energy costs, they  
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3 find themselves in a situation of energy vulnerability, and this situation may represent a  
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5 deterioration of living conditions and socio-economic development for society in general.  
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7 For this reason, the need to protect citizens from energy vulnerability (Bouzarovski 2012)  
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9 and to prevent social exclusion by ensuring basic access to energy at reasonable and stable  
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11 prices (CESE, 2013) has been considered in all Europe. This consideration is acknowledged,  
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13 in fact, in the third energy package of the year 2009 (Rab et al. 2011), in which Member  
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15 States of the European Union should take appropriate steps to protect these clients.  
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21 Nevertheless, the EU approach has led to some fragmentation in member States'  
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23 actions concerning energy poverty, not only in relation to the definition of energy poverty or  
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25 vulnerable consumers but also regarding measurement and the definition of preventive or  
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27 palliative measures implemented in each country. In most member countries, market  
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29 competition is not the main factor affecting the significant components of individuals' final  
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31 energy bill but rather numerous taxes, levies, supports for energy diversification and  
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33 security, etc. that depend on national energy policy.  
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38 In this context, it is important to have primary source material to provide a complete  
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40 picture of the energy poverty phenomenon in each country, in line with the approach  
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42 proposed by Howden-Chapman, et al. (2012) and by Brunner et al. (2012). These authors  
43  
44 advocate for a holistic approach to the daily energy practices of households on low incomes  
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46 and/or suffering from fuel poverty that is needed at national and local level.  
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51 The paper is focused on this goal and it is divided into five sections. After the  
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53 introduction, the second section presents a background of literature on energy poverty in  
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55 terms of its definition and operationalization. The third section provides an account of the  
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57 empirical work conducted, including the sample, variables, and methodology used for  
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1 analysis. The fourth section describes the main results, and in the last section, the main  
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3 research conclusions are presented.  
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## 6 **2. Background**

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8  
9 In recent years, the definition of the concept of energy poverty has been a recurrent  
10 issue that has reached a certain level of agreement about issues of affordability and unmet  
11 needs of domestic energy services. The advisability of using Boardman's (1991) initial  
12 proposal at the European level has been debated, with the author stating that the proportion  
13 of household income spent on energy services in a household is the main indicator of the  
14 scope of energy poverty.  
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24 Based on this fundamental contribution, the use of 10% of income to sufficiently meet  
25 energy needs (Boardman 1991) as an index to detect households in energy poverty was  
26 introduced in the debate (Lidell et. al. 2012), in addition to other needs regarding the  
27 analysis of comfort in a home with indoor temperatures ranging between 18 °C and 21 °C  
28 (see BERR report 2001). Other authors, such as Hills (2012), the International Energy  
29 Agency (IEA 2011), Tirado-Herrero et al. (2012), and Thomson and Snell (2013),  
30 introduced concepts such as “cold home,” “energy debt,” and “relative” perspectives into the  
31 definition of “energy poverty” (Grévisse and Brynart 2011). Li et al. (2014) provide a  
32 summary of the related concept as used in the literature and foremost a principal distinction  
33 regards access versus affordability. In general terms energy poverty is frequently used  
34 regarding the inability to obtain or maintain service, and fuel poverty means a temporal  
35 variability of domestic energy deprivation.  
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54 Bouzarovski et al. (2014) pointed out that the factors that contribute to the rise of  
55 domestic energy deprivation can be captured under the concept of ‘energy vulnerability’ –  
56 defined, simply, as the propensity of an individual to become incapable of securing a  
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1 materially and socially needed level of energy service in the home, thinking brings to the  
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3 fore issues of resilience and precariousness.  
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6 These different concepts highlight that the term's definition is not univocally applied  
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8 and outside the third world energy poverty is now generally considered to be relative, in line  
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10 with Moore (2012). A relative conception of the phenomenon is therefore applied in this  
11  
12 study, and a household is considered to suffer energy poverty if its dwellers are unable to  
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14 pay for energy services sufficient to satisfy domestic needs, once such economic necessity  
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16 has been "accredited" by the Social Services that attend/support the home, whether  
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18 regional/local or other competent authorities depended on for this purpose.  
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24 Despite the fact that the accreditation of energy poverty may be restrictive and those  
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26 households that suffer the consequences of this problem without being recipients of social  
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28 aid may be excluded from the analysis, the application of this approach allows one to limit  
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30 urgent situations to a territorial level to clearly define the problem determinants by tracing  
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32 households in need according to their features, thus planning public and private  
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34 interventions based on specific measurements.  
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39 Defining households in energy poverty on the basis of accreditation also responds to a  
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41 holistic view of the problem that regards energy poverty as one of the indexes of relative  
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43 poverty (Practical Action, 2013) in a context of the overall poverty that represents the  
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45 problem according to a classification of society into two groups: those who are most  
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47 disadvantaged, which could be called "poor" (in this case in "energy" terms) and the rest.  
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52 In Europe, the latter typically involves the intervention of social services or social  
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54 action agencies. The implementation of this approach allows one to identify urgent  
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56 situations using a broader criterion that goes beyond age or household member income  
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58 (Boardman 2012). As Chaudhuri and Ravallion (1994) indicate, the most important studies  
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1 in this field highlight the direct relationship between household income and level of poverty,  
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3 both general and relative in order to define the solutions.  
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6 In Spain, Tirado-Herrero et al. (2014) estimates that, in 2012, 17% Spanish  
7 households ( 12% in 2010) were subject to disproportionate domestic energy expenses (over  
8  
9 10% of their annual income). The 2012 percentage figure is equivalent to 7 million people  
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11 affected by this condition (5 million in 2010) and 9% of Spanish households (8% in 2010)  
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13 were unable to keep their home adequately warm during wintertime. In the same year, the  
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15 percentage of households in Region of Aragon (in the Northeast of Spain) with domestic  
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17 energy expenses over 10% of their annual income was higher than the Spanish average,  
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19 while the percentage of households unable to keep their home adequately warm during  
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21 wintertime was below the Spanish average throughout the series studied by Tirado-Herrero  
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23 et al. (2014).  
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31 In Europe, different empirical studies that have been conducted using large sample  
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33 sizes are not numerous, and the relationship between energy poverty, thermal comfort, and  
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35 the consequences of living in inadequately heated housing (Healy and Clinch 2002)  
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37 continues to be the subject of analysis with regard to defining specific actions to be  
38  
39 undertaken. Even that, the most recent publications has yielded further clarity regarding the  
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41 phenomenon experienced by households in Europe. Devaliere (2010) conducted a  
42  
43 quantitative empirical study in France in 2010 that focused on 2 samples of 40 homes in 2  
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45 territories. Along similar lines, the empirical analysis of Santamouris et al. in Greece  
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47 provided a large sample of households (598) and defined 2 types of situations derived from  
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49 income level while furthering the characterisation of energy consumption in a time series.  
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51 Similarly, the level of energy consumption in each household and its social impact have  
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53 been extensively analysed by Roberts (2008) and Tirado-Herrero et al. (2014).  
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1           However, some authors have identified the lack of uniformity among European and  
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3 national statistical data as a limitation, as well as a shortage of data and a lack of surveys  
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5 and specific methodology for measuring the phenomenon (Heindl, P. 2013).  
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9           When we look closely at the analysis of preventive or palliative proposals, Grévisse  
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11 and Brynart (2011) provide a synthesis of the measures undertaken in the European Union,  
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13 differentiating between the activities aimed at consumer protection and those designed to  
14  
15 avoid disconnection of energy supply. The energy refurbishment of housing (Espada-  
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17 Nicolas et al, 2012 and Tirado-Herrero et al. 2012) has also been identified as a possible  
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19 solution in Europe. Additionally, improvement in energy efficiency for community-based  
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21 services (Practical Action, 2013), centralised energy generation (Santillan-Cabeza, 2011),  
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23 and modification and relaxation of requirements to qualify for social tariff or reduced rates  
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25 (Tirado-Herrero et al., 2014) have also been recurrent proposals.  
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31           It has to be taken into account that energy poverty policy (as social inclusion  
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33 initiatives) and measures imply in fact a multiple governance levels because it can rarely be  
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35 dealt with independently from other pressing issues at the local level due to its  
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37 complementarities with other issues as energy efficiency or green technologies (European  
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39 Commission 2013). European Regions are at least involved in this phenomenon.  
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44           Here lies the main reason for deciding to perform a deep analysis of energy poverty in  
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46 an European region as a case study in Spain, from a suitable perspective for decision-  
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48 making by the regional administration and proposing potential decisive and effective  
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50 measures in a multi-level governance scheme: the Regional Government has in Spain  
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52 administrative powers in planning and provide regional social services while local  
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54 administrations, as municipalities (with more than 20,000 inhabitants) or counties, provide  
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56 the primary social services in the territory.  
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1 In the Spanish region of Aragon, selected as a case study, there was an increase in the  
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3 degree of attention paid to energy poverty during the recent years because of the increasing  
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5 number of households that requested financial support to public administration or private  
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7 NGOs in order to pay energy bills (Table 1) from 2012.  
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### 10 **TABLE 1**

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19 **Table 1. Households receiving public aid to pay energy bills in Aragón form 2011 to 2015. (Source: by**  
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21 **authors)**

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24 The need to assess the extent of this phenomenon and its main causes within the  
25  
26 Region of Aragón lead in fact to the development of this research study (Table 2).  
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### 29 **TABLE 2**

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38 **Table 2. Evolution of aid amounts (euro) to pay energy bills in the Aragonese households from 2011 to**  
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40 **2015. (Source: by authors)**  
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## 45 **3. Method**

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47 The steps taken to achieve an understanding of the energy poverty phenomenon in this  
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49 case study included: definition, measurement, monitoring, and recording and information, as  
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51 proposed by Pachauri and Spreng (2011). Qualitative and quantitative analysis were  
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53 considered necessary to obtain regional and disaggregated data regarding each household  
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59 situation.  
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1 Gathering information for the decision-making process represents a difficult task in  
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3 general because most of the statistical data available regarding energy poverty in the EU are  
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5 of the aggregate type (EU-SILC, 2003). Additionally, such data are obtained through  
6  
7 nonspecific statistical databases (household surveys) or through empirical studies of partial  
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9 or local samples (Morrison and Shortt 2008), which makes extrapolation to other climatic  
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11 zones and different regional socio-economic environments more difficult.  
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16 The Region of Aragon has a population density of 28.2 inhabitants per km<sup>2</sup> (IAEST  
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18 2013), more than 95% of the region of Aragon is included in the range of application of the  
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20 law, and approximately 42% the Aragonese population lives in the countryside, where its  
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22 population density is 3 times below the national average. Out of the 1,347,150 inhabitants of  
23  
24 the region, 682,004 (IAE 2013) reside in the city of Zaragoza, which means that there are  
25  
26 considerable differences within the territory between the rural areas and the main city. The  
27  
28 region is entirely located in the continental north climate area of Spain (Blázquez et. al.  
29  
30 2013). This Region has not been excluded from the debate related to energy poverty due to  
31  
32 the precarious economic situation of numerous families. The proposition of Regional Decree  
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34 no. 466/13 related to energy poverty of November 2013 highlighted the need of analysing  
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36 the rate of occurrence of this phenomenon and to define the opportune measures to alleviate  
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38 and prevent the problem in households in the region.  
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### 46 3.1 Design of the study 47 48

49 As a first step of the study, a qualitative analysis of the regional energy poverty was  
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51 carried out to achieve the principal objective of this work. A group of 65 experts and  
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53 professionals representing 44 entities in Aragon answer to a semi-structured (“in depth”)  
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55 interview specially designed for this study, as they were considered “key informants”  
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57 directly or indirectly related to the subject of the analysis. Furthermore, a total of 113  
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1 representatives of different nature entities throughout the region collaborated (social  
2 services, NGOs and other organizations), whether in the preparation and gathering of the  
3 surveys, dissemination of the study and later in the collection of data and information<sup>1</sup>.  
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9 Data from secondary sources obtained from Social Services and NGOs actively  
10 working on this issue on a regional level were taken into account during the elaboration of  
11 the questionnaire for the empirical study. In fact, different several local administrations are  
12 responsible for providing basic social services and numerous NGOs in the region offer  
13 charities for assisting the most disadvantaged households. Neighbourhood and neighbour  
14 associations, foundations, and other non-profit entities offer a local support network to  
15 people under serious risk of exclusion in the territory as well.  
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26 The qualitative analysis indicated that households in the region could suffer different  
27 degrees of energy poverty depending on income level, the percentage of income devoted to  
28 energy expenditures, a series of other factors inherent to the building itself and its insulation  
29 systems, available facilities, and the habits of the household residents, on one hand, and the  
30 cost of energy supply (total amounts of energy bills), on the other. Ultimately, everything  
31 related to energy expenditures in the household was considered to be of interest when  
32 analysing its impact on the intensity of relative household poverty in terms of energy. Direct  
33 information about the state of the art was collected during this first phase of the analysis to  
34 better outline the study case and the empirical phase.  
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49 Thus, taking into account the objectives of the study and the results obtained through  
50 the qualitative analysis, the literature review and the secondary sources of information, the  
51 empirical phase was focused on homes in accredited energy poverty, i.e., those households  
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59 <sup>1</sup> For more details about this phase of the study, please see:  
60 <http://www.aragon.es/estaticos/GobiernoAragon/Departamentos/IndustriaInnovacion/StaticFiles/Pobreza%20Energetica.pdf> page 22. (Accessed in June 2015).  
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1 that receive emergency regional public or private aid for paying basic expenditures related to  
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3 the house, in which aids for energy bills are included. These aids are subject to prior  
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5 verification of such need and they are regulated by a number of specific regulations in each  
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7 local authorities and private NGO.  
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11 Current emergency aid for these purposes includes special economic benefits aimed at  
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13 addressing situations of need, as they arise, impacting individuals and families deprived of  
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15 the essential means of livelihood. This complementary income, included in the budget of  
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17 Spanish Ministry for Health, Social Services and Equality and delivered by local  
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19 administrations<sup>2</sup>, aims at addressing the following needs, among others: a) the inability to  
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21 continue using and enjoying a habitual residence, in particular, rent payments to maintain  
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23 the right to use it; b) the lack of economic means to maintain conditions of habitability or to  
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25 acquire basic utilities for the habitual residence; c) the aid granted to households in the  
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27 region selected for study falls under the second category, focusing on the payment of some  
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29 unpaid bills that could lead to situations of non-payment and service outages.  
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36 Once the population were defined, a questionnaire defining the scope of the  
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38 phenomenon of energy poverty intensity in the region was designed. During the elaboration  
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40 of the questionnaire, energy poverty indexes proposed by Mirza and Szirmai (2010) were  
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42 analyzed. However, they were designed principally for rural areas of developing world  
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44 where traditional biomass is important and relevant for our understanding of the complex  
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46 phenomenon of energy poverty and the general conditions of households cannot be  
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48 compared with the European needs. In terms of measurements and indicators that assess the  
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56 <sup>2</sup> These public funds are regulated in the framework of a national agreement concerning the “Basic  
57 Social Services Local Authorities of the Spanish Ministry of Health, Social Services and Equality implemented  
58 by the Regional Governments, in this case by the Aragonese Institute for Social Services (IASS) and local  
59 authorities. At regional level, public aids are regulated by the Decree 48/1993 of 19 May and by Regional Law  
60 4/1987 March 25 (BOA 59, May 28, 1993). Moreover, almost all Local authorities have issued a specific  
61 regulation to deliver emergency aid in its scope.  
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1 phenomenon of energy poverty, Morrison and Shortt (2008) offer a clear analysis of the  
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3 main variables chosen to represent the social component of fuel poverty. The development  
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5 of indicators, an ongoing process that continues to require advances and efforts towards  
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7 standardisation at the European level, was considered necessary for conducting empirical  
8  
9 research studies. Home occupation was considered among the variables, as well as the  
10  
11 average number of rooms per house. Additionally, installation quality and materials were  
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13 taken into consideration in the design of the survey in these homes as noted by Rudge  
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18 (2012).  
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21 A series of variables were selected to measure different aspects of the households and  
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23 their residents, the characteristics of the residences and the facilities available in the home,  
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25 consumption habits, etc.  
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29 When the questionnaire was fully drafted, it was sent to a team with multidisciplinary  
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31 expertise who validated or proposed modifications to the questions. The received comments  
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33 were introduced in the majority part of the cases and improved regarding the clarity of  
34  
35 question formulation and how well the questions fit the goal of the study. A pre-test sent to a  
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37 small sub-sample of households (through social workers in the case of the specific  
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39 questionnaire) was carried out for obtaining the beta version of the questionnaire that was  
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41 subsequently used in the online application. This step made it possible to enhance the design  
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43 and layout features and to correct errors in the questions.  
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49 The first section of the questionnaire focused on personal data related to the  
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51 respondent and included questions referring to education, age, gender, and the location of  
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53 the housing. The second part of the questionnaire collected household data and included the  
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55 number of residents, amount of income, housing conditions, and facilities. Expenditures  
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57 related to electrical power, other forms of energy and transport, and certain habits of  
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1 consumption were reflected in the third section. Finally, the respondent was asked whether  
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3 he or she had received economic aid to cope with energy bill payments and the source from  
4  
5 which this aid derived.  
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9 A population of 7,222 households receiving emergency aid to pay for the expenditures  
10 related to houses during 2013 was considered as households accredited by social services.  
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12 Meanwhile, a large households that do not meet this criterion were excluded from analysis.  
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14 The collection of quantitative data was conducted through social services and regional  
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16 NGOs coordinated by the researchers involved in the study. Social workers (civil servants)  
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18 and NGOs volunteers made home visits to households affected by energy poverty from  
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20 which primary source data were gathered using both, paper questionnaires and on-line  
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22 system, depending on the visitors. The data were collected checking the energy invoices of  
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24 the families when the bills were available and the charges for energy consumption was taken  
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26 into consideration including all the concepts as taxes or other cost components.  
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34 The questionnaires were administered from June to September 2014 resulting in a  
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36 total of a sample 615 valid cases of households under conditions of energy poverty.  
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38 Conducting the survey during the summer does not refute the results obtained, first, because  
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40 energy expenditure data most sensitive to seasonality were requested for the entire year, and  
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42 second, because increases in electricity expenditures in the summer may occur due to high  
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44 temperatures in the region.  
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## 51 2.2 Variables

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54 For the purpose of selecting appropriate study variables, features of the household  
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56 (unit of analysis) and its members were analysed to describe the residences that the study  
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1 participants live in and their energy consumption habits. Variables used in other studies of  
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3 this type were also sought.  
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6 The variables chosen as indicators of the degree of household energy poverty in  
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8 relation to “social” factors and thus to household characteristics (Morrison and Shortt 2008),  
9  
10 were developed by the research team based on previous studies such as that conducted by  
11  
12 Baker et al. (2003). Similarly, the definitions of approximate measurements of low income,  
13  
14 unemployment level, and pensioner households (identified as high-risk factors) were based  
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16 on insights provided by Cormack et al. (2004), Baker et al. (2003), and Rudge (2001).  
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21 Variables used to address home typology (Cormack et al., 2004) are those defined by  
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23 Baker et al. (2003) and Rudge (2001), albeit for a different context. Meanwhile, we can refer  
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25 to Cormack et al. (2003) and Baker et al. (2003) regarding single-parent households with  
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27 young dependent children (also identified as a major risk for vulnerability) and for  
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29 determining household characteristics in terms of heating systems as a risk of energy  
30  
31 poverty. It is worth noting that the “income” indicator has been considered a proxy variable  
32  
33 for quality of life and welfare in the household. Expenses related to lighting and power  
34  
35 (household appliances), studied by authors such as Sovacool et al. (2012), were not itemized  
36  
37 separately in the empirical study.  
38  
39  
40  
41  
42

43 Taking into consideration the limitations of data availability, we do not consider the  
44  
45 possibility of assigning different weights to the various indicators to generate a specific  
46  
47 index, as described by Nussbaumer et al. (2012).  
48  
49  
50

51 The variable of the houses location was considered in order to differentiate two sub-  
52  
53 samples, the rural or the urban area, taking into account that the extent of fuel poverty in  
54  
55 areas with high proportions of small households (urban) can be overestimated and it can be  
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1 underestimates in areas (rural) with high proportions of large households (Fahmy et al,  
2  
3 2011).  
4  
5

6 Thus, the following were considered to be indicators of energy poverty intensity: 1)  
7  
8 the amount of household energy expenditures in absolute terms, and 2) the relative  
9  
10 significance of energy expenditures in relation to household's income. The Table 3 shows  
11  
12 the variables selected in our study.  
13  
14  
15

### 16 **TABLE 3**

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22

23 **Table 3. Variables used in the study and descriptive analysis of principal results. (Source: by authors)**  
24

25 The first section of the questionnaire focused on personal data related to the  
26  
27 respondent and included questions referring to education, age, gender, and the location of  
28  
29 the housing. The second part of the questionnaire collected household data and included the  
30  
31 number of residents, amount of income, housing conditions, and facilities. Expenditures  
32  
33 related to electricity, other energies and transport, and certain habits of consumption were  
34  
35 reflected in the third section. Finally, the respondent was asked whether he or she had  
36  
37 received economic aid to cope with energy bill payments and the source from which this aid  
38  
39 derived.  
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## 48 **2.3 Empirical Study**

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51 After selecting the relevant variables, the information to be used in the analysis was  
52  
53 organised. In this case, the information was compiled from an observational and non-  
54  
55 experimental perspective. After the exploratory data analysis, the main results obtained were  
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1 contrasted with evidence resulting from the statistical analysis to depict the common  
2  
3 characteristics of households living in energy poverty in the region studied.  
4  
5

6 A correlation analysis between the variables described and the two variables of  
7  
8 household energy expenditures was performed for the observational phase of the study.  
9  
10 Hence, in our analysis the assumptions of normality is not met (Muthen & Satorra, 1995;  
11  
12 Rivera & Satorra, 2002; Satorra & Bentler, 1994; Satorra, 2003), the general estimation  
13  
14 method we use is MLR, Maximum Likelihood Robust, parameter estimates with standard  
15  
16 errors that are robust to non-normality of the observed variables) (Muthen & Muthen, 1998-  
17  
18 2012). The software applications used were MPLUS 7.1 (Muthén and Muthén 1998-2012).  
19  
20 The method of analysis was considered appropriate for an initial approximation of the  
21  
22 relationship between energy costs in vulnerable households and the aforementioned  
23  
24 variables.  
25  
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### 34 **3 Results**

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36  
37 In order to approach the energy poverty phenomenon in this case stud, the principled  
38  
39 characteristics of the 615 households sample affected by energy poverty in Aragón are  
40  
41 described.  
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44

45 The situation of energy poverty of these households was certified by social services.  
46  
47 This premise allow us to consider that both, the amount of household energy expenditures in  
48  
49 absolute terms as this amount in relation to household income can be considered proxy  
50  
51 indicators of energy poverty intensity.  
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55 These households have already accredited their incomes and their inability to meet the  
56  
57 energy services. Thus, they will be more vulnerable as the energy costs increase, or when  
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1 the relationship between their energy costs and their incomes increase. In this context, the  
2  
3 main associations between the characteristics of the sample and the energy intensity  
4  
5 indicators were analysed.  
6

7  
8  
9 The main results of the analysis can be seen in Table 4.

10  
11  
12 **Table 4**  
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17 **Table 4. Main results. (Source: by authors)**  
18

19  
20 One of the obtained results is that the main cause of energy poverty in the households  
21  
22 studied is their low income level (the income derived from work or other types of public  
23  
24 funds or compensation, as well as that coming from cash transfers) and, in particular, the  
25  
26 unemployment that affects the vast majority of respondents. In fact, in more than 70% of the  
27  
28 homes, all members were unemployed at the time of the completion of the questionnaire.  
29  
30

31  
32 In more than 50% of the cases, more than 4 people reside in the household, with  
33  
34 children living in more than 75% of these residences. With regard to household income,  
35  
36 over 79% of the households are at the threshold of earning less than 9,000 euro a year in  
37  
38 2014. The percentage of households belonging to Spanish citizens is noteworthy because the  
39  
40 45.2% of the surveyed households are foreigners (immigrant population  
41  
42  
43  
44

45 With regard to the type of electrical supply contract stipulated in each household, it  
46  
47 should be noted that, in more than 50% of the cases, the respondents say they do not clearly  
48  
49 differentiate the electricity contract type in detail. Main contracts considered in the  
50  
51 questionnaire for the electricity: Voluntary Price for the Small Consumer (VPSC), “Free  
52  
53 market” tariff and “Social Tariff”. This indicates a general lack of knowledge and  
54  
55 information on rates and the possible contracts available in the Spanish market. In addition,  
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1 it is noteworthy that most respondents do not know in detail the power usage rates for which  
2  
3 they are under contract with the power companies.  
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5

6 In relation to building characteristics, most households are old houses of less than 90  
7  
8 m<sup>2</sup> (51% were built prior to 1970, and 41% are smaller than 60 m<sup>2</sup>). The tenure status is  
9  
10 predominantly rental (68.4%), and the households are located in blocks of flats (80%). With  
11  
12 regard to living conditions, a self-reported variable indicates that than 44% of the  
13  
14 respondents' households consider to have temperatures below 18 C° in winters, and a  
15  
16 similar percentage declares to have temperatures above 28 C° at home in summers. To this  
17  
18 end, more than 58% of households express dissatisfaction with these temperatures.  
19  
20  
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23

24 A study of the sample indicates that the impact of household energy supply costs  
25  
26 (bills) and resident consumption habits do not represent a significant factor in the degree of  
27  
28 the intensity of energy poverty in Aragon, except in specific cases.  
29  
30

31 In more than 80% of the analyzed cases, energy costs represent more than 10% of  
32  
33 household income. This data was considered only for descriptive purposes because the  
34  
35 energy poverty situation of households was certified by the social services. In this sense, it  
36  
37 has to be taken into account that some households may actually be under-spending precisely  
38  
39 because they are suffering energy poverty.  
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43

44 For a purely descriptive purpose, in general terms we can see how the total energy  
45  
46 expenditure in the various provinces of the region are not equally distributed, with lower  
47  
48 energy costs in the principal province (Zaragoza), where the largest city and the regional  
49  
50 capital are located. The relationship with the residence location is negative when it is located  
51  
52 in urban areas, and thus spending on energy resources is greater when the household is  
53  
54 located in rural areas. In general terms, the households located in rural areas of the sample  
55  
56 have greater incomes than the urban households. Finally, despite the fact that no significant  
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1 relationship was found between the presence of children in the home and energy  
2  
3 expenditures, as mere descriptive data, we can see that households with at least 1 child have  
4  
5 less income.  
6

7  
8  
9 It is demonstrated that the power supply contract under the social tariff programme  
10 (regulated rate reduced by 25% called “bono social”) corresponds to a lower level of energy  
11 expenditure. Consequently, the easing of conditions to access this regulated tariff could be  
12  
13 an advantage for those homes and a first step towards alleviating energy poverty in Spain. It  
14  
15 is also demonstrated that city gas and oil heating systems entail greater energy costs, while  
16  
17 butane cylinders and electric heating systems have lower costs. In short, homes located in  
18  
19 rural areas are mostly owned by survey respondents, are larger than those located in urban  
20  
21 areas, and have fewer facilities for heating and air conditioning systems (HVAC), which  
22  
23 represents an increase in electrical expenditures. Nonetheless, they possess heating systems  
24  
25 with alternative energy sources such as stoves and fireplaces, a point in favour when  
26  
27 exploring at a local level for alternative sources of energy in the region.  
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36 At this point, it is noteworthy that the possible use of renewable sources, which are  
37  
38 abundant in the region, was not analysed, primarily because almost all of the households  
39  
40 studied are connected to the network and currently there is low penetration of solar thermal  
41  
42 or photovoltaic equipment in homes with the aforementioned features where the survey  
43  
44 respondents reside. In addition, the Spanish rules for renewables do not represent an  
45  
46 affordable framework for these solutions and premium tariffs for micro-generation or small  
47  
48 scale renewable heat have not been promoted to help the fuel poor.  
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54 With regard to types of social aid, it was possible to confirm that households receiving  
55  
56 more support spend less in the energy bills, and thus, users of this type of social services  
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1 might generally control spending more carefully, probably because of its situation of urgent  
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3 necessity and the indirect control of social services.  
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6 It may be proposed, then, that there is an increased and more pressing intensity of the  
7  
8 energy poverty phenomenon in those homes located in urban areas, where building features  
9  
10 and available facilities, such as home appliances, have a negative impact that limits the use  
11  
12 of alternative energy sources and possible preventive measures in terms of refurbishing their  
13  
14 residences because they are mostly block flats and rental units because the majority of urban  
15  
16 houses are not equipped with fireplaces and they cannot use other fuels such as biomass.  
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#### 24 **4. Discussion**

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27 In the region analysed as study case, there was an increase in the degree of attention  
28  
29 paid to energy poverty during the recent years by the regional institutions, as well as by  
30  
31 society and the media. This was principally due to the notable increase in emergency aid for  
32  
33 energy requested by families that in 2014 increased by 90% compared to the previous year.  
34  
35 These aids have been generally linked to housing (mainly under the Art. 47 of Spanish  
36  
37 Constitution), without detriment to the fact that this phenomenon has to be dealt with as an  
38  
39 index of relative poverty within the relevant problem related to absolute poverty.  
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45 At present, these subsidies received or requested by the homes affected by energy  
46  
47 poverty in the region are different in number and magnitude and they depend on the county  
48  
49 or the municipalities. Public administration and private entities (NGOs) that also work in  
50  
51 these households do not have common aid criteria. Furthermore, these criteria do not  
52  
53 correspond to the poverty rate for each household but instead to local regulations and budget  
54  
55 availability. Additionally, there are differences in the provision of services that are  
56  
57 ultimately unrelated to the needs associated with the level of energy poverty in the  
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1 household or the gravity of the situation. Thus, an urgent need to unify the criteria for  
2  
3 allocating the subsidies in the whole region was pointed out as result of this study.  
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5

6 Despite their heterogeneity, the emergency measures implemented in the Region to  
7  
8 date can be considered adequate to provisionally alleviate the problem of energy poverty.  
9  
10 However, experts interviewed during the qualitative analysis stressed that these are  
11  
12 measures which, as the name suggests, have to be used only for urgent and unexpected  
13  
14 situations, during a short period. Specific planning at regional level seems to be necessary in  
15  
16 this regard to prevent household needs growing uncontrollably. The measures are justified  
17  
18 by their urgency but if they are used indefinitely could cause an increase in the problem  
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20 instead of promoting its prevention.  
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26 In this context, potential measures to be taken in the region in order to address  
27  
28 principal needs pointed out by the study were analysed: a) to elaborate specific regional  
29  
30 policy measures, especially concerning energy efficiency and the emergency measures  
31  
32 management; b) to avoid electricity disconnections in the energy poverty households; c) to  
33  
34 propose amendments to the regional or national legislation. Principal proposals regarding  
35  
36 this subject are summarized in the following paragraphs.  
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39  
40

41 As a first step, the development of administrative powers of the Regional Government  
42  
43 in areas such as consumer, energy and social services were also analysed. In Spain, regions  
44  
45 could regulate the protection of energy consumers and, in particular, those in energy  
46  
47 poverty<sup>3</sup>. In this point the possibility to regulate the electricity as an essential service could  
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57  
58 <sup>3</sup> By amending regional Law 16/2006 of 28 of December on the Protection and Defense of Consumers  
59 and Users of Aragon and article 5 of Law 16/2006, about consumers that can be protected (paragraph f refers  
60 to vulnerable consumers so it could be applied to households in energy poverty).  
61  
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1 be considered in those household affected by energy poverty, particularly where elderly and  
2  
3 children resided, in order to avoid electricity disconnections<sup>4</sup>.  
4  
5

6 This analysis led to the conclusion that an interdepartmental group of experts would  
7  
8 have to be constituted in relation to prevent regional energy poverty to propose as well  
9  
10 specific solutions for those affected households. The accreditation by social services of  
11  
12 households affected by energy poverty respond to this need in most cases, despite the fact  
13  
14 that it could prove restrictive in some cases by excluding a number of households that suffer  
15  
16 the consequences of the problem that are not recipients and/or applicants for social aid.  
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21 By conducting the field work in close collaboration with both regional social services  
22  
23 and active NGOs in this area, it was possible to measure the extent of the phenomenon of  
24  
25 accredited energy poverty and to observe some of the determinants in homes at the regional  
26  
27 level. In fact, the accreditation of energy poverty makes it possible to define the intensity of  
28  
29 the problem at a regional level, to locate households in need according to their  
30  
31 characteristics and to plan public and private interventions.  
32  
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35

36 The public grants aimed at energy refurbishment of buildings available at regional  
37  
38 level were also discussed given the results obtained in the empirical phase. The grants  
39  
40 offered by the Regional government yearly would have to be amended in order to apply  
41  
42 them to specific situation of houses under energy poverty. At present their purpose is in fact  
43  
44 raised to reduce energy consumption and improve thermal conditions of the buildings under  
45  
46 parameters required by regulation. This means a private investment and high energy saving  
47  
48 performance. Thus, these conditions preclude its usefulness for houses affected by energy  
49  
50 poverty because they cannot contribute to the investments and they have reduced energy  
51  
52 consumptions.  
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60 <sup>4</sup> This could be achieved amending Law 16/2006 and applying article 89 of RD 1955/2000.  
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63

1 Another question pointed out through the empirical study was related to the  
2  
3 coordination of the different public urgent aids offered by social services and other  
4  
5 monetary donatives delivered by non-profit entities. It definitively required of the  
6  
7 implementation of a coordinated track of the households receptors. In this sense, the need to  
8  
9 harmonize protocols for specific data collection related to energy poverty at regional level  
10  
11 was pointed out as one of the commitment of the Region in the short term.  
12  
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16 A lower level of energy expenditure in households with social tariffs was detected in  
17  
18 the analysed sample. It led to the conclusion that easing the conditions of access to  
19  
20 electricity social tariffs is needed in Spain. It is noteworthy that in some cases the owners  
21  
22 are the electricity contracts holders rather than tenants, making it impossible to demand  
23  
24 social tariffs in those households affected by energy poverty where it is impossible to  
25  
26 adequately manage the bills.  
27  
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31 In order to avoid electricity disconnection, the solution adopted in another Spanish  
32  
33 region, Catalonia, was taken into consideration where it is illegal to disconnect the power  
34  
35 during the cold winter months in these households (Síndic de Greuges de Catalunya 2013).  
36  
37 In Aragón, this option was rejected. As an alternative solution, several agreements were  
38  
39 signed between local authorities and electricity utilities in order to avoid disconnections of  
40  
41 those households' receiving emergency aid for energy.  
42  
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44  
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46 When analysing a regional plan for energy poverty in the midterm, a specific training  
47  
48 action for social services was proposed as one of the potential solutions to promote the  
49  
50 implementation of the low-cost measures for these households. The training action would be  
51  
52 focused on the information needs about electricity tariff, contracts and potential savings  
53  
54 related to energy consumption and bills.  
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## 5. Conclusion and Policy implications

Spain has not been excluded from the energy poverty phenomenon and various national institutions have taken steps mainly to assess the problem at the local, regional, and national level and define which actions ought to be taken and measures adopted. In this country, a sphere of powers allows regions (called “Autonomous Communities”) to regulate specific measures related to energy poverty through the establishment of regional policies<sup>5</sup>. Exclusive administrative powers in the field of consumption, training and education or the regulation of authorizations for energy facilities and energy planning at regional level correspond to the regions (called “Autonomous Communities”). Social action, including the management, organization and development of a public system of social services, is regulated under the jurisdiction of shared competencies as well.

Indeed, the development of regional strategies in the energy field intended to restrict the exclusion of homes affected by energy poverty is deeply impacted today by the multi-level governance aspects and the limitations in the public budget available for this problem.

In this context, this study has sought to achieve a first approximation of the characteristics that lead to energy poverty in a Spanish region, Aragón, where the public energy poverty strategy occur is affected by 2 essential factors: a deep economic crisis and the fact that we are addressing a problem within a general framework of poverty.

The Regional Government of Aragon, within its powers, monitors at present the distribution and commercialization utilities concerning the customer’s rights, paying special attention to the rights of vulnerable consumers. Thus, the agreements signed between

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<sup>5</sup> Under the articles 140 and 149.1 of Spanish Constitution



1 utilities and local administrations in order to avoid disconnection in these households can be  
2  
3 considered an adequate solution.  
4  
5

6 In any case, regions must identify the households that are the most vulnerable to the  
7  
8 problem and their main features to take concrete steps which are preventive and/or palliative  
9  
10 in nature, suitable for every type of home, and considered on the basis of the index of energy  
11  
12 poverty. However, such aid is allotted according to stipulated amounts and local budget  
13  
14 availability.  
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19 That is why it is necessary for the responsible authorities to have an understanding of  
20  
21 the determining factors of the energy poverty and its intensity in each case to implement a  
22  
23 series of specific measures.  
24  
25

26  
27 The results obtained through the analysis can be applied to the decision-making of the  
28  
29 regional government to implement palliative measures, while long-term preventive measures  
30  
31 are not being adopted because they require higher budgetary allocation.  
32  
33

34  
35 In this context, domestic consumers affected by energy poverty, in particular, those  
36  
37 living on a limited income but with required energy expenditures, should benefit from  
38  
39 special pricing schemes to avoid the negative impact of the crisis because these homes suffer  
40  
41 the negative consequences of this phenomenon on a daily basis.  
42  
43

44  
45 National practices of the member countries concerning vulnerable consumers under  
46  
47 the EU Directives could affect the number of consumers living in energy poverty because  
48  
49 the price of essential energy products only represents a percentage of the final bill;  
50  
51 numerous taxes, levies, supports for diversification and energy security, etc., which depend  
52  
53 on national energy policy, must be added.  
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1           Despite the limited powers of the Spanish regions in this field, there is still room for  
2  
3 significant improvement on the part of the regional and local administrations regarding the  
4  
5 prevention of electricity disconnections in these households.  
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8  
9           Nevertheless, any proposals coming from the regional government led to the  
10  
11 modification of national regulation in the energy field have no binding character. Regional  
12  
13 proposals in this case were addressed to the regulatory changes concerning the application  
14  
15 of specific inclusion of those people living in energy poverty, because they have to have  
16  
17 access to this social tariff whatever the circumstances. A reduction of VAT (value added  
18  
19 tax) and other tax rates for those consumers in energy poverty could be proposed as well.  
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23  
24           Additionally, in relation to performance, regional institutions should provide  
25  
26 transparent information to consumers and education, efficient control management, and  
27  
28 specific local measures, among others, particularly in publicly owned housing, even if only  
29  
30 in the local sphere.  
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33  
34           For this reason, the main objectives of this work have been achieved through the  
35  
36 development of a methodology for an observational quantitative analysis and the description  
37  
38 of energy poverty in households through a regional case study.  
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41

42           It is important to note that this study is only a description of a state or moment in time  
43  
44 in a Region, and cannot capture the dynamic interrelationships among the different factors.  
45  
46 The use of more complex statistical techniques that enable the study of the type and the  
47  
48 direction of the relationship between variables remains a future line of inquiry, especially  
49  
50 because the methodology used in the present only allowed for studying linear relationships.  
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53

54           The limitations of the study in terms of geographic scope and the breadth of the  
55  
56 variables tested can open new lines of future research aimed characterising and modelling  
57  
58 the main determinants of the energy poverty index in European households and to establish  
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1 correlations between these determinants and the palliative or preventive measures to be  
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3 applied.  
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3

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13  
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15

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19  
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Table 1

	2011	2012	2013	2014	2015 ( <i>estimated</i> )
Total number of households	542	716	1301	2471	3088

Table 2

	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015 (estimated)</b>
Local Administrations (Euro)	144,492.01	144,558.98	217,909.45	382,049.91	447,950.09
NGOs (Euro)	NA	NA	428,114.66	837,235.10	981,650.62
Total (Euro)	144,492.01	144,558.98	646,024.11	1,219,285.01	1,429,600.71

Table 3

VARIABLES	VALUE LABELS	%	Cumulative%
<b>PROVINCE</b>	Huesca	14.8	
	Teruel	13.0	
	Zaragoza	72.2	
<b>RESIDENCE</b>	Rural	21.6	
	Urban	78.4	
<b>NACIONALITY</b>	Spanish	54.8	
	Others	45.2	
<b>HOUSEHOLD INCOME</b>	Less than 9,000€/year	79.7	79.7
	From 9,000 to 14,000€/year	15.8	95.4
	From 14,001 to 19,000€/year	2.3	97.7
	From 19,001 to 25,000€/year	2.3	100.0
<b>HOUSEHOLD STRUCTURE</b>	1 Member	10.9	10.9
	2-3 Members	32.0	42.9
	4-5 Members	43.9	86.8
	More than 5 Members	13.2	100.0
<b>CHILDREN IN THE HOUSEHOLD</b>	No Childrens	24.1	24.1
	1 Child	21.8	45.9
	2 Childrens	27.8	73.7
	3 Childrens	16.1	89.8
	More than 3 Childrens	10.2	100.0
<b>ACTIVE WORKRES</b>	All members unemployed	71.2	71.2
	At least one member	24.9	96.1
	Two or more members	3.9	100.0
<b>HOME OWNERSHIP</b>	Owner	25.2	
	Rent	60.8	
	Other	14.0	
<b>YEAR OF CONSTRUCTION OF THE BUILDING</b>	Before 1970	49.6	49.6
	From 1970 to 1979	16.8	66.4
	From 1980 to 1989	12.0	78.4
	From 1990 to 1999	9.8	88.2
	From 2000 to 2010	10.0	98.3
	After 2010	1.7	100.0
<b>HOUSING TYPE</b>	Housing in Tower Block	81.5	
	Houses	18.5	
<b>TAMAÑO DE VIVIENDA (m<sup>2</sup>)</b>	Less than 60 m <sup>2</sup>	39.9	39.9
	From 60 to 75 m <sup>2</sup>	25.3	65.2
	From 76 to 90 m <sup>2</sup>	17.1	82.4
	More than 91 m <sup>2</sup>	17.6	100.0
<b>NUMBER OF ROOMS</b>	Less than 4	16.2	16.2
	5 Rooms		
	6 Rooms		
	More than 6		
<b>TYPE OF CONTRACT (ELECTRICITY)</b>	Voluntary price small cons. (VPSC)	46.3	
	“Free Market”	35.9	
	“Social Tariff”	17.8	
<b>POTENCIA</b>	Less than 3 kW	58.7	58.7
	From 3 to 4 kW	17.9	76.7
	From 4 to 5 kW	10.5	87.2
	More than 5 kW	12.8	100.0
<b>HOT WATER SYSTEM</b>	Individual	90.5	
	Centralized	6.9	
	Solar collectors	2.6	
<b>HOT WATER HEATING SYSTEM</b>	No	39.6	
	Yes	60.4	
<b>HEATING SYSTEM</b>	Individual	80.8	
	Central	19.2	
<b>ALTERNATIVE HEATING SYSTEM (No electricity and no gas)</b>	No	65.9	
	Si	34.1	

TABLE 4.

	<i>ENERGY COSTS</i>	<i>% ENERGY EXPENDITURES ON TOT. HOUSEHOLDS INCOME</i>
<b>PROVINCE</b>		
HUESCA*	.096**	.021
TERUEL*	.162***	-.026
ZARAGOZA*	-.198***	.003
<b>RESIDENCE</b>		
URBAN *	-.081**	.084**
<b>NATIONALITY</b>		
SPANISH*	.054	-.069*
<b>HOUSEHOLD INCOME</b>		
ANNUAL INCOME	.477***	--
INCOME HIGHER THAN 9,000 €	.434***	--
<b>HOUSEHOLD STRUCTURE</b>		
HOUSEHOLD SIZE	.019	.039
NUMBER OF ADULTS	.075*	-.031
CHILDREN IN THE HOUSEHOLD *	-.011	.078*
NUMBER OF CHILDREN	-.023	.065
<b>LABOUR STATUS</b>		
ALL MEMBERS UNEMPLOYED *	-.300***	-.008
NUMBER OF ACTIVE MEMBERS	.301***	-.047
NUMBER OF UNEMPLOYED MEMBERS	-.115***	.000
<b>HOME OWNERSHIP</b>		
OWNER	.101**	-.081**
RENT	-.122***	.025
OTHER	.044	.066
<b>CHARACTERISTICS OF THE HOUSING</b>		
CONSTRUCTION AFTER 1970	.114***	.035
YEAR OF CONSTRUCTION	.195***	.063
HOUSING IN TOWER BLOCK *	.057	-.032
SURFACE AREA OF THE HOUSING (m2)	.174***	-.022
NUMBER OF ROOMS	.195***	-.009
<b>CHARACTERISTICS OF SUPPLY</b>		
UNKNOWN TYPE OF CONTRACT *	-.122***	-.032
UNAWARE OF POWER *	-.193***	-.064
UNAWARE OF CONTRACT AND POWER *	-.176***	-.054
KILOWATTS CONTRACTED (kW)	.207***	.049
TYPE OF CONTRACT –VOLUNTARY PRICE (VPSC)	.120***	.103**
TYPE OF CONTRACT- FREE MARKET *	.103**	-.006
CONTRACT TYPE-SOCIAL TARIFF *	-.103**	-.089**
<b>HEATING SYSTEM</b>		
ELECTRIC	-.188***	-.156***
CITY GAS	.259***	.244***
OIL	.174***	.067*
CYLINDER	-.051	.000
NONE	-.174***	-.129***
<b>HOT WATER EQUIPMENT</b>		
INDIVIDUAL	-.150***	-.211***
CENTRALIZED	.192***	.234***
SOLAR COLLECTORS	-.029	.018
<b>LIVING CONDITIONS</b>		
ELECTRICITY DISCONNECTIONS*	-.020	.075*
TEMPERATURE IN WINTER	.367***	.228***
TEMPERATURE IN SUMMER	-.167***	.001
TEMPERATURE SATISFACTION*	.161***	-.013
HEATING SYSTEM *	.302***	.213
COOLING SYSTEM *	.093**	.049
<b>SITUATION</b>		
NUMBER OF SUBSIDIES FOR ENERGY	-.071*	.039
SOCIAL SERVICES AID *	-.088**	.074
NGOS AID*	-.105***	-.022
FAMILY AID FRIENDS *	.031	.036

\* Dichotomous Variable: 1, presence of the feature/attribute; 0, absence

\* p-value &lt;0.10; \*\* p-value &lt;0.05; \*\*\* p-value &lt;0.00.