3 How Do We Measure Energy Poverty? The Limitations of Energy Expenditure as an Indicator

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3.1 Introduction

The discourse around energy poverty, like economic poverty, has developed from one-dimensionality to a multidimensional perspective. The most recent advances recognise that energy poverty refers not only to access and affordability of energy services but also to the quality of energy and the equipment available to satisfy different energy uses. In this way, Ibáñez Martín et al. (2019) define energy poverty as the deprivation of essential energy services for human life, arising from a lack of access, quantity, and quality not only of energy but also of appliances. This deprivation is caused by various factors (socioeconomic, geographic, buildings, cultural and so on), which ultimately affect the level of well-being of household members. Also, the most severe state of energy deprivation, called energy indigence, refers to the lack of access to energy services (*ibid.*).

Despite recognising the multidimensionality, most of the antecedents that empirically address the subject do so from a single indicator. The studies commonly resort to the indicator proposed by Boardman (1991), under which a household is energy poor if it allocates more than 10% of its income to energy expenditure. Without considering spending as an input, there are also the indicators proposed by Nussbaumer et al. (2011), which focus on the deprivation of access to modern energy services. Alternative approaches have been proposed since then. For instance, Healy (2004) measures fuel poverty with an index that considers three objective and three subjective indicators. The objective indicators address housing conditions and equipment, whilst the subjective ones capture if people experience any kind of deprivation in their energy needs. Dehays and Schuschny (2018) propose indicators that seek to assess the degree of social inequality with respect to household access to and use of energy. García Ochoa (2014) applies the Method of Satisfaction of Absolute Energy Needs. Under this approach, energy poverty occurs when a household does not have all the assets (appliances or equipment) considered essential to satisfy the needs of household members. There are several studies that apply this method in the literature (Alfaro, 2017; Schimer et al., 2023; Velásquez, 2023). There are also other advances in terms of multidimensional indicators to measure energy poverty, both for Argentina (Durán & Condori, 2016) and the rest of the world (Bollino & Botti, 2017; Hernández et al., 2018; Mendoza et al., 2019; Sokołowski et al., 2020).

The objective of this chapter is to carry out an application of the various indicators proposed by the literature for the measurement of energy poverty in Argentina and to show the dissimilar results that can be reached depending on the indicator used. On the other hand, a discussion regarding the usefulness of the self-reported energy expenditure indicator will be presented. The results obtained from the energy expenditure declared in the National Household Expenditure Survey 2017–2018, conducted by the National Institute of Statistics and Censuses (INDEC

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to use its acronym in Spanish), will be compared to the expenditure calculated from a model, following Dubois (2022), to estimate consumption per household based on its equipment and declaration of use of this survey. The main objective of this analysis is to expose that empirically approaching a multidimensional phenomenon with a single indicator based on energy expenditure is an extreme simplification of a central and complex problem in the present world.

3.2 Energy poverty: a multidimensional phenomenon?

Energy poverty is a phenomenon that has gained attention in academic discussions since the 1980s. However, its definition is still under debate (Romero et al., 2018). The first academic contributions on energy poverty adopt a subsistence approach and take the definition of poverty proposed by Rowntree (1901), for whom a household is deprivedwhen its members can't meet basic satisfiers to maintain a certain level of physical efficiency with their income. Under this perspective, also adopted by the European Economic and Social Council (EESC), fuel poverty is defined by the estimation of a poverty line using a temperature threshold that guarantees thermal comfort and the percentage of income allocated to fuel costs required to reach said level (García Ochoa, 2014). Under this notion, the most widely used indicator places households as energy poor if they spend more than 10% of their income to satisfy energy services (Boardman, 1991; Foster et al., 2000).

Some authors (Healy & Clinch, 2002; Whykey & Callender, 1997) criticise the subsistence focus on fuel poverty. Their criticism is based on the methodological difficulty of obtaining precise data on the comfort temperature in the dwellings, the occupation time of the people who inhabit them, and the sources of household income. Therefore, broader definitions of energy poverty arise, considering the lack of access to modern and clean sources of energy (UNDP, 2005). Modi et al. (2005) define as energy poor as a household that cannot access the basic energy services necessary to combat poverty. From this perspective, energy and energy services are considered fundamental inputs for the development of personal capacities.

In line with the discussions on economic poverty, the debate around the definition of energy poverty transitioned from a one-dimensional to a multidimensional perspective. Under the last approach, energy poverty is evaluated based on the incidence that this state of deprivation has on people's development. Then, the conceptions advanced towards multidimensional definitions (García Ochoa, 2014). Along these lines, the European Observatory on Energy Poverty considers a household to be in a situation of energy poverty if it experiences inadequate levels of energy services due to a combination of high energy expenditure, low income, inefficient buildings and appliances, and specific household energy needs. Rojas and Ibáñez Martín (2016, p. 123) define access to energy as "the scope to clean, reliable and affordable energy services for cooking and for heating, lighting, communications and productive uses. The lack of access is recognized as energy poverty and the people who suffer from it belong to the so-called vulnerable sectors". Castelao Caruana et al. (2019) agree that this problem is the result of a lack of access to modern and reliable energy services, conditioned by the connection, the quality of the service, and the type of technology available. At the same time, energy poverty is the product of the interaction between energy prices, the energy efficiency of dwellings –its infrastructure and equipment – and household income. In this sense, the definition of the phenomenon has advanced towards positions that contemplate not only access and the relationship between energy expenditure and household income but also incorporate elements such as subjectivity, the temporality of satisfaction, and the various energy services and appliances.

3.3 How to measure energy poverty?

As mentioned in the previous section, the conceptual discussion of energy poverty has advanced towards multidimensionality; however, the empirical approach to energy poverty has prevailed mainly in one-dimensional measurements. This predominance finds various justifications, but mostly it is due to the lack of information sources that contemplate multiple aspects related to the satisfaction of energy services, affordability, disposition of appliances, building conditions, etc. Additionally, some definitions contemplate subjective dimensions to assess the state of the energy shortage, making it even more complex to have such information in the periodic surveys of developing countries.

It is worth noting that in recent years, measurements from a multidimensional perspective have increased (Abbas et al., 2022; Falak et al., 2014; Liu et al., 2022; Mendoza et al., 2019; Sokołowski et al., 2020; Wang & Lin, 2022). However, because multidimensional measurements are very demanding regarding the availability of information, their measurement is not usual in the economies of Latin American countries (with the exception of Chile). Based on a single indicator or dimension in developing countries, studies are mostly used to compare realities between economies (Calvo et al., 2021; Lampis et al., 2022; Rocha & Schuschny, 2018; Soares et al., 2023).

Within the studies that focus their efforts on measuring the phenomenon of energy poverty, there are a series of indicators that are mostly used. One of the most widely used indicators is the one that derives from the concept of fuel poverty, known in the literature as the "10% indicator" (Boardman, 1991). The calculation of the latter consists of classifying a household as poor if it allocates more than 10% of its total income to the payment of energy services (*ibid*.), considering any type of carrier/fuel to satisfy energy needs (e.g., natural gas, bottled gas, firewood, coal, kerosene, waste, electricity, etc.). Using household energy expenditure in relation to their income is intended to capture their ability to pay to satisfy energy services (for cooking, heating, sanitary hot water, food refrigeration, and space cooling, among others). Behind this indicator, just like the measurements of economic poverty by income, it is implicit that income is a good measure to capture the well-being of the population. In the work of Calvo et al. (2021), in order to analyse the ability of households to achieve an energy expenditure that allows for satisfying the needs within the home, the representative expenditure of each country is estimated, weighting the average energy consumption with the respective energy prices for each year. In order to evaluate the economic pressure that this expense means on the home, it must be compared with the income of the population, considering quintiles. In other words, what is usually criticised for this indicator is its inability to capture the real-world perspective of each country. In countries, such as Argentina, where the energy used at the residential level is heavily subsidised, the 10% threshold may be too high and only capture very severe deprivation situations (Zabaloy et al., 2022).

The 10% indicator is also criticised for other aspects. On the one hand, permanent surveys usually collect information on spending declared by the household referent. This type of information usually has problems in its collection because, in many cases, the respondent is not the one who pays the household expenses, or, with the advance of electronic payments, in many cases there is no detailed monitoring of this type of expenditure (Cecchini et al., 2021). In homes that use firewood, coal, and kerosene, this type of expense is usually not linked to a bill and is made intermittently throughout a month (e.g., depending on the needs at the time, when the fuel runs out, when income is received, etc.). This type of behaviour can cause underestimations or overestimations of energy expenditure, which is one of the two main inputs for measuring energy poverty with this indicator. Although the indicator proposed by Boardman is based

on the required energy expenditure and is therefore modelled and not based on statistics, many empirical applications build this indicator from household survey statistics. The other criticism is associated with the other input of this indicator: household income. The important survey problem presented by the income variable is well known. According to various studies, lower-income households tend to declare more income than they actually have, whilst higher-income households underreport their values. This type of bias has been extensively studied by specialists in vulnerability and poverty measurements (Bonelli et al., 2021; Gasparini et al., 2022).

Another strategy to measure energy poverty is to analyse the fuel that households use to satisfy their energy needs. In this sense, there are various studies that characterise as energy poor those households that burn highly polluting fuels for cooking, heating, and obtaining domestic hot water (Castelao Caruana et al., 2019; Ibáñez Martín et al., 2019; Lampis et al., 2022). Ibáñez Martín et al. (2022) analyse this situation of energy deprivation and reflect on its use as an indicator of energy poverty. The authors conclude that the use of traditional fuels to satisfy energy service needs indicates a deprivation of access to other less polluting (and generally less expensive) sources and, therefore, could be associated with the notion of energy indigence (*ibid.*).

The European Union's Energy Poverty Observatory (EPOV) proposed a set of indicators that are divided into primary and secondary. There are four primary indicators: two relating to subsistence – double the median (2M) and half the median (M/2) – and two consensual – delay in utility bills and inability to keep the dwelling adequately warm. The suggested subsistence indicators complement each other. The 2M indicator consists of capturing those households in which the energy expenditure-income ratio is more than double the national median. On the other hand, the M/2 indicator captures those who spend on energy less than half the national median. The latter could be innovative since it takes into account those households that may be saving energy in order to be able to pay for the service. However, there are several weaknesses to this indicator, which are pointed out in the next section. In the next section, an alternative absolute threshold metric that addresses some of the M/2 shortcomings, that is, the hidden energy poverty (HEP) indicator, is proposed. The EPOV's secondary indicators pursue the objective of explaining the origin of deprivation, that is, why it is possible for households to be in energy poverty. To do this, they consider the prices of the different types of energy used to generate electricity (e.g., petroleum derivatives, mineral coal, and solid biomass) and the final prices of electricity and natural gas paid by users. Aspects of the household are also considered, such as the number of people who live in it, its floor area, the presence of water leaks or humidity, the home's energy efficiency rating, and access to equipment. Finally, other macro indicators are considered, such as the economic poverty rate, deaths during the winter period, and population density.

Of the indicators proposed by EPOV, the most used in empirical application studies are 2M and M/2 (Emre & Sozen, 2022; Longo et al., 2020; Stevens et al., 2022; Thema & Vondung, 2020). The 2M indicator is also adjusted to capture the fact that the attributes and consumption of a household do not change proportionally but rather depend on the size of the household. This modification gives rise to the relative 2M (2Mr). Its diffusion is mainly linked to the ease of its calculation, the potential for making comparisons and the low demand for information that it possesses. On the contrary, the secondary indicators do not find a high application, at least for countries that do not belong to the European Union, due to the important requirement that they imply in terms of data collection (Martín-Consuegra et al., 2020).

Leaving aside the unidimensionality, indicators that try to capture the complexity of energy poverty have been developed. On this path are the "Satisfaction of Absolute Energy Needs" (NAEs, to use its acronym in Spanish) elaborated by García Ochoa (2014). García Ochoa (2014) develops the method of NAEs and includes the energy services of cooking and refrigerating

food, heating water for personal hygiene, adequate lighting, and entertainment activities. This methodology uses economic assets as a measurement instrument to determine if a household is in energy poverty, considering that a household does not have the economic assets determined to satisfy the NAEs. The other approach is the "Multidimensional Energy Poverty Index" (MEPI) method, developed by Nussbaumer et al. (2011). The MEPI proposes to capture, both in quantity and quality, the access to energy services considered and offers a greater analysis of the elements that determine energy demand. Consequently, dimensions are defined for particular energy services relating to cooking, lighting, food preservation, entertainment, education, and telecommunications. Then, the methodology assigns dichotomous variables for each dimension that inquire about the possession of the necessary equipment, access to electricity, and access to safe energy sources for cooking. Finally, it assigns a weighting for each dimension, and the index is calculated. The MEPI measures incidence – number of households in PE; and intensity – how poor are the energy poor (Nussbaumer et al., 2011). As mentioned above, the application of these multidimensional perspectives has increased in recent years. The growth of multidimensional measurements of energy poverty is accompanied by an improvement in the collection of primary data in different countries. For instance, national surveys are beginning to collect information on energy issues, as is the case of the National Household Expenditure Survey 2017–2018 in Argentina.

3.4 Energy poverty in the Argentinian context: an application for the province of Buenos Aires

As mentioned in previous sections, energy poverty indicators based on energy expenditure are the most widespread. However, the conclusions that can be reached with its use can vary. The objective of this section is to carry out the application of these indicators for a specific case, an area of the province of Buenos Aires, and to highlight the disparity of results that can be reached based on the information used for its analysis. Additionally, it is discussed whether the 10% threshold is representative of the real-world situation in Argentina.

3.4.1 Data and sample

Given the objective to apply energy poverty indicators based on energy expenditure, the National Household Expenditure Survey (ENGHo, to use its acronym in Spanish) for the year 2017–2018 is used as the main source of information. The ENGHo is carried out by the National Institute of Statistics and Censuses (INDEC, to use its acronym in Spanish), with a variable frequency. The first available information base is from the period 1985–1986, and there are also the 1996–1997, 2004–2005, 2012–2013, and 2017–2018 editions. The National Household Expenditure Survey appraises urban centres whose population is equal to or greater than 2,000 inhabitants and reaches approximately 45,000 households throughout the country in order to represent the regional and socioeconomic diversity of Argentina.

INDEC, as coordinator of the National Statistical System (SEN), oversees the ENGHo, and the Provincial Statistics Offices are responsible for the survey in their respective jurisdictions. The ENGHo 2017–2018 edition incorporates – based on a technical cooperation agreement between the Ministry of Energy and INDEC in 2017 – a Special Energy Module (INDEC, 2022). This special module aimed to expand and update the equipment section of the ENGHO 2012–2013 and add (in addition to ownership) questions about the use of the equipment, its age, the energy efficiency label (if applicable), and other questions related to the use of energy. The aforementioned difference that ENGHo 2017–2018 has makes it a fundamental input for the

development of energy policies oriented to the residential sector, and therefore it will be used as a source of information. Additionally, the "energy consumption" block allows for estimating the energy matrix of households.

In order to limit the volume of data and also reduce the climatic heterogeneity that the Argentine territory presents, a determining aspect in energy consumption (OLADE, 2017), the sample has been limited to those households that comprise part of the interior of the province of Buenos Aires (Figure 3.1). The ENGHo 2017–2018 contains a representative sample of 1,725 urban households in the considered region, whose representativeness reaches the value of 1,633,388 households. Within the considered subregion, there are two different bioclimatic zones according to the bioenvironmental characterisation specified in the IRAM 11603 standard. These are the warm temperate zone (III) and cold temperate zone (IV). A brief characterisation of each zone is explained below. Zone III, classified as warm temperate, has relatively hot summers and average temperatures between 20°C and 26°C, with average maximums greater than 30°C. Winter presents average temperature values of between 8°C and 12°C and minimum values that are rarely less than 0° C. This area is subdivided into two subzones: a and b, depending on the thermal amplitudes: subzone IIIa with thermal amplitudes greater than 14°C and subzone IIIb with thermal amplitudes less than 14°C. Zone IV, classified as cold temperate, is divided from Zone III by the isoline of 1,170 heating degree days (HDD18) and, as a lower limit with Zone V, by the isoline of 1,950 HDD18. Within it, summers are not harsh and have average maximums that are rarely higher than 30°C. Winters are cold, with average values between 4°C and 8°C, and the average minimums often reach values lower than 0°C. This zone is subdivided into four subzones (IVa, IVb, IVc, and IVd) by means of the thermal amplitude lines of 14°C and 18°C. In any case, within the considered area, there are only subzones IVc, transition, and IVd, maritime.

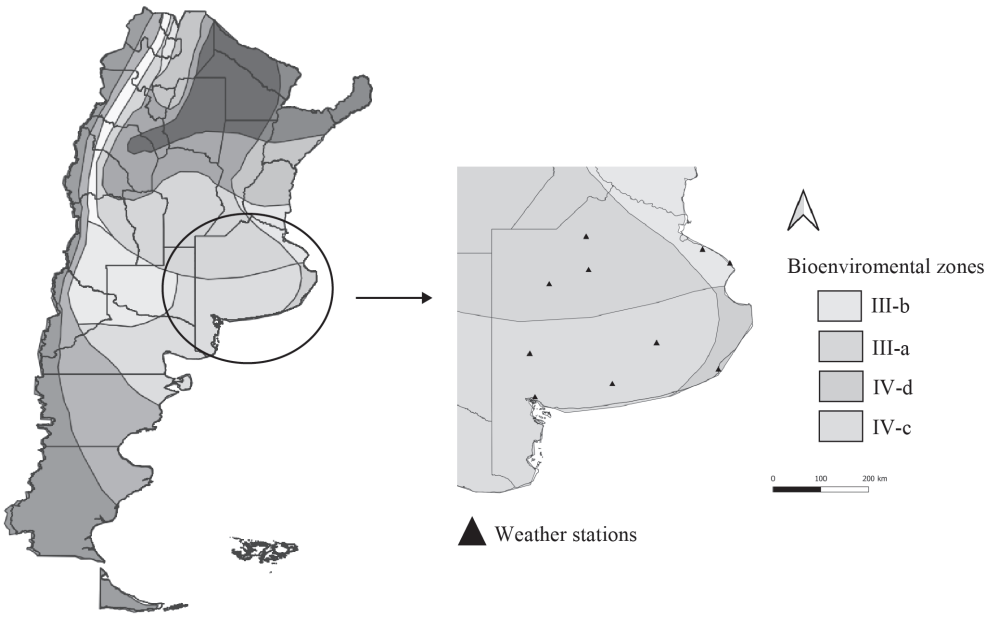

Figure 3.1 Geographic location and bioclimatic zones of the selected sample of households.

Source: Qwn elaboration.

3.4.2 Results

For this analysis, the indicators already mentioned are used: 10% and 2Mr (double the relative median). As developed, both indicators relate energy spending to household income. The 10% indicator considers in energy poverty the household that allocates more than this proportion of its income to pay for energy (Boardman, 1991). The 2Mr indicator determines that a household is energy poor if it has an "energy expenditure-income" ratio that exceeds twice the median of the "energy expenditure-income" ratio of the sample considered (EPOV).

For the estimation of the indicators, some methodological considerations were made, which is necessary given the Argentine context. Given that the survey is carried out for a full year and that, in addition, the increase in the Wage Index for said period was 28% (INDEC), income is deflated based on the quarter to which the declarations of each home correspond. For this, the last quarter (months September, October, and November) is considered the reference period, deflating the income of the declarations taken in the other quarters. Additionally, to estimate the 2Mr indicator, a "Modified Equivalence Scale" proposed by the OECD is used, which is based on the assumption (empirically validated) that certain economic variables of the household do not increase in the same proportion depending on the number of household members whilst also distinguishing between adult and minor members (Mancero, 2001). Thus, this equivalence expresses that both income and energy consumption, and consequently energy expenditure, do not increase in the same proportion according to the number of household members. The equivalence is applied using the following equation:

$$y = \frac{Y}{1 + 0,7\left(A - 1\right) + 0,5K} \tag{3.1}$$

Where y is the number of equivalent household members, Y is the number of members declared in the survey, A is the number of adults, and K is the number of children under the age of 14 years. Given the characteristics of the 2Mr indicator, using this equivalence allows for less distortion in the estimation of the median.

The indicators are calculated in two different ways: on the one hand, the information on income and expenses declared by the respondents; on the other hand, the estimated energy expenditure through the methodology proposed by Dubois (2022). The author proposes a model that allows for estimating energy consumption at the residential level for the selected sample. This model includes various energy services (cooking, food preservation, refrigeration, heating, lighting, domestic hot water production, laundry, and other uses), the equipment used to satisfy them (considering the use, the frequency of use, the number of hours of use, the level of efficiency of the devices, and the age), the number of rooms in the home, and the number of members who live there. With this information, the energy consumption of the home is obtained, which is then translated into energy expenditure. The second component – energy expenditure – is estimated using the electricity and natural gas tariff tables, in force for November 2018, and the Maximum Reference Price for the 10kg gas bottle, set by the National Secretariat of Energy. For electricity, the values of the EDEN distributor are taken, and for natural gas, those of the Camuzzi Gas Pampeana distributor. Likewise, the main taxes are considered: the value-added tax (IVA, for its acronym in Spanish) and the provincial taxes, which result in 32% for the electricity rate and 25% for the natural gas rate. A similar model of "required energy expenditure" (Barrella et al., 2022) is used to estimate the HEP indicator presented in Chapter 4 and the 2M indicator in the Spanish case study (Barrella et al., 2021).

The purpose of estimating energy poverty indicators considering two different sources of energy expenditure is to analyse whether self-declared expenditure is a good input to measure

this phenomenon. It is worth clarifying that in Argentina, the energy market has a complex structure that differs between electricity and natural gas. This structure makes the estimation of spending through energy consumption (estimated by the Dubois (2022) methodology) laborious due to the diversity of taxes, tariffs, the application of energy subsidies, and other issues. Faced with this difficulty, it was decided to make the empirical application for the selected sample and not for the entire country.

When estimating both indicators using household income and the energy expenditure declared in the surveys as the main sources, it is found that 23.5% of the households in the sample spend more than 10% of their income on energy, which represents 375,600 families. This value is more severe if the 2Mr indicator is taken into account, indicating a third of the analysed population experiences energy deprivation. Although these results seem worrying, the situation of energy poverty in the selected regions is even worse when household energy expenditure is estimated based on their modelled energy consumption. In this case, the 10% indicator amounts to 28.3%, 4.8 percentage points more than in the estimate with declared energy expenditure (Figure 3.2). This change in the estimation methodology implies that 80,000 additional families experience energy poverty. In the case of the 2Mr estimator, the situation is similar: when contemplating the modelled energy expenditure, the indicator rises to 31.8%, distancing itself by almost two percentage points from the previous estimate (Figure 3.2).

The differences, beyond the result of the indicator, are also translated into the characteristics of households that are in energy poverty. When contemplating the results of the indicators estimated from the ENGho data, a certain parity is found in the gender of male and female heads of household who are in a situation of deprivation. However, when analysing the gender distribution (of the household leader) considering the modelled expenditure indicators, it is observed that energy poverty seems to have a higher incidence in households headed by women. Another disparity is observed when evaluating the size of the household. In the results obtained from the modelled energy expenditure, it is found that more than 45% of energy poor households have more than 5 members, whilst this value is reduced to 32% if they evaluate the indicators obtained with direct data from INDEC. The same trend is observed with regard to educational attainment and health coverage tenure; households with lower educational attainment and those without health insurance have a greater exposure to energy poverty.

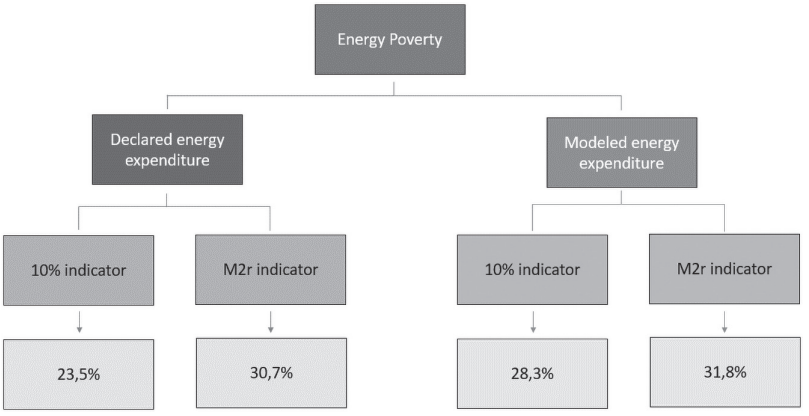

Figure 3.2 Energy poverty estimates for the selected sample – results.

Source: own elaboration based on own estimation.

These disparities are in line with studies that analyse the relationship between energy poverty and other multidimensional deprivations. In this sense, Ibáñez Martín et al. (2019) and Lampis et al. (2022) find that in Argentina, energy poverty can be promoted and generated by other deficiencies relevant to social life. In turn, these dissimilar results show that the way in which the estimators are calculated is not trivial and highlight the relevance of a good compilation of energy expenditure and income. Likewise, it allows us to visualise how a simple methodological change leads to a non-negligible measurement error.

Finally, as commented in previous sections, one of the great discussions around this type of indicator is "where to set the threshold". In Argentina, according to data from ENGho, on average households allocate 4.7% of their income to cover their energy expenses, whilst for the selected sample, this value is 5.4%. The difference can be explained by the variability of rates, subsidies, climates, and income that exist throughout the country. However, this value is well below the 10% threshold that the literature suggests for measuring energy poverty.

As previously mentioned, the calculations carried out up to now included subsidised energy expenditure, and only the subsidy known as the universal allowance per child was excluded. This methodological treatment is due to the fact that in Argentina, until 2022, a universal supply subsidy scheme was applied to natural gas and electricity services, so that the entire population connected to the distribution networks accessed this type of subsidy. In other words, the subsidy is not reflected in the energy bill, as the subsidy goes from the government to the companies at the wholesale level. Additionally, vulnerable families were favoured by an additional subsidy (known as Social Tariff)[1]. In Argentina, until mid-2022, a universal subsidy strategy for natural gas and electricity was applied, which in turn was complemented with targeted subsidies for vulnerable populations (which also affect bottled gas). Given this reality, a household in Argentina pays 45% of the total cost of natural gas and only 38% of the cost of electricity. Thus, energy expenditure in households in Argentina is very low due to the strong component of subsidies contained in energy[2]. Undoubtedly, given this situation, using the 10% indicator (which is the most widely used in research on the subject) underestimates a problem that affects a high percentage of the population.

3.5 Concluding remarks

The discussion about economic poverty has shifted from focusing on one-dimensionality to multidimensionality. The same has happened with the concept of energy poverty. Although energy poverty is defined from a multidimensional perspective, in practise, it is measured from a one-dimensional approach. Energy expenditure has gained prominence in energy poverty measurements; thus various indicators use it as the main input for measurement. Globally, there are studies that use the indicators of 10% and 2M proposed, respectively, by Boardman and EPOV. The 2Mr indicator, based on OECD suggestions, is calculated by modifying the 2M indicator in order to better capture the dynamics of household energy expenditure based on its composition and specificities.

The biggest criticism of one-dimensional indicators to measure energy poverty is their extreme simplification of a reality that is extremely complex and delicate. This debate is similar to the one in the literature regarding the measurement of economic poverty from indicators based only on income.

This chapter focused on the discussion around two indicators: 10% and 2Mr. From the application of these two indicators, the objective is to demonstrate that the way in which they are calculated and the data that feed their calculation can lead to dissimilar results. In this sense, it is found that the number of households that are captured in a state of deprivation is substantially

different when the indicators are calculated from the energy expenditure declared by households versus the estimated expenditure from an energy demand model. In this sense, the modelling of the demand considering the hours of use, the equipment, and the essential energy services could incorporate (although in a reduced way) the intrinsic multidimensionality of energy poverty. This difference finds coincidence with evidence and papers that postulate that households do not always know their energy expenditure and that the permanent surveys on household expenditure have problems collecting these aspects.

Regarding the 10% indicator, one of the discussions that emerge from the analysis carried out is whether this value is really a valid threshold for the Argentine reality and the selected sample. In Argentina, subsidies have a strong impact on energy spending since until mid-2022, more than 50% of the national energy cost was covered by the National Treasury. Argentina began to change its energy subsidy policy. Indeed, it has begun to move from universal to targeted electricity and natural gas subsidies to reduce the burden that these represent on the public budget. The results of this work show that on average, the households in the interior of the province of Buenos Aires spend 4.7% of their income on energy bills. This finding allows us to question whether the 10% threshold is adequate to measure energy poverty in Argentina. Since universal energy subsidies are applied, another threshold could be considered in Argentina.

Finally, this application aims to highlight the need to complement the one-dimensional measurements of energy poverty. Reducing the measurement of the phenomenon to an indicator based on energy expenditure and household income is a simplification that leaves out many relevant aspects of energy deprivation. Being able to move towards measurements that include equipment, energy efficiency, the dwelling's envelope, occupant habits, and the macroeconomic conditions of the territory becomes essential if a conscious measurement of the phenomenon is to be sought. Additionally, this application has shown that the methodological decisions regarding the measurement of the variables used substantially change the characterisation of the energy poor. This aspect is important since when deprivations are analysed, it is not only important to know who is deprived, but also what other deprivations those groups suffer. Understanding these issues contributes to designing better public policies. Likewise, energy poverty can be reduced not only through energy policies but also through other economic policies that promote better education, health, and housing, among others.

Notes

1 A more exhaustive description of the tariff situation in Argentina can be found in Dubois (2022).
2 The subsidy is applied to the wholesale price because it is a supply side subsidy; that is to say, the government applies it directly to the supply. Therefore, final users do not visualise the subsidy in the energy bill. For example, in the case of electricity, the subsidy is in the difference between the monomic price (real cost of production) and the seasonal price (the one charged to the end user).

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