4 Unveiling Hidden Energy Poverty in a Time of Crisis

A Methodological Approach for National Statistics

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4.1 Introduction

The academic study of energy poverty dates back to the work of Brenda Boardman in the early 1990s (Boardman, 1991). In her pioneering studies, the definition of this issue identified as energy-poor households those that spent more than 10% of their income on required energy costs. That first step consolidated an approach to energy poverty in which this social problem was identified with excessive pressure of energy bills on the household budget. This initially identified issue was later recognised as a dimension of energy poverty due to disproportionate spending (Lowans et al., 2021).

However, over the years, it has become clear that there is another key dimension that is just as important or even more important than the previous one. Due to various circumstances linked to different vulnerabilities, many households extremely reduce energy expenses from their basket of basic needs (Anderson et al., 2012; Stojilovska et al., 2021). Of course, if they were to meet them, they would incur disproportionate expenses, but the reality is that they are pushed to decrease them to afford other basic needs. Such households 'choose' to deprive themselves of these energy services, further exacerbating their precarious living situation. This reality was called 'hidden energy poverty' (Meyer et al., 2018).

This is a more elusive dimension of energy poverty: how can we measure whether a household is underconsuming? It should be remembered that the main statistics used to calculate objective indicators come from the Household Budget Survey. This reflects the different consumption of goods and services by households. Thus, using these data, it is easy to identify whether a household is overstressing its economy because of energy bills. However, it is by no means easy to detect whether it is underconsuming.

The only EU official indicator to date – proposed in the Belgian barometer (Meyer et al., 2018) and introduced in both EPOV and EPAH dashboards – that attempts to measure this reality is the M/2. According to this indicator, a household is in energy poverty if it spends less than half the national median on energy expenditure. It is easy to understand the limitations of the indicator: how can we guarantee that this threshold is appropriate? Moreover, using a relative benchmark to identify a household in energy poverty is problematic and can be more a measure of inequality than poverty. Can we admit that what happens in an average household is the correct benchmark for others? We think not. A correct measurement of hidden energy poverty cannot take as a reference a value relative to the whole population. On the contrary, what is needed is an absolute reference. According to this, a household would be in hidden energy poverty if it spent less than it should to cover its energy costs. That 'should' can be defined based on a model that calculates the required energy needs of each household and later uses bills' prices to obtain its expenditure. In this chapter, we propose a set of energy poverty indicators that could be

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applied at the national and regional levels, which puts particular emphasis on the hidden energy poverty dimension without neglecting the other main ones identified in the literature (Meyer et al., 2018), that is disproportionate expenditure, declared inadequate temperature and arrears on utility bills. This approach is then applied to the case study of an EU country: Spain.

The year 2021 got off to a frosty start within the Spanish Kingdom. *Filomena* snowstorm visited Spain during January of that year. The week of heavy rain and snowfall was followed by days in which people in many parts of Spain were forced to live with snow and ice, thus with exceptionally low temperatures. Luckily, the social shield introduced in 2020 was still in force, and by its mercy, the interruption of basic supplies to beneficiaries of the social tariffs was prohibited (a measure that would later be extended until the end of 2022). On the other hand, the second half of 2021 was characterised by exceptionally high energy prices. The take-off in prices began in June and reached unprecedented heights. In parallel and underlying, the increase in gas prices on the wholesale market began in the same summer months of 2021. In the case of electricity, the customers with a regulated tariff (PVPC is the Spanish acronym) suffered the most from the rise, as the price was directly indexed to the wholesale electricity market price. In the case of natural gas, the opposite occurred, with households on the regulated tariffs (TUR is the Spanish acronym) being the least affected, as prices are set quarterly by the Government and were well below free market prices.

Such was the pace of price increases in electricity and gas that the Spanish Government had to act. Firstly, Royal Decree Law (RDL) 12/2021, of June 24, introduced changes on taxation by reducing the value-added tax (VAT) and the generation tax, while RDL 17/2021, of September 14, acted on the special electricity tax, among other measures. All of this tarnished the proposed new electricity tariff that came into force on June 1, 2021.

From the point of view of vulnerable households, it is easy to imagine that the situation, far from improving, might have continued to worsen. Spain (like the rest of the world) was coming from the year of the pandemic, where, despite an exceptionally low energy price scenario, some energy poverty indicators, especially those of late payments and inadequate temperature in the home, had worsened considerably (Romero et al., 2023). It was therefore foreseeable that the situation, especially from the second half of the year onwards, would become tenser. This is precisely what we propose to analyse in this chapter, with particular emphasis, as highlighted above, on the hidden poverty dimension. To do so, we first propose a methodological approach to analysing the multiple dimensions of energy poverty through different metrics (Section 2). Secondly, we present the main results obtained for Spain (Section 3), starting with the EPOV primary indicators (also included in the indicators' review of EPAH; Gouveia et al., 2022) and continuing with two alternative indicators proposed, respectively, by Romero et al. (2018) and Barrella et al. (2022a). These are, on the one hand, the disproportionate expenditure indicator based on the Minimum Income Standard approach (MIS) and, on the other hand, the HEP indicator of Hidden Energy Poverty. The latter is analysed more deeply for its significance in objectively identifying people who are underconsuming because of the lack of energy affordability. We end the chapter with the main conclusions and lessons learned (Section 4).

4.2 Methodological approach to unveil energy poverty

As indicated in Section 1, the four primary indicators identified by the EPOV (and included in the new EPAH dashboard; EPAH, 2022) were selected as the first set of metrics of the proposed methodological approach:

- High share of energy expenditure in income (2M).
- Low absolute energy expenditure (M/2).

- Inability to keep the home adequately warm (Inadequate temperature).
- Arrears on utility bills.

The first two indicators can be classified as objective or income-expenditure-based indicators. In particular, the 2M attempts to detect the disproportionate expenditure dimension of energy poverty, while the M/2 detects the underspending one. On the other hand, the 'Inability to keep home adequately warm' and 'Arrears on utility bills' are subjective or consensual indicators. These indicators are also used by the Spanish Government to annually monitor energy poverty at the national and regional levels.

Regarding the 'alternative metrics', The MIS-based indicator is a disproportionate expenditure indicator that uses a different methodology than the 2M presented above. While the latter identifies a household as 'in energy poverty' when it spends more than twice the national median on energy, the MIS-based indicator sets the threshold of disproportionate expenditure at a basket of basic needs. This metric was proposed in the United Kingdom (Moore, 2012) (based on an investigation on the definition of the basket of basic needs in this country; Bradshaw et al., 2008) and has not been widely disseminated outside its borders. However, we consider it to be a very appropriate indicator of disproportionate expenditure (Barrella et al., 2022b; Romero et al., 2018) precisely because of the type of absolute threshold it uses. According to Romero et al.'s methodology, this threshold includes all non-energy household expenses to provide for their basic needs.

The MIS indicator considers 'in energy poverty' those households that, after subtracting the standard minimum income from their real income, do not have sufficient resources to cover their energy bill. The used formula is the one proposed by Romero et al. (2018). Regarding the absolute income threshold, Spain does not have a specific study for the quantification of equivalent MIS as other countries do, for example the UK, France and Portugal. In this chapter, a proxy for the equivalent MIS – income threshold – has been used, that is the minimum wage (SMI for its acronym in Spanish) set by the National Government, which is equal in all the regions. This wage reference was set at €900, €950 and €965 (in 12 payments), respectively, in 2019, 2020 and 2021. The last SMI value also corresponds to the maximum Minimum Insertion Income (RMI[1] is the Spanish acronym) available in 2021 for eligible households in the Community of Madrid.

On the other hand, the Hidden Energy Poverty (HEP) indicator seeks to complement the M/2 underspending indicator presented above by proposing an alternative absolute energy expenditure approach. The ultimate aim of this metric is to unpack the complex reality of hidden energy poverty, that is those households that consume less energy than necessary because they are financially unable to afford it. According to the selected HEP indicator – proposed by (Barrella et al. 2022a) – a household is in energy poverty if:

1 Its actual energy expenditure is less than half of its required energy expenditure (RENE/2).
2 The household belongs to one of the five lowest equivalised income deciles.

The first threshold is used to measure household energy underspending, and the second one is applied to filter households with low consumption due to affordability problems, that is households suffering from hidden energy poverty. The applied RENE model[2] was designed and validated for the Spanish case study (Barrella et al., 2022a). However, an adaptation of this model to other EU countries or the use of similar national models could make it possible to apply the HEP indicator to other European case studies. The former adaptation might be performed by taking into account the climate (Castaño-Rosa et al., 2021) and building stock (EU Building Stock Observatory (BSO), 2022) differences across Europe.

4.2.1 Data

The database used to calculate the objective indicators was the Spanish Household Budget Survey (HBS). This survey of the National Statistics Institute (INE) aims to obtain information on the nature and destination of consumption expenditure, as well as on various characteristics relating to the living conditions of households. It is carried out annually on a sample of approximately 24,000 households, which statistically represent all of the country's population.

On the other hand, the database used to obtain the subjective indicators was the Survey on Living Conditions (SILC). This is also an annual survey and is carried out on a sample of 15,000 dwellings distributed in 2,000 census sections throughout the national territory.

In this chapter, we have used the data from the HBS and SILC carried out in 2019, 2020 and 2021.

4.3 Energy poverty in Spain

4.3.1 EPOV primary indicators

Table 4.1 shows the results obtained for the four main EPOV indicators for 2019, 2020 and 2021 so that the evolution in the pre- and post-pandemic period can be seen.

First, we see that the 2M indicator of disproportionate expenditure decreases from 16.1% in 2020 to 15.2% in 2021, returning to 2019 values. In other words, just over 15% of Spanish households (almost 3 million) spent more than double the national median on energy in 2021, placing them in energy poverty according to this dimension of disproportionate expenditure. A relevant fact to understand this indicator is the value of the median household energy expenditure (M) itself, which, multiplied by two, constitutes the reference threshold. In 2020, this median was 4.5%, while in 2021 it stood at 4.4%. In other words, there is a slight decline. This may seem counterintuitive given the scenario of high energy prices that we outlined in the introduction. In our opinion, two phenomena explain this figure. On the one hand, it should not be forgotten that high energy prices started to escalate in the middle of the year, peaking just in December. This makes their impact on the survey much more moderate. On the other hand, although energy expenditure grew in 2021 compared to 2020, so did household income (as pointed out in Romero et al., 2022a), offsetting this growth to the point of marginally reducing both the median energy expenditure over income and the 2M indicator itself.

Secondly, the underspending indicator (M/2) was reduced from 11.2% to 10.1%. This is a relatively small but significant reduction: according to this indicator, in 2021, this energy poverty dimension affected around 200,000 fewer households than in 2020. What the M/2 tells us is that we detect a decrease in under-consuming households compared to the national median. This may be an indication that the social shield apparently continued to do its job of containing underspending. However, it is worth waiting for the rest of the results to see if this hypothesis is confirmed.

Table 4.1 EPOV primary indicators for Spain in 2019, 2020 and 2021

Indicator	*2019*	*2020*	*2021*
2M (households)	15.20%	16.10%	15.22%
M/2 (households)	11.50%	11.20%	10.12%
Arrears on utility bills (individuals)	6.60%	9.60%	9.50%
Inadequate temperature (individuals)	7.60%	10.90%	14.27%

Source: Own calculation from HBS and SILC databases.

Thirdly, the 'Arrears on utility bills' indicator, after a significant deterioration in the second studied year, remained almost constant in the last one: from 9.6% in 2020 to 9.5% in 2021. In other words, almost 10% of our country's citizens reported being late in paying their utility bills in 2021. This figure suggests two readings, one positive and the other somewhat less so. On the one hand, the indicator does not show a worsening of arrears during 2021, but at the same time, it should be noted that 10% of households with delayed bills is still a very worrying figure, especially when we note that the current situation does not suggest that the energy crisis will be resolved quickly and significantly in terms of a reduction in energy prices.

Finally, the 'Inadequate temperature' indicator had the most worrying development. It rose from 10.9% in 2020 to 14.3% in 2021. This metric denotes that more than 14% of the Spanish population stated that they do not have adequate thermal comfort conditions in the winter. Probably one of the causes of this increase has to do with the echoes of the *Filomena* storm. The extreme cold that settled over the peninsula at the beginning of January has no doubt engraved in our subconscious how fragile Spanish homes are to events of this nature. On the other hand, it can also be assumed that this indicator is showing what the official indicators based on income and expenditure, due to their limitations, do not manage to reflect. Namely, this metric could highlight that, in 2021, Spanish households continued and extended their dynamic of controlling energy expenditure even at the cost of maintaining an inadequate temperature inside their homes. To unpack this issue, Figure 4.1 shows the 2021 regional disaggregation of the 'Inadequate temperature' indicator. The map points out that the islands are the most affected by the subjective perception of inadequate temperature at home during winter, followed by southern regions like *Extremadura*, *Comunidad Valenciana* and *Región de Murcia*. Moreover, an autonomous city that performed as badly as the islands is Melilla, where the 18.91% of people could not adequately warm their home in 2021. In contrast, in the nearby city of Ceuta, the indicator was only 2.89%.

Figure 4.1 'Inadequate temperature' indicator by region for Spain in 2021 [% of population].

Source: Own elaboration from the calculation carried out using the SILC database.

Table 4.2 MIS-based indicator for Spain in 2019, 2020 and 2021

	2019	*2020*	*2021*
MIS_{SMI}	15.30%	16.60%	14.62%
SMI	€900	€950	€965

Source: Own calculation from HBS database and Ministry of Labour and Social Economy, https://www.mites.gob.es/estadisticas/bel/SMI/index.htm

4.3.2 Alternative indicators

Table 4.2 shows the results of the MIS-based indicator for 2019, 2020 and 2021. As with the 2M disproportionate spending indicator, the MIS also improved in 2021 compared to 2020, 14.6% compared to 16.6%. Again, we need to be cautious before celebrating a small improvement in these metrics. It is always positive that the incidence of some of the dimensions of energy poverty is decreasing. However, the extent of this issue remains very high. Therefore, we are still far from considering this problem of disproportionate spending under control in Spain.

Figure 4.2 shows the values obtained by the MIS indicator in the different Spanish regions. The MIS values in the cities of *Ceuta* and *Melilla* (not shown on the map) are, respectively, 20% and 18.5%. Figure 4.2 shows that the differences are very significant. The MIS ranges from 9% in the *País Vasco* to 22.7% in *Extremadura*. More generally, Northern Spain and the *Comunidad de Madrid* have a lower incidence of disproportionate spending in 2021, according to the MIS indicator. On the other hand, the Autonomous Communities with the highest incidence (*Extremadura, Canarias, Andalucía*) correspond to those with the lowest equivalent net income.

Table 4.3 shows the results obtained for the HEP indicator in 2019, 2020 and 2021. Before analysing the 2021 figure in comparison with the previous year, it is worth taking some time to

Figure 4.2 MIS indicator by region for Spain in 2021 [% of households].

Source: Own elaboration from the calculation carried out using the HBS database).

Table 4.3 HEP indicator for Spain in 2019, 2020 and 2021 [% of households]

Indicator	*2019*	*2020*	*2021*
HEP	25.20%	21.10%	31.21%

Source: Own calculation from HBS database.

understand these figures. The reader may be surprised by the magnitude of the result. In 2021, more than 31% of households were in hidden energy poverty, as defined by the indicator itself. What this is saying is that almost a third of households spent less than half of their theoretical expenditure on energy needed to cover their energy needs (thermal and electricity) once the income filter was applied. The key, as can be understood, is again the threshold used, which in this case is, as indicated above, an absolute threshold calculated from a theoretical model of household energy consumption and expenditure, that is the RENE model described in a previously mentioned study (Barrella et al., 2022a). It is a model that uses the Spanish building regulation as a reference with respect to the comfort temperature in the home, that is 20 degrees Celsius, and the operation hours and floor area, that is a 24h/7d occupancy and 100% climate-controlled area.

Regarding the evolution to 2021, Table 4.3 shows that HEP worsened extraordinarily. This contrasts with the evolution of the M/2 indicator (shown in Table 4.1), which improved slightly. The reason for this behaviour lies in the relative nature of the M/2. The rise in energy prices experienced in 2021 had a controversial effect on this indicator: the impact on the most vulnerable was masked by the increase in energy bills for the general population. This is not the case with the HEP indicator, as the threshold that determines the vulnerability of each household is absolute, that is it is not related to the behaviour of the rest of the households but only to its own benchmark of required expenditure. This observation points out the need to complement the vision offered by the EPOV/EPAH indicator of M/2 underspending with some other absolute metric, such as the HEP, when identifying hidden energy poverty in a country.

On the other hand, the HEP trend aligns with those of the subjective indicators of 'inadequate temperature' (shown in Table 4.1). This might confirm the abovementioned assumption that Spanish households reduced their energy consumption in 2021, even at the expense of their comfort, for reasons derived from price rises and the consequent 'fear of bills'. This result requires particular attention, given that the scenario of high prices that was outlined in the second half of 2021 went on long beyond that year and was even intensified by the Russian invasion of Ukraine in 2022.

Thereafter, an additional scenario is offered in which the threshold is set at one quarter of the required energy expenditure (RENE/4). In this way, we seek to measure 'extreme hidden energy poverty'. Table 4.4 shows the extreme HEP results in the past two years of the selected series. Although in logic with the previous HEP results (Table 4.3), we would expect a significant increase, the magnitude of the indicator is surprising and alarming. In 2021, more than 10% of Spanish households spent less than a quarter of their theoretical energy expenditure and belonged to one of the five lowest income deciles, that is the households in extreme HEP doubled with respect to 2020.

Table 4.4 Extreme HEP indicator for Spain in 2020 and 2021 [% of households]

Indicator	*2020*	*2021*
Extreme HEP	4.80%	10.32%

Source: Own calculation from HBS database.

Figure 4.3 Extreme HEP (HEP-RENE/4) indicator by region for Spain in 2021 [% of households].

Source: Own elaboration from the calculation carried out using the HBS database.

Finally, Figure 4.3 shows the 2021 results for each Spanish region, thus pointing out a significant territorial disparity in the extreme HEP incidence. *Canarias* is, in this case, the region with the lowest incidence (3.2%), which is understandable considering that it is the territory with the lowest required demand for heating. At the other extreme is *Andalucía*, where the indicator rises to 19% of households. In the latter case, despite having a fairly favourable climate during the winter in most of the territory, the low penetration of air conditioning appliances in the lowest income deciles (both for heating – according to the HBS – and for cooling; Instituto de Estadística y Cartografía de Andalucía, 2019), the high demand for cooling and the insufficient level of income create a perfect breeding ground for the proliferation of hidden energy poverty. In general terms, it can be said that Figure 4.3 shows a higher incidence of the severe hidden poverty indicator in the southern regions of the peninsula compared to the north.

Finally, to check the impact of the government's measures on this indicator, a calculation of the HEP has been made based on a counterfactual scenario. This scenario is an alternative situation in which the National Government's electricity bill reduction measures[3] would not have been in place. In both cases (HEP and extreme HEP), the counterfactual scenario is 1% point above the actual scenario, that is 32.68% and 11.65%, respectively. That is, if the government's measures had not been implemented, the incidence of hidden energy poverty would have reached approximately 200,000 more households.

4.4 Conclusions

This chapter proposes a set of indicators to measure the different dimensions of energy poverty in a country, emphasising the underspending issue (hidden energy poverty), which has not been adequately addressed in official statistics. Moreover, this chapter compares the results obtained from the application of this methodological approach to the Spanish case study in 2021 with those from previous years.

Concerning subjective indicators, the results show that, in 2021, 9.5% (4.5 million people) and 14.27% (6.7 million people) of the population were, respectively, in arrears on utility bills and with a subjective perception of inadequate temperature at home, compared to 9.6% and 10.9% in 2020. The former indicator consolidates its value after the significant increase from 2019 to 2020, but the latter worsens very significantly: 1.6 million more people compared to 2020 and double compared to 2019.

Moreover, two indicators have been calculated to unpack the disproportionate expenditure dimension: 2M and MIS. The results obtained are, respectively, 15.22% (almost three million households) and 14.62% (2.7 million households) compared to the values obtained for 2020, 16.10% and 16.6%. The two metrics show the same trend: a slight reduction in the incidence of the disproportionate expenditure issue in 2021 compared to 2020.

Finally, two indicators of underspending were calculated: M/2 and HEP. The results for the M/2 and extreme HEP indicators in 2021 were, respectively, 10.12% and 10.32% (almost 2 million households), compared to 11.20% and 4.8% in 2020. In this case, there is a very noticeable trend discrepancy between the two metrics. While the former reveals an improvement in the last year, the latter indicates an extraordinary worsening. The analysis carried out in this chapter points out that the latter indicator deserves more credit for several reasons. The first is because it aligns with the subjective indicator of 'inadequate temperature'. It seems sensible to state that when a household declares that it cannot maintain its dwelling in minimum comfort conditions in the winter, it is in hidden energy poverty. On the other hand, it is crucial to bear in mind that 2021 was, on the one hand, the turning point of the COVID-19 pandemic (which started at the end of 2019 and affected the health and economy of the population all over the world) and, on the other hand, the year of the beginning of a global energy price crisis (that was lately exacerbated by the Russian invasion of Ukraine in March 2022). The latter has significantly impacted Spanish households' economies, especially from autumn onwards. In this sense, the results of the 'inadequate temperature' and HEP indicators seem to indicate that many families restricted their spending for fear of bills that became unaffordable overnight.

Several lessons can be drawn from this picture of hidden energy poverty in Spain. The first is that this might be the most critical dimension of energy poverty in the country. More than 30% of Spanish households did not cover half of their required energy expenditure, and around 10% did not meet even a quarter of it. Traditionally, in the fight against energy poverty, much weight has been given to the dimension of disproportionate expenditure, but this analysis highlights that it is urgent to balance the focus. A second lesson learned is that territorial differences are once again enormous, which might suggest to policymakers that specific local actions are needed. A third lesson comes from the counterfactual scenario. This tells us that the measures implemented to contain the increase in the bill, although they did not manage to stop the blow, at least brought relief to a non-negligible percentage of households. Finally, from a methodological perspective, using an absolute threshold might allow scholars and decision-makers to assess energy poverty rather than energy inequality, the latter being the most common outcome of relative threshold metrics such as the M/2. This issue is further analysed in Chapter 3. In the same line, according to this chapter's results, the HEP indicator seems to better capture the underspending behaviour of Spanish households (especially in an energy price hike scenario), which is misunderstood if using a relative energy threshold comparison.

Eventually, 2021, from an energy poverty perspective, was a year of some light and a big shadow for Spain. Fewer households spent a disproportionate share of their income on covering their energy costs, but, in contrast, many more households entered the dark abyss of extreme hidden energy poverty. The latter suggests the importance of using proper indicators to unveil this usually mismeasured and pressing dimension of hidden energy poverty, especially in a time of crisis.

Notes

1 The RMI was used as MIS income threshold in several studies carried out for Spain (for example, Romero et al., 2018; Rodriguez-Alvarez et al., 2019), but it is considered insufficient to meet household basic needs (Barrella et al., 2022a).
2 The RENE model is a bottom-up construct intended to estimate the theoretical energy costs that a Spanish household would have to pay to meet its energy needs, including both thermal (heating, cooling and DHW) and electricity (lighting, appliances and cooking) uses (Barrella et al., 2022a). These needs are estimated according to household characteristics, such as the number of members, the dwelling size, the location (climate zone) and the building age.
3 The Government reduced the VAT from 21% to 10%, the electricity tax from 5.11% to 0,5% and charges by 96%. Their impact on energy bills is shown in Barrella (2021). For a complete understanding of electricity bills in Spain, the curious reader may refer to Chaves Ávila et al. (2021).

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