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Understanding the impact of COVID-19 lockdown on energy poverty in Spain

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Abstract

The year 2020 will always be remembered in the world as the year of the COVID lockdown. In Spain, as in many other countries around the world, population confinement measures were implemented. This fact, together with other socio-economic consequences of the pandemic, were reflected in the reality of energy poverty in the country. This study presents an analysis of this phenomenon in the light of the available data, i.e. using the 2020 Spanish HBS and SILC. This assessment is carried out by applying different metrics, namely the four main indicators proposed by the EU Energy Poverty Observatory (EPOV), and two additional metrics of disproportionate expenditure and underspending, respectively. The results show that while the disproportionate and underspending indicators, in general, did not change significantly as a result of the policies prohibiting supply cut-offs, the subjective indicators, i.e., arrears in utility bills and inadequate temperature, worsened significantly. On the other hand, the additional metric of under-spending reveals a very relevant incidence (21%) of hidden energy poverty in the country. The study also highlights an uneven geographical distribution of energy poverty.

Keywords

Energy poverty; Affordability; COVID-19; Hidden Energy Poverty; Under-spending; Over-spending

1. Introduction

The year 2020 will always be recalled as the year of the COVID-19 lockdown. European countries will always remember that fateful month of March when all households were confined overnight with uncertainties and fears. Once the emergency is finally over, it is time to look back and try to understand how this reality impacted households from the perspective of energy poverty. This article is the result of an analysis carried out for the Spanish case study.

Faced with this exceptional situation and under the protection of the state of emergency (which centralized the political management), the Spanish Government deployed the so-called social shield through Royal Decree Law 11/2020 of 31 March (Jefatura del Estado 2020). One of the measures included was the guarantee of basic supplies, which in practice meant the suspension of energy and water disconnections. This measure, as will be seen later, had a very relevant impact. Moreover, additional temporary measures have been put in place to protect consumers, such as the energy price caps and the extension of the social tariffs to other vulnerable categories, i.e. self-employed people who significantly decrease their income because of the lockdown. For further details on these measures, the reader is invited to consult the following references: (Mastropietro et al. 2020), (Mastropietro 2022), which are framed in a broader international context where many countries introduced social policies to tackle the COVID lockdown effects (Hesselman et al. 2021), (Anastasiou and Zaroutieri 2023) or (Lyra et al. 2022).

In this context, previous studies attempt to theoretically evaluate the impact of the measures introduced to address COVID-19 socio-economic consequences on energy poverty and vulnerable consumers. (Bienvenido-Huertas et al. 2019) analysed the impact of unemployment benefits and the electricity social tariff extension on the energy poverty situation during lockdown and suggested that the Spanish government should establish policies and targets that consider the constraints associated with future pandemics. Moreover, another study (Mastropietro 2022) presented a critical review of the COVID energy consumer protection measures, based on the regulatory theory and international experiences, and suggests that 'emergency measures should rely on a robust but flexible targeting strategy and be supported by appropriate financing'.

It is important to bear in mind that Spain was coming from the year 2019 in which the National Strategy Against Energy Poverty 2019-2024 (ENCPE) came into force. In this Strategy, the four axes that form the backbone of the national government's plan to address this problem were set out (Roberto Barrella 2020). Namely, axis 1 aims to improve the identification and measurement of energy poverty; axis 2 focuses on mitigating measures; axis 3 focuses on medium- and long-term structural measures and axis 4 on consumer protection and awareness-raising measures.

Within axis 1, the strategy chose four indicators as those that it would be monitored periodically to analyse the evolution of the phenomenon in our country. Specifically, these indicators are the ones proposed by the European Energy Poverty Observatory (EPOV). The issue of measuring energy poverty is not an easy endeavor, as pointed out in the literature, e.g. (Charlier and Legendre 2021). It is a complex social reality that can hardly be captured in a single figure. It is important to understand that each indicator used to measure it is capturing a particular reality or dimension of energy poverty. Specifically, there are four main dimensions included in EPOV's indicators, namely (1) disproportionate expenditure, i.e. households in energy poverty because of overspending; (2) underspending, or households in energy poverty because they do not meet baseline energy needs; (3) arrears on utility bills, or households in energy poverty because of the accumulation of energy debts; and (4) inadequate temperature, or households in energy poverty because of the inability to maintain the dwelling at an adequate temperature (traditionally referred to winter). The first two ones are traditionally measured by objective indicators, while the last two are considered by the subjective ones (see Figure 1).

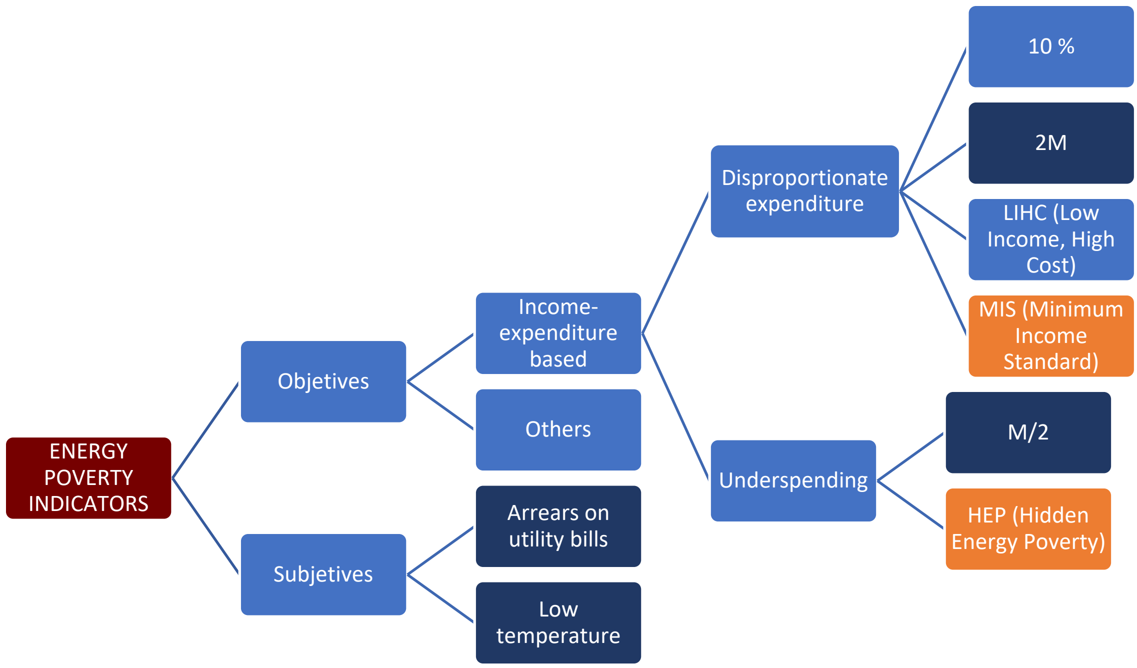

Figure 1. Classification of the most used energy-poverty indicators and the ones proposed in this paper – Dark Blue: EPOV indicators; Orange: Additional indicators proposed by the authors.

In this context, the present study assesses the 2020 energy poverty situation in Spain by estimating the four indicators from EPOV and complements them with two additional ones that allow for a broader look at the different dimensions of energy poverty. The former is an indicator of disproportionate expenditure based on a Minimum Income Standard. The latter is an indicator of hidden energy poverty.

2. Methodology and results

2.1. EPOV indicators

We begin by showing the results obtained for the four EPOV primary indicators obtained for 2019 and 2020, which were calculated according to the methodologies described in (Tirado Herrero. et al. 2018) and (Thema and Vondung 2020). The database used to calculate the objective indicators was the Spanish Household Budget Survey (HBS). It is carried out annually on a sample of approximately 24,000 households. On the other hand, the database used to obtain the subjective indicators was the Spanish Survey on Income and Living Conditions (SILC). It is also annual and is carried out on a sample of 15,000 households distributed in 2,000 census sections throughout the national territory.

Table 1 includes the results obtained for the EPOV indicators.

Table 1: EPOV Indicators for Spain in 2019 and 2020

EPOV indicator	2019	2020
2M[1]	15.20%	16.10%
M/2[2]	12.06%	11.20%
Arrears on utility bills	6.60%	9.59%
Inadequate temperature	7.60%	10.90%

[1] Confidence interval 95% in 2019: 14.90% - 15.61% and in 2020: 15.63% - 16.12%
[2] Confidence interval 95% in 2019: 11.85% - 12.27% and in 2020: 10.90% - 11.12%

Firstly, the 2M indicator of disproportionate expenditure increases from 15.2% to 16.1%. In other words, just over 16% of Spanish households spent more than twice the national median on energy expenditure over income in 2020, putting 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 2019, this median was 4.7%, while in 2020 it stood at 4.5%. In other words, there is a slight decline. One reason for this reduction in the median energy expenditure relative to income in 2020 lies in lower average energy prices in this year compared to 2019.

About the evolution of the 2M indicator itself, this experienced a limited but not negligible increase, which is largely due to the particularities of the year 2020. The lockdown forced many households to consume more than normal, something that particularly affected the most energy-inefficient dwellings, which are more commonly inhabited by low-income households (R. Barrella et al. 2022).

Secondly, the under-spending indicator fell from 12.1% to 11.2%. This is certainly a small reduction, but a very significant one. This indicator shows that there has not been an increase in the number of households that under-consume compared to the national median. This may indicate that the social shield has fulfilled its minimum function. It might be inferred that two of the measures implemented within the social shield were the ones that contribute most to this reduction, i.e., the energy price caps and the suspension of energy disconnections. The latter was probably the most effective one because it allows people to consume energy even if their income was too low to afford it. In other words, they did not fall into an extreme situation of underconsumption (a null energy consumption) because their supply could not be cut.

Thirdly, the indicator of arrears on utility bills experienced a very notable worsening. It went from 6.6% in 2019 to 9.6% in 2020. In other words, almost 10% of Spanish citizens reported being late in paying their energy bills during that year. To understand this result, we should not lose sight of the fact that, as indicated in the introduction, one of the policies that constituted the social shield during the state of emergency was the prohibition of cutting off supply. In other words, many households fell into arrears, but this did not lead to supply being cut off. This assumption would in any case have to be corroborated by a causality analysis which is beyond the scope of this paper.

Finally, the inadequate temperature indicator also increased very significantly, from 7.6% in 2019 to 10.9% in 2020. It is very relevant to understand this indicator well. What it is telling us is that almost 11% of citizens stated that they do not have adequate thermal comfort conditions in winter. Probably one of the causes of this phenomenon is the lockdown itself. The fact that Spanish citizens were forced to stay in their homes for weeks at a time brought home the true reality of energy efficiency of the building stock in Spain[3]. While this reality was not so evident for many families in a more active way of life, it became evident when life was restricted to the four walls of the house. As with the previous indicator, the explanatory assumptions outlined here would have to be corroborated by a causality analysis that is beyond the scope of this paper.

[3] In this regard, it is worth considering the energy solvency concept presented in (Sánchez-Torija et al. 2022)

Figure 2 and Figure 3 show the disaggregation by region of the subjective indicators in 2020. Both indicators were higher in the southern regions and islands. Particularly, in the latter territories, the shares of households that declared to be unable to keep their home adequately warm were much higher than the rest of the country. The Autonomous cities not shown in the abovementioned figures, i.e., Ceuta and Melilla, have an 'Arrears on utility bills' share of, respectively, 25.3% and 8.1%. Thus, the former city is an outlier, and the very high indicator value might denote a serious bills delay problem in that city. On the other hand, the 'Inadequate temperature' indicator reached, respectively, 2.9% and 18.9%. In this case is Melilla to be among the worst performing territories in Spain.

Figure 2. 'Arrears on utility bills' by region in Spain 2020

Figure 3. 'Inadequate temperature' by region in Spain 2020

2.2. Alternative indicators

MIS indicator of disproportionate expenditure

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 energy poor 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 is an indicator that was proposed in the United Kingdom and has not been widely used outside its borders. However, there are some studies that brought this methodology to Spain, e.g. (Romero et al. 2018) or (Gómez-Navarro et al. 2021).

The MIS based indicator considers energy poor to those households that, after deducting from their net income the actual housing costs and the minimum income standard (the rest of the household's non-energy expenditures to provide for their basic needs in Spain) do not have sufficient resources to cover their energy bill. Or, to put it another way, households whose energy expenditures strain household finances to the point of having to limit other basic supplies are considered as energy poor.

It is evident that the key to this indicator lies in the definition of this minimum income standard. This is where the main stumbling block in its calculation lies. The original methodology used in the United Kingdom is based on a fieldwork involving a group of control households and a subsequent pooling and consensus-building process, from which the elements that make up this basket of basic needs for any given household are determined. In Spain there is no similar work, so we have opted to apply the methodology described in (Romero et al. 2018) and use three alternative fixed minimum income thresholds:

- Integration minimum Income ('Renta Mínima de Inserción') (RMI): In this first calculation we used the population-weighted average of the RMIs of each Spanish autonomous community[4] (€505.6 for both 2019 and 2020[5]). In this case, this value was increased according to the composition of the household (Modified OECD scale).
- Minimum Wage (SMI): In this second approach, the minimum wage set by the National Government (SMI - €900 in 2019 and €950 in 2020, equal in all the regions) was used as the equivalent of the minimum income standard of an 'average household'[6].
- Public Indicator of Multiple Effect Income ('Indicador Público de Renta de Efectos Múltiples') (IPREM)[7]: In this last calculation, 1.5 times the IPREM (€806.7 for both years) was used as the equivalent of this minimum income. This is not an arbitrary value as it is consistent with the most restrictive income limit (that which corresponds to a household without children) set by the regulations for the granting of the Spanish social tariff for electricity.

[4] We obtained two versions of the RMI-based indicator, one using the national weighted average, as indicated in the text, and the other applying to each HBS household its own RMI according to its region. The result was identical at 0.01%, so we decided to include only the first calculation in the main text.

[5] Although neither the RMI nor the IPREM changed, the other parameters for the calculation did, i.e., average energy expenditure and real expenditure of each household. It was the variation in these two values that explains the change in the indicators.

[6] The SMI is the minimum wage guaranteed for a person working full-time in Spain. However, given the higher value of the SMI compared to the RMI (income aid for an entire household), this minimum wage reference was set as the income threshold of the whole household.

[7] it is decided by the Government every year within the General State Budget Law. Therefore, it depends on a political decision as the RMI.

Table 2 shows the results of the MIS-based indicator using the three thresholds mentioned above for the two study years 2019 and 2020.

Table 2: MIS based indicators in Spain 2019-2020

MIS indicator	2019 (threshold)	2020 (threshold)
MIS_{RMI}[8]	7.7% (€505.6)	7.8% (€505.6)
MIS_{SMI}[9]	15.3% (900€)	16.9% (950€)
MIS_{IPREM}[10]	9.7% (806.7€)	9.0% (806.7€)

Albeit unevenly, there has been no significant worsening or improvement in any of them, as was the case for the 2M indicator above. What is certainly striking is the significant change in the indicator depending on the reference threshold. Just by increasing the threshold from €800 to €900 (the difference between 1.5 times the IPREM and the SMI), the indicator in 2019 went from around 10% to more than 15%. Even more striking is this jump in 2020 (from 9% to 16.6%), although in this case it is influenced by the increase in the SMI from €900 in 2019 to €950 in 2020, while the IPREM reference remained unchanged. These differences are certainly striking, but entirely consistent with what is found in the literature (Romero et al. 2015). Small changes in the minimum income threshold generate significant changes in the indicator. The main reason is to be found in the binary nature of these energy poverty metrics. There is a substantial pool of vulnerable households that enter de facto energy poverty when faced with relatively small changes in the boundary conditions.

In addition to the calculation of the aggregate indicator for the population, we considered it relevant to include a couple of additional broken-down analyses. These analyses consist of obtaining the indicator by deciles of household income and by autonomous community. In this way, we could obtain a more accurate picture of the behavior of the indicator.

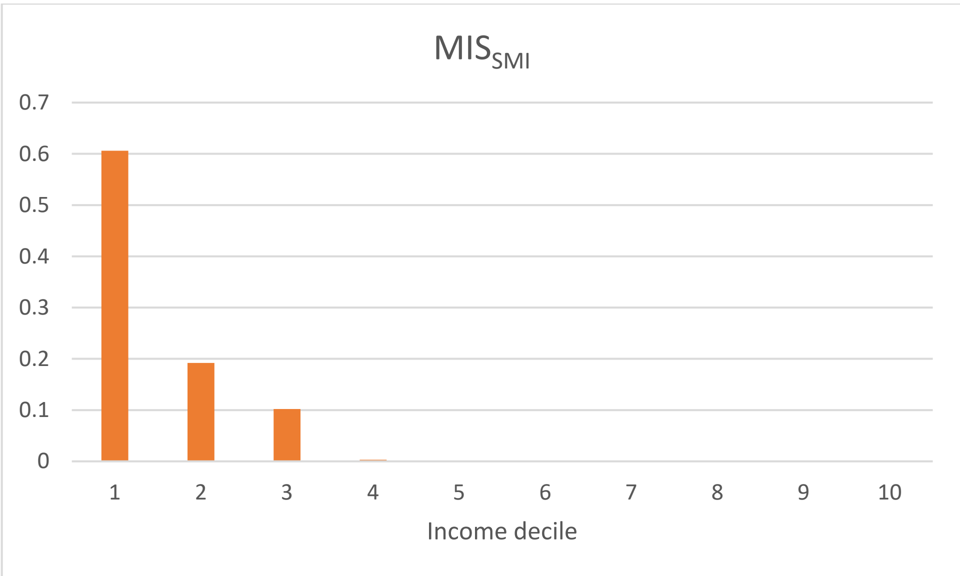

Figure 4. MIS_{SMI} disaggregated by income deciles in Spain 2020

Taking as a reference the MIS that uses the SMI as a threshold, and focusing on the year 2020, Figure 4 shows the disaggregated results of the indicator according to deciles of household income in Spain. It can be seen very clearly how the bulk of the incidence of disproportionate

[8] Confidence Interval 95% in 2020: 7.78% - 7.81%
[9] Confidence Interval 95% in 2020: 16.83% - 16.87%
[10] Confidence Interval 95% in 2020: 9.01% - 9.04%

spending according to this indicator is concentrated in the first three income deciles, most notably in the first one.

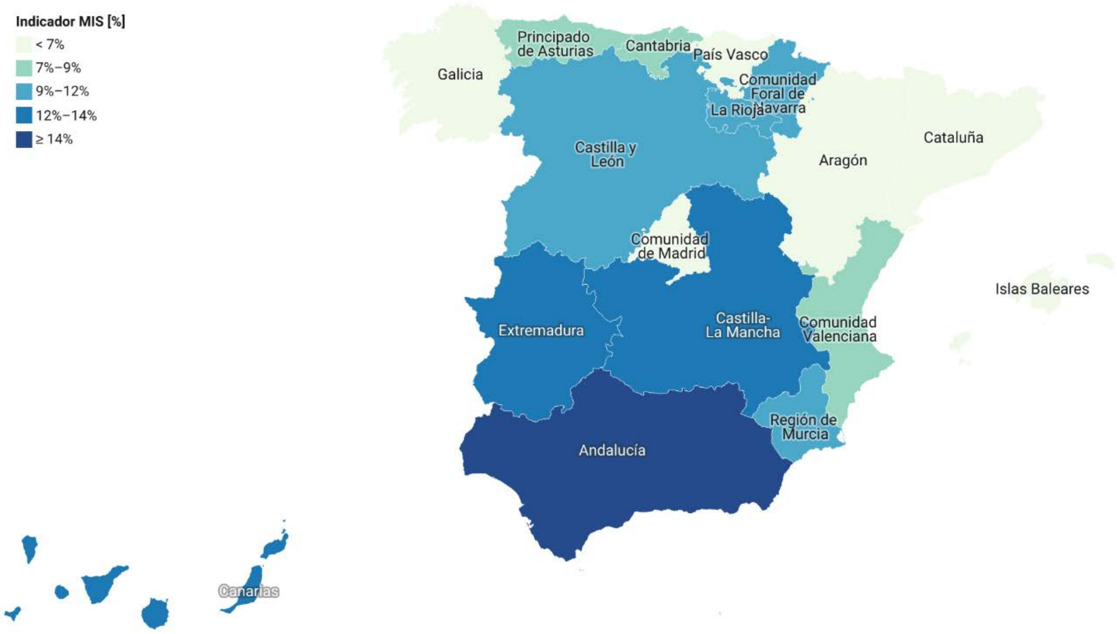

Figure 5. MIS_{SMI} indicator by regions in Spain 2020

On the other hand, Figure 5 shows the values obtained by the indicator in the different Autonomous Communities. The differences are very significant as the MIS ranges from 3.6% in the *País Vasco* to 22.5% in *Ceuta* and 19.1% in *Melilla* (two autonomous cities that are not shown in Figure 5). More in general, the northern regions and *Comunidad de Madrid* are less affected by energy poverty (according to the MIS indicator) than the southern ones.

Several lessons can be drawn from this study of the MIS-based disproportionate expenditure indicator. The first is that it has remained quite stable between 2019 and 2020. A second insight is that the territorial differences are enormous, which suggests that, to implement mitigating and structural measures against energy poverty, it is necessary to pay careful attention to this disparity. Good practices should be learned from those territories where the incidence is lower, and priority must be given to the most disadvantaged regions. A final lesson has to do with the disaggregation of the indicator by income level. The enormous concentration of the incidence of this indicator in the first income decile indicates that special attention is needed for the most disadvantaged stratum in our country, for which compensation measures such as the social electricity tariff or thermal social allowance are clearly insufficient (García Alvarez and Tol 2020), (Roberto Barrella et al. 2021).

Hidden energy poverty indicator

This last indicator presented in the report seeks to complement the M/2 under-spending indicator presented above. The aim is to offer an indicator that goes beyond the mere dimension of household energy under-consumption and approaches the complex world of hidden energy poverty, i.e., those households that consume less energy than necessary due to their financial inability to meet this expenditure.

To do this, the indicator starts by obtaining the required energy expenditure (RENE) of each household according to its characteristics and the year of the survey, thus comparing it with its actual energy expenditure. All households spending less than half of their RENE are affected by underconsumption. Secondly, an income criterion is applied that excludes those deciles (from the sixth decile onwards) in which the phenomenon of insufficient expenditure is mainly due to reasons not linked to the vulnerability of the household. A detailed description of the methodology can be found in (R. Barrella et al. 2022).[11]

Table 3: Hidden Energy poverty indicator (HEP) in Spain. 2019 and 2020

	2019	2020
HEP[12]	25.2%	21.1%

Thus, Table 3 shows the result obtained for the HEP indicator in 2019 and 2020. Before analysing the 2020 figure in comparison with the previous year, it is worth taking some time to understand these results. The reader may be surprised by the magnitude of the result. In 2019, more than 25% of households were in hidden energy poverty. What this is saying is that more than a quarter of households spent on energy less than half of their theoretical expenditure necessary to cover their energy needs (thermal and electricity ones) once the income filter is 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 (R. Barrella et al. 2022). It is a model that uses as a reference the Spanish regulations with respect to the comfort temperature in the home: 20 degrees Celsius.

In this regard, it should be noted that, in the abovementioned study (R. Barrella et al. 2022), it was inferred that the RENE model may overestimate household expenditure, precisely because most households in Spain do not maintain that comfort temperature, or at least not in the entire dwelling. Hence, for the implementation of the indicator, following the logic of the M/2 underspending indicator itself, a lower threshold of theoretical expenditure was chosen, i.e., RENE/2[13]. Thus, a household would be in hidden energy poverty according to this indicator if it spends less than half of its theoretical expenditure necessary to satisfy its energy needs. This is precisely the result shown in Table 3, and yet it can be seen to be very high.

Focusing on the evolution to 2020, the indicator decreases four points with respect to 2019. This confirms what was observed in the M/2 indicator. Spanish households did not consume less energy despite the exceptional circumstances experienced during the pandemic, which had a significant impact on the economy of many households in the country. This fact reinforces the hypothesis that the social shield, at least from this perspective of hidden energy poverty, worked. As inferred for the M/2 indicator, measures such as the energy price cap and the suspension of energy disconnections were probably the “lifelines" to not fall into the hidden energy poverty abysm. On the other hand, the relative threshold used in the M/2 does not make it possible to consider each household energy needs, thus giving a result that depends on the overall national energy expenditure tendency. This is the main reason why the results of the two indicators (M/2 and HEP) are not directly comparable.

Returning to the issue of the theoretical expenditure threshold, to assess the impact on the indicator of changing the threshold, a couple of additional scenarios were carried out in which

[11] An alternative simplified methodology to calculate theoretical energy consumption was presented in (Sánchez-Torija and Nieto 2022).
[12] Confidence Interval 95% in 2020: 21.07% - 21.11%
[13] For a deeper understanding of this topic the reader is invited to consult (R. Barrella et al. 2022), which carried out a sensitivity analysis of changing the energy expenditure threshold on the HEP result.

the threshold was set at one quarter (RENE/4) and three quarters (3/4 RENE) of the required energy expenditure, respectively.

Table 4: Additional hidden energy poverty indicators in Spain 2020

	2020
HEP (RENE/4)[14]	4.82%
HEP (3/4 RENE)[15]	36.55%

Table 4 shows these results. The first indicator sets the incidence of hidden energy poverty in 2020 at around 5%. This would be what could be called extreme hidden energy poverty as it includes those households that are severely under-consuming. The other indicator is estimating the households potentially vulnerable to hidden energy poverty, i.e., those households that spent less than three quarters of their theoretical energy consumption.

Finally, a disaggregation of the hidden poverty indicator by autonomous communities was also considered. In this case, the initial HEP which uses the threshold of half of the RENE was chosen. It was carried out only on data for 2020.

Figure 6. HEP by region in Spain 2020

Figure 6 shows the results obtained. Once again, there is a wide disparity. *País Vasco* is once more the autonomous community with the lowest incidence (11.4%), while *Extremadura* is this time the one with the highest hidden energy poverty, at 37%. The Autonomous cities not shown in Figure 6, i.e., Ceuta and Melilla, have a HEP share of, respectively, 25% and 22.7%. Overall, in the mainland, this indicator shows a similar geographical distribution as the MIS, i.e., higher values in the southern regions. However, this time the islands (particularly *Canarias*) show much lower values than the southern mainland regions.

There are several lessons that can be drawn from this study of hidden energy poverty in Spain. The first is that we are probably facing the most pressing dimension of energy poverty in the

[14] Confidence Interval 95% in 2020: 4.81% - 4.83%
[15] Confidence Interval 95% in 2020: 36.53% - 36.57%

country. More than 20% of Spanish households did not manage to cover even half of their theoretical energy expenditure because of lack of affordability. Traditionally, in the fight against energy poverty, much weight has been given to the dimension of disproportionate expenditure, and it is urgent, in our view, to balance the scales. A second take-away is that territorial differences are once again enormous, which invites us to delve deeper into the roots of this poverty dimension and try as far as possible to alleviate it.

3. Conclusion

By way of conclusion, it should be noted firstly that the four EPOV indicators show very different evolutions in 2020. While the objective indicators (disproportionate expenditure and underspending) have experienced little change, the two subjective indicators have worsened markedly. On the one hand, the increase in the late payment indicator indicates that the social shield may have worked in the short term, but that debts are accumulating. It is very urgent to address this reality to prevent this debt situation from becoming chronic and ending up leading sooner or later to the supply being cut off. In this sense, the novelty of the Minimum Vital Supply policy introduced by the Spanish Government in 2021 (Jefatura Del Estado 2021), which extends the moratorium on cuts by 6 months, allows some breathing space, but it does not solve the problem in the long term. We will have to keep a close eye on the evolution of this indicator over the next two years to see how the energy debt of vulnerable families in Spain is evolving.

On the other hand, the inadequate temperature indicator has also worsened noticeably. Although it is risky to reduce the whole explanation to a single cause, we consider that lockdown is certainly one of them. The mandate to stay at home opened the eyes of Spaniards to the precariousness and inefficiency of most of their dwellings. This suggests the need of enhancing energy efficiency programs in Spain following, for example, identified public and private best practices (Trotta et al. 2018) and prioritizing vulnerable households.

About the additional disproportionate expenditure indicator that has been analysed, namely the one based on the minimum income standard, we find a similar development. We do not see a very noticeable increase in 2020 compared to 2019. What does stand out with this indicator is how sensitive it is to the threshold that is determined. It will be very interesting to study its evolution in future reports, incorporating as far as possible this new threshold resulting from the detailed study of the basket of basic needs in Spain. Finally, the enormous regional differences are striking. Clearly, there is an urgent need for reflection in this respect, leading us to copy successful models in some regions and to put more effort into the most disadvantaged ones.

Finally, the hidden energy poverty indicator (HEP) has offered a new perspective on this elusive dimension of the phenomenon of energy poverty, comparing the actual expenditure of households with their required energy expenditure. Its evolution in 2020 compared to 2019 shows the same trend as the M/2 indicator, but its high incidence tells us that hidden energy poverty is far from being a minor dimension of the problem but, on the contrary, it is probably the most pressing one.

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