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Unveiling energy poverty in Southern Europe: indicators, vulnerability factors, and policy implications

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8th AIEE Energy Symposium
Current and Future Challenges to Energy Security

Padua, 28-30 November, 2024

Why assessing energy poverty in the EU?

- 1 Why assessing energy poverty in the EU?**
- 2 Objectives and methodology
- 3 Measuring energy poverty in three European countries
- 4 Identifying vulnerable households
- 5 Conclusions and future developments

Energy poverty, a growing concern in Europe

9.3% of the European population was unable to keep their home adequately warm during winter in 2022 (10.6% in 2023)

+128% Increase in the share of Spanish households unable to keep their home adequately warm between 2019 and 2022

Source: Eurostat

Assessing energy poverty as a societal issue

- A growing and complex dimension of general poverty affecting millions in Europe
- A need for measuring and understanding energy poverty

Objectives and methodology

1 Why studying energy poverty?

2 Objectives and overall methodology

3 Measuring energy poverty in three European countries

4 Identifying vulnerable households

5 Conclusions and future developments

Objectives

Critically analyze the state of the art on energy poverty measurement

Measure and compare energy poverty in European countries by computing the key indicators

Evaluate the impact of socio-economic factors on energy poverty and identify vulnerability factors

Overall methodology

Literature Review



- Identify the different indicators to measure energy poverty
- Select the most relevant indicators

Measuring tool



- Develop programs in R language to compute the different indicators
- Use of two databases:
 - Household Budget Survey (HBS)
 - Statistics on Income and Living Conditions (SILC)

Econometric analysis



- Identify vulnerability factors
- Apply to French 2020 data

Measuring energy poverty in three EU countries

1 Why studying energy poverty?

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Employing various indicators to capture different dimensions of energy poverty

Subjective indicators

Computed based on households' self-assessment

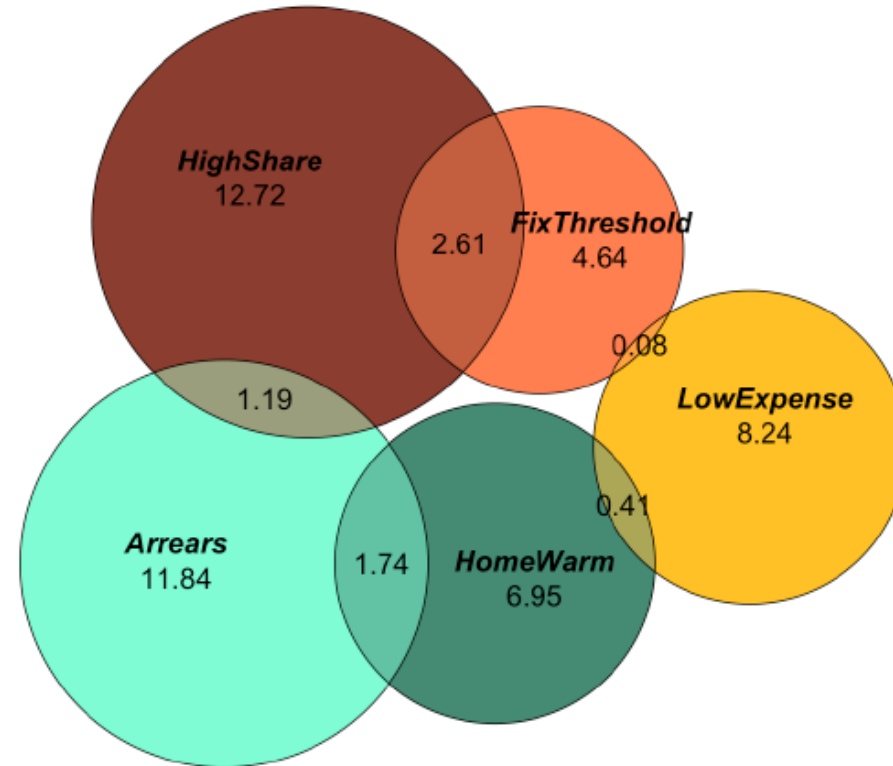
- Share of the population that had **arrears on utility bills** over the last year
- Share of the population that was **unable to keep home adequately warm** over the last year
- Share of the population **living a dwelling with presence of leak, damp and rot**

Expenditure-based indicators

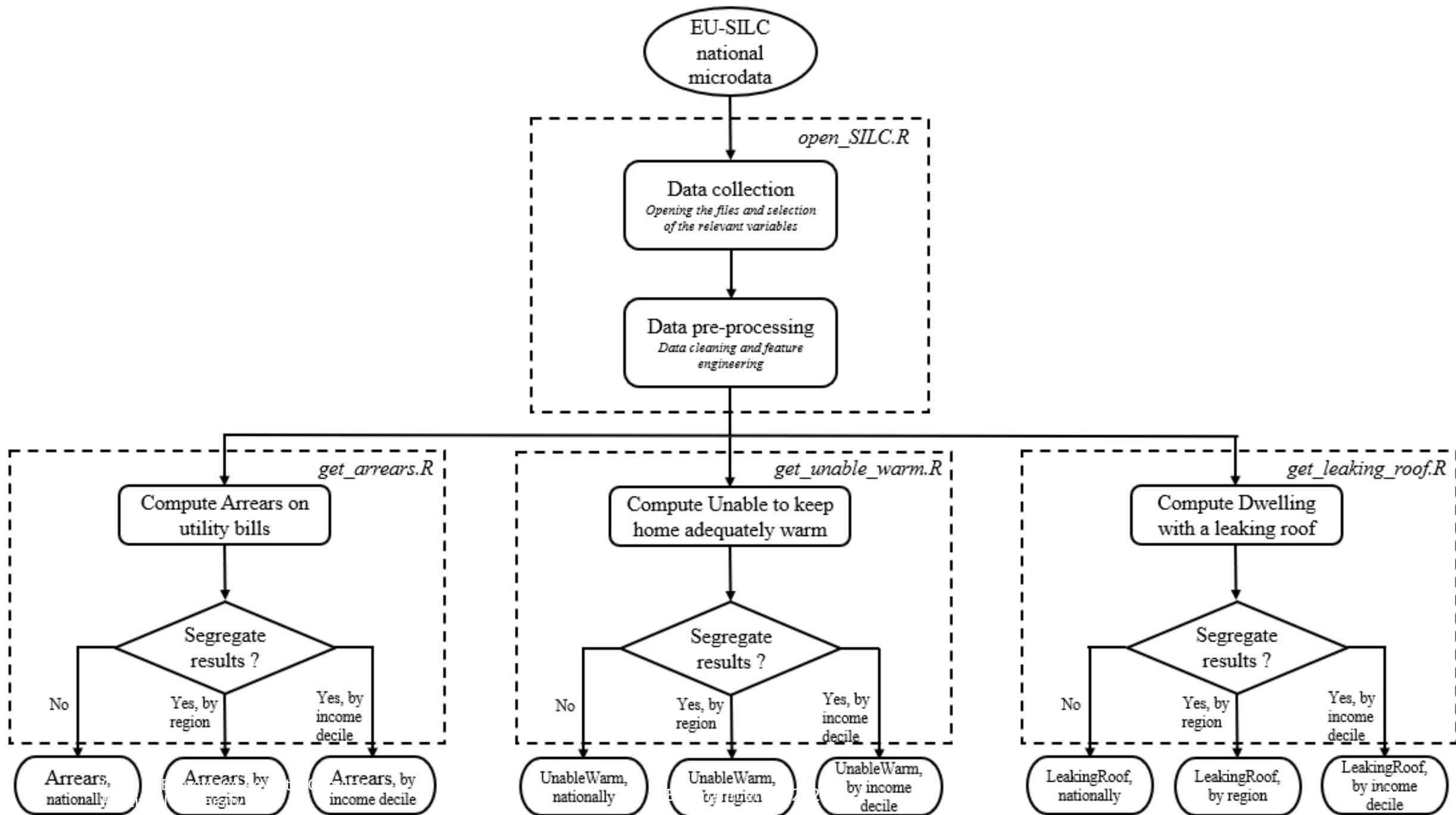
Computed comparing households' energy expenses with a threshold

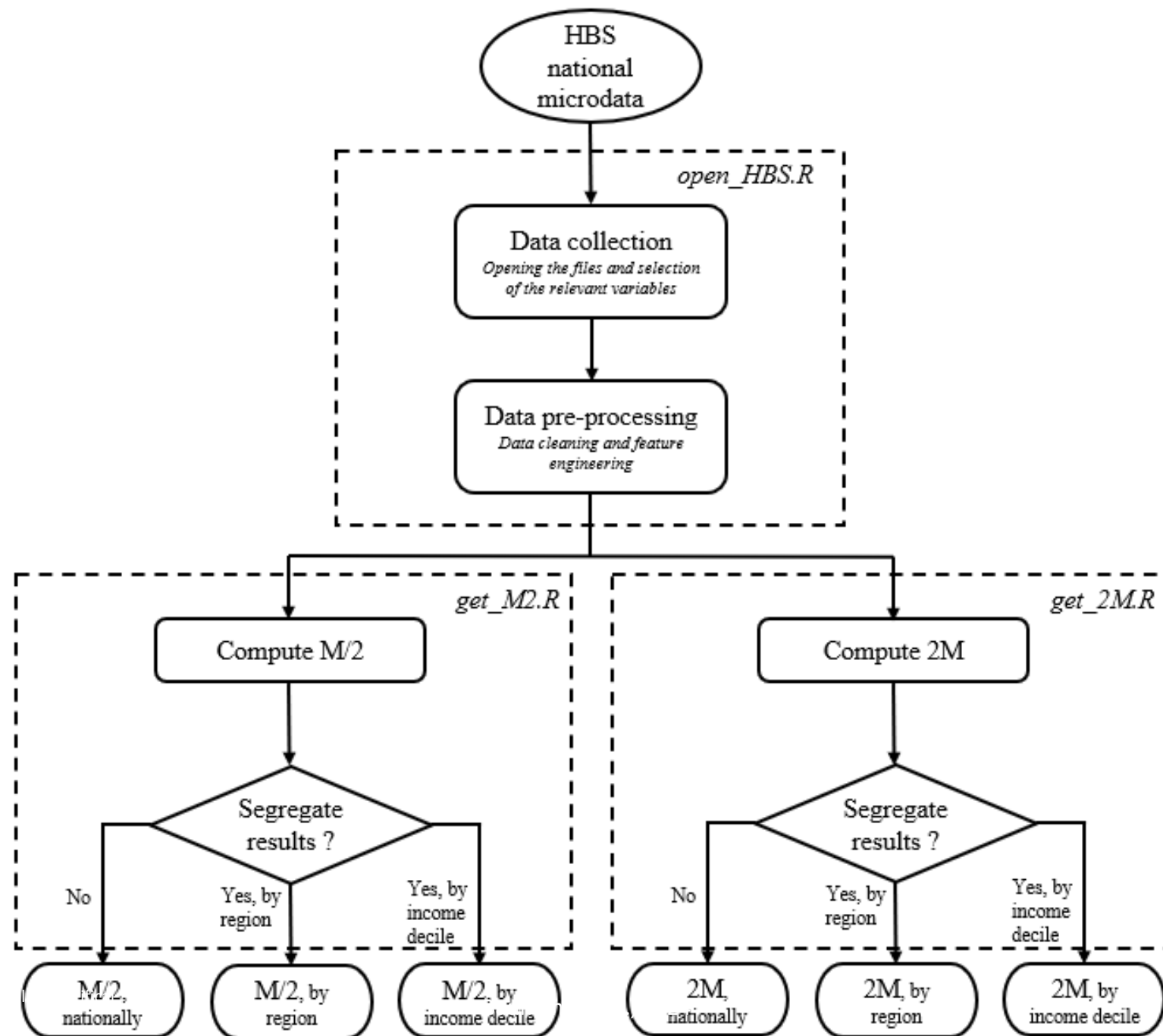
- **M/2**: share of the population which absolute energy expenditure is below half the national median.
- **2M**: share of the population which share of energy expenditure is above twice the national median

Employing various indicators to capture different dimensions of energy poverty



Five different energy poverty indicators rates and their overlap rates in Hungary in 2018 (Menyhert, 2023)





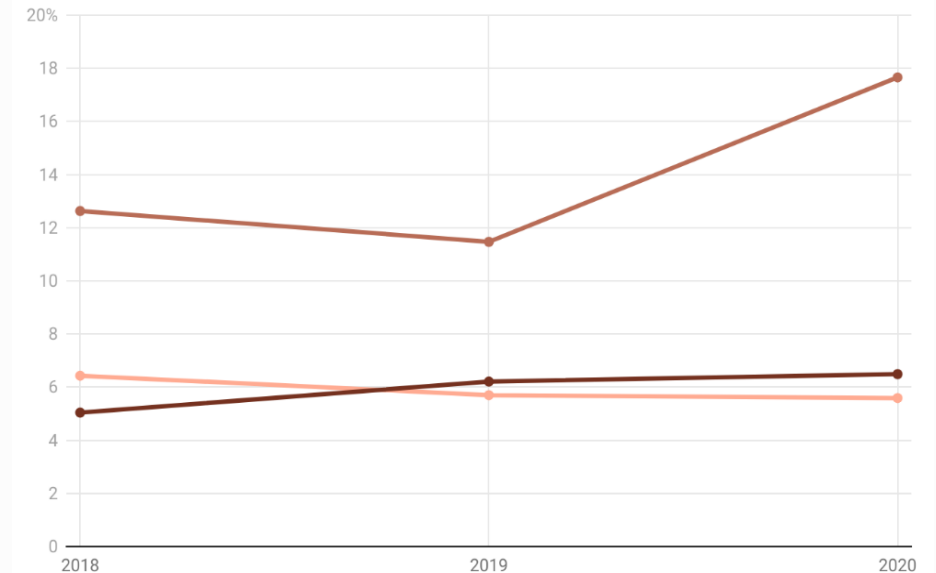
Assessing energy poverty in France

- All indicators either increase or remain steady over the last years

The evolution of energy poverty in France between 2018 and 2020

Evolution of three consensual-based energy poverty indicators between 2018 and 2020 in France

— Arrears on utility bills — Inability to keep home adequately warm — Population living in a dwelling with presence of leak, damp and rot



Source: French Statistics on Income and Living Conditions microdata • Created with Datawrapper

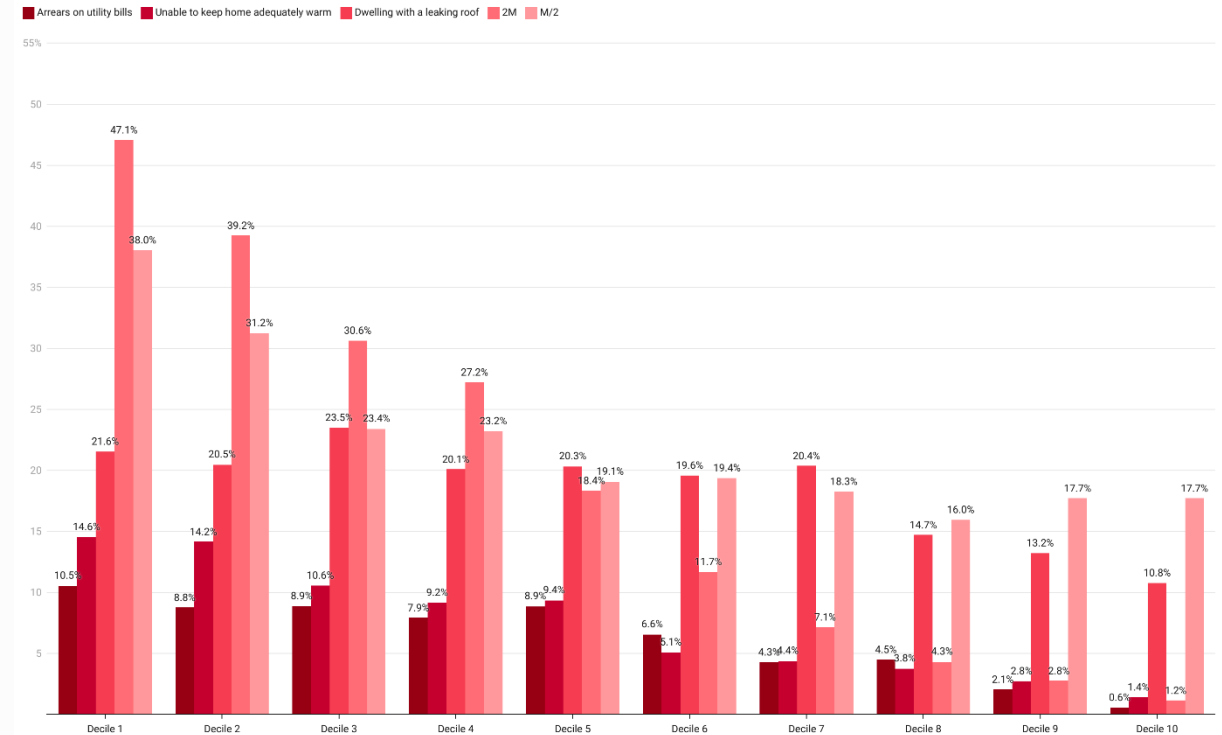
*Subjective energy poverty indicators in France
between 2018 and 2020*

Assessing energy poverty in France

- All indicators either increase or remain steady over the last years
- Disparities are observed when it comes to income

Five energy poverty indicators in France by total household income per capita decile

Arrears on utility bills, Unable to keep home adequately warm, Dwelling with a leaking roof; data from 2020. 2M and M/2: data from 2017.



Source: French Household Budget Survey & Statistics on Income and Living Conditions microdata - Created with Datawrapper

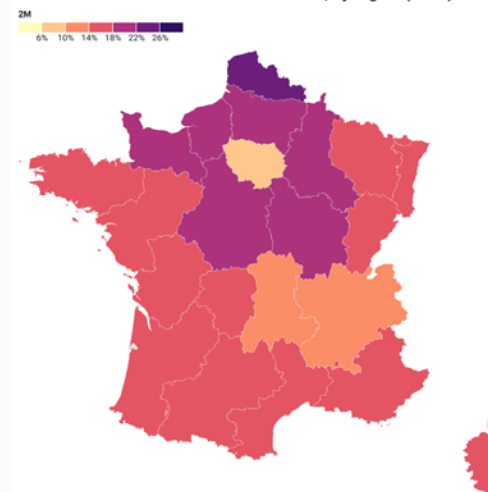
*Subjective energy poverty indicators in France
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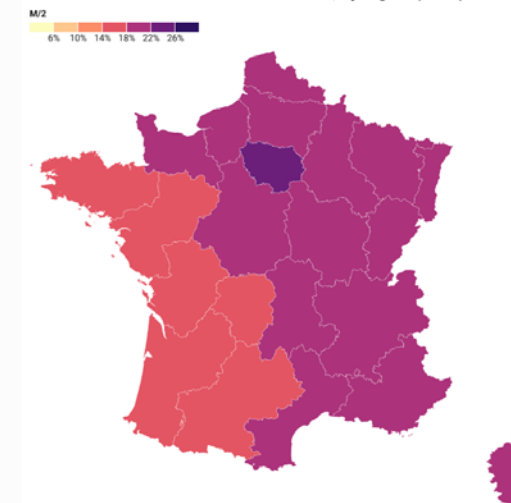
Assessing energy poverty in France

- All indicators either increase or remain steady over the last years
- Disparities are observed when it comes to income
- There is a significant regional divide, particularly in the 2M indicator

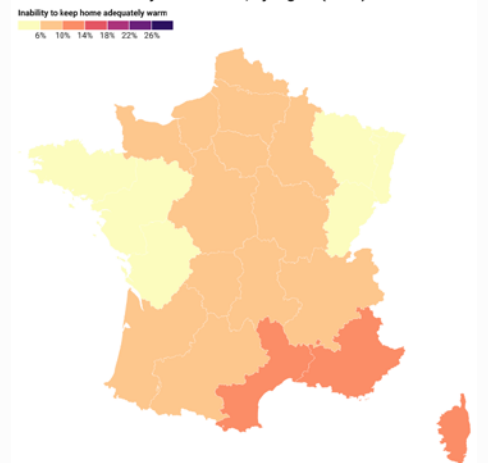
Share of the population which share of energy expenditure is above twice the national median in France, by region (2017)



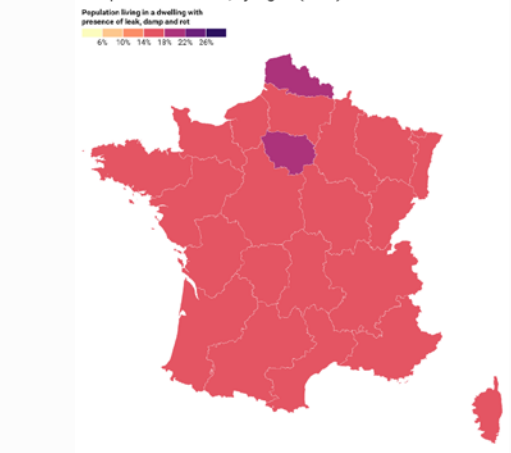
Share of the population which absolute energy expenditure is below half the national median in France, by region (2017)



Share of the population that was unable to keep home adequately warm over the last year in France, by region (2020)



Share of the population living in a dwelling with presence of leak, damp and rot in France, by region (2020)

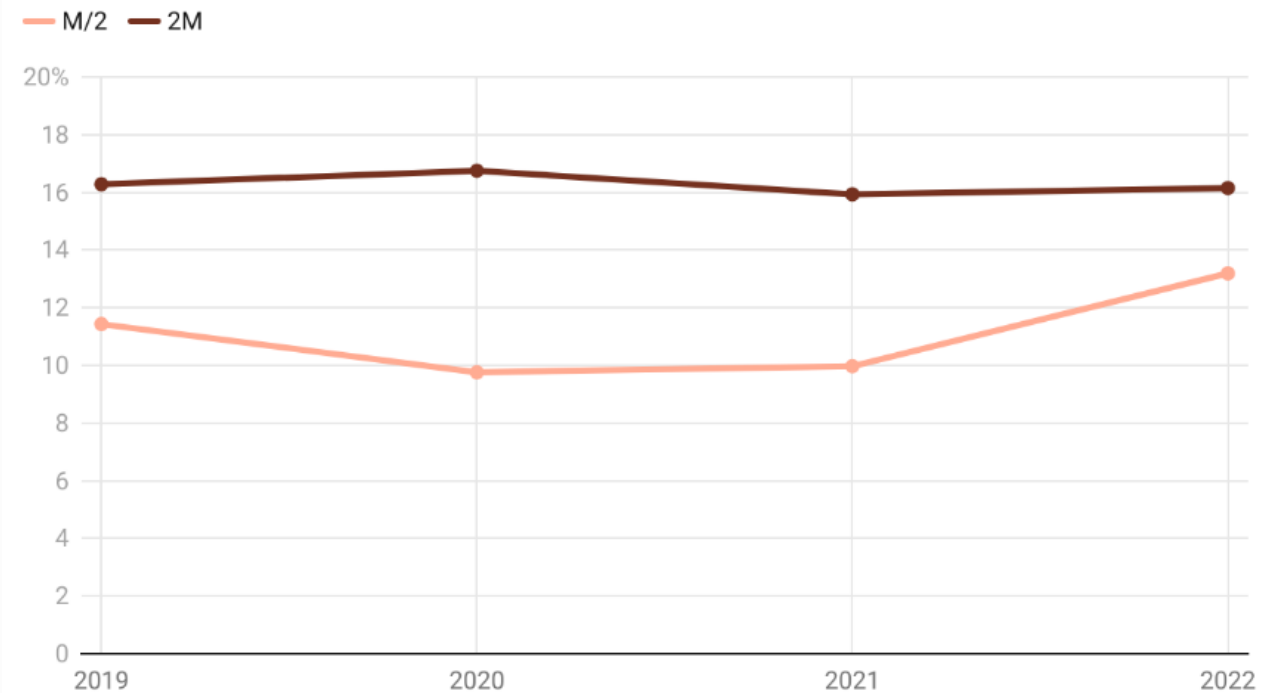


Assessing energy poverty in Italy

- The objective indicators remained steady or decrease until 2021 then increased in 2022

The evolution of energy poverty in Italy between 2019 and 2022

Evolution of two energy poverty indicators between 2019 and 2022 in Italy

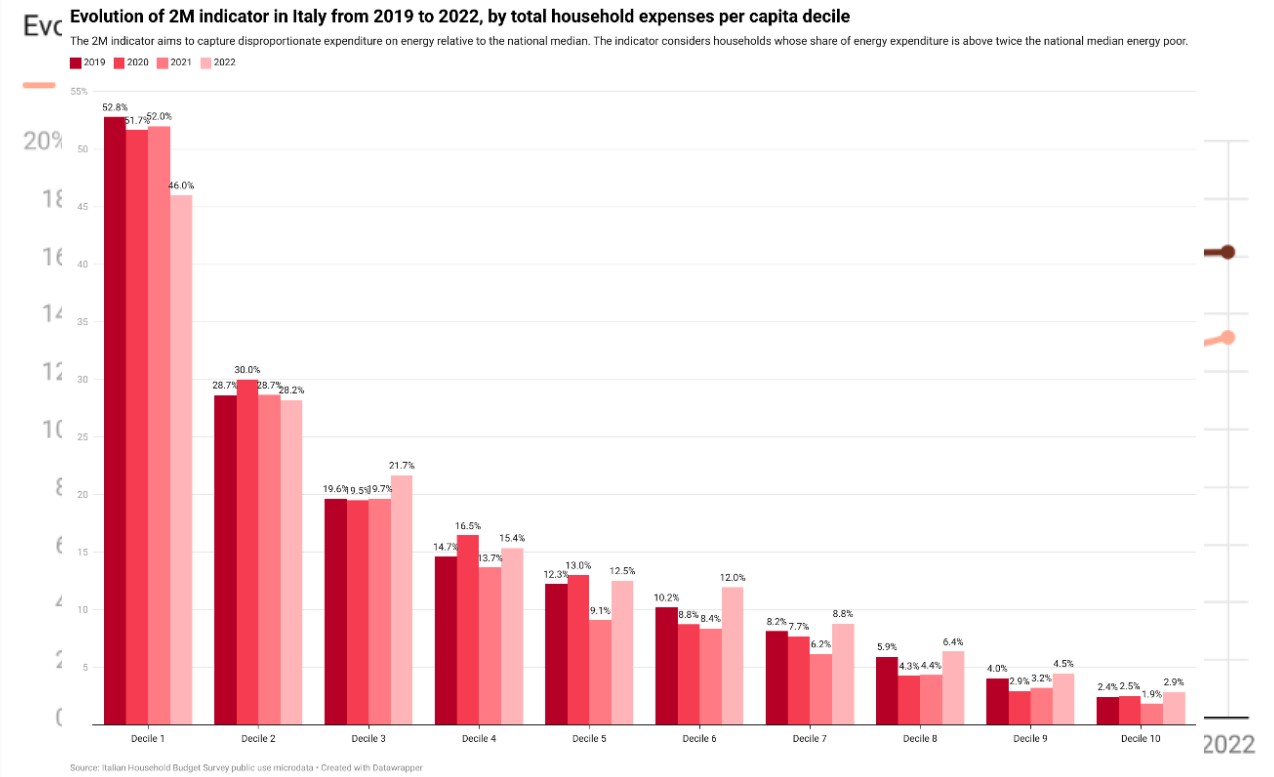


Source: Italian Household Budget Survey public use microdata • Created with Datawrapper

Assessing energy poverty in Italy

- The objective indicators remained steady or decrease until 2021 then increased in 2022
- The highest disparities are observed when it comes to income

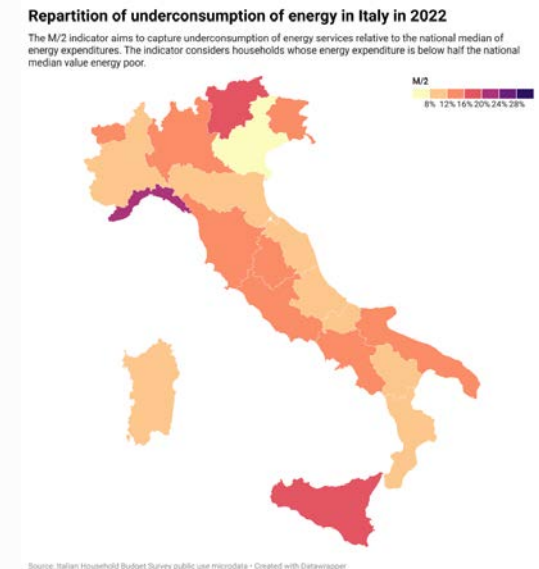
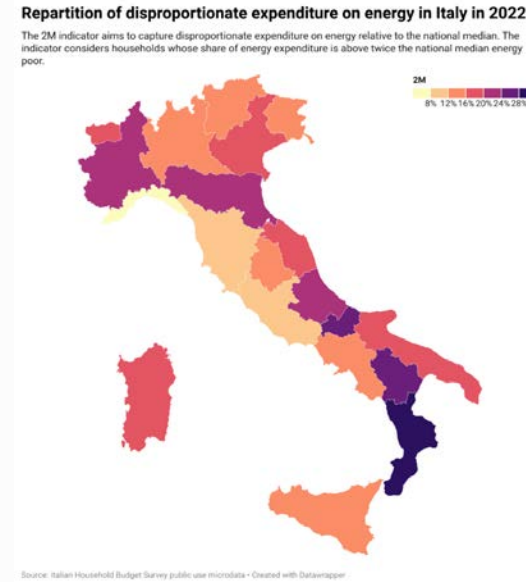
The evolution of energy poverty in Italy between 2019 and 2022



Source: Italian Household Budget Survey public use microdata • Created with Datawrapper

Assessing energy poverty in Italy

- The objective indicators remained steady or decrease until 2021 then increased in 2022
- The highest disparities are observed when it comes to income
- There is an outstanding regional divide in both indicators

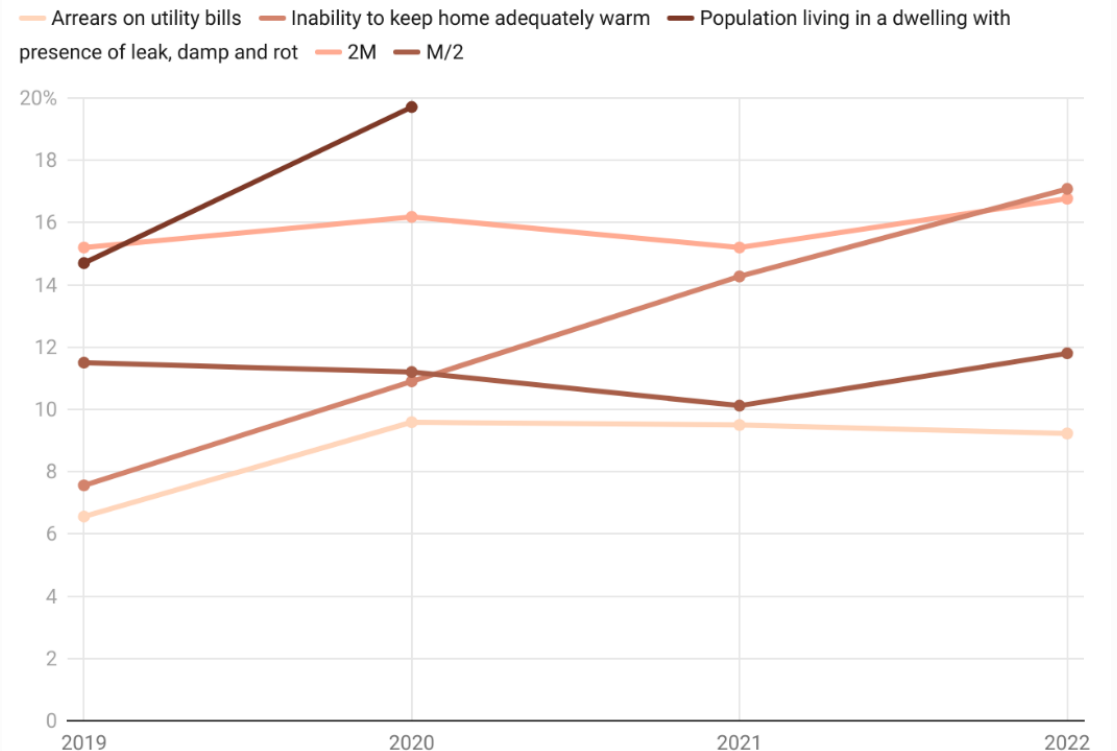


Assessing energy poverty in Spain

- All indicators either increase or remain steady over the last years

The evolution of energy poverty in Spain between 2019 and 2022

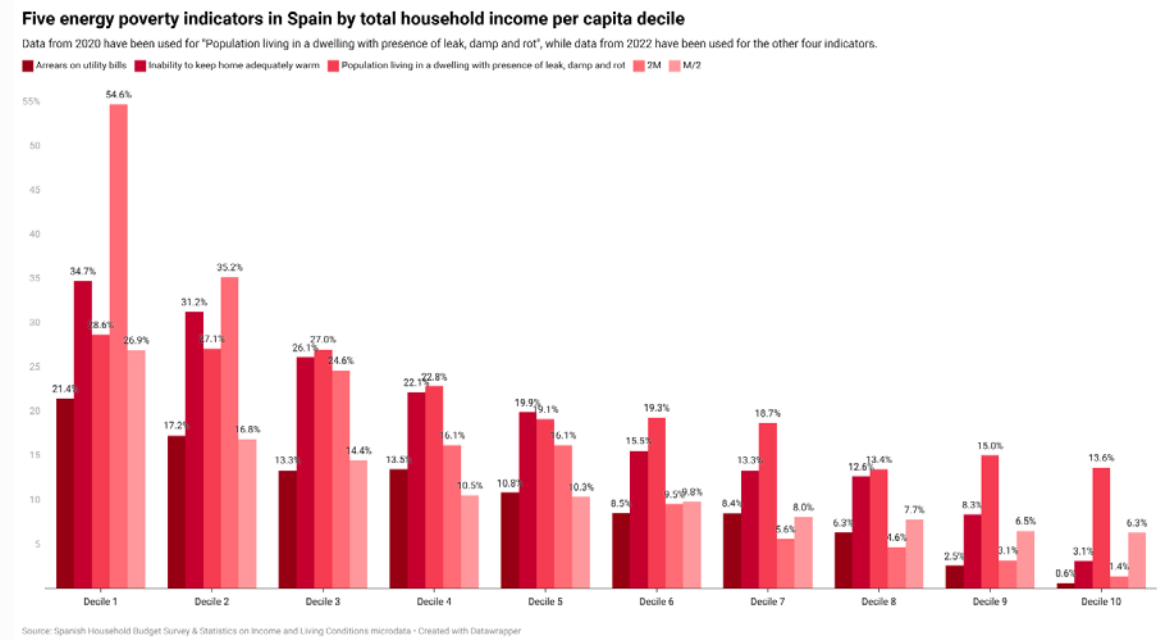
Evolution of five energy poverty indicators between 2019 and 2022 in Spain



Source: Spanish Household Budget Survey & Statistics on Income and Living Conditions microdata • Created with Datawrapper

Assessing energy poverty in Spain

- All indicators either increase or remain steady over the last years
- Even higher disparities are observed when it comes to income

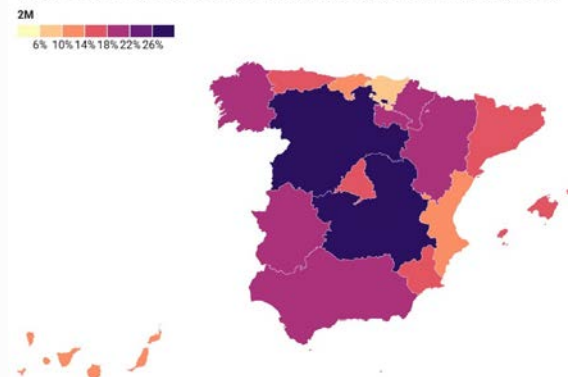




Assessing energy poverty in Spain

- All indicators either increase or remain steady over the last years
- Even higher disparities are observed when it comes to income
- There is a significant regional divide in all indicators

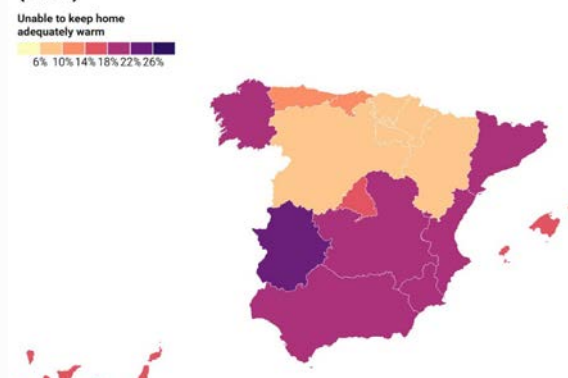
Share of the population which share of energy expenditure is above twice the national median in Spain, by region (2022)



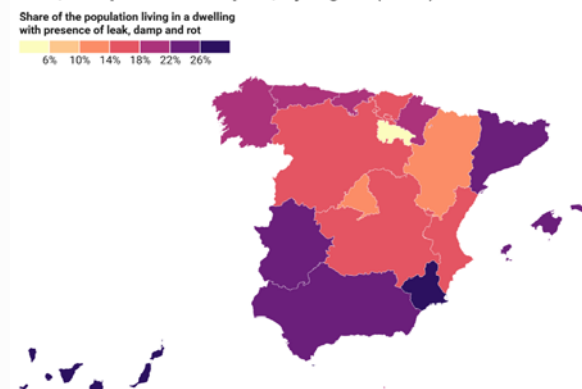
Share of the population which absolute energy expenditure is below half the national median in Spain, by region (2022)



Share of the population that was not able to keep their home adequately warm over the last year in Spain, by region (2022)



Share of the population living in a dwelling with presence of leak, damp and rot in Spain, by region (2020)



Comparison of energy poverty incidence in Spain, Italy and France

- Similar trends in all subjective indicators
- A worsened situation from 2020 onwards, reflecting the impact of the Covid-19 crisis and the energy and inflationary crisis
- Coordinated policies to tackle energy poverty at the European level could be relevant

Spain

Indicator	2017	2018	2019	2020	2021	2022
Arrears on utility bills	9.6%	7.2%	6.6%	9.6%	9.5%	9.2%
Inability to keep home adequately warm	8.0%	9.1%	7.6%	10.9%	14.3%	17.1%
Population living in a dwelling with presence of leak, damp and rot	11.5%	15.9%	14.7%	19.7%	-	-

France

Indicator	2017	2018	2019	2020	2021	2022
Arrears on utility bills	7.5%	6.4%	5.7%	5.6%	7.1%	7.1%
Inability to keep home adequately warm	4.9%	5.0%	6.2%	6.5%	6.0%	10.9%
Population living in a dwelling with presence of leak, damp and rot	11.1%	12.6%	11.5%	17.7%	-	-

Italy

Indicator	2017	2018	2019	2020	2021	2022
Arrears on utility bills	4.1%	4.5%	4.5%	6.0%	6.5%	5.0%
Inability to keep home adequately warm	15.2%	14.1%	11.1%	8.3%	8.1%	8.8%
Population living in a dwelling with presence of leak, damp and rot	16.1%	13.2%	14.0%	19.6%	-	-

Identifying vulnerable households

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Identifying the characteristics of those households more vulnerable to energy poverty ...

Econometric analysis - logistic regression with French 2020 data:

- Dependent variable: whether a household is unable to keep their home warm
- Explanatory variables: socioeconomic factors such as number of inhabitants, education level, professional status, etc.

Variables	Description	Reference
Dummy overpopulated household	***	***
Type of household	Single person; Single-parent family; Couple without children; Couple with at least one child; Others	Others
Tenure status of households	Owner; Tenant or sub-tenant; Free lodger	Free lodger
Type of house	Detached house; Semi-detached house; Apartment in a building with less than 10 dwellings; Apartment in a building with 10 or more dwellings; Others	Others
Type of employment of the main breadwinner	Farmers; Artisans, shopkeepers and company managers; Executives and higher intellectual professions; Intermediate professions; Office employees; Workers; Retired people; Others	Others
Employment of the main breadwinner	Employed; Student or trainee; Unemployed; Retired; Inactive	Inactive
Education level of the main breadwinner	Doctorate or equivalent; Master or equivalent; Licence or equivalent; DUT or equivalent; Bac or equivalent; CAP-DNB or equivalent; No diploma	Doctorate or equivalent
Area of residence	High-density area; Intermediate-density area; Low-density area	Intermediate-density area
Number of children in the household	***	***
Number of adults in the household	***	***

Source: French SILC in 2020

... to design effective policies

Vulnerability factors identified:

- Single-person and single-parent or large families
- Not owning their dwelling (tenants)
- Living in a rural area
- The main breadwinner being inactive or unemployed

	Coefficients	Probability ratios
Dummy overpopulated household	-0.0214	0.9788
Type of household		
Single person	0.1047	1.1104
Single-parent family	-0.0464	0.9547
Tenure status of households		
Tenant or sub-tenant	0.2405	1.2719
Employment of the main breadwinner		
Unemployed	-0.1406	0.8688
Area of residence		
Low-density area	0.2045**	1.2269**

Pseudo R-squared = 0.1060

Note: Asterisks indicate the level of significance of the parameter, so that:

*** indicates significance at 1%, ** at 5%, *at 10%

Measuring energy poverty in three EU countries

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- Despite some discrepancies, France, Italy and Spain share similar trends in terms of energy poverty
- This reinforces the idea that coordinated policies at the European level could be relevant to tackle energy poverty
- In France, non-owner households with many children and/or with one adult (single-parent), living in a rural area, with a main breadwinner in the situation of job instability are more likely to be unable to keep their home adequately warm

Limitations and further work

- Refining the set of indicators used to measure energy poverty, enabling a more comprehensive identification of affected households
- Conducting comparative analyses involving other European countries to identify potential regional disparities
- Applying the proposed vulnerability analysis' methodology to data from multiple years and countries and using a range of energy poverty indicators



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Thank you for your attention

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Annex: Methodology of the vulnerability analysis

According to the logit model methodology, we presume that there exists a latent variable y_i^* such:

$$y_i^* = x_i' \cdot \beta + \varepsilon_i$$

where x is the vector of explanatory variables and ε is the error term.

Annex: Methodology of the vulnerability analysis

The variable y_i^* is unobservable, we only observe y_i , the binary variable equal to 1 if household i is unable to keep its home adequately warm, and equal to 0 otherwise. It is assumed that the error term follows a standard logistic regression.

Then, the probability of household i to be vulnerable to being unable to keep home adequately warm is given by:

$$P(y_i = 1) = P(y_i^* > 0) = P(\varepsilon_i > -x_i' \cdot \beta)$$



Annex: Results of the vulnerability analysis

	Coefficients	Probability ratios
Dummy overpopulated household	-0.0214	0.9788
Type of household		
Single person	0.1047	1.1104
Single-parent family	-0.0464	0.9547
Couple without children	-0.6721**	0.5106**
Couple with at least one children	-0.8105**	0.4446**
Tenure status of households		
Owner	-0.4756*	0.6215*
Tenant or sub-tenant	0.2405	1.2719
Type of house		
Detached house	-0.2693	0.7639
Semi-detached house	0.0368	1.0375
Apartment in a building with less than 10 dwellings	0.1067	1.1126
Apartment in a building with 10 or more dwellings	-0.2853	0.7518

	Coefficients	Probability ratios
Type of employment of the main breadwinner		
Farmers	-0.1778	0.8371
Artisans, shopkeepers and company managers	0.4802	1.6164
Executives and higher intellectual professions	-0.9346**	0.3927**
Intermediate professions	0.0677	1.0700
Office employees	0.6066*	1.8342*
Workers	0.2868	1.3322
Retired people	0.1827	1.2005
Employment of the main breadwinner		
Employed	-0.8808**	0.4145**
Student or trainee	-1.3373***	0.2626***
Unemployed	-0.1406	0.8688
Retired	-0.8541***	0.4257***
Education level of the main breadwinner		
Master or equivalent	-0.9696**	0.3792**
Licence or equivalent	-0.5905	0.5541
DUT or equivalent	-0.5612	0.5705
Bac or equivalent	-0.1733	0.8409
CAP-DNB or equivalent	-0.1000	0.9048
No diploma	0.0736	1.0764
Area of residence		
High-density area	-0.1072	0.8983
Low-density area	0.2045**	1.2269**
Number of children in the household		
	0.1936***	1.2136***
Number of adults in the household		
	0.0709	1.0735

Pseudo R-squared = 0.1060

Note: Asterisks indicate the level of significance of the parameter, so that:

*** indicates significance at 1%, ** at 5%, * at 10%