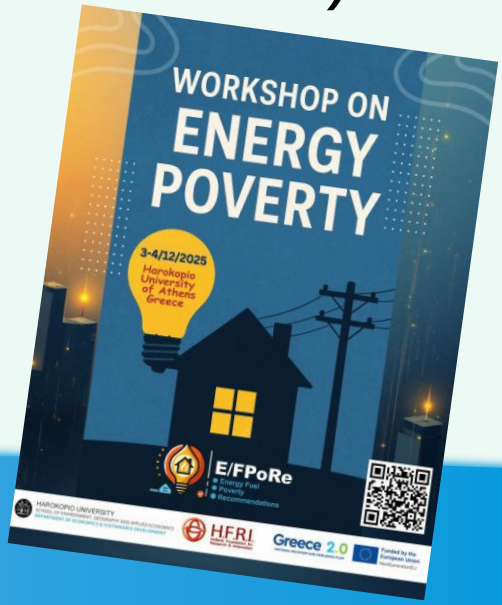
The research project is implemented in the framework of H.F.R.I call “Basic research Financing (Horizontal support of all Sciences)” under the National Recovery and Resilience Plan “Greece 2.0” funded by the European Union –Next Generation EU (H.F.R.I. Project Number: 016638).

Energy/**F**uel and human **PO**verty: public policy and **RE**commendations in **S**outhern **E**urope (EFPORE-SE)



Workshop

Date: December 3-4, 2025
Location: Harokopio University of Athens
H.F.R.I. Project Number: 016638
Funded by the EU - Next Generation EU

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Prof. George Dedousis. Dean of Harokopio University of Athens

Prof. Roido Mitoula. Dean of the School of Environment, Geography, and Applied Economics at Harokopio University of Athens

Prof. Dimitrios Zbainos. Head of the Department of Economics and Sustainable Development, Harokopio University of Athens

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Session I.A

Keynote Speaker

Daniel Zachary, Program Director, MS in Energy Policy and Climate Program, Johns Hopkins University, USA

Integrating Energy, Environment, and Equity through Optimization

Session I.B

EFPORE project's presentations

- **Ioannis Kostakis (Coordinator)**, Department of Economics and Sustainable Development, Harokopio University of Athens, Greece
- **Vivian Angeletopoulou**, Department of Economics and Sustainable Development, Harokopio University of Athens, Greece
- **Dimitra Papadaki**, University of Athens, Greece, & Johns Hopkins University, USA
- **Giacomo Di Foggia**, Department of Business and Law, Bicocca University, Milan, Italy
- **Pedro Palma**, NOVA University Lisbon, Portugal

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Session II

Mado Baboula. Greek Antipoverty Network, Greece
Energy poverty as is: research results and experiences from the field

Alice Corovessi. Initializing Energy Balance Towards Zero (INZEB), Greece
Diagnosis of Energy Poverty at Local Level: Results of Technical Support to Local Authorities

George Pavlikakis. Consumers' Association "The Quality of Life" (EKPIZO), Greece
The Role of One-Stop Shops in the Energy Upgrading of Homes of Vulnerable Households

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Session III

Sevastianos Mirasgedis. National Observatory of Athens, Greece
Energy Poverty in Greece: Measurement, Impacts, and Policy Responses

Dimitrios Damigos. National Technical University of Athens, Greece
Supporting energy-poor households via deep renovations: Lessons and recommendations from the REVERTER project

Christos Tourkolias, Centre for Renewable Energy Sources and Saving, Greece
Revision of the Action Plan for Addressing Energy Poverty

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Thursday
4/12/2025

Session IV

Paul Yohana (PhD. Cand., Nova, Portugal).
Multidimensional Energy Poverty in Nigeria: Pathways to Climate Resilience and Sustainable Development

Evandro Ferreira (PhD. Cand., Nova, Portugal).
Smart Meters and Surveys: A Combined Framework for Measuring and Addressing Energy Poverty

Frederico Marques (MSc student, NOVA, Portugal)
Evolution of energy poverty in Portugal: Historical analysis of the Energy Poverty Vulnerability Index"

Session V

Students workshop

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EFPORE-SE primary goals

Budget 133.800 euro
March 2024-
December 2025

- Develop strategies to assess energy poverty levels,
- Identify vulnerable households in Southern Europe,
- Enhance public policies and approaches to address energy poverty issues.

The research team explores energy poverty in four Southern European countries:

EFPORE-SE specific objectives

1

Provide an overview of households' energy consumption in Greece, Italy, Spain and Portugal.

2

Identify specific indicators defining vulnerable population.

Highlight key differences among countries.

EFPORE-SE specific objectives

3

- Interactive website to publish all project outcomes
- Anonymous household questionnaire
- Data collected: socioeconomic, demographic, regional, and dwelling characteristics
- Platform assesses each household's energy poverty status
- Provides tailored recommendations

4

Provide a comprehensive overview of how energy needs impact energy poverty.

Understand how societies respond to major economic and social disruptions while attempting to meet energy needs.

The research team

	Group 1	Group 2	Group 3	Group 4	Group 5
Organization	Harokopio University of Athens (host) and National Technical University of Athens	Biccoca University, Milan and Technical University of Crete	Nova University of Lisbon	Rovira i Virgili University, Reus	Panteion University, Athens
Group leader	Prof. Sardianou	Prof. Di Foggia	Prof. Gouveia	Prof. Arauzo-Carod	Prof. Bithas
Subject	Investigation in Greece	Investigation in Italy	Investigation in Portugal	Investigation in Spain	CBA (cost benefit analysis)

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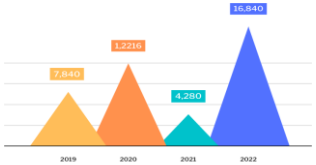
Basic considerations

Area under investigation

- Southern European countries: Greece, Italy, Portugal, Spain

Time period covered

- Annual observations between 2016-2024
- NUTS 1 NUTS 2



Data retrieval

- EUROSTAT macro-data
- National statistical authority of each partner country (EU-SILC)

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An introduction to energy poverty

Worldwide numbers and global focus

International organizations concentrating

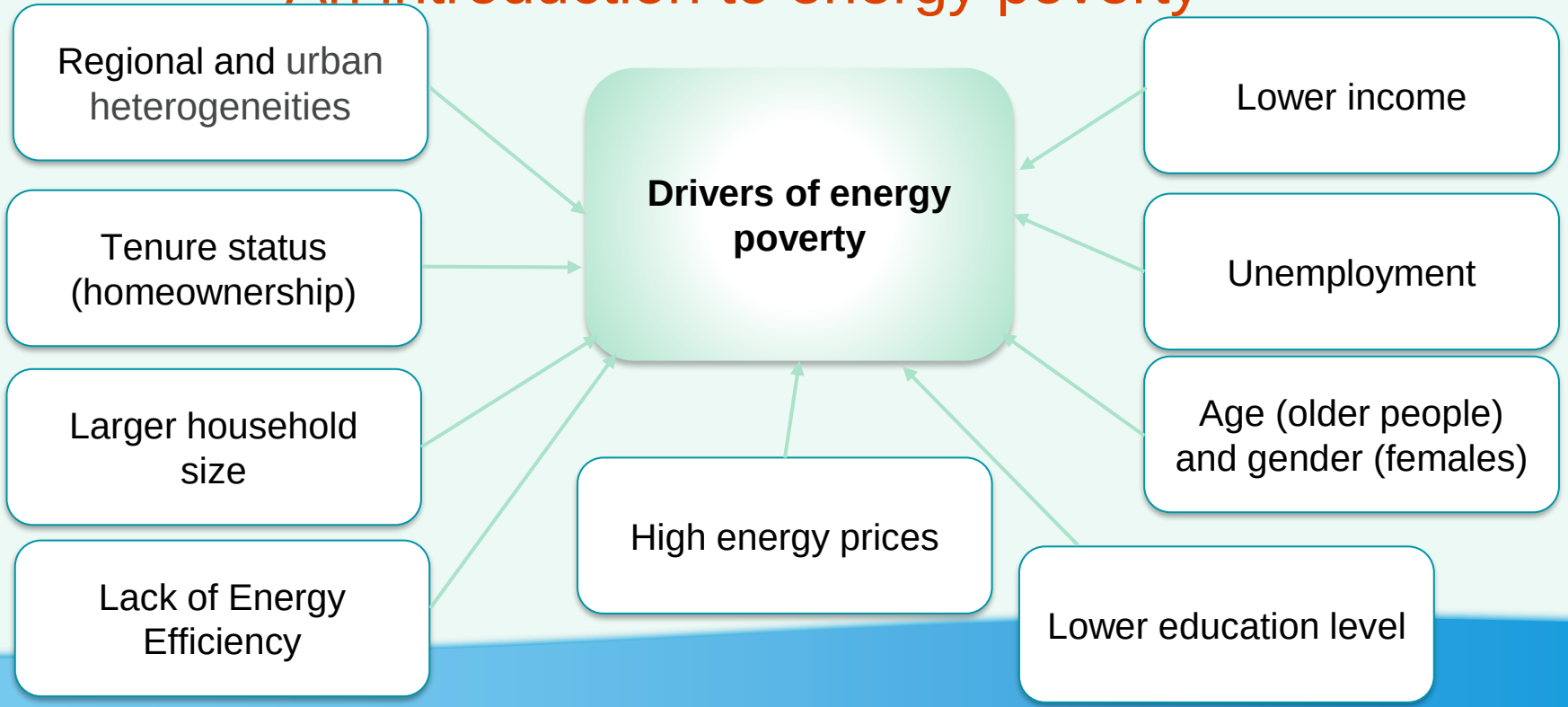
- the World Health Organization,
- the World Bank,
- the United Nations with the program "Sustainable Energy for All" in 2001,
- the 7th Sustainable Development Goal in 2015

Approximately 760M people worldwide are left without access to electricity

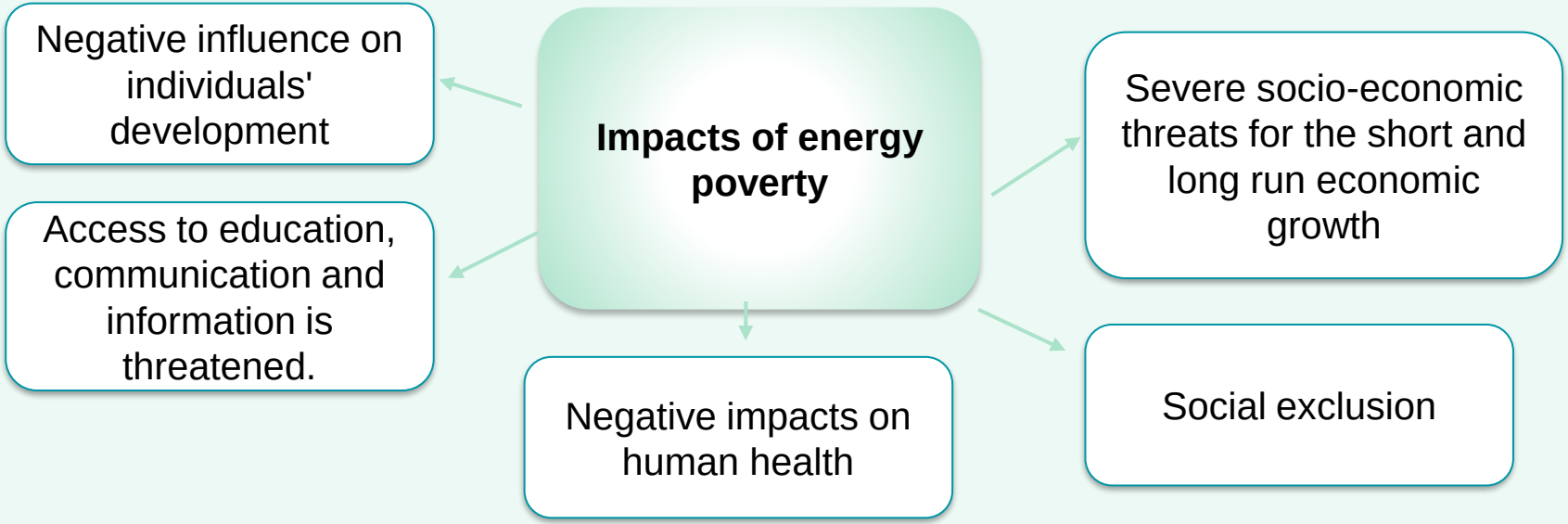
2.3B people depend on traditional fuels for cooking

Indoor air pollution, primarily from cooking smoke, is associated with approximately 3.7M premature deaths annually

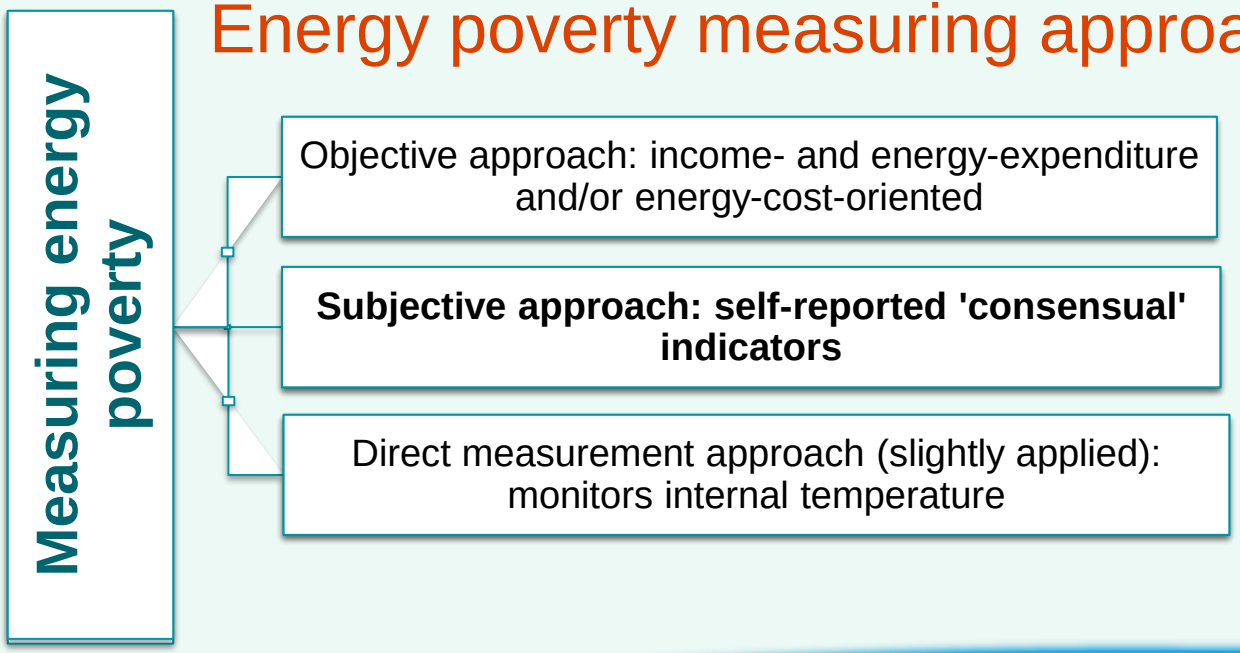
An introduction to energy poverty



An introduction to energy poverty



Energy poverty measuring approaches



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Energy poverty indicators: the challenges

Indicators should be expanded and more inclusive.

Significant gaps between energy poverty indicators.

Disaggregated research could provide more reliable findings

Hidden energy poverty and persistent energy poverty need further treatment.

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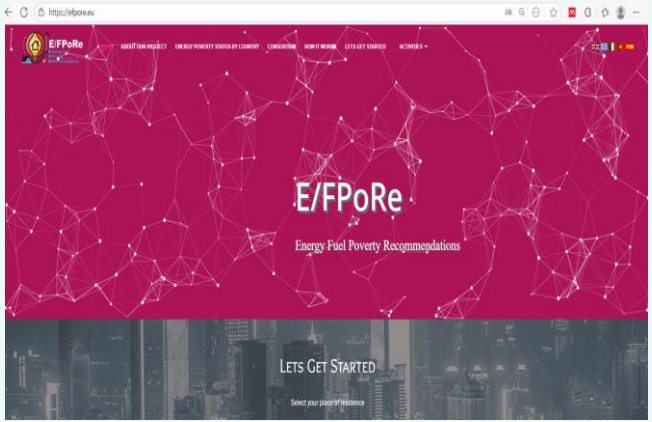
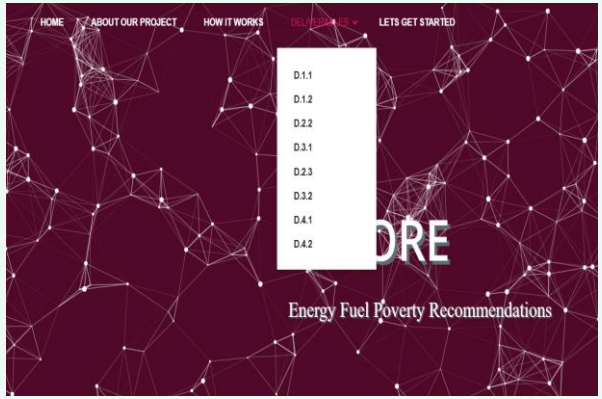
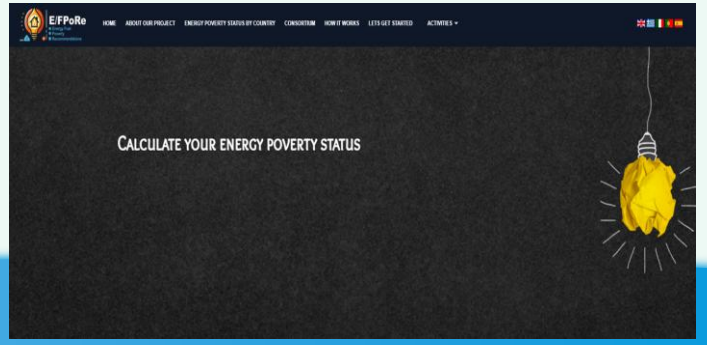
EFPORE-SE website https://efpore.eu







Energy/Fuel and human POverty: public policy and REcommendations in Southern Europe
December 3-4, 2025

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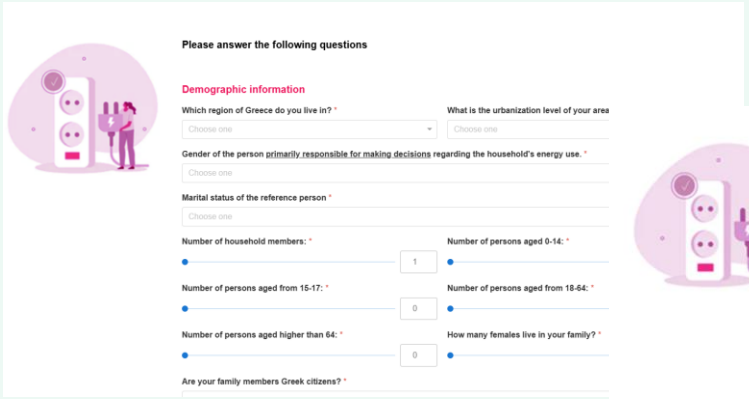

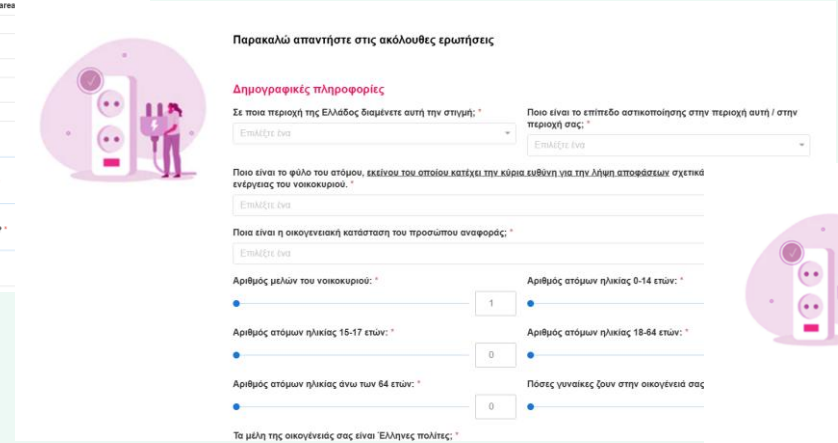

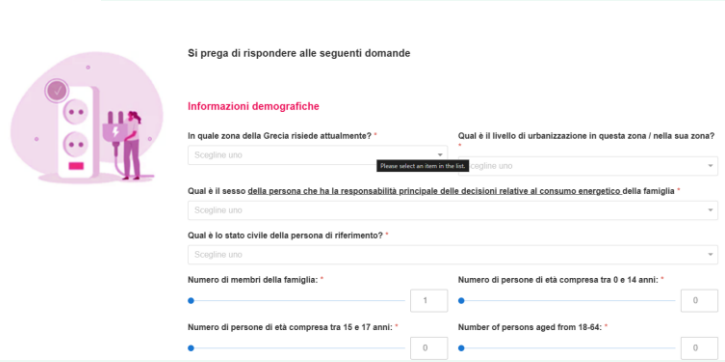

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EFPORE-SE website – “Calculate your energy poverty status” page

Your household is considered energy poor based on :

Binary Indicators

We classify your household as energy poor because you are unable to keep your home adequately warm.

Your household is also classified as energy poor because you cannot keep your home cool during the summer.

We classify your household as energy poor because you have unpaid bills.

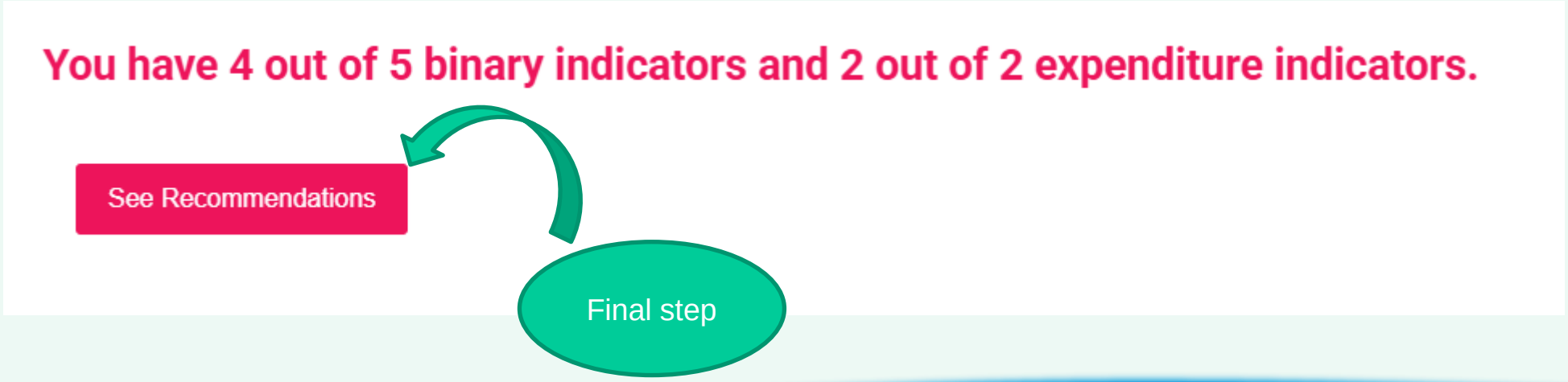
We classify you as energy poor because your home has a leaking roof or other structural issues.

Expenditure Indicator

Based on your response, we classify your household as energy poor because you spend more than 10% of your income on energy costs.

Your household is classified as energy poor based on your monthly income. According to your household composition, your income falls below the minimum social threshold.

EFPORE-SE website – “Calculate your energy poverty status” page



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Risk of poverty

Summer energy poverty

Material deprivation

Results of descriptive and econometric analysis

(Logit, Ordered logit, LPM, GLM, Fraction, Pseudo-panels, etc)

Inability

Arrears

Leaks

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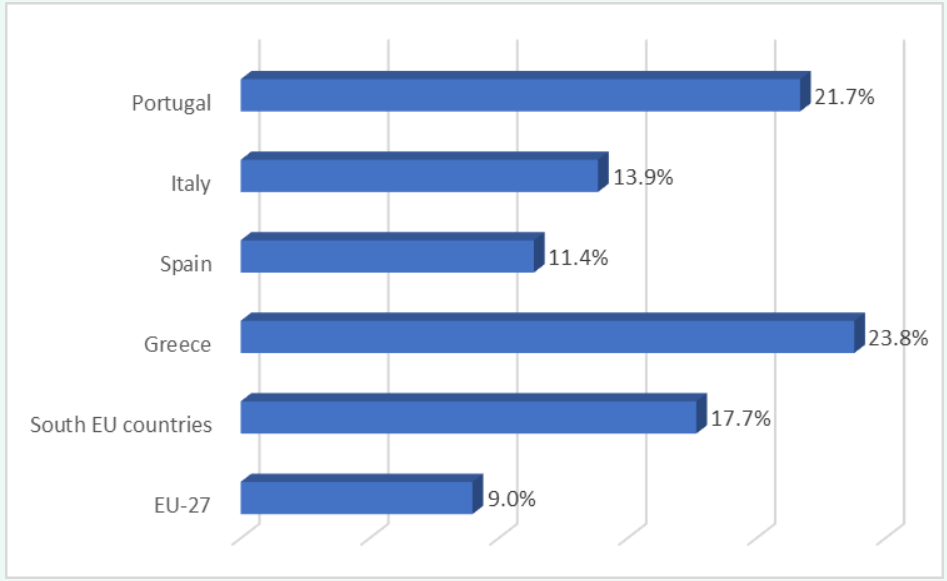
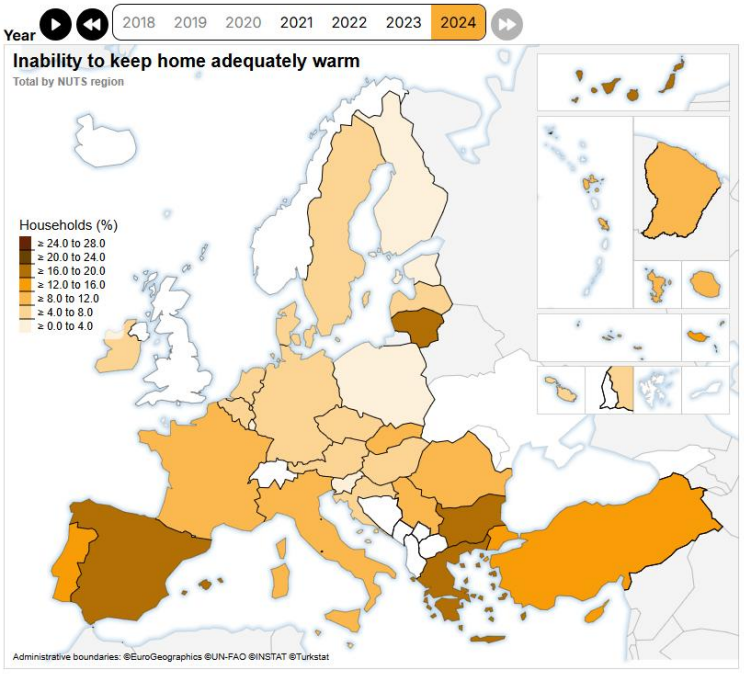
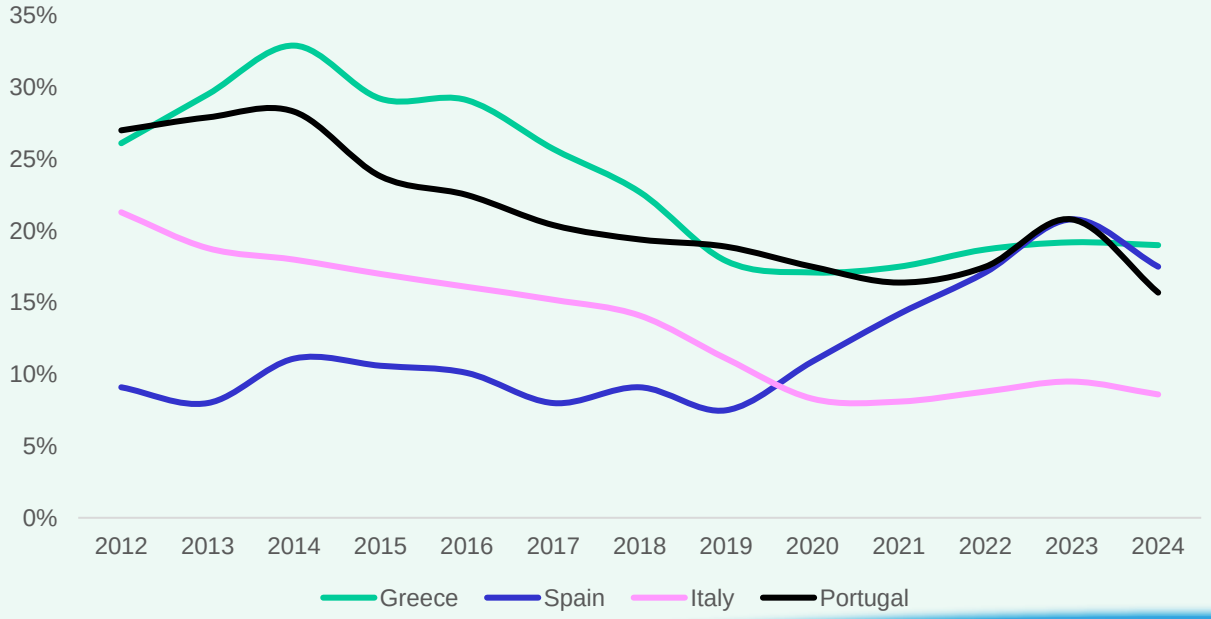
Inability to keep home adequately warm





Energy/Fuel and human POverty: public policy and RECommendations in Southern Europe
December 3-4, 2025

Inability to keep home adequately warm



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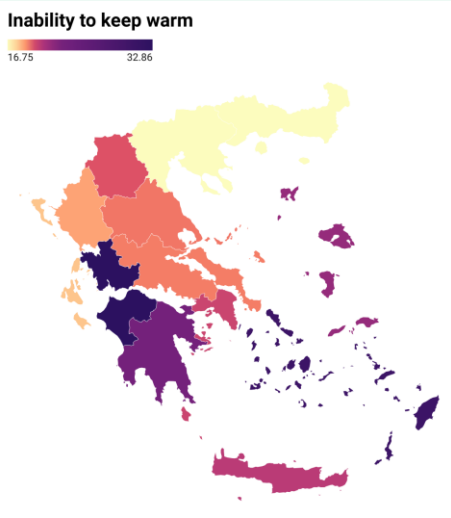
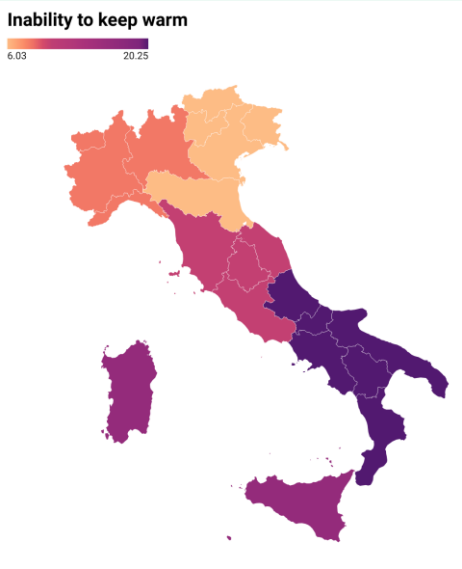
Inability to keep home adequately warm





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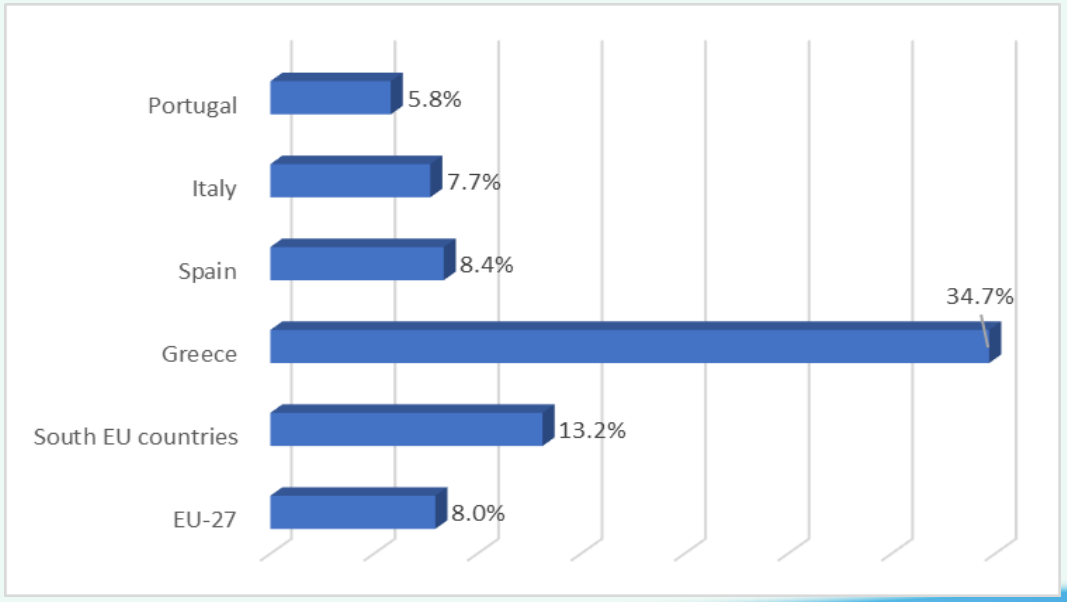
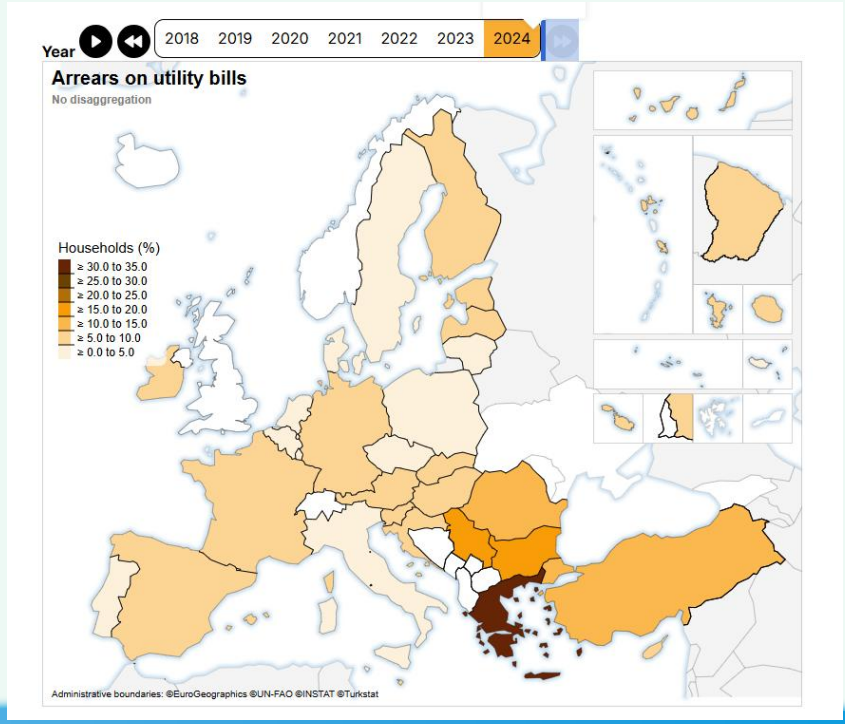
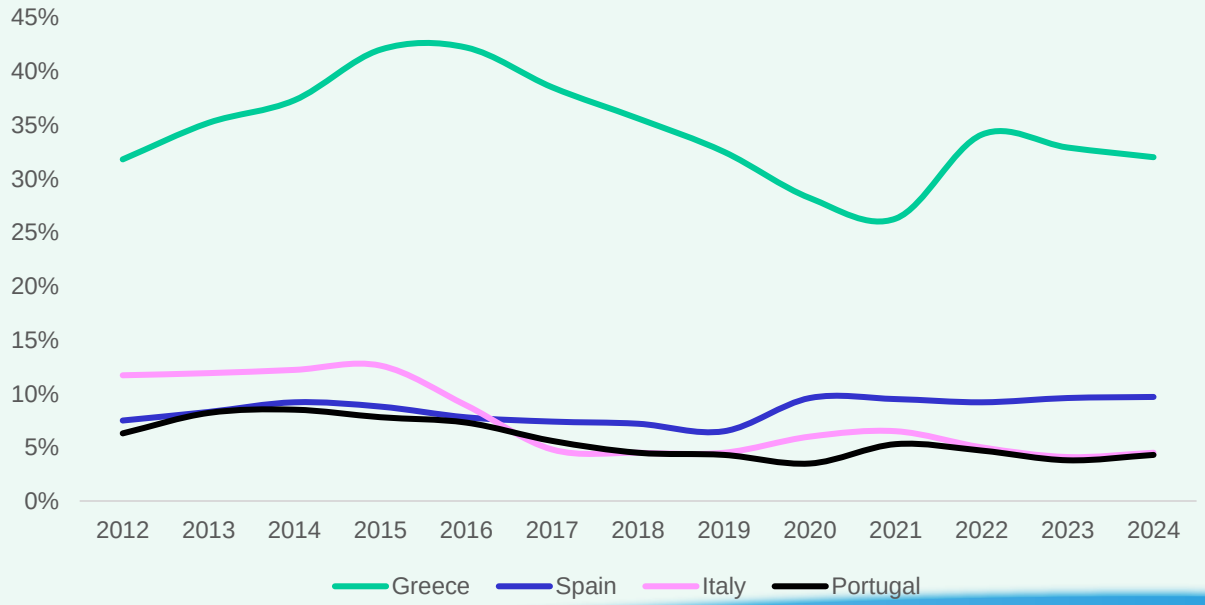
Arrears on utility bills





Arrears on utility bills



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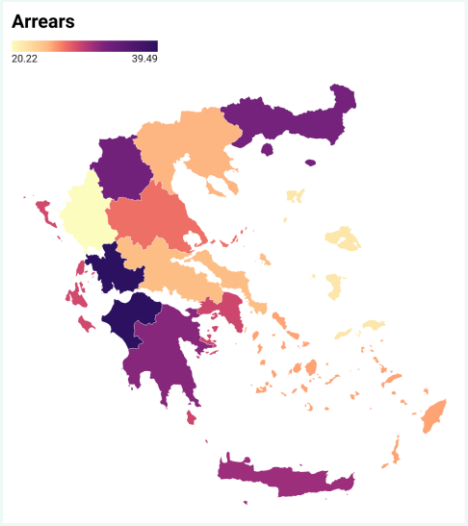
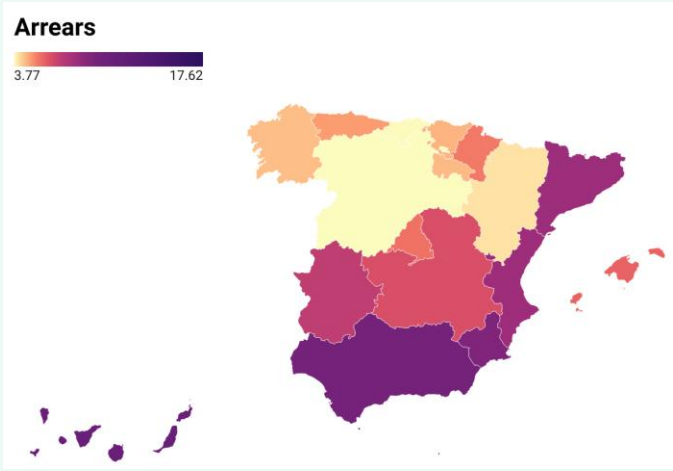
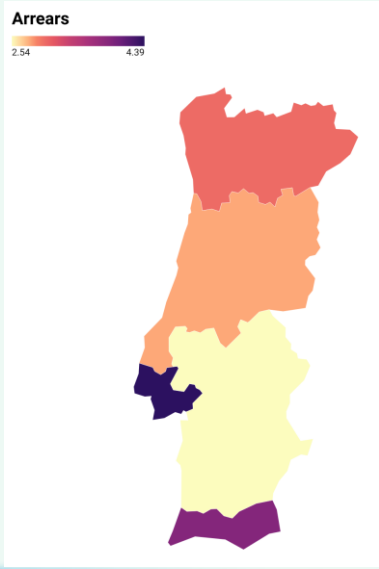
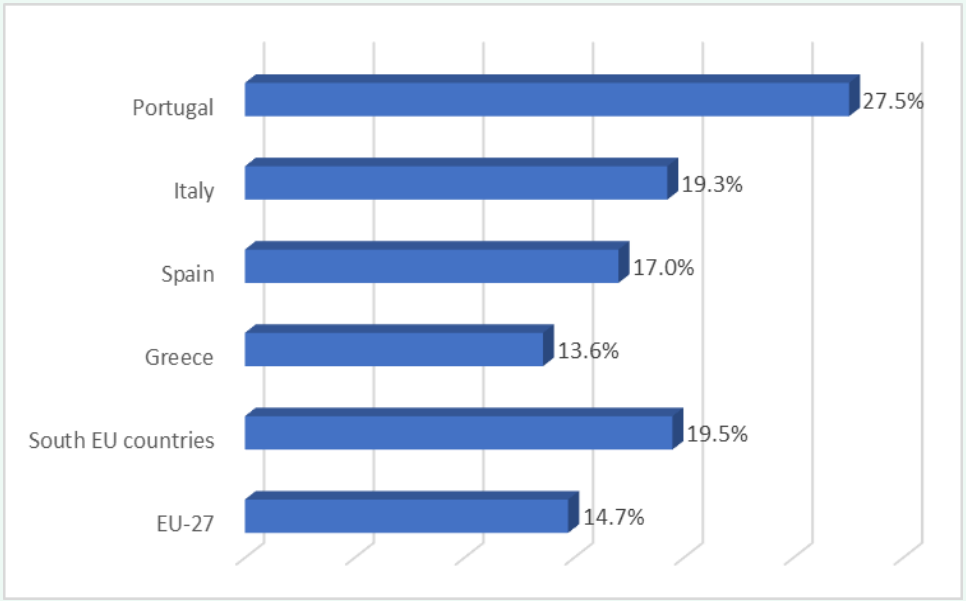
Arrears on utility bills

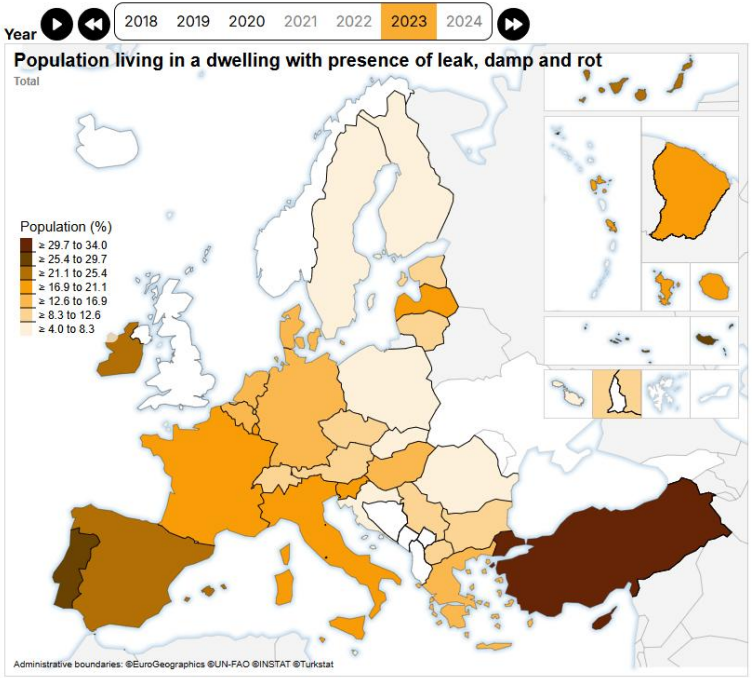




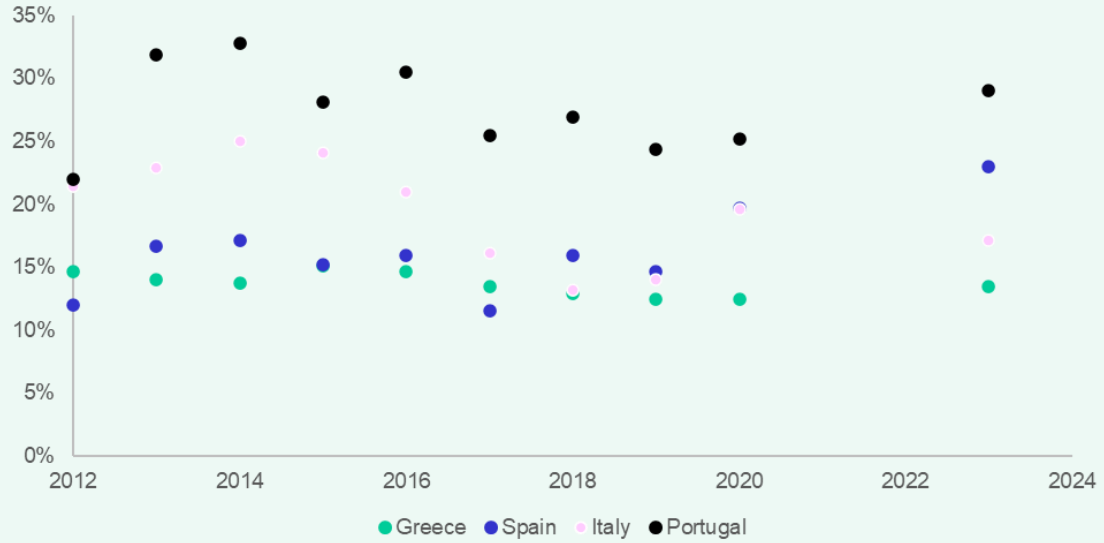


Dwellings with leak, damp, or rot





Dwellings with leak, damp, or rot



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The Greek case study – descriptive analysis

***E**nergy/**F**uel and human **PO**verty: public policy and **RE**commendations in **S**outhern **E**urope*
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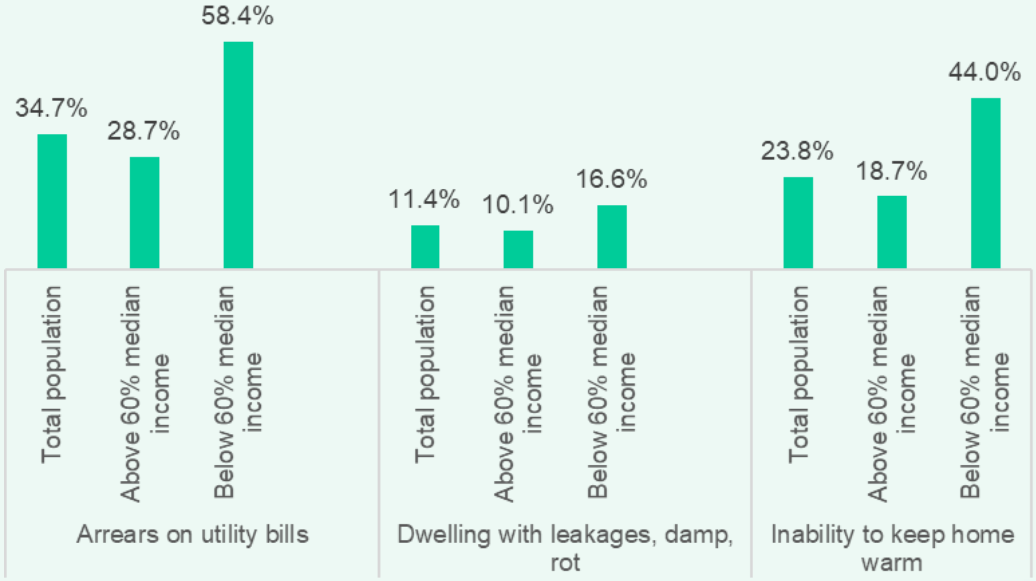
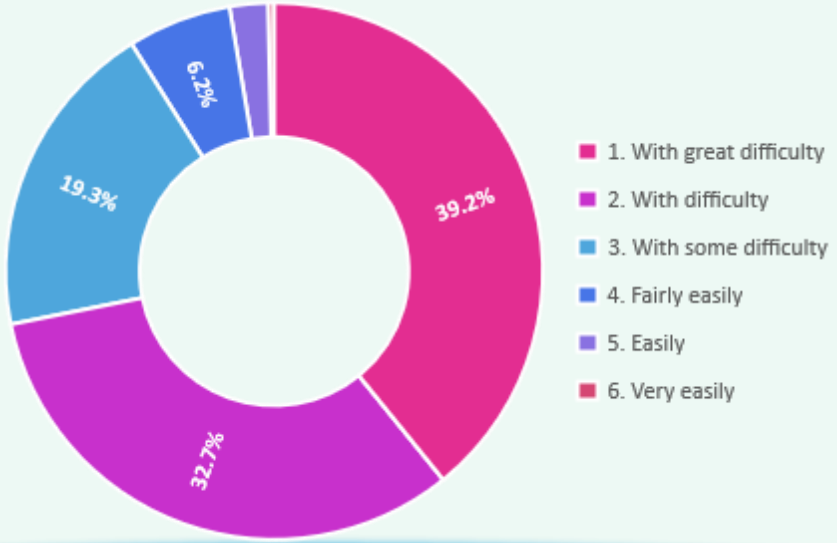
Average values of energy poverty EU-SILC indicators



Ability to make ends meet, average values



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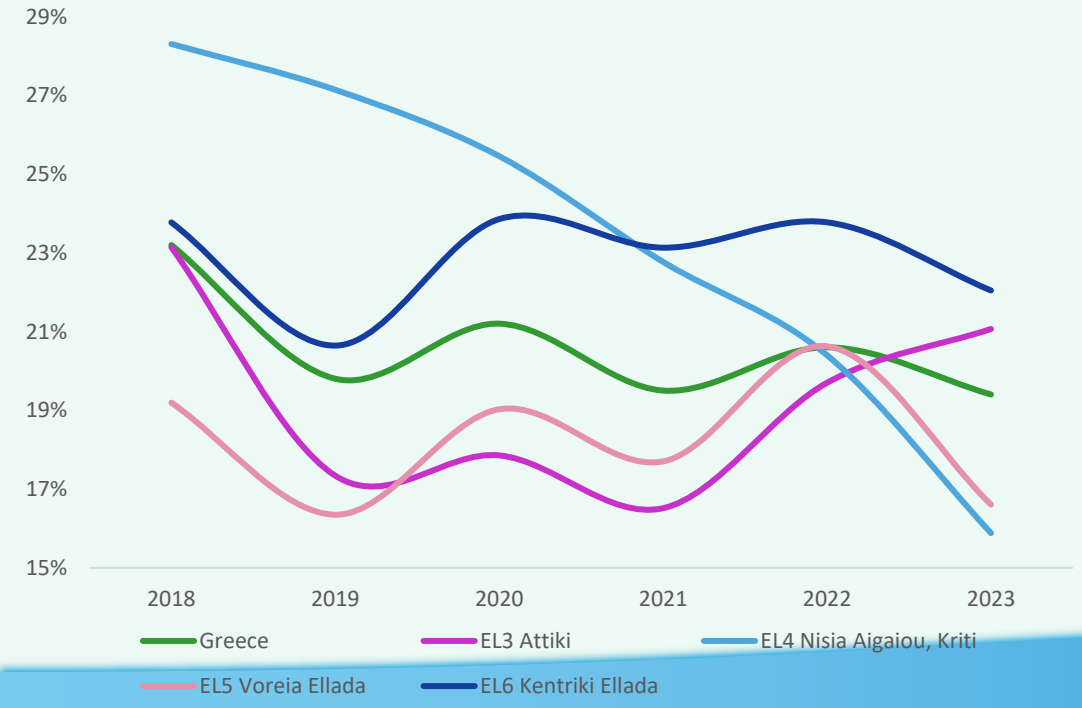
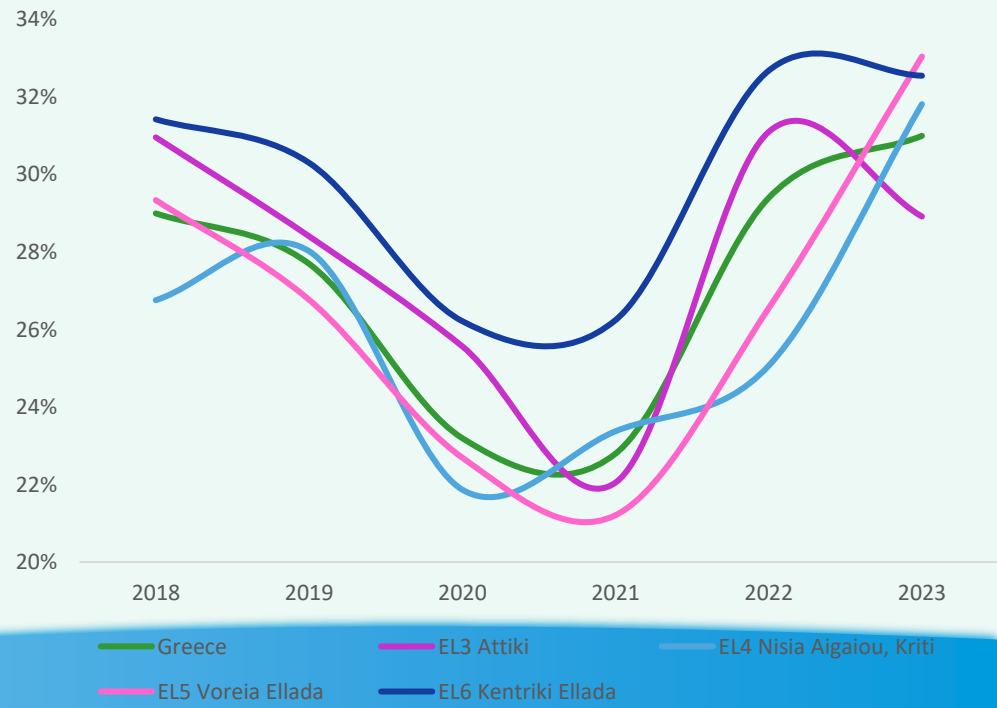
Inability to keep home adequately warm – NUTS1



Arrears on utility bills – NUTS1



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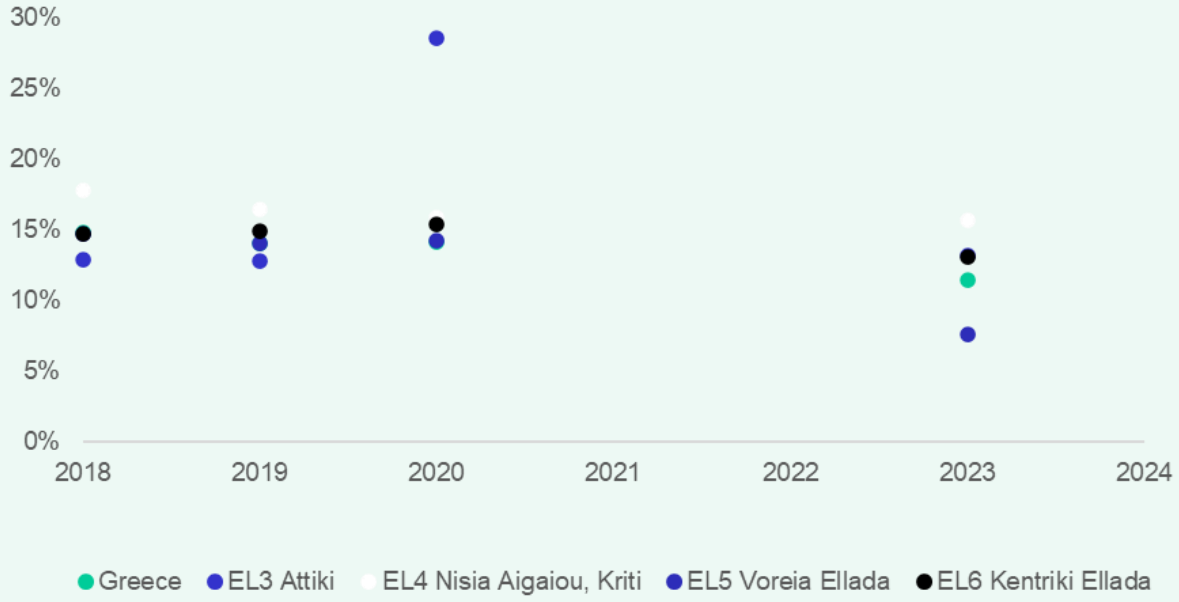
December 3-4, 2025

Dwelling with leak, damp, or rot – NUTS1



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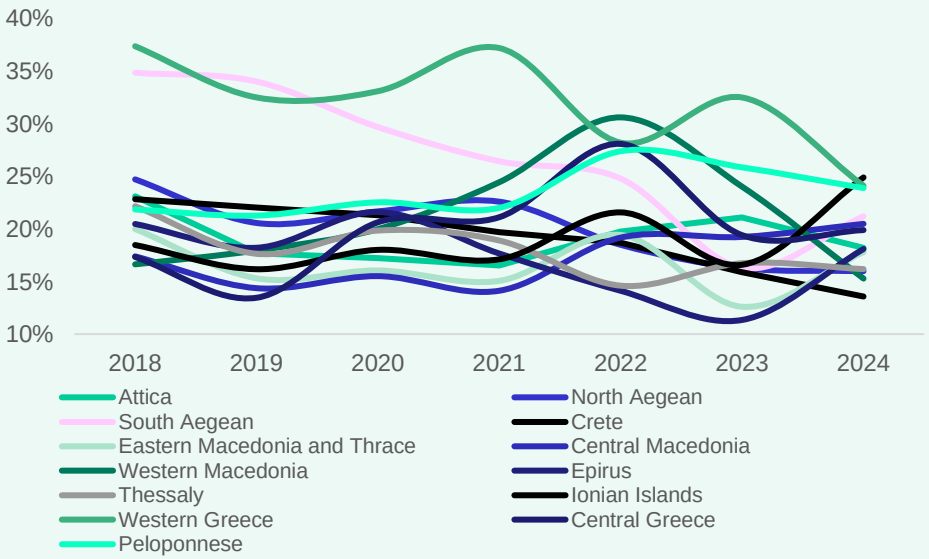
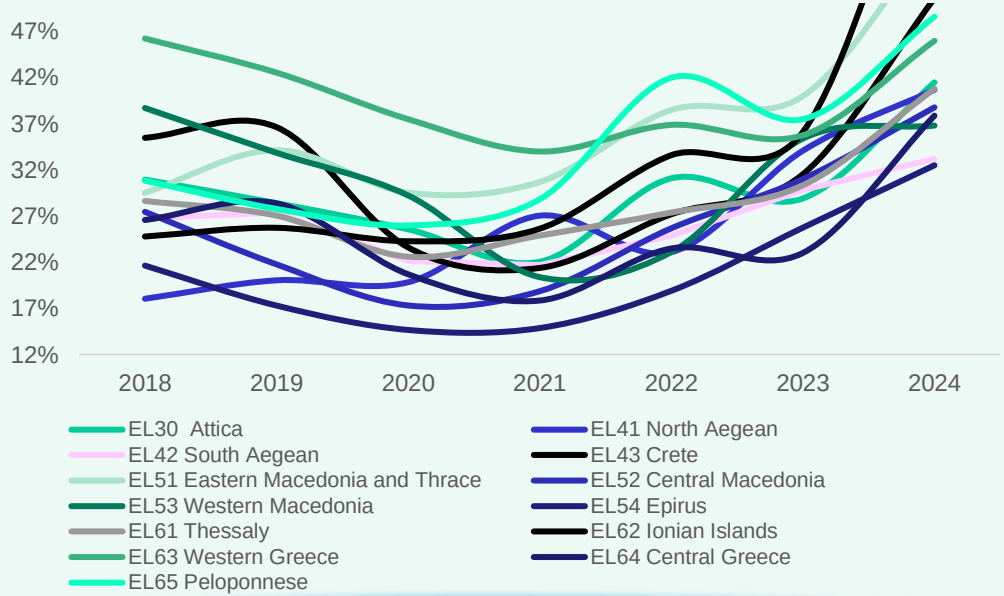
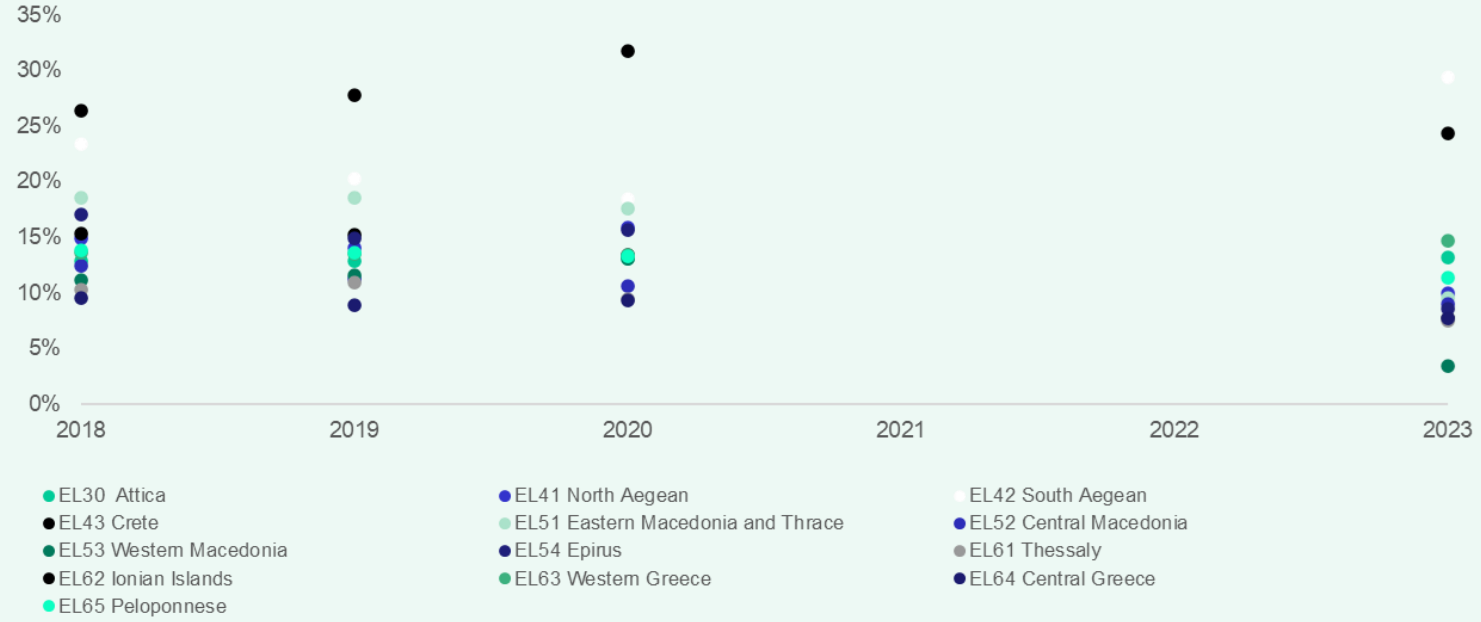
Inability to keep home adequately warm – NUTS2



Arrears on utility bills – NUTS2



Dwelling with leak, damp, or rot – NUTS2



The Greek case study- Econometric analysis

Model 1 - Inability to keep home warm	2018	2020	2022
Ln(income)	-0.061***	-0.080***	-0.082***
Education	-0.066***	-0.069***	-0.071***
Age	0.002**	0.005***	0.004***
Age2	-0.00002***	-4.03e-05***	-3.90e-05***
Unemployed	0.083***	0.084***	0.071***
Persons-per-rooms	0.040***	0.0361**	0.054***
Health	0.031***	0.029***	0.035***
Gender	0.031***	0.021***	0.038***
Ability to make ends meet	0.134***	0.097***	0.084***
Observations	22,912	14,182	7,806

Model 2 – Arrears on utility bills	2018	2020	2022
Ln(income)	-0.058***	-0.058***	-0.034***
Education	-0.059***	-0.073***	-0.101***
Age	0.012***	0.013***	0.017***
Age2	-0.0001***	-0.0001***	-0.0002***
Unemployed	0.080***	0.134***	0.091***
Persons-per-rooms	0.083***	0.088***	0.086***
Health	0.028***	0.032***	0.043***
Gender	0.016**	0.011	0.0001
Ability to make ends meet	0.148***	0.11***	0.109***
Observations	22,900	14,162	7,806

Model 3 - Dwelling with a leaking roof, damp walls/floors/foundation, or rot	2018	2020	2023
Ln(income)	-0.026***	-0.040***	-0.042***
Education	-0.012*	-0.021**	-0.024***
Age	-0.001	-0.0003	0.002
Age2	1.33e-05*	2.40E-06	-0.00002*
Unemployed	0.025***	0.030***	-0.006
Persons-per-rooms	0.052***	0.057***	0.073***
Health	0.041***	0.032***	0.014***
Gender	0.021***	0.026***	-0.011
Ability to make ends meet	0.017***	0.022***	0.008*
Observations	22,912	14,182	8,459

Model 4 AROPE	2018					2020					2022				
	Coefficient	Outcome 1	Outcome 2	Outcome 3	Outcome 4	Coefficient	Outcome 1	Outcome 2	Outcome 3	Outcome 4	Coefficient	Outcome 1	Outcome 2	Outcome 3	Outcome 4
Ln(income)	-2.672***	0.326***	-0.214***	-0.084***	-0.003***	-3.265***	0.356***	-0.217***	-0.107***	-0.031***	-2.850***	0.334***	-0.189***	-0.114***	-0.031***
Education	-0.387***	0.047***	-0.031***	-0.012***	-0.004***	-0.336***	0.037***	-0.022***	-0.011***	-0.003***	-0.388***	0.045***	-.026***	-0.015***	-0.004***
Age	0.099***	-0.012***	0.008***	0.003***	0.001***	0.107***	-0.012***	0.007***	0.004***	0.001***	0.104***	-0.012***	0.007***	0.004***	0.001***
Age2	-0.001***	0.0001***	-0.00009***	-0.00004***	-0.00001***	-0.0012***	0.0001***	-0.00008***	-0.00004***	0.00001***	-0.001***	0.0001***	-0.00007***	-0.00004***	-0.00004***
Unemployed	1.442***	-0.176***	0.116***	0.045***	0.015***	1.550***	-0.169***	0.103***	0.051***	0.015***	1.461***	-0.171***	0.097***	0.058***	0.016***
Persons-per-rooms	1.162***	-0.142***	0.093***	0.037***	0.012***	1.665***	-0.181***	0.110***	0.055***	0.016***	1.547***	-0.181***	0.103***	0.062***	0.017***
Health	0.230***	-0.028***	0.018***	0.007***	0.002***	0.314***	-0.034***	0.021***	0.010***	0.0030***	0.325***	-0.038***	0.022***	0.013***	0.004***
Gender	0.121***	-0.015***	0.010***	0.004***	0.001***	0.0875*	-0.010*	0.006*	0.003*	0.0008	0.174***	0.020***	0.011***	0.007***	0.002***
Ability to make ends meet	0.754***	-0.092***	0.060***	0.024***	0.008***	0.670***	-0.073***	0.045***	0.022***	0.006***	0.686***	-0.080***	0.045***	0.027***	0.008***
Observations	22,912					14,182					7,806				

Model 1 - Inability to keep home adequately warm, for NUTS1 regions of Greece (2018, 2020, 2022)

	2018	2020	2022
EL5 Voreia Ellada	-0.073***	-0.0373**	-0.054***
	(0.007)	(0.008)	(0.010)
EL6 Kentriki Ellada	-0.030***	0.009	-0.009
	(0.007)	(0.009)	(0.012)
EL4 Nisia Aigaiou, Kriti	0.014*	0.025**	-0.030**
	(0.008)	(0.010)	(0.013)
Observations	*22,912*	*14,182*	*7,806*

Model 2 - Arrears on utility bills, for NUTS1 regions of Greece (2018, 2020, 2022)

	2018	2020	2022
EL5 Voreia Ellada	-0.058***	-0.109***	-0.091***
	(0.009)	(0.011)	(0.014)
EL6 Kentriki Ellada	-0.020**	-0.044***	-0.027*
	(0.009)	(0.011)	(0.0149)
EL4 Nisia Aigaiou, Kriti	-0.074***	-0.080***	-0.084***
	(0.009)	(0.012)	(0.017)
Observations	*22,900*	*14,162*	*7,806*

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Model 3 - Dwelling with leak, damp, or rot, for NUTS1 regions of Greece (2018, 2020, 2023)

	2018	2020	2023
EL5 Voreia Ellada	-0.004	-0.021***	-0.055***
	(0.006)	(0.008)	(0.009)
EL6 Kentriki Ellada	0.003	-0.007	-0.024**
	(0.006)	(0.008)	(0.010)
EL4 Nisia Aigaiou, Kriti	0.035***	0.009	-0.014
	(0.007)	(0.009)	(0.012)
Observations	*22,912*	*14,182*	*8,459*

Model 4 – Being at risk of poverty or social exclusion for Greek NUTS1 regions (2018, 2020, 2022).

	2018					2020					2022				
	Coefficient	Outcome 1	Outcome 2	Outcome 3	Outcome 4	Coefficient	Outcome 1	Outcome 2	Outcome 3	Outcome 4	Coefficient	Outcome 1	Outcome 2	Outcome 3	Outcome 4
EL5 Voreia Ellada	-0.170***	0.020***	-0.013***	-0.005***	-0.002***	-0.122*	0.013*	-0.008*	-0.004*	0.001*	-0.279***	0.032***	-0.018***	-0.011***	-0.003***
	(0.051)	(0.006)	(0.004)	(0.002)	(0.001)	(0.071)	(0.008)	(0.005)	(0.002)	(0.001)	(0.0812)	(0.009)	(0.005)	(0.003)	(0.001)
EL6 Kentriki Ellada	0.049	-0.006***	0.004***	0.002***	0.0005 ***	0.141**	-0.016**	0.009**	0.005**	0.001**	-0.006	0.0007 ***	0.0004 ***	0.0002 ***	0.00007 ***
	(0.051)	(0.006)	(0.004)	(0.002)	(0.000)	(0.072)	(0.008)	(0.005)	(0.002)	(0.001)	(0.083)	(0.010)	(0.005)	(0.004)	(0.001)
EL4 Nisia Aigaiou, Kriti	0.007	-0.0009 ***	0.0006 ***	0.0002 ***	0.00008 ***	0.025	-0.003	0.002	0.0008	0.0002	-0.204**	0.024***	-0.013***	-0.008***	-0.002***
	(0.054)	(0.007)	(0.004)	(0.002)	(0.000)	(0.078)	(0.008)	(0.005)	(0.003)	(0.000)	(0.103)	(0.012)	(0.007)	(0.004)	(0.001)
Observations	*22,912*					*14,182*					*7,806*				

Econometric analysis – pseudo panels

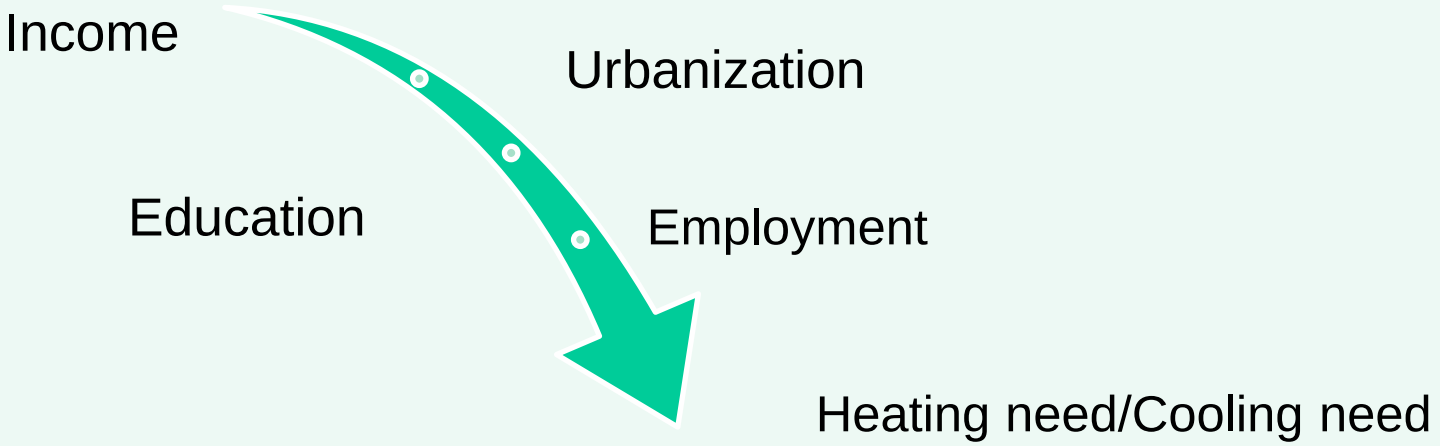
Inability to keep home adequately warm									
Models	LPM			Fraction Logit			Group binomial GLM		
Income	-0.138***	-0.165***	-0.115***	-0.949***	-1.081***	-0.882***	-0.796***	-1.105***	-0.876***
Household size	0.03	0.021	-0.011	0.32	0.353	0.059	0.172	0.108	-0.022
Urbanization	-0.116*	-0.096	-0.025	-0.513	0.084	0.175	-0.834*	-1.216**	-0.666
Detached house	-0.065	0.111	0.092	-0.252	0.751	0.558	-0.548	0.704	0.567
Employment	-0.040*	-0.041	-0.061	-0.216	-0.116	-0.14	-0.198	-0.758	-0.682
Tertiary ratio	-0.206***	-0.162**	-0.138*	-1.171***	-0.971*	-0.811	-1.370***	-1.186**	-0.976*
HDD/CDD	-0.164***	-0.101**	-0.300***	-0.901**	-0.302	-1.500***	-0.876**	-1.016***	-2.333***
Constant	1.244***	1.186***	1.165***	5.036***	3.949***	4.701***	4.759***	5.658***	6.154***
Cohort effects (NUTS 1)	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Time effects	No	No	Yes	No	No	Yes	No	No	Yes
Observations	392	392	392	392	392	392	392	392	392

Arrears on utility bills									
Models	LPM			Fraction Logit			Group binomial GLM		
Income	-0.181***	-0.287***	-0.238***	-0.982***	-1.355***	-1.317***	-0.877***	-1.439***	-1.277***
Household size	0.129**	0.081	0.12	0.771***	0.38	0.697*	0.636***	0.437	0.425
Urbanization	-0.125	-0.12	0.078	-0.354	-0.523	0.199	-0.808**	-0.709	0.07
Detached house	-0.071	0.042	0.062	-0.144	0.046	0.288	-0.512	0.047	0.077
Employment	-0.095***	0.011	0.078	-0.416***	0.196	0.54	-0.418***	-0.455	-0.097
Tertiary ratio	-0.059	-0.073	-0.052	-0.113	-0.2	-0.069	-0.486*	-0.578	-0.204
HDD/CDD	-0.138*	-0.350***	-0.165	-0.844**	-2.400***	0.093	-0.6	-1.643***	-1.760***
Constant	1.454***	2.148***	1.485***	4.987***	8.445***	4.842***	4.894***	8.345***	7.365***
Cohort effects (NUTS 1)	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Time effects	No	No	Yes	No	No	Yes	No	No	Yes
Observations	392	392	392	392	392	392	392	392	392

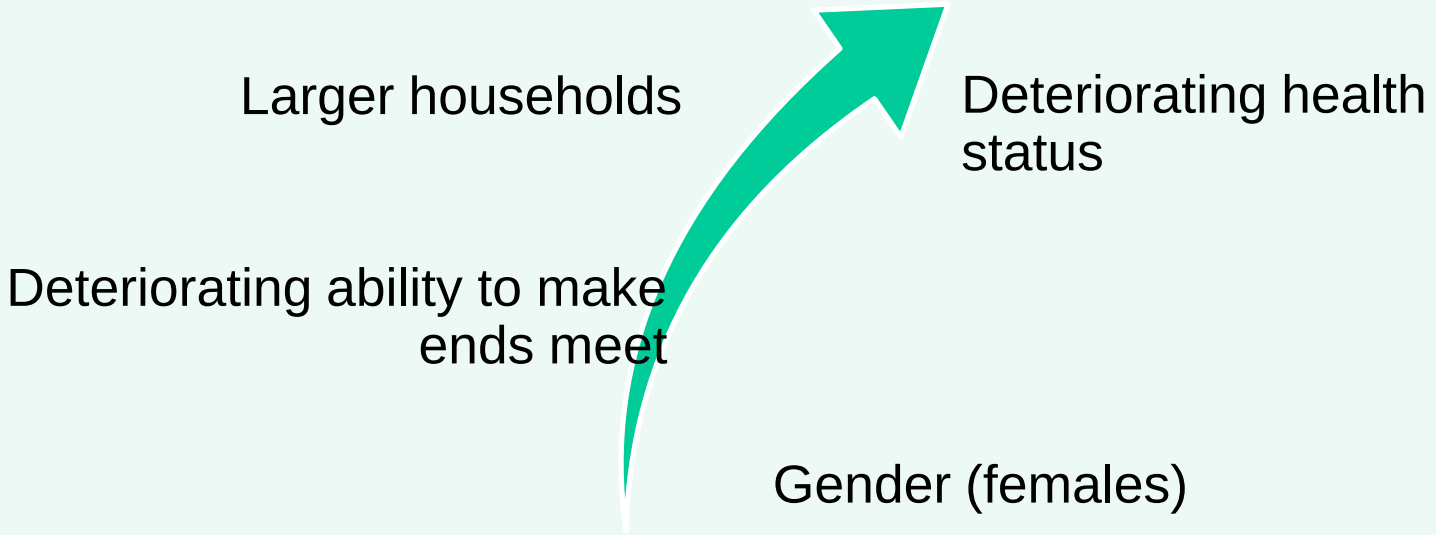
Leaking roof, damp walls/floors/foundation, or rot in window frames or floor									
Models	LPM			Fraction Logit			Group binomial GLM		
Income	-0.032	0.001	0.06	-0.657***	-0.553	-0.323	-0.016	0.386	0.775
Household size	-0.017	-0.036	-0.168**	0.411	0.59	-0.294	-0.396	-1.032*	-1.885***
Urbanization	-0.04	-0.037	-0.139*	-0.298	0.159	-0.721	-0.516	-0.614	-1.436*
Detached house	-0.023	-0.049	-0.141	-0.091	-0.347	-1.098*	-0.343	-0.877	-1.589*
Employment	-0.01	-0.007	-0.05	0.164	0.499	0.127	-0.279*	-0.158	-0.498
Tertiary ratio	-0.067	-0.124	-0.083	-0.534	-0.311	-0.128	-0.728	-1.142	-0.828
HDD/CDD	-0.069**	0.146	-0.138*	-0.917***	2.616***	0.52	-0.37	1.47	-1.415*
Constant	0.443***	0.07	0.346	2.427**	-1.94	0.825	-0.241	-2.975	-0.191
Cohort effects (NUTS 1)	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Time effects	No	No	Yes	No	No	Yes	No	No	Yes
Observations	224	224	224	224	224	224	224	224	224

	Inability to keep home adequately warm (NUTS 2)			Arrears on utility bills (NUTS 2)			Leaking roof, damp walls/floors/foundation, or rot in window frames or floor (NUTS 2)		
	LPM	Fraction Logit	Group binomial GLM	LPM	Fraction Logit	Group binomial GLM	LPM	Fraction Logit	Group binomial GLM
Disposable income	-0.154***	-0.149***	-0.132***	-0.172***	-0.218***	-0.210***	-0.039**	-0.008	0.014
	(0.029)	(0.034)	(0.033)	(0.031)	(0.049)	(0.044)	(0.018)	(0.028)	(0.033)
Household size	0.060	0.057	0.055	0.128***	0.143***	0.201***	-0.005	-0.011	-0.076*
	(0.037)	(0.038)	(0.037)	(0.037)	(0.049)	(0.052)	(0.021)	(0.040)	(0.041)
Urban area	-0.053*	-0.073	-0.029	-0.063	-0.081	0.015	0.050**	-0.072	-0.112*
	(0.031)	(0.050)	(0.050)	(0.042)	(0.070)	(0.073)	(0.022)	(0.057)	(0.058)
Detached house	-0.009	-0.001	0.001	-0.014	-0.102*	-0.069	0.040	0.001	-0.035
	(0.029)	(0.044)	(0.044)	(0.040)	(0.058)	(0.058)	(0.024)	(0.051)	(0.052)
Employment status	-0.011	0.084	0.084	-0.094***	0.043	0.077	-0.003	0.008	-0.018
	(0.019)	(0.055)	(0.053)	(0.021)	(0.073)	(0.078)	(0.016)	(0.048)	(0.047)
Tertiary ratio	-0.174***	-0.087	-0.082	-0.104**	-0.116*	-0.103*	-0.093**	-0.104*	-0.093
	(0.038)	(0.055)	(0.054)	(0.045)	(0.063)	(0.061)	(0.039)	(0.061)	(0.062)
HDD/CDD	-0.035***	-0.025***	-0.033**	-0.026***	-0.061***	0.030	-0.037***	0.018	-0.017
	(0.007)	(0.008)	(0.014)	(0.010)	(0.017)	(0.023)	(0.005)	(0.013)	(0.012)
Constant	1.048***	0.949***	0.846***	1.212***	1.458***	1.186***	0.337***	0.223*	0.259*
	(0.136)	(0.179)	(0.173)	(0.140)	(0.264)	(0.243)	(0.080)	(0.134)	(0.156)
Cohort effects (NUTS 2)	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Time effects	No	No	Yes	No	No	Yes	No	No	Yes
Observations	1273	1273	1273	1273	1273	1273	728	728	728

Determinants of energy poverty in Greece – overall insights



Determinants of energy poverty in Greece – overall insights



The research project is implemented in the framework of H.F.R.I call “Basic research Financing (Horizontal support of all Sciences)” under the National Recovery and Resilience Plan “Greece 2.0” funded by the European Union –Next Generation EU (H.F.R.I. Project Number: 016638).

Cost-benefit analysis for Greek case studies

Dr. Dimitra Papadaki, University of Athens, Greece, & Johns Hopkins, USA

Dr. Konstantinos Bithas, Panteion University & Michigan State University, USA

The research project is implemented in the framework of H.F.R.I call “Basic research Financing (Horizontal support of all Sciences)” under the National Recovery and Resilience Plan “Greece 2.0” funded by the European Union –Next Generation EU (H.F.R.I. Project Number: 016638).

The Portuguese case study

Pedro Palma, NOVA University, Lisbon, Portugal

H.F.R.I.
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Greece 2.0
NATIONAL RECOVERY AND RESILIENCE PLAN

Funded by the European Union
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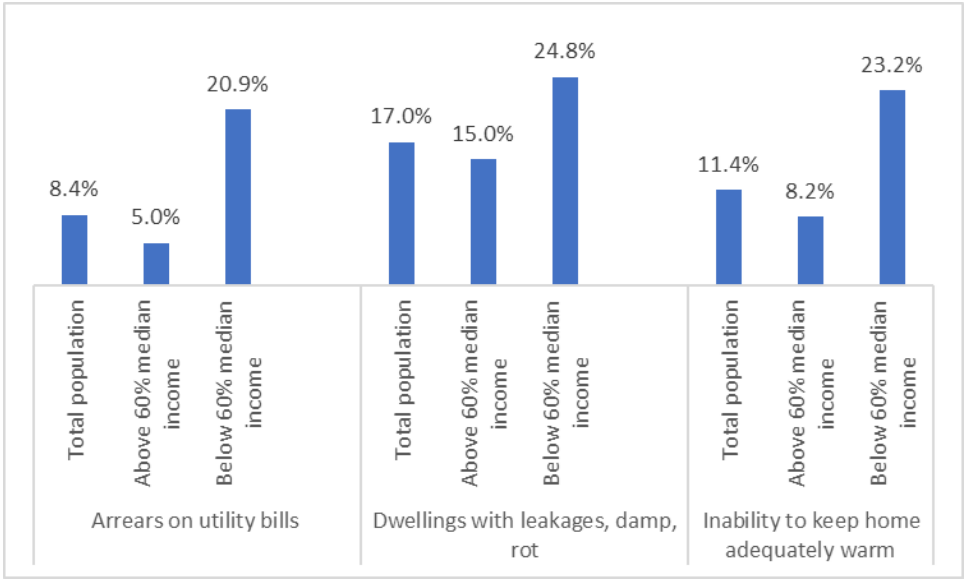
The Spanish case study

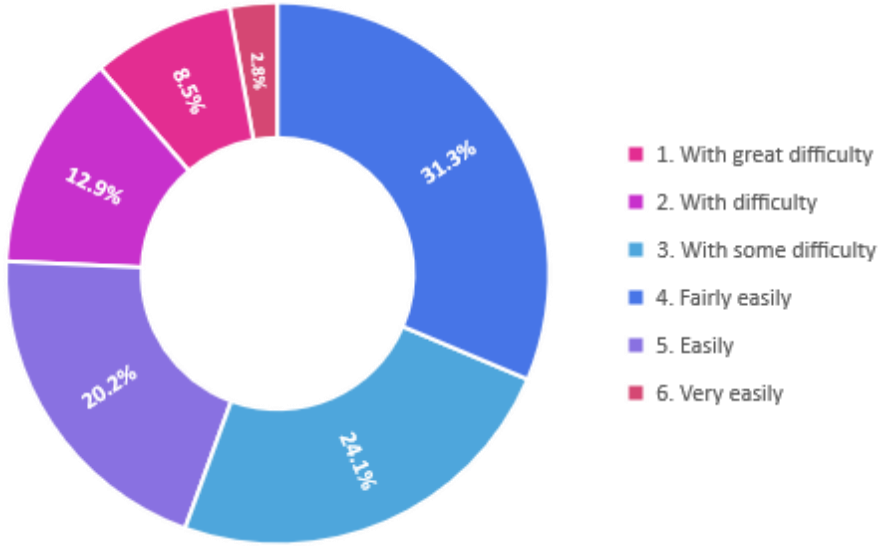
Josep-Maria Arauzo-Carod, Reus University, Spain

***E**nergy/**F**uel and human **PO**verty: public policy and **RE**commendations in **S**outhern **E**urope*
December 3-4, 2025

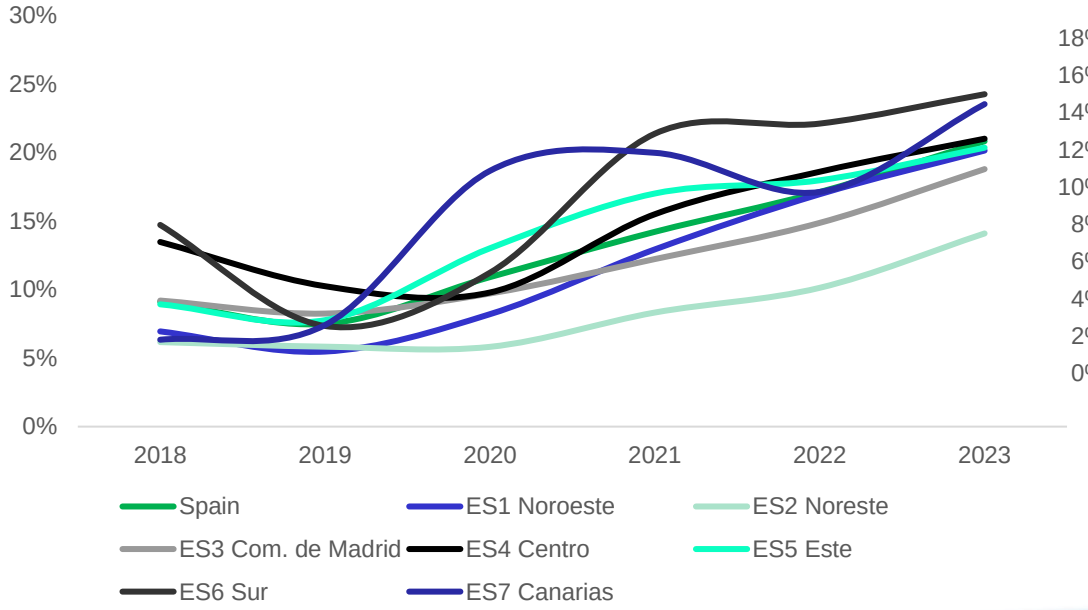
Average values of energy poverty EU-SILC indicators



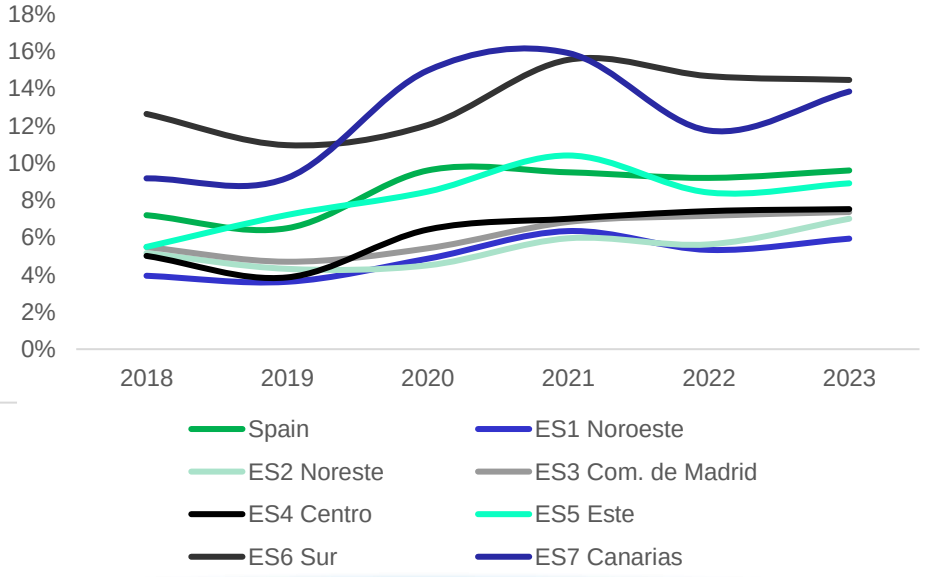
Ability to make ends meet, average values



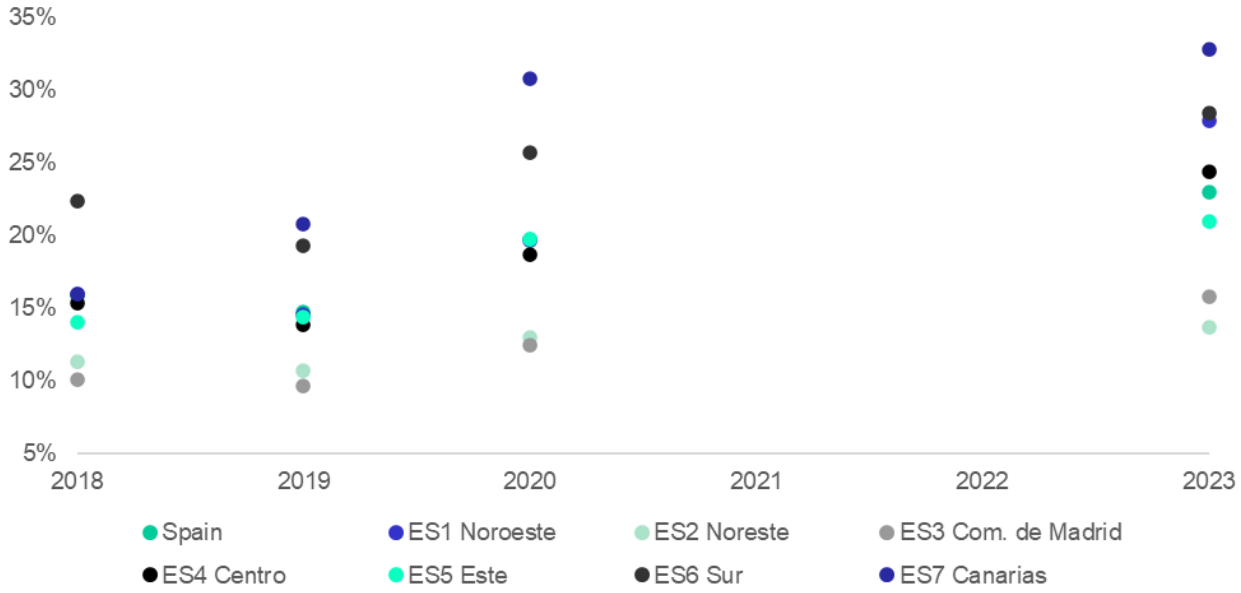
Inability to keep home adequately warm – NUTS1



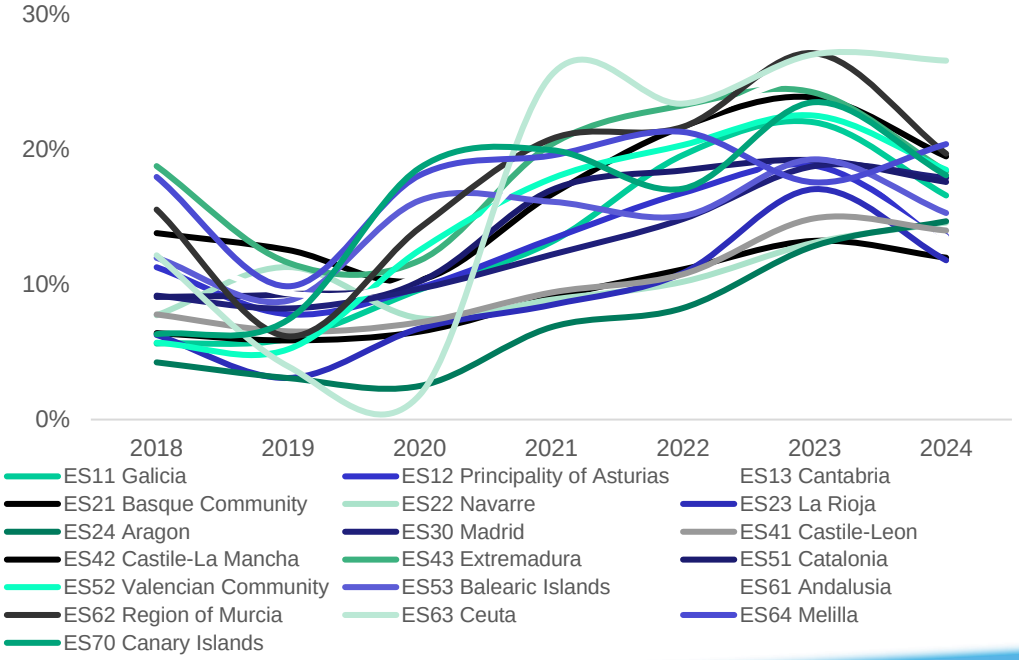
Arrears on utility bills – NUTS1



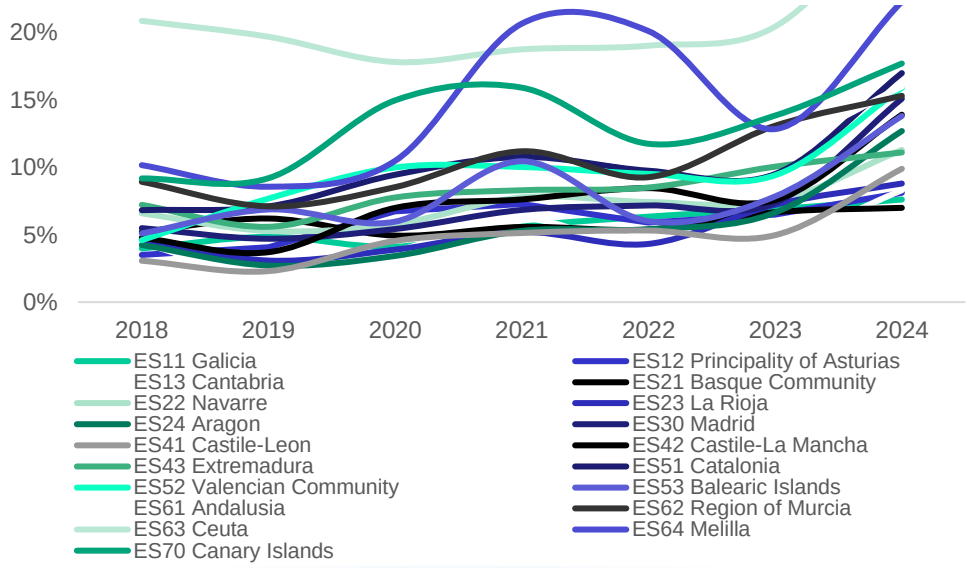
Dwelling with leak, damp, or rot – NUTS1



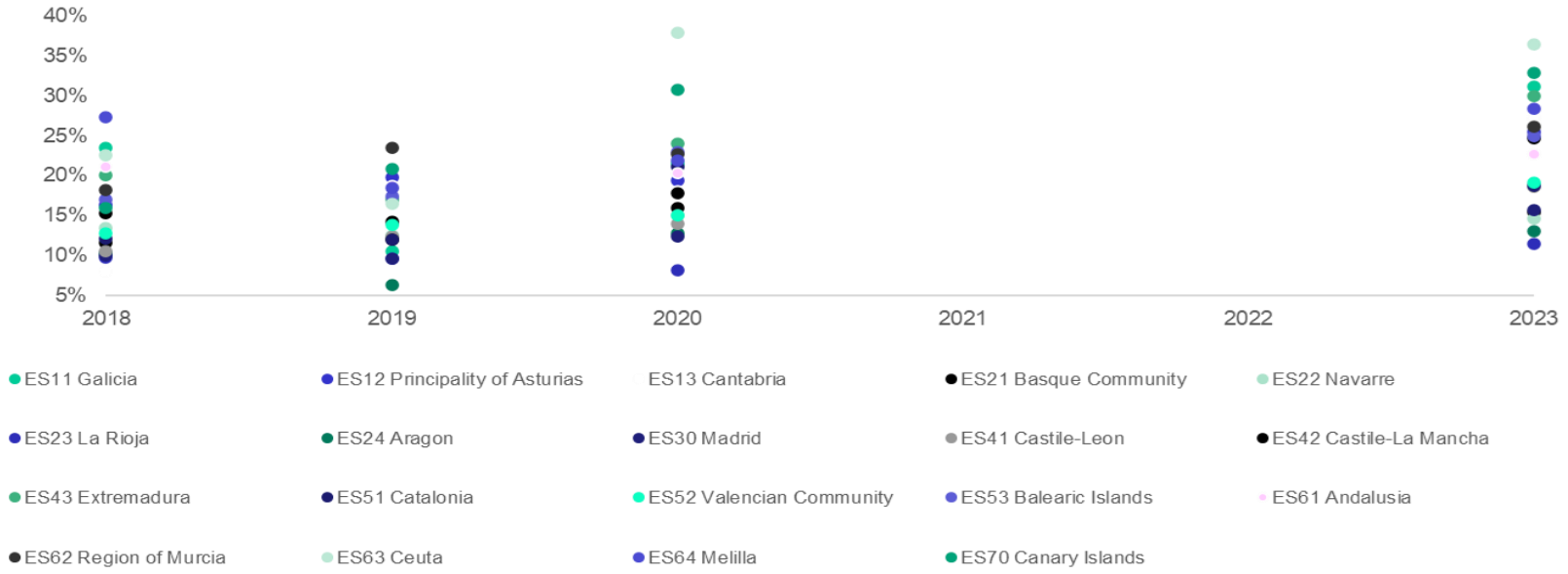
Inability to keep home adequately warm – NUTS2



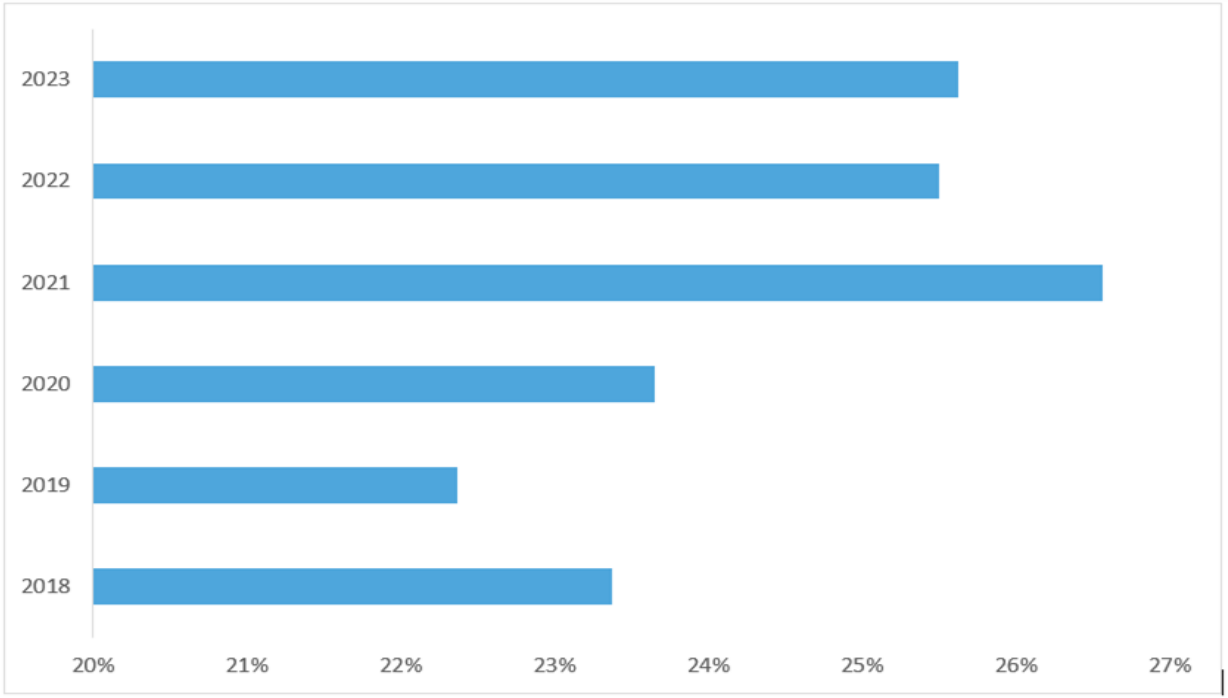
Arrears on utility bills – NUTS2



Dwelling with leak, damp, or rot – NUTS2



People at risk of poverty or social exclusion – NUTS1



The Spanish case study - Econometric analysis

Model 1 - Inability to keep home warm	2018	2020	2022
Ln(income)	-0.011***	-0.013***	-0.031***
Education	-0.019***	-0.021***	-0.026***
Age	0.0005	0.001*	0.002**
Age2	-3.47E-06	-1.15e-05*	-1.95e-05**
Unemployed	0.015***	0.008*	0.020***
Persons-per-rooms	0.001	0.010**	0.012**
Health	0.008***	0.014***	0.028***
Gender	0.006**	0.008**	0.010***
Ability to make ends meet	0.042***	0.041***	0.081***
Observations	*13,228*	*14,865*	*23,798*

Model 2 – Arrears on utility bills	2018	2020	2022
Ln(income)	-0.005***	-0.007***	-0.008***
Education	-0.007***	-0.011***	-0.008***
Age	0.001***	0.0003	0.0009**
Age2	-1.59e-05***	-1.01e-05***	-1.74e-05***
Unemployed	0.006***	0.004**	0.009***
Persons-per-rooms	0.011***	0.017***	0.019***
Health	0.004***	0.007***	0.004***
Gender	0.002	-0.001	0.002
Ability to make ends meet	0.018***	0.022***	0.027***
Observations	13,151	14,807	*23,667*

Model 3 - Dwelling with a leaking roof, damp walls/floors/foundation, or rot	2018	2020	2023
Ln(income)	-0.011***	-0.021***	-0.011***
Education	-0.004	-0.002	0.006
Age	-0.004***	-0.009***	-0.004***
Age2	2.95e-05***	6.66e-05***	1.48E-05
Unemployed	0.006	0.020**	0.017**
Persons-per-rooms	0.050***	0.047***	0.035***
Health	0.026***	0.033***	0.050***
Gender	0.0127**	0.012*	0.024***
Ability to make ends meet	0.030***	0.037***	0.046***
Observations	13,229	14,870	*22,620*

Model 1 - Inability to keep home adequately warm, for NUTS1 regions of Spain (2018, 2020, 2022)

	2018	2020	2022
ES1 Noroeste	-0.018***	-0.017**	0.009
	(0.006)	(0.008)	(0.009)
ES2 Noreste	-0.012*	-0.028***	-0.033***
	(0.006)	(0.007)	(0.008)
ES4 Centro	0.019**	-0.019***	-0.004
	(0.007)	(0.007)	(0.008)
ES5 Este	-0.004	-0.005	0.011
	(0.006)	(0.007)	(0.008)
ES6 Sur	-0.005	-0.023***	0.007
	(0.006)	(0.007)	(0.008)
ES7 Canarias	-0.033***	0.005	-0.040***
	(0.006)	(0.011)	(0.010)
Observations	*13,228*	*-0.017***	*23,798*

Model 2 - Arrears on utility bills, for NUTS1 regions of Spain (2018, 2020, 2022)

	2018	2020	2022
ES1 Noroeste	-0.004	-0.0006	-0.006*
	(0.003)	(0.003)	(0.003)
ES2 Noreste	0.002	-0.0004	-0.002
	(0.003)	(0.003)	(0.004)
ES4 Centro	-0.001	0.002	-0.002
	(0.003)	(0.003)	(0.003)
ES5 Este	0.003	0.012***	0.006**
	(0.003)	(0.003)	(0.003)
ES6 Sur	0.002	0.010***	0.003
	(0.002)	(0.003)	(0.003)
ES7 Canarias	-0.002	0.017***	-0.003
	(0.003)	(0.006)	(0.004)
Observations	*13,151*	*14,807*	*23,798*

Model 3 - Dwelling with leak, damp, or rot, for NUTS1 regions of Spain (2018, 2020, 2023)

	2018	2020	2023
ES1 Noroeste	0.073***	0.078***	0.122***
	(0.012)	(0.013)	(0.012)
ES2 Noreste	0.023**	0.0195*	-0.016
	(0.011)	(0.012)	(0.010)
ES4 Centro	0.046***	0.051***	0.068***
	(0.012)	(0.012)	(0.011)
ES5 Este	0.023**	0.065***	0.026***
	(0.010)	(0.011)	(0.009)
ES6 Sur	0.073***	0.072***	0.055***
	(0.012)	(0.012)	(0.010)
ES7 Canarias	0.032*	0.132***	0.124***
	(0.017)	(0.022)	(0.018)
Observations	*13,229*	*14,870*	*22,620*

Model 4 – Being at risk of poverty or social exclusion for Spanish NUTS1 regions (2018, 2020, 2022).

	2018	2020	2022
ES1 Noroeste	0.043***	0.016*	-8.17e-05
	(0.010)	(0.010)	(0.009)
ES2 Noreste	0.020**	-0.002	-0.009
	(0.009)	(0.009)	(0.009)
ES4 Centro	0.050***	0.029***	0.016*
	(0.009)	(0.009)	(0.009)
ES5 Este	0.016**	0.008	-0.006
	(0.007)	(0.008)	(0.008)
ES6 Sur	0.033***	0.005	0.015*
	(0.008)	(0.008)	(0.009)
ES7 Canarias	0.015	-0.005	-0.018
	(0.011)	(0.012)	(0.012)
Observations	*13,229*	*14,875*	*23,820*

Econometric analysis – pseudo panels

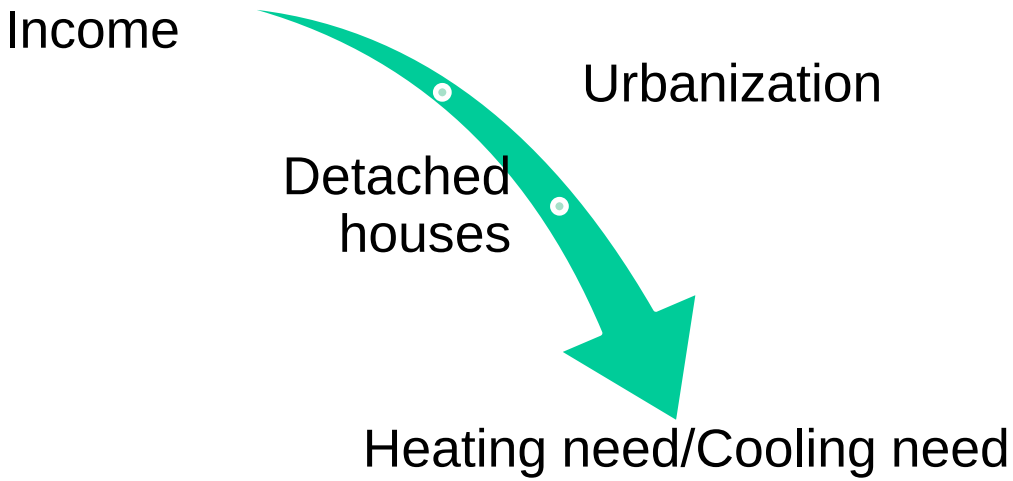
Inability to keep home adequately warm									
Models	LPM			Fraction Logit			Group binomial GLM		
Income	-0.036*	-0.045	-0.057*	-0.059	-0.669*	0.241	-0.377**	0.294	-0.118
Household size	-0.068**	-0.104*	0.01	-0.631**	-1.655***	-0.855	-0.174	-1.317*	-0.683
Urbanization	-0.088**	-0.246***	-0.004	-0.423	-0.451	0.791*	-0.503	-2.215***	0.245
Detached house	-0.158***	-0.1	0.045	-1.106***	-0.116	0.787	-0.719*	-1.027	0.632
Employment	-0.048**	-0.160*	0.036	-0.552***	0.179	1.252	-0.059	0.683	-1.769***
Tertiary ratio	0.096***	0.205***	-0.102*	0.377	0.479	-1.293**	0.518	0.446	-1.693**
HDD/CDD	-0.027***	-0.068***	-0.013	-0.231***	-0.837***	-0.273***	-0.284***	-1.119***	-0.192*
Constant	0.565***	0.756***	0.452***	0.317	-2.126	-3.058*	1.217	1.576	-1.126
Cohort effects (NUTS 1)	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Time effects	No	No	Yes	No	No	Yes	No	No	Yes
Observations	882	882	882	882	882	882	882	882	882

Arrears on utility bills									
Models	LPM			Fraction Logit			Group binomial GLM		
Income	-0.109***	-0.060**	-0.084***	-1.606***	-0.776*	-1.176**	-1.517***	-0.335	-0.758***
Household size	0.164***	0.083***	0.125***	2.538***	1.826***	2.301***	2.570***	1.155***	1.564***
Urbanization	-0.048**	-0.088***	-0.04	-1.489***	-1.740**	-1.373	-0.491	-1.271***	-0.525
Detached house	-0.016	-0.027	0	-0.656	-0.184	0.161	0.105	-0.155	0.487
Employment	0	0.038	0.070*	-0.704***	0.042	0.42	0.049	0.596	0.489
Tertiary ratio	0.065**	0.058**	-0.028	0.337	0.068	-0.646**	0.895**	0.081	-0.816**
HDD/CDD	-0.023***	-0.015***	-0.004	-0.377***	-0.443*	0.026	-0.536***	-0.554*	-0.052
Constant	0.588***	0.384***	0.437***	6.021***	2.572	2.706	4.217**	0.811	0.833
Cohort effects (NUTS 1)	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Time effects	No	No	Yes	No	No	Yes	No	No	Yes
Observations	882	882	882	882	882	882	882	882	882

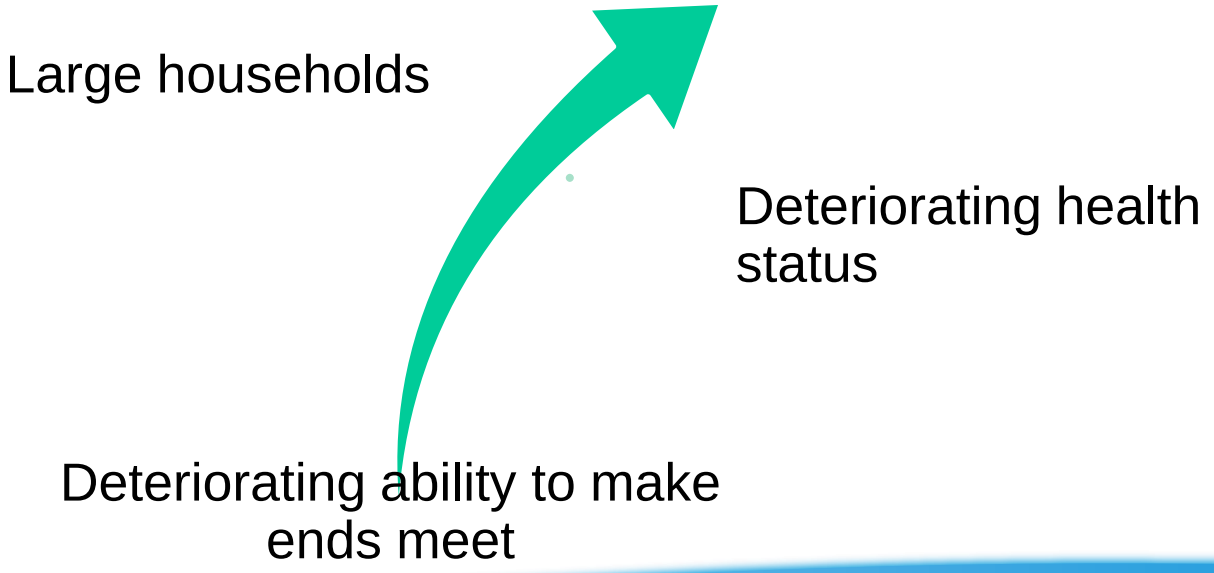
Leaking roof, damp walls/floors/foundation, or rot in window frames or floor									
Models	LPM			Fraction Logit			Group binomial GLM		
Income	-0.114***	0.004	-0.051	-0.815***	0.550**	0.175	-0.950***	0.163	-0.445*
Household size	0.04	0.019	0.087*	0.307	-0.936**	-0.333	0.636***	0.198	0.48
Urbanization	-0.019	-0.079	-0.026	-0.499	-0.073	0.233	-0.031	-0.64	-0.637
Detached house	-0.175***	-0.152**	-0.074	-1.639***	0.072	0.344	-0.845***	-0.895*	-0.443
Employment	-0.028	0.091	0.154**	-0.321	0.986*	0.926	-0.012	1.533***	-1.324***
Tertiary ratio	0.125***	0.172***	-0.067	0.468	-0.468	-1.317**	0.647**	0.673	-0.505
HDD/CDD	0.001	-0.145***	-0.087***	-0.07	-1.124***	-0.432**	-0.063	-1.194***	-0.701***
Constant	0.868***	0.362*	0.504**	4.152***	-0.985	-1.096	3.587***	0.798	2.626*
Cohort effects (NUTS 1)	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Time effects	No	No	Yes	No	No	Yes	No	No	Yes
Observations	588	588	588	588	588	588	588	588	588

	Inability to keep home adequately warm (NUTS 2)			Arrears on utility bills (NUTS 2)			Leaking roof, damp walls/floors/foundation, or rot in window frames or floor (NUTS 2)		
	LPM	Fraction Logit	Group binomial GLM	LPM	Fraction Logit	Group binomial GLM	LPM	Fraction Logit	Group binomial GLM
Disposable income	-0.066***	-0.049	-0.068***	-0.104***	-0.050***	-0.066***	-0.099***	0.003	-0.038
	(0.014)	(0.030)	(0.021)	(0.015)	(0.016)	(0.016)	(0.017)	(0.029)	(0.028)
Household size	-0.014	-0.096**	0.008	0.160***	0.067***	0.101***	0.038*	-0.007	0.062*
	(0.020)	(0.039)	(0.031)	(0.017)	(0.020)	(0.021)	(0.021)	(0.037)	(0.035)
Urban area	-0.055**	-0.099***	0.010	-0.058***	-0.038**	-0.015	-0.033	-0.053	-0.031
	(0.022)	(0.037)	(0.022)	(0.016)	(0.015)	(0.014)	(0.023)	(0.042)	(0.038)
Detached house	-0.086***	0.001	0.058**	-0.019	-0.022	-0.012	-0.186***	-0.126***	-0.093**
	(0.027)	(0.039)	(0.028)	(0.017)	(0.016)	(0.016)	(0.022)	(0.045)	(0.041)
Employment status	-0.028*	-0.123**	0.035	-0.006	0.034	-0.062**	-0.031*	0.027	0.075
	(0.016)	(0.059)	(0.041)	(0.012)	(0.028)	(0.027)	(0.017)	(0.053)	(0.051)
Tertiary ratio	-0.066**	-0.149***	-0.079**	-0.051**	0.030	-0.031	-0.109***	-0.105**	-0.062
	(0.028)	(0.046)	(0.036)	(0.021)	(0.021)	(0.020)	(0.029)	(0.049)	(0.044)
HDD/CDD	-0.008***	-0.007***	-0.002	-0.006***	-0.001	-0.000	0.004	-0.022**	-0.006
	(0.003)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.004)	(0.010)	(0.008)
Constant	0.602***	0.556***	0.474***	0.559***	0.303***	0.356***	0.799***	0.244	0.393**
	(0.074)	(0.168)	(0.112)	(0.065)	(0.074)	(0.075)	(0.090)	(0.158)	(0.154)
Cohort effects (NUTS 2)	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Time effects	No	No	Yes	No	No	Yes	No	No	Yes
Observations	2388	2388	2388	2388	2388	2388	1591	1591	1591

Determinants of energy poverty in Spain – overall insights



Determinants of energy poverty in Spain – overall insights



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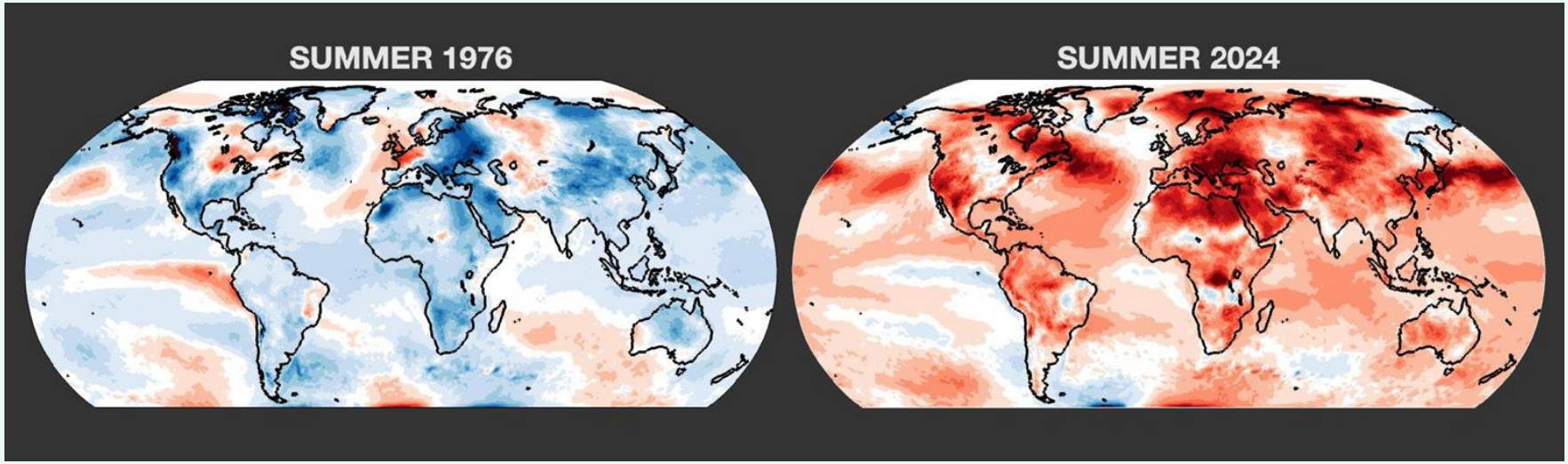
Now, why also summer energy poverty?



Sources: J.P. Gouveia; from an EPAH event presentation, 2025.

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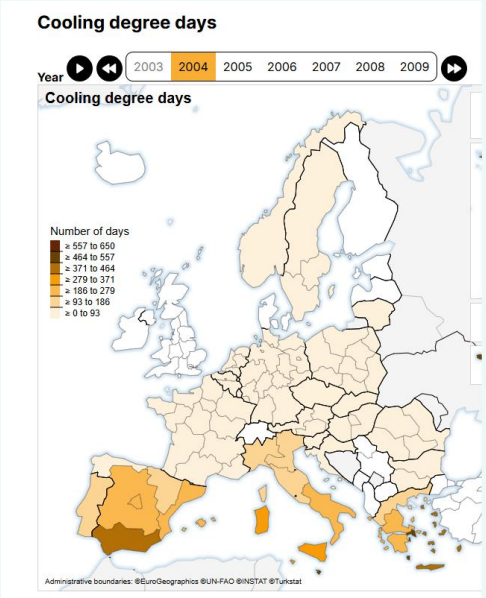
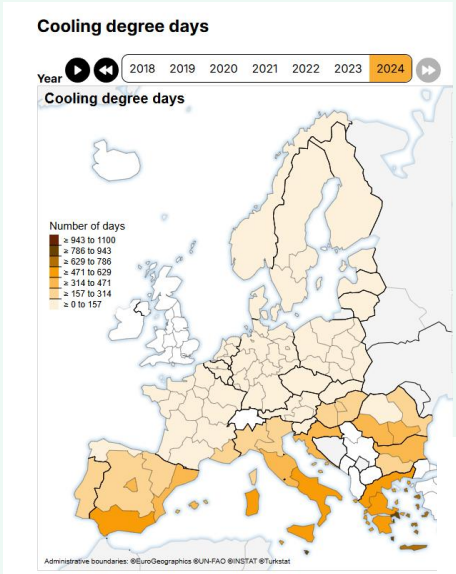
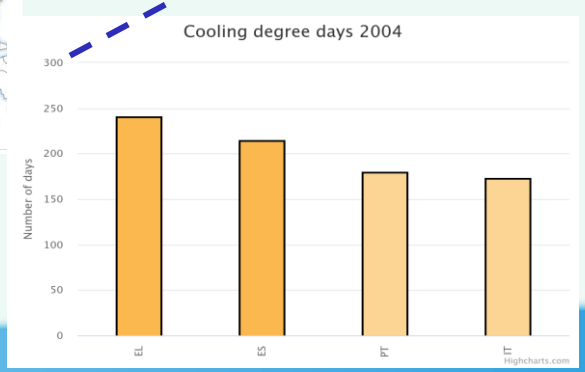
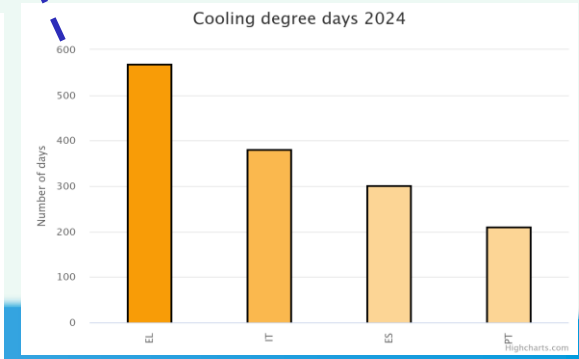
CDD 2004 vs 2024





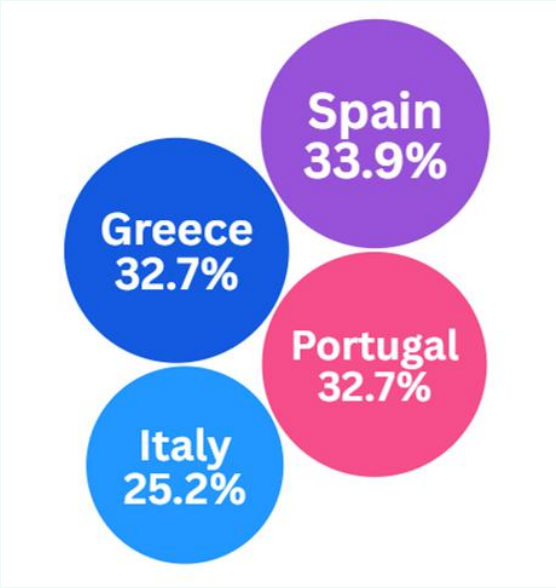
Double



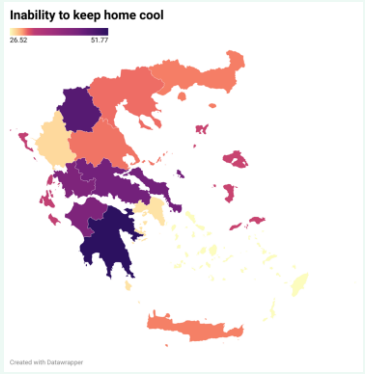


Energy/Fuel and human POverty: public policy and REcommendations in Southern Europe
December 3-4, 2025

Inability of existing cooling and insulation to keep homes cool



Inability of existing cooling and insulation to keep homes cool



Variables	Inability to keep home adequately cool
1946 – 1960	0.140
	(0.197)
1961-1980	-0.234
	(0.184)
1981 – 2000	-0.694***
	(0.185)
2001 – 2020	-1.186***
	(0.195)
After 2021	-1.519***
	(0.435)
Household size	0.045
	(0.030)
Semi-rural area	0.275***
	(0.070)
Rural area	0.406***
	(0.074)
Age	-0.002
	(0.002)
Tertiary education	**-0.301*** **
	(0.072)
Income	**-0.000*** **
	(0.000)
Region effects	**Yes**

❑ Policies

- ✔ Strengthen income support and social welfare measures (especially within large families)
- ✔ Promote employment and economic inclusion (especially in rural areas)
- ✔ Include special consideration in social frameworks for populations experiencing health issues and female-headed families
- ✔ Address high heating and cooling demand with energy efficiency programs and affordable renewable solutions
- ✔ Enhance educational opportunities and awareness

❑ Limitations

- ❖ Measurement of energy poverty
- ❖ Unavailable data for NUTS 2 & 3 analysis for some cases
- ❖ Self-reported data (EU-SILC)

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Thank you for your attention!!

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