Selecting Indicators to Measure Energy Poverty

Under the Pilot Project 'Energy Poverty – Assessment of the Impact of the Crisis and Review of Existing and Possible New Measures in the Member States

Framework Contract ENER/A4/516-2014

Annex 1
Methodological & Technical Report

Trinomics

Contract details

European Commission, DG Energy
ENER/B3/2015-507 – under framework contract ENER/A4/516-2014
"Selecting Indicators to Measure Energy Poverty"

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Date

Rotterdam, 18th of May 2016

Acknowledgements

The authors are grateful for the cooperation from the Spanish Statistical Office - INE (Spain), the National Institute for Statistics - Istat (Italy), Statistics Netherlands - CBS (Netherlands) and the Statistical Office of the Slovak Republic (Slovakia).

Rotterdam, 18th of May 2016

Client: European Commission, DG Energy – Unit B3

DG ENER – ENER/B3/507-2015
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Annex 1
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In association with:

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1. Introduction

This report complements the main report on "Selecting Indicators to Measure Energy Poverty". It aims to provide detailed methodological and technical information supporting the findings and discussion presented in the main report. The report provides the following:

- Methodology for the classification and assessment of energy poverty indicators;
- Assessment results at the indicator level;
- Methodology for the indicator testing at MS level;
- Testing results for selected Member States; and
- Discussion of the results.

2. Methodology for the Classification & Assessment of Energy Poverty Indicators

This section provides the detailed methodology used to identify, classify and appraise indicators suited for regular and systematic assessment of energy poverty in the EU and the impact of the economic conditions and the developments in the energy sector on energy poverty. The full list of identified and classified indicators relevant for energy poverty are listed in a different annex.

2.1. Identification approach

The first step is to identify indicators that are useful for the assessment of energy poverty in the EU. The identification of indicators is based on existing literature and review of data sources. The team identified and reviewed the major pieces of (prior) work on the topic:

- **INSIGHT E's** work on "Energy poverty and vulnerable consumers in the energy sector across the EU" and its accompanying country reports which led to further MS literature.
- **EUROSTAT and official national statistics** have also been reviewed and taken into account when possible.
- **EU Fuel Poverty Network**, an online portal for information about EU energy poverty that aims to raise awareness and to further the dialogue on energy poverty across the EU.
- **National research and initiatives** on energy poverty such as:
    - French National Observatory of Fuel Poverty (ONPE)
    - Belgian Energy Poverty Barometer
    - UK's Annual Fuel Poverty Statistics Report
    - **EU Building Stock Observatory** which takes into account:
    - **Odyssee** database contains detailed data from the year 1990 to 2013 on the energy consumption drivers by end-use, as well as energy efficiency and CO2 related indicators.
    - **ZEBRA2020** is an Intelligent Energy Europe which provides an overview of the current building stock including renovation and construction and monitors Energy Performance Certificates (EPC) activities by country. Further, it gathers relevant indicators of nZEB buildings constructed after 2010 in selected European countries, including e.g. energy performance.
    - **ENTRANZE** provides data on the penetration of nZEB and RES-H/C within the existing national building stocks. It provides detailed data on the EU28 building stock, including U values for different components, breakdown by ownership & tenure among low income households, etc.

The identified approaches to measuring energy poverty are taken into account while assessing indicators. The main energy poverty metrics identified are expenditure-, consensual- or outcome-based. Further indicators are identified to support the primary indicators in their reflection of certain aspects of energy poverty.

Indicators relevant to energy poverty drivers and outcomes include for example energy expenditure, ability to keep a home warm, and arrears on utility bills. In addition, others such as energy prices,

energy usage by fuel type, share of building types, basic income, at risk of poverty indicators, types of central heating, or lack of such systems, build fabric indicators (u-values etc.) etc. are also relevant. They may form the building blocks of indicators, or be used as they are in combination with a set of indicators to help understand vulnerability. For example u-values or type of heating system have a direct influence on energy expenditure; energy efficient building envelope and technical system reduce energy use and thus decrease the energy poverty.

2.2. Classification approach & classification aspects

The second step is to classify the indicators across several aspects. The information gathered through the classification is used directly as input during the assessment. Classification includes, for example, what the indicator aims to measure (driver, outcome, etc.), whether data is readily available, whether the indicator is objective or subjective, etc. Aspects include:

- Indicator approach;
- Indicator category;
- Method of application to the energy poverty issue;
- Indicator type;
- Comparability;
- Quality and robustness;
- Experience of application to energy poverty issue; and
- Data availability.

These aspects and the different classifications possible are described in detail below.

Indicator approach

The indicator approach aims to state whether the indicator is an expenditure-based, outcome-based or consensual-based metric or a supporting indicator.

- Expenditure-based
- Consensual-based
- Outcome-based
- Other EP metric
- Supporting indicator

Indicator category

The indicator category is the link to the conceptual map. The table below provides a mapping between conceptual map and indicator categories. This allows for a general grouping of the indicators based on whether the indicator is measuring a key driver, a factor affecting energy poverty or an outcome.

Table 2-1 Mapping between conceptual map and indicator categories

Indicator categories	Conceptual map groups
Income / expenditure	Income (driver) and expenditure
Energy demand	Energy demand and use
Physical infrastructure	Physical infrastructure
Demographics	Demographic factors
Policy-based	Policy interventions
Outcomes	Energy poverty outcomes

Method of application to the energy poverty issue

- A single metric
- Constructed or combinatory metric
- Constructed or combinatory metric using modelling

This aspect aims to reflect in which way the indicators are applied to energy poverty, distinguishing between single and combinatory metrics. Combinatory metrics use several datasets/metrics in order to construct a metric. Most of the combinatory metrics follow the expenditure approach. In order to provide more detail, combinatory or constructed metrics are split between the simpler combinatory metrics and those that require modelling or a high level analysis. The latter includes those metrics which estimate required expenditure needs using detailed knowledge of the building stock, and its efficiency.

Indicator type

- Subjective
- Objective

The indicator type aims to classify indicators in objective and subjective. The latter is usually linked to the consensual approach, in particularly self-reported subjective indicators such as households' ability to keep the home sufficiently warm.

Comparability

- Yes (indicator 100% the same in all MS)
- Limited (MS-specific data used)
- Not comparable between MS

In terms of comparability, the aim is to classify the indicators taking into account whether their design allows for application at EU28 scale or not. Further, when it is possible to apply the indicator at EU scale, it provides a distinction between those indicators which can be fairly compared across Member States and those that might result in a bias due to certain factors. For example, for combinatory or constructed metrics where national values such as average or mean expenditure at the national level are used.

Quality and robustness

- Official statistics (Eurostat/ MS statistics)
- Project data, commercial databases, etc.
- Anecdotal evidence
- Data not published / Not available

This aspect aims to provide information that will allow for the assessment of quality and robustness of the indicator and its underlying data. It implies that official statistics such as Eurostat (including EU-SILC) and Member State statistics are more robust than commercial and project data, while this in turn are more robust than anecdotal evidence.

Experience of application to energy poverty issue

- Extensive
- Limited
- None (literature)

The last aspect identifies to what extent the indicator has been applied to energy poverty, differentiating between those that have been applied at MS level from those that have only been proposed in literature. A distinction is made based on geographical coverage, identifying indicators that have been applied in one MS or in a number of MS.

Data availability

Four different aspects have been considered regarding data availability:

- Source of indicator / underlying data
- Application scale
- Frequency of publication
- Access

Together, these aspects provide enough information per indicator to perform a qualitative assessment. In order to have a structured and coherent assessment of the different indicators identified, a matrix was prepared (Table 2-2) providing the different options available to classify the indicators for each of the aspects.

Table 2-2 Matrix to classify identified indicators

Aspects	Classification	Clarification
Approach	Outcome-based	Energy poverty metric using outcome-based approach
	Expenditure-based	Energy poverty metric using expenditure-based approach
	Consensual-based	Energy poverty metric using consensual-based approach
	Other EP metric	Energy poverty metric using a different or combined approach
	Supporting	Indicators that provide additional information regarding the energy poverty metrics
Indicator category	Income/expenditure	Indicators measuring energy poverty using income or expenditure figures
	Energy demand	Indicators measuring energy/heating demand
	Physical infrastructure	Indicators providing information regarding the physical infrastructure including heating systems and buildings
	Demographics	Indicators providing information regarding demographics and vulnerable consumers (e.g. elderly, at-risk-of-poverty, etc.)
	Policy-based	Indicators that are linked to existing policies (e.g. those in receipt of EE interventions and / or energy payments, welfare recipients, on regulated tariffs, on pre-payment meters)
	Outcomes	Indicators measuring outcomes of energy poverty such as winter seasonal mortality, disconnections, 'unable to keep homes warm'
Explicitly used as proxy for energy poverty?	Yes	The indicator is explicitly used as a proxy for energy poverty in literature / policy
	No	The indicator is not explicitly used as a proxy for energy poverty in literature / policy
Method of application to energy poverty issue	A single metric	This can be a single or set of stand-alone indicators used to determine energy poverty. An example of a set of stand-alone indicators are the EU-SILC 'set of three' often used.
	Constructed or combinatory metric	The indicator is a combination of single metric indicators, and / or static (absolute) or varying (relative) thresholds. Some analysis has been done to combine and construct these indicators.
	Constructed or combinatory metric using modelling	The indicator is a combination of single metric indicators, and / or static (absolute) or varying (relative) thresholds. High level analysis and/or modelling has been done to combine and construct these indicators.
Indicator type	Subjective	Indicators are based on perception of householders, not on objective, quantitative metrics
	Objective	Indicators are based on measurement or modelling e.g. energy consumed, energy expenditure etc.
Source of indicator / underlying data	Collated centrally	Data is gathered at EU level
	At Member State level	Data is gathered at MS level
	Non-existent	Data is not gathered / not available
Application scale	EU-wide / applicable to all EU MS	The indicator can be applied at the EU level, across all MS
	Regional level (group of MS)	The indicator is only applicable to a group of MS in a selected region (i.e. it is not relevant for all MS and not at MS level)
	Member State level	The indicator is applicable to the Member State level (national scale) but not applicable to all EU MS (i.e. not EU-wide)
	Sub-national level	The indicator is applicable to the sub-national level of a MS (e.g. a selected region within the MS; only urban areas; only rural areas, …)

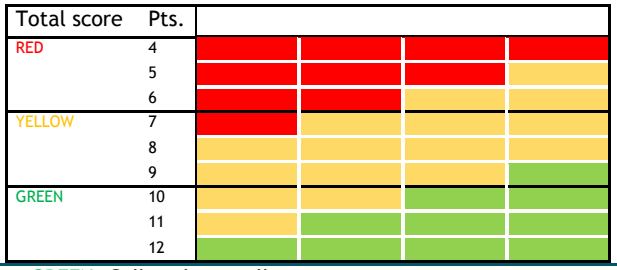
Aspects	Classification	Clarification
Frequency of publication	One-off	Data is published once, as part of an initiative or project (e.g. in a one-time report)
	Annual	Data is published annually
	Biennial	Data is published every two years
	Every five years	Data is published every five years
	Other	Data is published at other intervals or irregularly
	Data not published / Not available	Data is not published (e.g. not yet available)
Access	Freely accessible	Data is available and free to access (e.g. Eurostat)
	Accessible against cost	Data is available but access requires a fee
	Not accessible	Data is available but not accessible (e.g. confidential)
	Data not published / Not available	Data is not published (e.g. not yet available)
Comparability	Yes (indicator 100% the same in all MS)	Indicator is applicable at EU-scale and there are no factors that affect comparability across MS
	Limited (MS-specific data used)	Indicator is applicable at EU-scale but there are factors that might affect comparability across MS (e.g. energy mix/ heating structure, use of national average, etc.)
	Not comparable between MS	Indicator is not applicable at EU-scale
Quality and robustness	Official statistics (Eurostat/ MS statistics)	Data is reported under Eurostat or MS statistics / MS reporting (e.g. SILC)
	Project data, commercial databases, etc.	Data is available as part of a(n) (EU) project or database (e.g. EU Building Observatory)
	Anecdotal evidence	Limited data is available in literature
	Data not published / Not available	Data is not published (e.g. not yet available)
Experience of application to energy poverty issue	Extensive	The indicator has been applied extensively (e.g. in more than one MS)
	Limited	The indicator has been applied to a limited extent (e.g. only one MS)
	None (literature)	The indicator has not been applied yet (e.g. only in literature)

2.3. Assessment approach

The last step within this section is the assessment. The aim of the assessment is to appraise the indicators as regards to their effectiveness and suitability for a systematic assessment of energy poverty in an EU-wide framework. The assessment will form the base for the selection of the short list of indicators for further testing. The selection however will be as well based on the above mentioned expenditure and consensual approaches and indicators reflecting outcomes of the energy poverty.

A matrix with several criteria was used to assess the indicators. The matrix makes direct use of the information gathered in the identification and classification stage. We scored all indicators on the basis of each of the criteria described above according to a traffic light reporting system. The status colours are presented in the table below. Most of the criteria have a direct link to the information gathered in the identification and classification stage, and have an automatic assessment (Referred to as auto in the table below). In other cases, criteria are assessed manually according to the descriptions presented in the matrix. However, given the large amount of indicators, the final assessment regarding weaknesses and policy applications was done as part as the shortlisting of suitable indicators.

Table 2-3 Matrix for indicator assessment[1]

Criteria	Colour code	Assessment
Use for measuring / monitoring energy poverty	GREEN: Indicator has been explicitly used as direct energy poverty proxy (and/or is a consensual-based, outcome-based, expenditure-based or other energy poverty metric) YELLOW: Measures outcomes or drivers (energy demand, physical infrastructure, demographics, policy-based). supporting indicator	Auto
Recognised weaknesses	GREEN: Limited recognised weaknesses YELLOW: A number of recognised weaknesses RED: Significant weaknesses identified w/ proxy	Manual
Comparability across MSs	GREEN: Indicator is applicable at EU-scale and there are no factors that affect comparability across MS YELLOW: Indicator is applicable at EU-scale but there are factors that might affect comparability across MS (e.g. energy mix/ heating) RED: Indicator is not applicable at EU-scale	Auto
Policy application	GREEN: Provides a basis for developing policy action / monitoring policy effectiveness and policy impact YELLOW: Provides an indication or recognition of the problem (i.e. energy poverty), but is ineffective as a basis for developing policy / monitoring policy RED: Does not provide an indication or recognition of the problem	Manual
Data		
Data availability	Data availability will be assessed on the scores of the sub-topics (Source/underlying data; application scale; frequency of publication and access), using the following scoring system (every red score = 1 point, every yellow score = 2 points, every green score = 3 points): 	Auto
- Source/Underlying data	GREEN: Collated centrally YELLOW: At MS level RED: Data not published / Not available	Auto
- Application scale	GREEN: EU-wide / applicable to all EU MSs YELLOW: Applicable at regional level or MS level RED Applicable only at sub-national level	Auto
- Frequency of publication	GREEN: Annual / biennial YELLOW: Every five years / other frequency RED: One off or data not published / Not available	Auto
- Access	GREEN: Free YELLOW: Data costs/ restrictions RED: Data not published / Not available	Auto
Quality and robustness of data	GREEN: Official statistics (Eurostat/ MS statistics) YELLOW: Project data, commercial databases, etc. RED: Anecdotal evidence / Data not published	Auto
Calculation complexity	GREEN: No need for calculation / A single metric YELLOW: Limited (Constructed or combinatory metric using e.g. static thresholds) RED: High (requires significant analysis / modelling beyond the indicators provided)	Auto

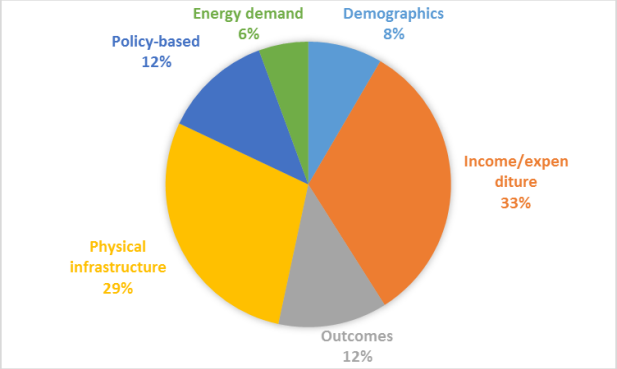
[1] This matrix is similar to the one used in Faiella and Lavecchia (2015).

3. Assessment results at the indicator level

We assessed 178 indicators in total, of which over 40% have been explicitly used or designed as energy poverty proxies.

42 of these indicators have been selected based on the preliminary work from the EU Building Stock Observatory, which has taken into account existing statistics and other databases available at EU level. 12 additional indicators have been selected from Eurostat and another 7 from SILC[2]. The remaining indicators have been gathered from other EU projects, country level statistics and literature.

Figure 3-1 Indicators assessed per category



Within the identified energy poverty metrics, 10 were consensual-based; 42 expenditure-based and 11 outcome-based; while another 14 energy poverty metrics had different approaches (i.e. combination of metrics or other approach). The section below provides a brief overview of the different indicators found under each category.

Income/Expenditure indicators

The category of 'income and expenditure' has the most indicators. It includes e.g. the share of household expenditures on energy, the energy spending for adequate space heating (based on theoretical demand), the disposable income before and after energy expenditure for adequate space heating. Indicators under this category can be broadly grouped in:

- **Rent related indicators** such as rent value and average rent value. Rent value covers prices for rental housing, including the energy costs. Further, these indicators can be used to calculate income "after housing costs".
- **Energy price** related indicators including average domestic energy prices and average district heating prices.
- **Income** related indicators such as disposable income and net income of a household (which can be used as input for the constructed metrics or be disaggregated by income group) as well as those that measure the share of (disposable) income spent for energy or heating. Income distribution will be taken into account during the testing phase.
- **Expenditure** related indicators which measure the share of expenditure dedicated to energy compared to total expenditures. Another example is the percentage of household budget spent on gas and electricity by households with low incomes or the minimum quantities of energy (expenditure) required by household.
- **Constructed indicators** which compare expenditure or income against a fixed or relative target. E.g. energy expenditure above 10% of disposable income, energy expenditure greater than twice the average/mean/median, or LIHC.

[2] While SILC is also presented by EUROSTAT, the surveys are run by national statistical offices.

- **Other indicators**, including for example the weight of household energy products in the Household Index of Consumer Prices, the cost of building renovations and average energy cost savings per retrofit.

Energy demand indicators

These indicators are the least available in the database. They reflect the energy demand by providing indicators on e.g. the total energy consumption and its breakdown (including energy consumption for space heating, for space cooling, for domestic hot water) or the theoretical energy use in a dwelling. This category also includes indicators providing information regarding the household fuel mix of final energy consumption in the residential sector.

Physical infrastructure indicators

These indicators encompass the dwelling size, building stock age and design (e.g. information regarding insulation and heating system). These are objective, in the sense they can be measured.
Thus, relevant indicators regarding dwelling size include average floor area per person, average number of rooms per person. Regarding building stock, indicators include the breakdown per heating system, dwelling type and construction period. Further indicators in this category concern the energy performance of the building stock: energy use per m2, percentage of buildings built before the thermal regulation, system inefficiencies (e.g. heating device capacity, disaggregation of heating system according to the age of the space heating equipment, heating system level), average energy performance of new construction, average U-value for overall building envelope, homes with cavity wall insulation and loft insulation, average efficiency rate of technical system for space heating, percentage of households with inadequate housing. Most of these indicators are not used as proxy for energy poverty and will be used as a complement to the energy poverty metrics and/or will be disaggregated by income level.

In addition, quality of the accommodation is also taken into account (e.g. whether the household has problems regarding leakage, humidity, etc.), but it is often a subjective indicators assessed by the interviewee. Other indicators related to the physical infrastructure include tenure, cumulative numbers of gas and electricity transfers[3] and the percentage of vulnerable consumers with/without heating installations. Access to energy services is expressed by such indicators as percentage of population with electricity/gas access or percentage of population with primary reliance on non-solid/solid fuels (not included in the database).

Demographics indicators

Demographic indicators are well-covered by SILC/EUROSTAT. They provide further detail regarding the factors that connect to energy poverty rather than an actual measure of energy poverty. These indicators include poverty related indicators, for example those at risk of poverty or those unable to make ends meet; indicators related to non-income vulnerability, such as elderly population; and indicators related to household size and family composition including e.g. the proportion of children, working adults and pensioners living in low-income households. Additionally, we include indicators such as amount of customers on prepayment meters and the percentage of under-occupied households, which is relevant to assess underestimation of energy demand compared to fully-occupied households.

[3] Cumulative numbers of gas and electricity transfers indicate the number of customers switching supplier.

Policy-based indicators

Policy-based indicators have a higher amount of qualitative indicators than the rest of the categories. These indicators aim to reflect MS policy intervention such as social support, direct energy payment support, social tariffs and tariff access, as well as other energy efficiency interventions. They include, for example, the number of years since market liberalization and the ability of consumers to switch tariffs. Additional indicators related to the energy market which may have an impact on energy prices are access to different suppliers and concentration of supply in retail rental market (not included in the database). Other indicators regarding beneficiaries of social support such as the number of beneficiaries of social aid, the amount of dwellings requiring social support to pay energy bills and the number of applicants (or beneficiaries) of energy efficiency schemes for low-income households are also included. Such indicators include the volume of support, e.g. amount of financial aid during the cold season. Information on both beneficiaries and total public expenditure other schemes (such as Warm Front, the winter fuel & cold weather payments in the UK) are also included. Finally, indicators related to vulnerable customers also fall under this category, e.g. amount of socially vulnerable consumers protected from disconnection, households that apply for the status of vulnerable electricity/gas consumer dwellings with voluntary certification schemes and the existence of the market regulation of the rental housing.

Outcome related indicators

Energy poverty outcomes include – as presented in our conceptual map - health issues, social stigma, mental well-being, indebtedness and disconnection. This category includes several subjective/self-perceived indicators (e.g. such as the perception of households regarding their ability to pay their bills or to keep their home warm). Indicators in this category regarding health include the excess winter mortality and health impacts linked to poor living conditions. There are also several indicators regarding debt and disconnection including for example the disconnection rates; average level of debt; self-disconnection; difficulty to pay utility bills; and debts owed to energy suppliers.

3.1. Summary of the results

Table 3-1 presents an overview of the assessment results per category of indicator. Of the 178 indicators assessed, 58 were related to income or expenditure while 51 were linked to physical infrastructure. On the other hand, energy demand indicators and demographic indicators only amount to 10 and 15 respectively. Some key findings:

- 75 of the 178 indicators (42%) were classified as being used or having being considered as energy poverty proxies. The exceptions are the categories of physical infrastructure, demographics and energy demand were very few or none of the indicators have been used explicitly as energy poverty metrics.
- 139 are single metrics while 39 are combinatory or constructed indicators, representing 22% of the total.
- Policy-based indicators are the most MS-dependent and thus the least comparable. They are mostly applicable at Member State level.
- Physical infrastructure indicators, on the other hand, are the ones with the least robust data.
- Regarding calculation complexity, the most complex to calculate consider the theoretical energy consumption or the minimum energy required (classified under 'Income/expenditure').

- The frequency of publication of the assessed data at the EU level varies a lot for different indicators.

From this analysis, we produced a list of indicators to be tested, which could be grouped in four different categories, according to their logical structure.

- Expenditure-based, above-the-threshold type of indicators: those metrics that classify as energy poor a household if its income share spent on energy is above a certain threshold.
- Expenditure-based, below-the-threshold type of indicators: those metrics that classify as energy poor a household if its income after energy costs falls below a certain threshold.
- Expenditure-based, hidden energy poverty: those metrics that classify as energy poor a household whose energy expenditure is below a certain threshold.
- Consensual based indicators: those metrics that are based on self-reported status of energy poverty.

These four categories are not exhaustive of the types of metrics that exist in the literature. However, other types (such as outcome-based indicators) require specific types of data that is hard to be obtained, reproduced and compared across countries. The four types mentioned above can be easily applied Europe-wide in a comparable fashion, being generic enough to give an interesting picture of the phenomenon in different Member States. Moreover, they can be obtained from harmonized data source (the SILC survey and Household Budget Surveys).

Table 3-1 Overview of the assessment results per indicator category. The percentages show, per indicator category, the share of indicators that scored green/red/yellow (according to the assessment matrix) and the share of indicators which the team was not able to assess (if any)

Indicator category	Assessment	Use for monitoring energy poverty	Comparability across MSs	Data availability	Quality and robustness of data	Calculation complexity
Demographics (Total: 15 indicators)	Green	0%	67%	87%	80%	93%
	Yellow	100%	33%	7%	13%	7%
	Red	NA	0%	7%	0%	0%
	Not assessed	0%	0%	0%	7%	0%
Income/ Expenditure (Total: 58 indicators)	Green	72%	50%	62%	53%	45%
	Yellow	28%	50%	36%	33%	43%
	Red	NA	0%	2%	12%	12%
	Not assessed	0%	0%	0%	2%	0%
Outcomes (Total: 22 indicators)	Green	91%	45%	73%	73%	91%
	Yellow	9%	55%	18%	9%	9%
	Red	NA	0%	9%	18%	0%
	Not assessed	0%	0%	0%	0%	0%
Physical infrastructure (Total: 51 indicators)	Green	6%	73%	82%	27%	94%
	Yellow	94%	27%	12%	57%	2%
	Red	NA	0%	6%	8%	4%
	Not assessed	0%	0%	0%	8%	0%
Policy-based (Total: 22 indicators)	Green	45%	23%	59%	55%	95%
	Yellow	55%	77%	32%	9%	5%
	Red	NA	0%	9%	23%	0%
	Not assessed	0%	0%	0%	14%	0%
Energy demand (Total: 10 indicators)	Green	0%	80%	90%	40%	100%
	Yellow	100%	20%	10%	60%	0%
	Red	NA	0%	0%	0%	0%
	Not assessed	0%	0%	0%	0%	0%

4. Methodology for the Testing of Indicators

In previous steps of this work, indicators were chosen based on the literature and their use across Member States. This allowed us to elaborate a shortlist of indicators consisting both of metrics of energy poverty and supporting indicators (related to causes or effects). But this preliminary, qualitative analysis is not enough to conclude which set of indicators are the most suited for a wide application in the European Union.

In order to decide which indicators are most adequate, we applied the selected indicators to selected Member States and analysed their behaviour across various years and in different income groups. Moreover, we performed econometric analyses of the relationships between the chosen metrics of energy poverty and a group of supporting indicators, which allowed us to decide which ones are more strongly associated with the phenomenon of energy poverty in each of the Member States analysed. We performed this analysis for four Member States with various energy poverty situations and policy approaches: Spain, Italy, Slovakia and the Netherlands.

The selected four Member States take into account the differences in regulatory environments. Thus our choice includes one country with highly regulated end-user electricity tariffs (SK), one with completely market-based pricing for retail electricity (NL), and one with semi liberalized retail market (ES).[4]

4.1. Data gathering

The first step was to gather the microdata (information at household level) for the selected countries. The main sources were the Household Budget Surveys (HBS) and the Surveys on Income and Living Conditions (SILC). The table below provides an overview of these sources per country with their key attributes.

Table 4-1 Main data sources in all countries

Spain	Survey on Living Conditions	Household Budget Survey
Period	2008-2014	2006-2014
Frequency	Annual	Annual
Spatial unit	Province	Province
Expectations on future collection	Expected to be available annually	Expected to be available annually
Observation unit	Households and individuals	Households and individuals
Number of observations	11 600 (in 2014)	22 146 (in 2014)
Data access	Microdata freely available	Microdata freely available

[4] In particular, the electricity market in the Netherlands has been fully open to competition since 2004, with four major players in the country. As such, the electricity market in this country can be seen as a liberalized retail market. Furthermore, the retail prices of electricity are not regulated in the Netherlands per se but suppliers are obligated to report all price changes. In this regard, the authorities have the power to reduce prices as suppliers cannot provide sufficient justification for the amounts charged.
A similar energy market is seen in Slovakia, where the wholesale activities were fully liberalized in 2005. As such, there are no price regulation at this level. Furthermore, in 2012, Slovakia adopted laws for the further liberalisation and harmonisation of the energy market in the country. Nevertheless, the largest power generating company (Slovenské elektrárne) had still a market share of almost 78 percent in 2011.
On the contrary, Italy has a free market which aims for free electricity trading for all commercial clients since July 2004 and a complete opening of the market for private customers from July 2007. However, the standard offer market remains concentrated, despite the numerous active suppliers, with three main operators.
Lastly, Spain has a highly regulated end-user electricity tariff. The electricity market in Spain was integrated with the Portuguese electricity market in 2007. There is a relatively high degree of concentration and vertical integration in the Spanish electricity market as a few players have a dominant role. (EC, country reports; European Energy Market Reform, Country profiles)

Source	INE, Spain's National Statistics Institute	INE, Spain's National Statistics Institute
Italy	**Survey on Living Conditions**	**Household Budget Survey**
Period	2004-2014	Not used
Frequency	Annual	
Spatial unit	Province	
Expectations on future collection	Expected to be available annually	
Observation unit	Households and individuals	
Number of observations	19 663 (in 2014)	
Data access	Microdata freely available after registration	
Source	Istat, Italy's National Institute for Statistics	
Netherlands	**Survey on Living Conditions**	**Household Budget Survey**
Period	2006-2012	2006, 2009 and 2012
Frequency	Annual	Every three years
Spatial unit	Province	Province and municipality
Expectations on future collection	Expected to be available annually	Expected to be available annually
Observation unit	Households and individuals	Households
Number of observations	24,949 (2012)	60,191 (2012)
Data access	Microdata available after specific request. This process is paid.	Microdata available after specific request. This process is paid.
Source	CBS (Dutch Statistical Bureau)	CBS (Dutch Statistical Bureau)
Slovakia	**Survey on Living Conditions**	**Household Budget Survey**
Period	2005-2013	2004-2012
Frequency	Annual	Annual
Spatial unit	Province	NUTS 1 and province
Expectations on future collection	Expected to be available annually	Expected to be available annually
Observation unit	Households and individuals	Households and individuals
Number of observations	5,403 (in 2013)	4,704 (in 2012)
Data access	Microdata freely available, after specific request	Microdata freely available, after specific request
Source	The Statistics Bureau of the Slovak Republic	The Statistics Bureau of the Slovak Republic

The most relevant data gathered and indicators constructed based on this data are presented in the sections below for each of the two surveys.

4.1.1. Expenditure-based metrics

For the calculation of the expenditure-based metrics, datasets must have information on energy spending of the households. This is obtained generally via Households Budget Surveys, which besides providing information about household composition and demographic characteristics, also lists the expenditure items and the amount spent on each of them. This study uses Household Budget Surveys of Spain and the Slovak Republic in order to calculate the expenditure-based metrics. In the case of the Netherlands, a special survey on household conditions was used, the WOON-Onderzoek. Finally, for Italy we used the Survey on Income and Living Conditions (SILC), which is the same used for the consensual-

based metrics. **This happens because the Italian SILC collects information on energy expenditure. The tables below describe the variables obtained from each country's surveys.**

In Spain, the Household Budget Survey is made of three questionnaires: expenses ("Fichero de gastos"), households ("Fichero de hogares") and household members ("Fichero de los miembros del hogar"). For this study, we used information extracted from the households' questionnaire and the expenses questionnaire. The two questionnaires can be linked by the household number. With these data, we can measure energy poverty in the population (and by income group) and the supporting indicators that are linked to this phenomenon: precipitators or outcomes of energy poverty. The following table summarizes the data that were collected for this exercise.

Table 4-2 Data from the household budget survey in Spain

Variable	Code	Questionnaire
Province (Comunidad Autónoma)	CCAA	Both (households and expenses)
Year of survey	ANOENC	Both (households and expense)
Identifier of the household in the different questionnaires	NUMERO	Both (households and expenses)
Population factor (how many households in the population are represented by this observation)	FACTOR	Both (households and expenses)
Age of main provider of household	EDADSP	Households
Number of members of household	NMIEMB	Households
Number of rooms	NHABIT	Households
Unemployment benefits and Other social benefits, respectively (binary variable)	DESEM, OTRSUB	Households
Total monthly income of the household	IMPEXAC	Households
Monetary expense by groups (housing, electricity, etc.)	GASTMON, CODIGO	Expenses

For the Slovak Republic, data were supplied already in a consolidated way. The following variables were taken for the calculation of the expenditure-based metrics.

Table 4-3 Data from the household budget survey in the Slovak Republic

Variable	Code
Year of survey	ROK
Year of birth of the responding individual	aq6273, aq6274, aq6275, aq6276, aq6277, aq6278, aq6279, aq6280, aq6437, aq6438, m3r2s1, m3r2s2, m3r2s3, m3r2s4, m3r2s5, m3r2s6, m3r2s7, m3r2s8, m3r2s9, m3r2s10
Province	Kraj
Cross-sectional Weight of household	vahy04k1, vahy05k1, vahy06k, vahy07o, vahy08o, vahy09c, vahyhd10, vahyhd
Total gross income	x300000
Income taxes	x201010
Social aid	x304000
Energy expenditure	x45000

For the Netherlands, as mentioned, the data were extracted from the WOON-Onderzoek. This survey is collected every three years and contains detailed information about household's characteristics, including income and expenditure.

Table 4-4 Data from the Woon-Onderzoek, the Netherlands

Variable	Code
Year of birth of the responding individual	geboren
Province	prov
Cross-sectional Weight of household	hweegwon
Disposable income (CBS concept)	bestinkh (*besteedbar inkomen*)
Social aid (binary)	ontvsubs
Energy expenditure	totener
Number of rooms in the house	kamers
Number of people in the house	aantalpp
Number of children in the house	aantkind

In Italy, the information collected were the same as for the consensual-based indicators. The difference is that the Italian SILC also collects data on energy expenditure, so that this survey is enough to calculate all indicators.

Table 4-5 Data from the SILC-survey in Italy

Variable	Code
Year of survey	HB010
Year of birth of the responding individual	PB140
Province	regione
Cross-sectional Weight of household	DB090
Equivalised disposable income	HX090
Social aid	HY010 – HY023
Energy expenditure	conris_e, risgas_e, elettr_e, legna_e, gas_e
Number of rooms in the house	kamers
Number of people in the house	aantalpp
Number of children in the house	aantkind
Leaking roof, damp walls/floors/foundation	HH040

4.1.2. Surveys on Income and Living Conditions (SILC)

SILC surveys are standardised across the EU to a certain degree. Thus, the name of the variables and the way they are constructed remain the same across countries. The table below provides an overview of the key variables used in our assessment. The SILC results are divided into four different files: the household register, the personal register, the household questionnaire and the personal questionnaire. All these questionnaires can be merged into one, as they have identifiers that link one to the other. Merging the datasets is necessary for this work, as information used in the analysis is obtained from different files.

Table 4-6 Data from the SILC survey

Variable	Code
Region or province	DB040
Year of survey	DB010, HB010
Identifier of the household in the different questionnaires	DB030, HB030, RB040
Household cross-sectional weight. Population factor (how many households in the population are represented by this observation)	DB090
Total disposable household income	HY020
Net income from social assistance (not for housing or family)	HY060N
Arrears on utility bills	HS021, HS020
Capacity to keep home adequately warm	HH050
Ability to make ends meet	HS120
Number of household members	HX040
Leaking roof, damp walls/floors/foundation, or rot in window frames or floor	HH040

4.2. Applying the energy poverty metrics

The first part of the evaluation of indicators consisted of calculating the selected energy poverty metrics in the chosen Member States. The data necessary to calculate the selected metrics was gathered for approximately 10 years, the latest year usually being 2014. This enabled us to show that comparable metrics can be calculated in different Member States, but also shed light in the challenges of defining these indicators.

Calculating and analysing the indicators for different Member States also led us to discard some indicators after specific analysis of very specific contexts. This qualitative judgment was done based on the analysis of the development of the indicators in time and its relationship with underlying developments in the respective countries' economies (energy prices, income levels, etc.). The yardstick that was used to assess whether the results made sense was the assumption that the phenomenon of energy poverty has gotten worse in the years just after the financial crisis, which hit all European countries, though in a different magnitude. This impact should be captured, at least partially, by each of the energy poverty metrics. In short, the following issues were assessed during this step:

1. Availability and/or accessibility of necessary data for the selected Member States, allowing for the calculation of the selected indicators;
2. Ability of indicators to provide insights about energy poverty levels and changes.

Various metrics were calculated at this stage for each of the countries, in the period for which data is available. In order to calculate the indicators, it is necessary to have access to household level data (microdata), which are produced in household surveys such as the SILC survey and Household Budget Surveyr throughout the EU. Such degree of disaggregation is necessary in order to identify precisely the energy consumption patterns of each interviewed household, and in order to correlate these patterns with various other characteristics (supporting indicators) of that household.

Management of microdata, and statistical analysis correlating the indicators to other characteristics, was done with use of software package Stata. The metrics that were tested in this exercise are summarised in the table below:

Table 4-7: Overview Energy Poverty Metrics

Group	Name of metric	A household is energy poor when:	Justification
Expenditure-based metrics & monetary gap[5]			
Energy expenditure above the threshold	Twice the national median share (2M)	Share of energy expenses relative to its disposable income (income minus taxes) is more than twice as large as the national median in the current year (**threshold changes each year**).	This allows for recalculation each year and accountability for fluctuation conditions (prices, climate, etc.). By multiplying the median by two, an effort is made to distinguish the most excessive expenditure while including situations still deemed "acceptable." Percentage based metrics in this group are expected to better capture energy poverty, since they take into account the income component.
	Twice the national median expenditure (2M Exp)	Expenses in energy are more than twice as large as the national median in the current year (**threshold changes each year**).	
	10%	Share of energy expenses relative to its disposable income (income minus taxes) is higher than 10% (threshold is fixed and independent of country specific patterns)	This is a simple indicator, easy to communicate and measures an absolute value for energy poverty which does not shift depending on the changes in the population. It has been used by many researchers – although it is highly arbitrary.
Minimum Income Standard	Low income, high cost (using actual expenditure) (LIHC)	Actual energy costs are above the median level and if they spend this amount, their residual income is below the official poverty line. (Obs: in the original LIHC proposed by Hills, "required energy costs" were used instead of "actual energy costs". As explained above, this study only uses actual expenditure data).	This measure is helpful in distinguishing energy poverty from generalized poverty as the household is not considered poor before deduction of energy costs (poverty *due to* energy costs).
	MIS as median expenditures of poorest 40% (MIS Low income)	Disposable income (income minus taxes) after energy costs is below or the same as MIS (after median housing and energy costs), using MIS as the median equivalised per capita overall consumption for the two quintiles with lowest income	This measure is more descriptive than LIHC regarding the extent to which quality of life declines given burdensome energy costs, especially if amounts for minimum life expenses are provided such that substitution can be estimated (e.g. given X increase in energy costs, food expenses fall below nutritionally recommended level).
	MIS as half the national median overall expenditures (MIS M/2)	Disposable income (income minus taxes) after energy costs is below or the same as MIS (after median housing and energy	

[5] The amount of money that would be necessary to spend so that all households that are energy poor under the specific metric would be precisely at the threshold.

Group	Name of metric	A household is energy poor when:	Justification
		costs), where MIS = 50% of equivalised national median per capita overall consumption	
	MIS as a quarter of the national median expenditures (MIS M/4)	Disposable income (income minus taxes) after energy costs is below or the same as MIS (after mean housing and energy costs), where MIS = 25% of equivalised national median per capita overall consumption	
Hidden Energy Poverty: Energy expenditure below a threshold	HEP 5 EUR	Equivalised energy costs is below € 5 per month.	Reflects how actual expenditures are not necessarily indicative of needs being met, focuses on energy services, and accounts for the coping strategy of energy restriction.
	Half the national median share (HEP M/2)	The share of energy expenses relative to disposable income (income minus taxes) is less than a half of the national median in each year (**threshold changes each year**).	
	HEP M/4	The share of energy expenses relative to disposable income (income minus taxes) is less than a 25% the national median (**threshold changes each year**).	
	Half the national median expenditure (HEP M/2 EXP)	The absolute per capita spending on energy is less than half of the median equivalised spending.	
	Half the national median expenditure (HEP M/4 EXP)	The absolute per capita spending on energy is less than 25% of the median equivalised spending.	
Consensual-based metrics			
Consensual-based	House not warm (Warmth)	The household declares the inability to keep the house warm.	Descriptive of perceived reality, regardless of income level
	Arrears in utility bills	The household declares to have had to delay its payments of utility bills.	Unique measure of non-payment coping mechanism (rather than limiting energy use or absorbing costs and subsequent decline in quality of life)
	Severe arrears	The household declares to have had to delay its payments of utility bills **more than once.**	Unique measure of non-payment and severity thereof

4.3. Estimating relationships

The second part of the evaluation assessed the meaningfulness of the indicators, estimating the relationship between the selected metrics and the supporting indicators that are assumed to be linked to the phenomenon of energy poverty. This was done by means of econometric regressions of the energy poverty metrics on a series of socio-economic supporting indicators.

Part of the understanding of energy poverty consists of finding its associated phenomena and causes. For this study, a set of supporting indicators was chosen to evaluate how the selected measures of energy poverty interact with them. These supporting indicators are thought of as being correlated with, and even precipitators of the phenomenon of energy poverty. By running regressions of the metrics of EP on the supporting indicators, we are not only evaluating the impact of the latter on the former, but also indirectly assessing the meaningfulness of our chosen metrics: it would be highly suspicious if these supporting indicators did not correlate at all with our metrics. As explained above, the expenditure-based energy poverty metrics are defined with share of energy expenditure or absolute monetary values. Therefore, we also estimated the impact of the supporting indicators on these two underlying variables.

This testing phase follows and complements the qualitative analysis that was performed under testing phase 1, which allowed us to observe the behaviour of the different metrics in time in the different selected Member States. Testing phase 2 aims to ensure that metrics not only make sense for each country under a qualitative assessment, but that they are also correlated with supporting indicators that are expected to be connected with energy poverty, be it a causal link or not.

Although this falls short of providing rigorous information on the causality between indicators and metrics, the quantitative assessment provides useful information on the nature of the relationship between metrics and supporting indicators. These estimations will allow us to validate our choice for energy poverty metrics and will suggest which supporting indicators should be observed by policy makers as a means to predict and address energy poverty.

The availability of microdata at household level allowed us to identify which households accumulate certain number of features and infer to which extent these features are, on average in the population, important to explain energy poverty. We performed these regressions for the expenditure-based and consensual based metrics. These two kinds of metrics are extracted from different surveys (except for Italy), the consensual based metrics being derived from the SILC survey and the expenditure-based ones from the Household Budget Surveys (and the Woon-Onderzoek for the Netherlands). With respect to the supporting indicators, these surveys unfortunately do not offer the same array of variables. This means that different supporting indicators were used to estimate relationships with expenditure-based and consensual based metrics. However, we tried to keep consistency of the econometric models to the extent possible.

The following table summarises the supporting indicators, highlighting when they are binary, and provides a theoretical justification for their choice. We use SILC data to relate consensual based metrics of energy poverty with a (smaller) set of supporting indicators. Since SILC and HBS surveys are not merged, not all regressions were run with the same set of supporting indicators. The supporting indicators were chosen based on the availability of data in the sources used. They are based on the first

review of supporting indicators considered by the literature as relevant for explaining the phenomenon of energy poverty.

Table 4-8. Supporting indicators

Supporting Indicator		Comment	Surveys
Eq. income	*Household's available Income per capita*	This variable captures the equivalised income per capita in the household. Richer households are expected to be less likely to suffer from energy poverty, that is, spend a smaller share of their disposable income on energy.	HBS, SILC and Woon
Social Aid	*Receives social aid*	This variable captures whether the household receives any kind of social aid (including unemployment benefits). On the one hand, it is a proxy for the fact that the family suffers from economic poverty, which suggests that its share of spending with energy as a proportion of income is likely to be large. On the other hand, social aid might ameliorate or partially tackle the problem of insufficient income, reducing the share of expenses on energy.	HBS, SILC and Woon
Number of people	*Number of members in the household*	A household with higher number of people is expected to have a higher level of energy needs. It is however possible that when more people live together, the average consumption of energy per capita falls, thus reducing the share of energy expenses.	HBS, SILC and Woon
Building age	*Age of the building where the household is living in*	The age of the building might be correlated to lack of adequate housing insulation, older electrical appliances which have a lower energy efficiency, less isolating windows, etc.	HBS (ES), Woon
Age of main provider	*Age of main provider*	Older people tend to spend more time indoor and be more sensitive to cold and hot temperature levels. The older average age of the household members, the higher the level of energy needs. The age of the main provider tried to capture the impact of this factor on the share of energy expenses.	HBS (ES), Woon
Number of rooms	*Number of Rooms*	This indicator is related to the number of rooms in the house. A larger house will require more energy spending to reach an adequate level of energy services. Since income is being controlled for, this variable was expected to increase the share of income spent with energy poverty, thus increasing the likelihood of being in energy poverty.	HBS (ES), SILC and Woon
Single parent	*Single parent in the household*	Being a single parent, might suggest a lower overall income or higher level of expenses which can increase the likelihood of being in energy poverty.	HBS, SILC and Woon
Leak	*Presence of leaks in the household*	This measure indicates whether the perception of being cold or excessive energy spending is related to the fact that the building is affected by leaks	SILC
Number of old people	*Number of old people in the household*	This indicator is related to 'Age of main provider', with the difference that this covers all older people in the household and not just the age of the main provider.	HBS, SILC
Energy Price	*Household Energy Price Index*	This indicator reflects the prices typically paid by residential customers in cities around the EU.	Eurostat

For both the national HBS and SILC datasets we have available yearly datasets with household answers to the survey, As these surveys did not track the same households, in technical terms our study analyses a "repeated cross-sections" dataset, as opposed to a "panel dataset", in which the same individual/household is followed in various periods.[6] This has implications for the kind of econometric strategy that can be applied for the estimation.

4.3.1. Binary Metrics

All energy poverty metrics used in this study have the characteristic of being binary indicators, that is, they assume the value 1 when the household is in energy poverty, and the value 0 when it is not. Because of this discontinuity, it is common practice to use non-linear probabilistic models in order to estimate the relationships between the supporting indicators (explanatory variables) and the metrics (dependent variables).

We performed logit regressions for each energy poverty metric, restricting the data to the last year available (2014 for Spain and Italy, 2012 for Netherlands and Slovakia). For robustness, we reproduced the same exercise for all other years available. The logit model guarantees that the estimates of the dependent variable (the energy poverty metric with 0/1 values) obtained from those estimators lie between 0 and 1 (which is consistent with the idea of using binary dependent variables). In case of binary variables – say for sake of simplicity replying Yes or No to question "Is this household energy poor?", the probability of a positive answer for the i-th household – coded as y_i =1 below - is modelled as:

$$p_i = \Pr[y_i = 1|x'_{it}] = \frac{\exp(\mathbf{a}_i + \mathbf{x}'_{it}\mathbf{b}_{it})}{1+\exp(\mathbf{a}_i + \mathbf{x}'_{it}\mathbf{b}_{it})} \qquad \text{i = 1, 2, ,..., N and t = 1, 2, ..., T.}$$

It is worth mentioning that the marginal effect of an indicator on an energy poverty metric varies across households as it depends on the value of each observation. Fortunately, one can compute the so-called odds ratio, i.e. the probability of an outcome relative to the probability of another, which does not vary across households or more generally on the value of data for a specific household. In the regression outputs displayed below, only the odds-ratio are shown.

4.3.2. Continuous Metrics

All expenditure-based metrics that were tested in the scope of this study as defined as a comparison between a threshold and an expenditure metric. This underlying variable is either the share of energy spending or an absolute monetary value. The logit regressions estimate the impact of the supporting indicators in the probability of being in energy-poverty. However, being in energy poverty or not is a mechanical effect that derives from the values of the underlying variables that define energy poverty. Therefore, we also estimated the impact of the supporting indicators on two underlying variables: the share of income spent on energy, and the equivalised total energy expenditure. These regressions can be performed with linear models, making interpretation and implementation easier. The fact that the dataset is made of repeated cross sections is also a smaller problem for linear models than it is for non-linear models such as logit. In these cases, it is possible to apply relatively simple transformations in the data that allow the researcher to make use of the time variation in the dataset, granting more

[6] The design of the SILC survey imposes that some families are followed over more than one year. But we did not use this panel-data aspect of the survey, adopting more general solutions to the "repeated-cross-section" problem.

robustness to the results.

In these cases, it is common practice to aggregate households of different years into groups of similar, exogenous characteristics, thus creating pseudo-individuals that are followed in time (Verbeek, 2007). Once this is done, it is possible to assume that the pseudo-individual is actually the same across all the periods, thus being able to perform panel-data estimation techniques that account for the autocorrelation of residuals for the same individuals. Usually the choice to define these cohorts is the birth cohort of the individual. In this study, the pseudo-individuals were created as cohorts of individuals *in each province*. This practice is not ideal, for province residence is not entirely exogenous, but it was chosen as the best way (in the sense that it was the most exogenous "grouping" possibility available) to increase the size of pseudo-individuals in the dataset.

After transforming the dataset in such a way, conventional linear panel data models can be applied. There are two main kinds of models are applied in panel data analysis: fixed effects and random effects. The model specification can be described by the following equation:

$$y_{it} = \mathbf{a}_i + \mathbf{x}_{it}^{'}\mathbf{b}_{it} + u_{it} \text{ with I = 1, 2, ,..., N and t = 1, 2, ..., T}$$

The variable y_{it} with I = 1, 2, ,..., N and t = 1, 2, ..., T observed across time period T and households N is a specific metrics of energy poverty. The variable $\mathbf{X}_{it}^{'}$ represent a collection of energy poverty indicators. The parameter $\mathbf{a}_i$ is supposed to convey the impact of all unobserved factors influencing the value of the energy poverty metrics, which vary across households but do not vary across time. The variable u_{it} is the unobserved disturbance term. In the fixed effects, model, $\mathbf{a}_i$ is a fixed parameter for each group, whereas in the random effects model, $\mathbf{a}_i$ is assumed to be part of the residual, thus random, but still autocorrelated within each group. The choice between these two models is suggested by the Hausman test, which tests for systematic differences between these two approaches. In case these systematic differences are not found, it is best practice to opt for the random effects estimator, which is more efficient. Normally the random effects model provides a more efficient (i.e. more precise, with a smaller range of possible values) estimate, thus being in general preferred. However, if the Hausman test suggests to use the fixed effects model, it is because there seems to be a correlation between the explanatory variables and the residuum, so that the values of the estimates in the random effects model would be biased. Even though the fixed effects model is less efficient, the value of the coefficient would be unbiased.

5. Results – Applying the EP metrics

This section aims to provide information on the different energy poverty metrics for each country, i.e. Spain, Italy, Slovakia, and the Netherlands. The results for the different countries are highlighted for the two groups of indicators, i.e. Expenditure based metrics and the Consensual based metrics. Furthermore, all indicators are divided in different groups based on the relevance of each measure:

- ✓ **Expenditure-based metrics:**
  - **Above Threshold**: These indicators highlight the share of energy relative to its disposable income above a certain threshold. These percentage-based metrics are expected to better capture energy poverty, since they take into account the income component;
  - **LIHC/ MIS**: These measures look if the disposable income is below or the same as the Median Income Standard;
  - **Hidden Energy Poverty**: These indicators take into account households that potentially restricted spending, given their low energy expenditure compared with that of households living in similar situation;
- ✓ **Consensual based metrics**: These are self-reported metrics for energy poverty, i.e. Arrears, Severe Arrears, and Warmth.

Furthermore, these four groups of indicators are highlighted for the total population and for each income group: (1) the lowest income group of the population, i.e. 0% - 20%; (2) the income group between 20% - 40% of the population; (3) the third group exist of the income group from 40% - 60%; (4) the group of the population with incomes between 60% - 80% of the total population; and (5) the highest income group: i.e. 80% - 100%.

Lastly, the following sections also present the results of a systematic statistical analysis of the relationships between the tested energy poverty metrics and a set of supporting indicators. This shows how each metric is affected by the different variables that are associated with the phenomenon of energy poverty. Two kinds of regressions were performed: probabilistic models to explain energy poverty status; and linear regressions to explain the level of energy expenditure and the share of energy expenditure. All results are reported in this Annex, but the interpretation of the most interesting findings can be read in Chapter 3 of the report.

5.1. Above Threshold

5.1.1. Total Population

Figure 5-1: Overview Indicators Spain (10%, 2M, and 2M Exp), with on X-axis time [Years] and on Y-axis Energy Poverty [%].

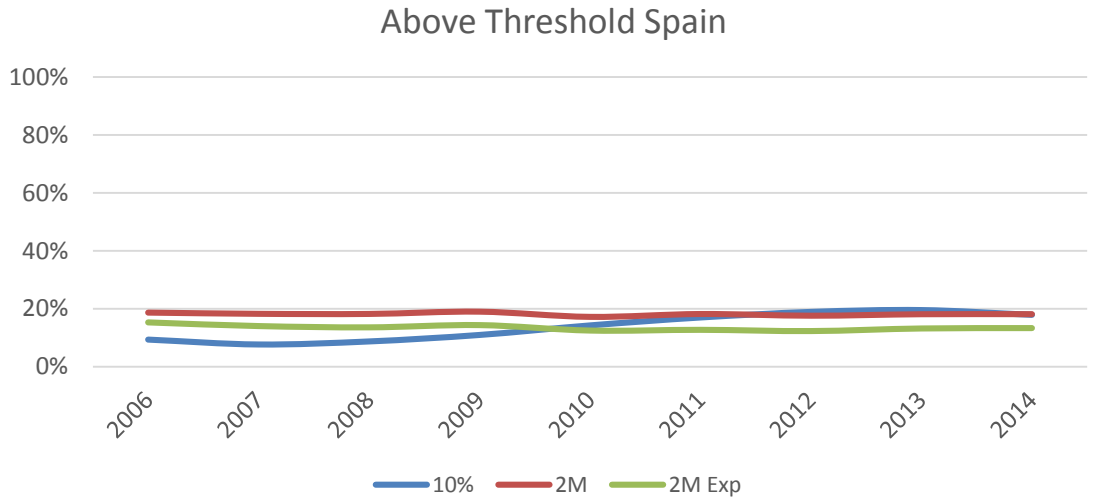


Figure 5-2: Overview Indicators Italy (10%, 2M, and 2M Exp), with on X-axis time [Years] and on Y-axis Energy Poverty [%].

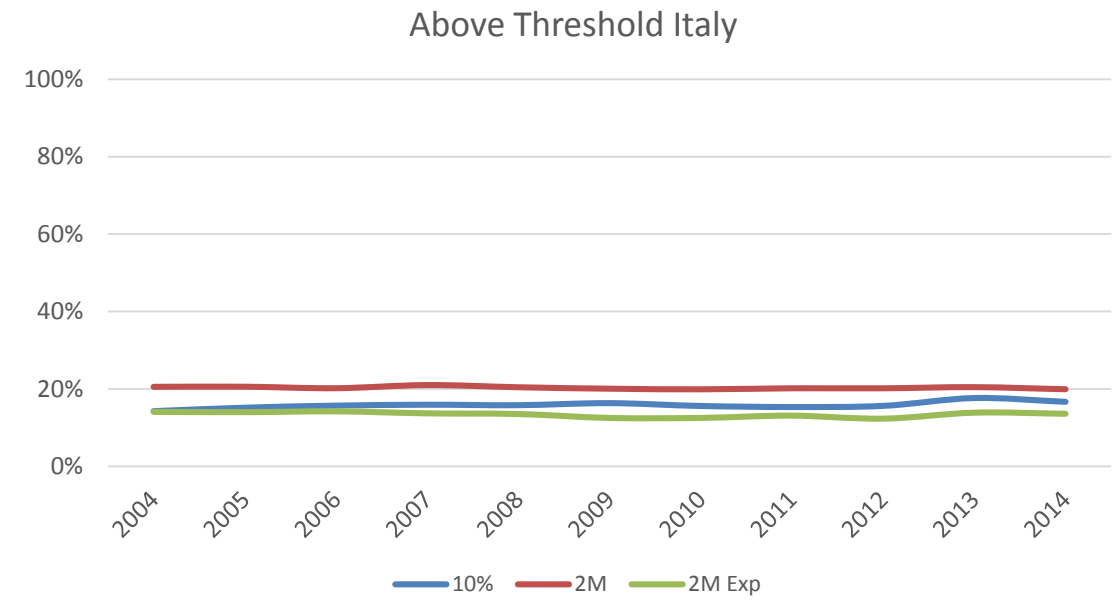
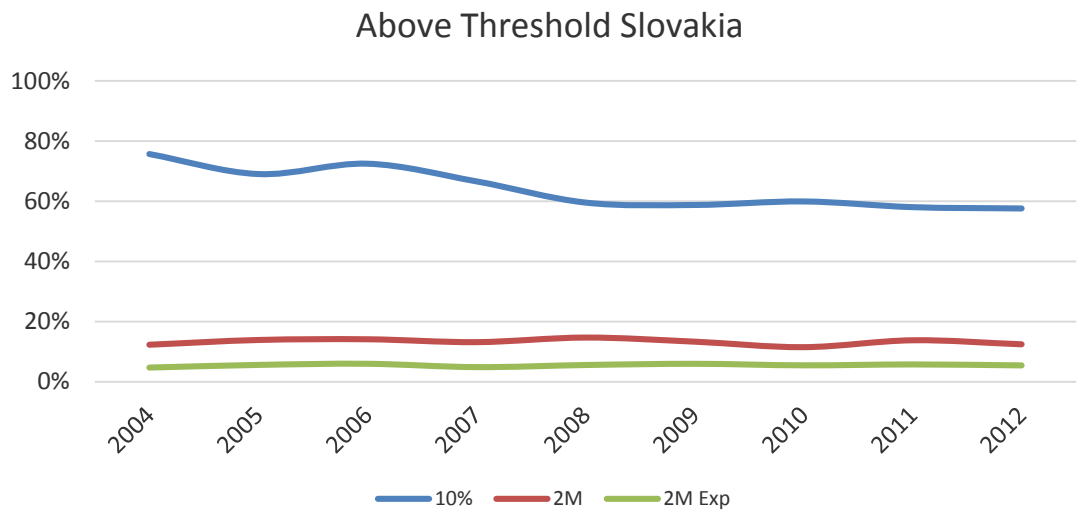


Figure 5-3: Overview Indicators Slovakia (10%, 2M, and 2M Exp), with on X-axis time [Years] and on Y-axis Energy Poverty [%].



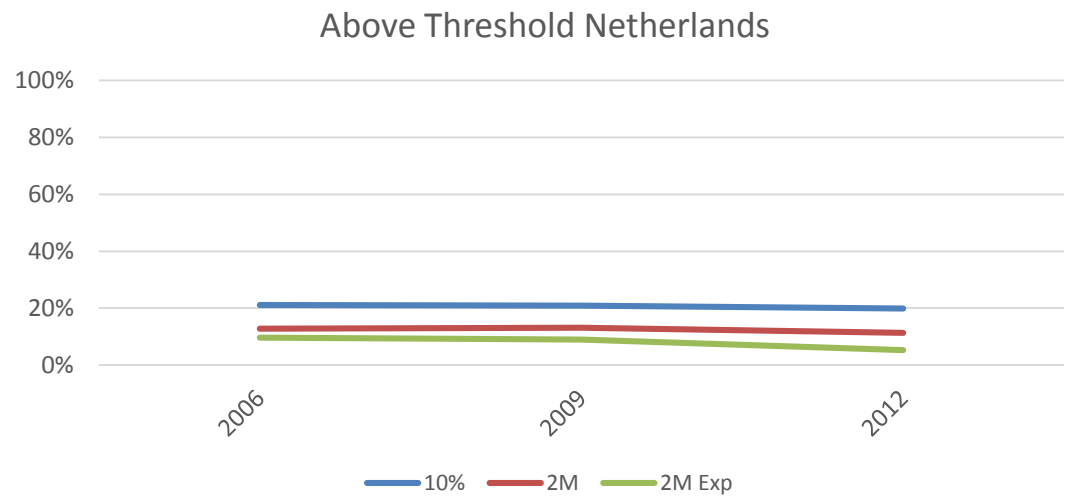


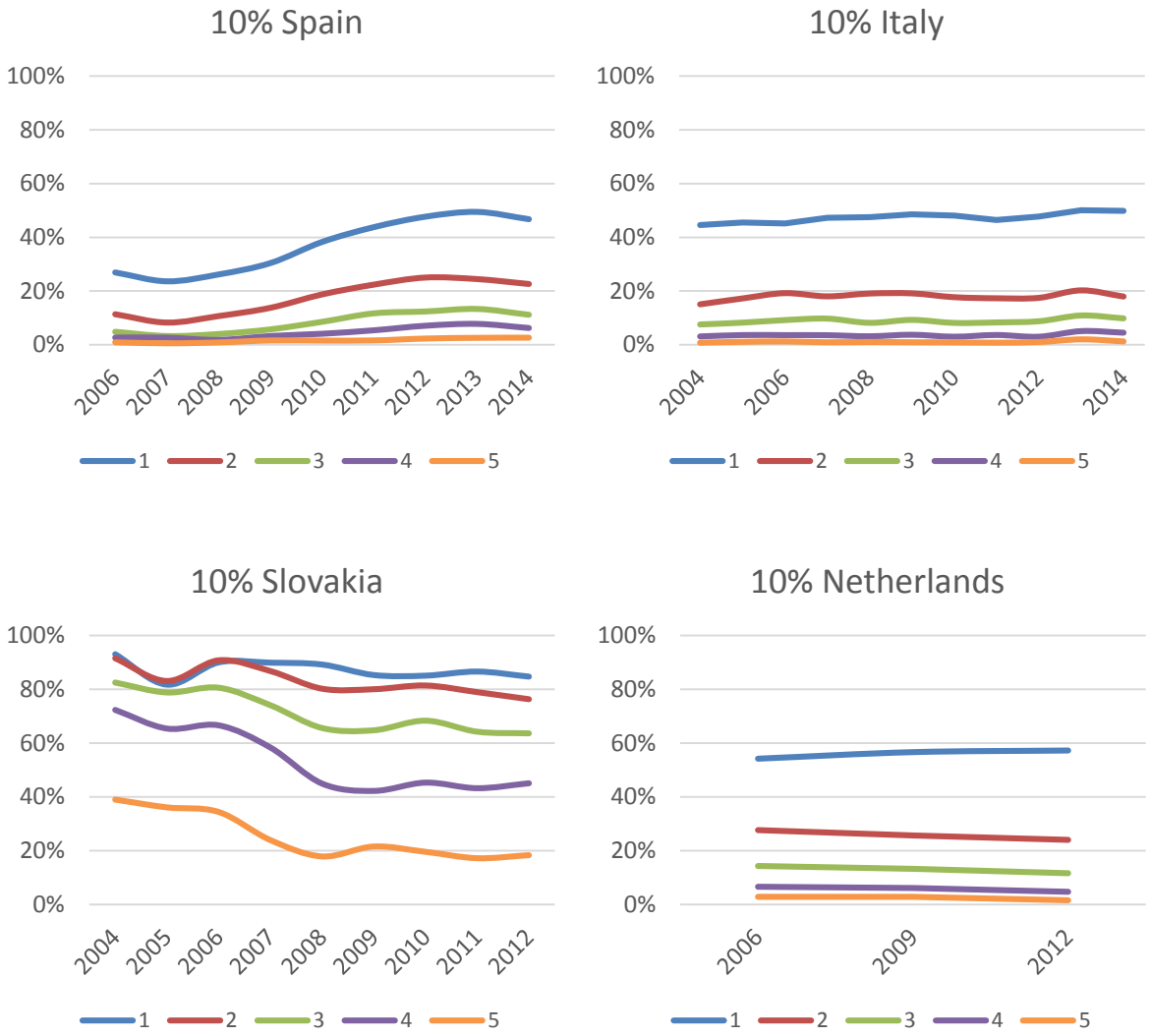
Figure 5-4: Overview Indicators Netherlands (10%, 2M, and 2M Exp), with on X-axis time [Years] and on Y-axis Energy Poverty [%].

5.1.2. Per Income Group

In this section, the energy poverty for the different countries will be highlighted per income group for the 'Above Threshold' measures.

Income group	Percentile in income distribution
1	0-20%
2	>20%-40%
3	>40%-60%
4	>60%-80%
5	>80%-100%

Figure 5-5: Overview '10% Above Threshold' Indicator (Spain, Italy, Slovakia, and the Netherlands), with on X-axis time [Years] and on Y-axis Energy Poverty [%].



Strengths

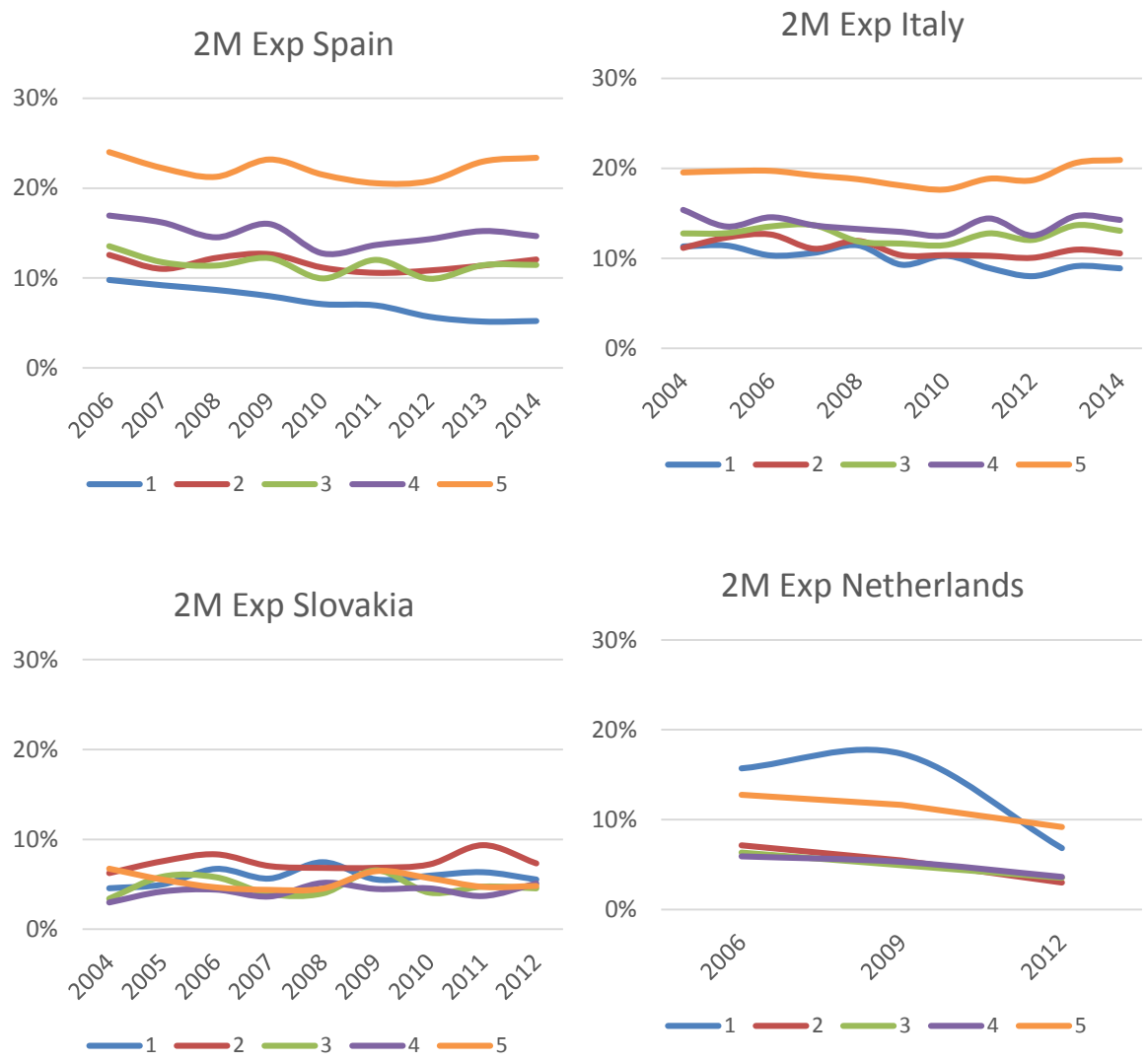
- ✓ Visible change over time;
- ✓ Clear distinction between income groups; and
- ✓ Simple measure and easy to communicate.

Weaknesses

- × Rather high percentage of energy poverty for the highest income groups (e.g. Group 5); and
- × Measure is arbitrary.

Reminder: the 10% metric classifies as energy poor the household that spend more than 10% of its income on energy

Figure 5-6: Overview '2M Exp Above Threshold' Indicator (Spain, Italy, Slovakia, and the Netherlands), with on X-axis time [Years] and on Y-axis Energy Poverty [%].



Strengths

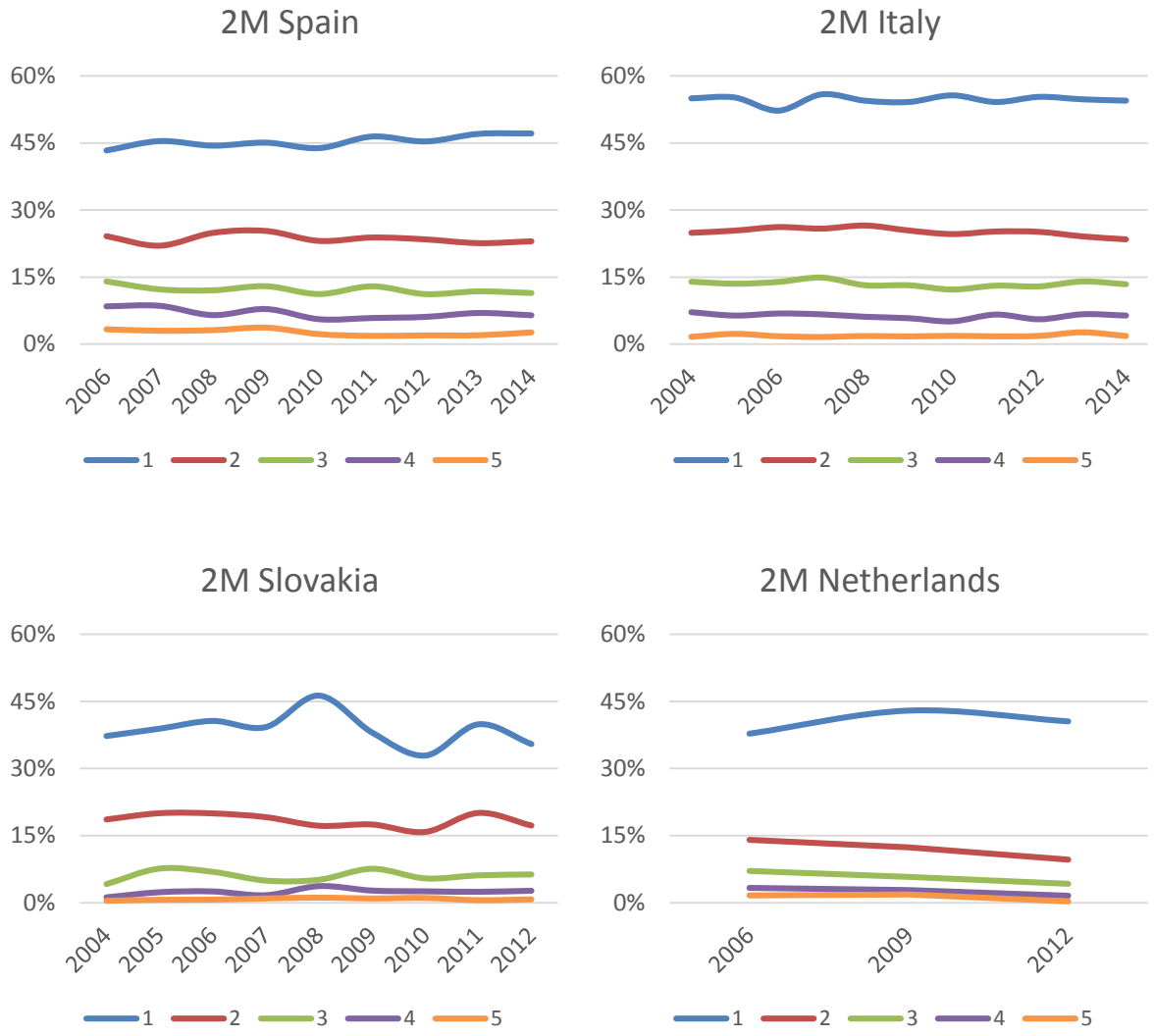
- ✓ This metric gives an indication of those households that spend abnormally high on energy, which may suggest high energy inefficiency of the household.

Weaknesses

- × Looks at the absolute expenses in energy and shows in this regard a higher percentage for the highest income groups, as they have the needs to spend more on energy;
- × Gives a decrease for energy poverty for the lowest income groups and an increase for the highest income groups.

Reminder: the 2M exp metric classifies as energy poor the household that spends more twice the national median equivalised energy expenditure.

Figure 5-7: Overview '2M Above Threshold' Indicator (Spain, Italy, Slovakia, and the Netherlands), with on X-axis time [Years] and on Y-axis Energy Poverty [%].



Strengths

- ✓ Clear distinction between the different income groups;
- ✓ The measure allows for fluctuations; and
- ✓ Possible to recalculate the indicator each year.

Weaknesses

- × It follows a rather straight path; and
- × Sometimes a high energy poverty percentage for the higher income groups.

Reminder: the 2M metric classifies as energy poor the household that spends, as a share of its income, more than twice the median energy expenditure share.

5.1.3. Regressions

Comments and interpretation for the main results can be found in the main report.

Dependent variable: Energy poverty status (0/1)	10%				2M Exp				2M			
	NL	ES	IT	SK	NL	ES	IT	SK	NL	ES	IT	SK
Eq. income	.996***	.997***	.999***	.994***	1.000***	1.000***	1.000**	1.000**	.995***	.997***	.999***	.992***
Social aid	.794***	1.178*	1.000***	1.001***	.631***	.838**	1.000***	1.001***	.689***	1.164**	1.000***	1.002***
Number of people	.337***	.735***	.642***	.750***	.203***	.671***	.429***	.652**	.307***	.736***	.628***	.805
Age of building	1.001***	.677***	-	-	1.005***	.677***	-	-	1.004***	.674***	-	-
Age of main provider	1.002	1.011***	-	-	.999	1.019***	-	-	.997	1.011***	-	-
Number of rooms	1.444***	1.349***	1.514***	-	1.366***	1.466***	1.836***	-	1.446***	1.342***	1.543***	-
Single parent	1.026	1.547**	1.21**	.647***	.637*	1.143	1.093	.929	.881	1.564***	1.108	1.343
Leak	-	-	1.144**	-	-	-	1.169**	-	-	-	1.175**	-
Number of old people	-	-	1.066	1.180*	-	-	1.379***	1.260**	-	-	1.036	1.153
Year	2012	2014	2014	2012	2012	2014	2014	2012	2012	2014	2014	2012
Country	NL	ES	IT	SK	NL	ES	IT	SK	NL	ES	IT	SK
Number of observations	60,191	21,925	19,501	4,704	60,191	21,805	19,501	4,704	60,191	21,925	19,501	4,704

5.2. Minimum Income Standard

5.2.1. Total Population

Figure 5-8: Overview 'Minimum Income Standard Indicators' for Spain (LIHC, MIS Low income, MIS M/2, MIS M/4), with on X-axis time [Years] and on Y-axis Energy Poverty [%].

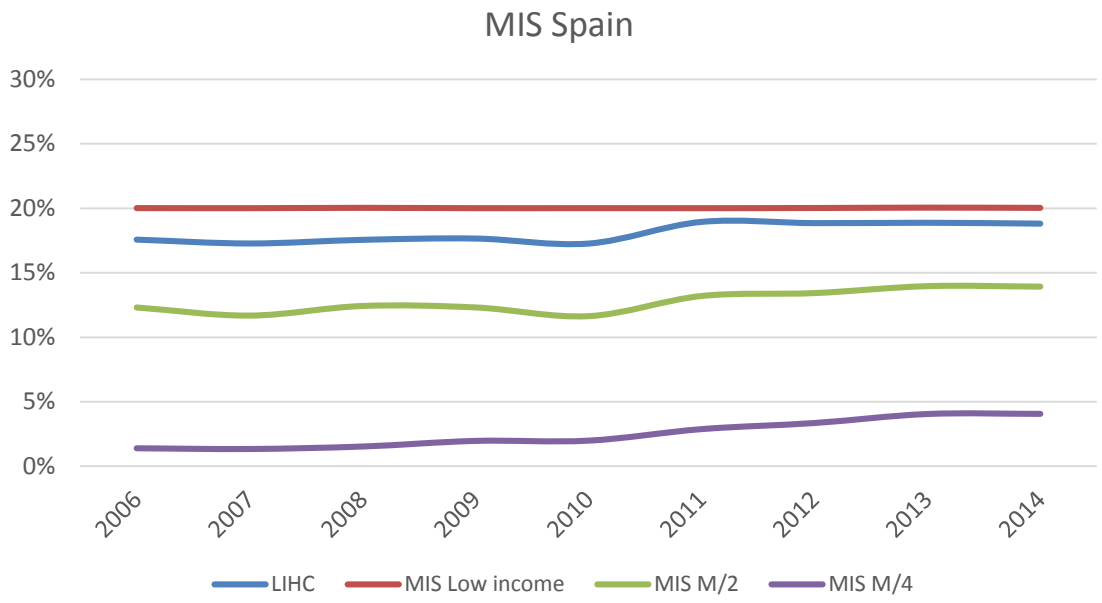


Figure 5-9: Overview 'Minimum Income Standard Indicators' for Italy (LIHC, MIS Low income, MIS M/2, MIS M/4), with on X-axis time [Years] and on Y-axis Energy Poverty [%].

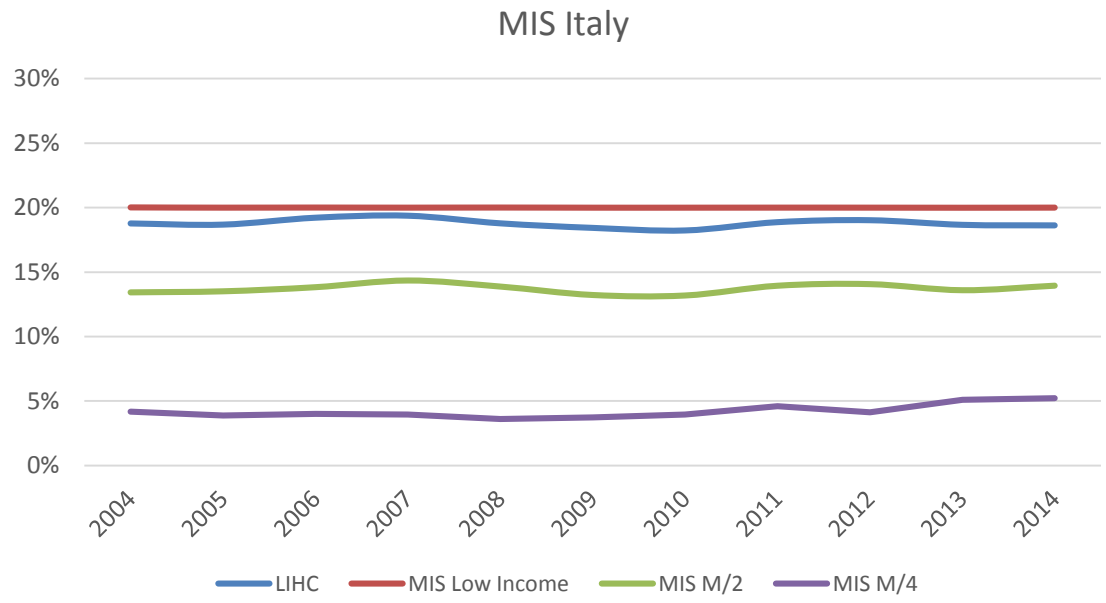


Figure 5-10: Overview 'Minimum Income Standard Indicators' for Slovakia (LIHC, MIS Low income, MIS M/2, MIS M/4), with on X-axis time [Years] and on Y-axis Energy Poverty [%].

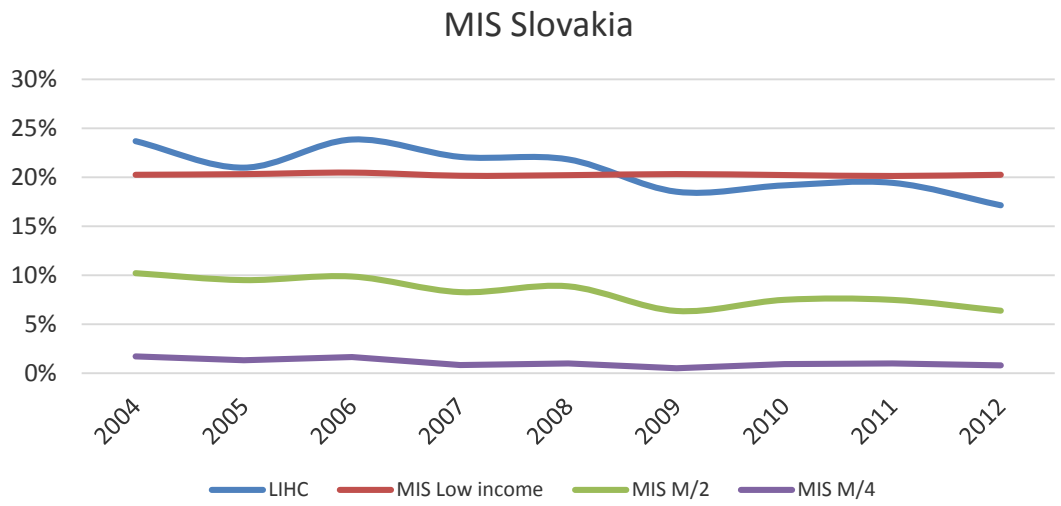
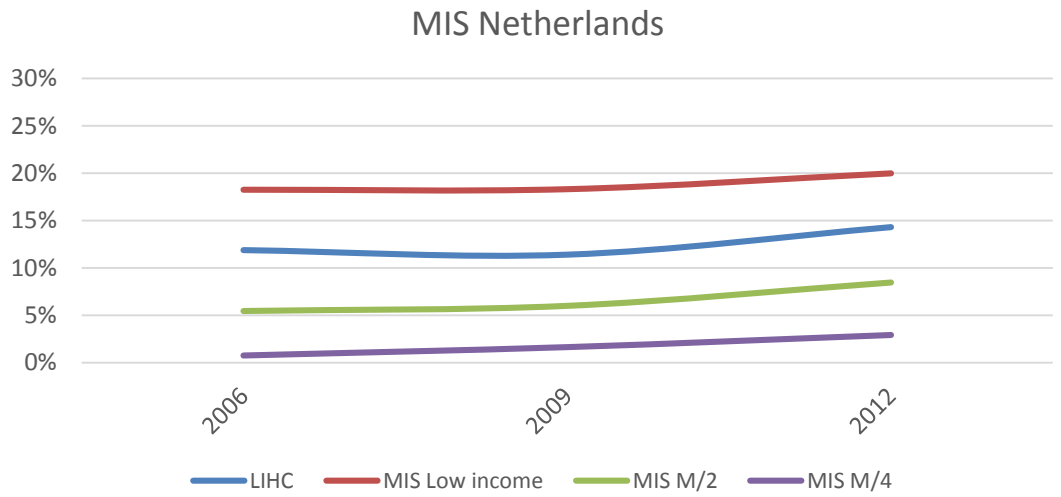


Figure 5-11: Overview 'Minimum Income Standard Indicators' for the Netherlands (LIHC, MIS Low income, MIS M/2, MIS M/4), with on X-axis time [Years] and on Y-axis Energy Poverty [%].

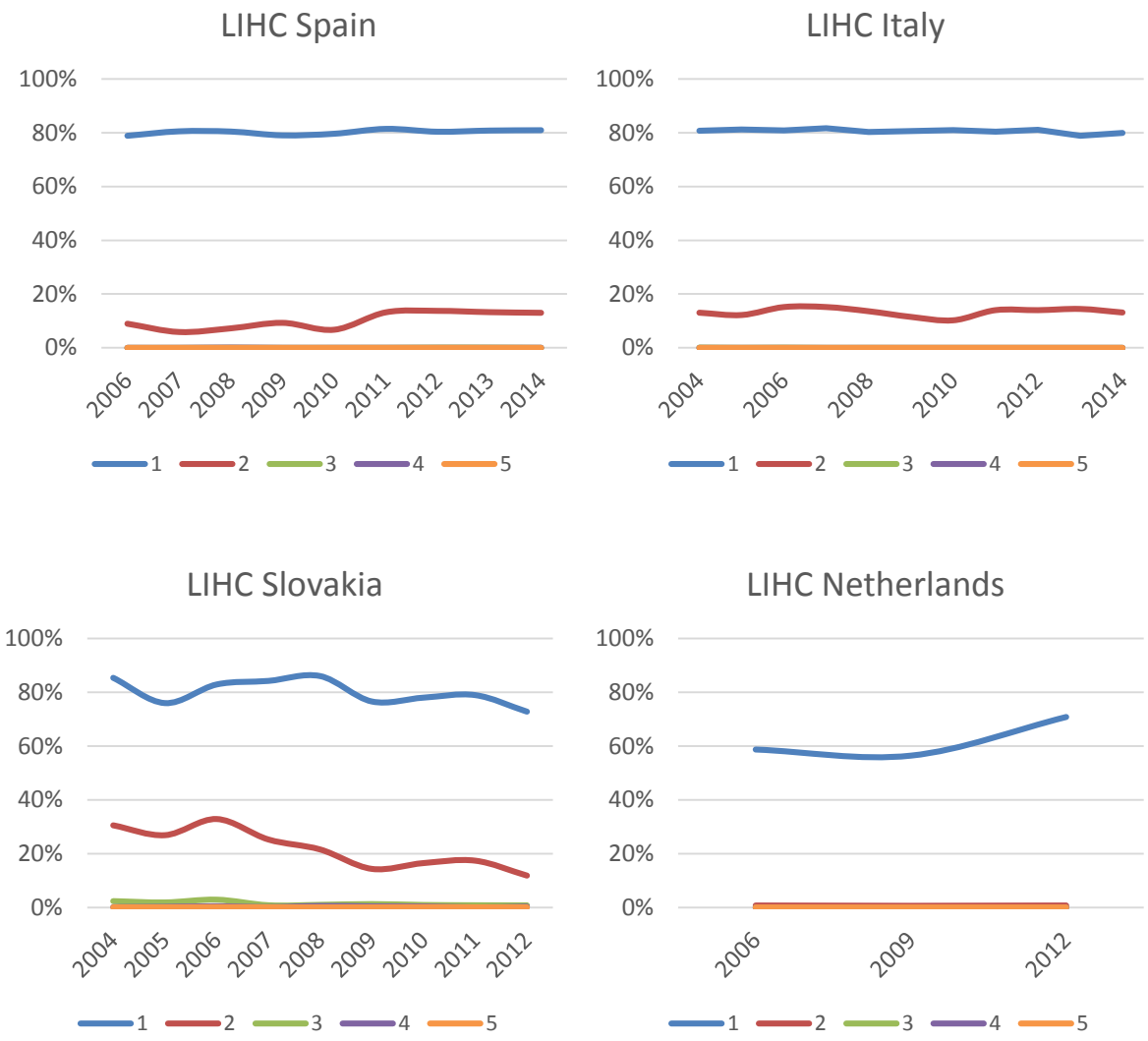


5.2.2. Per Income Group

In this section, the energy poverty for the different countries will be highlighted per income group for the 'Minimum Income Standard' measures.

Income group	Percentile in income distribution
1	0-20%
2	>20%-40%
3	>40%-60%
4	>60%-80%
5	>80%-100%

Figure 5-12: Overview 'LIHC Minimum Income Standard Indicator' (Spain, Italy, Slovakia, and the Netherlands), with on X-axis time [Years] and on Y-axis Energy Poverty [%].



Strengths

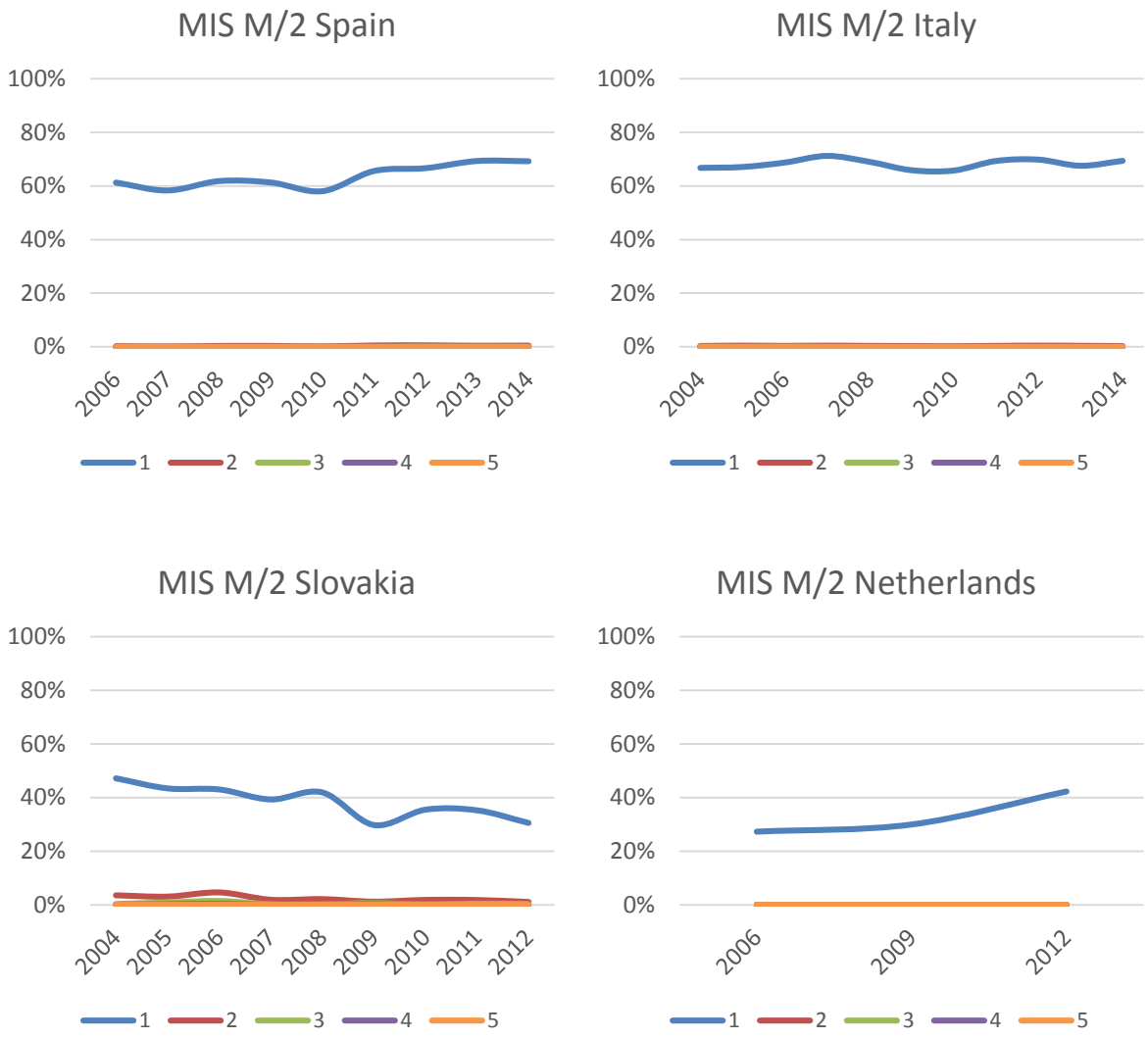
- ✓ Clear distinction between the different income groups;
- ✓ High percentage for the lowest income group and low percentage for the higher income groups; and
- ✓ Helpful measure to distinguish energy poverty from generalized poverty.

Weaknesses

- × Follows a rather straight path over the years.

Reminder: the LIHC metric classifies as energy poor the household that spends, as a share of its income, more than the median energy expenditure share and that has its income after energy costs falling below the poverty threshold (40% of median equivalised disposable income).

Figure 5-13: Overview 'MIS M/2 Minimum Income Standard Indicator' (Spain, Italy, Slovakia, and the Netherlands), with on X-axis time [Years] and on Y-axis Energy Poverty [%].



Strengths

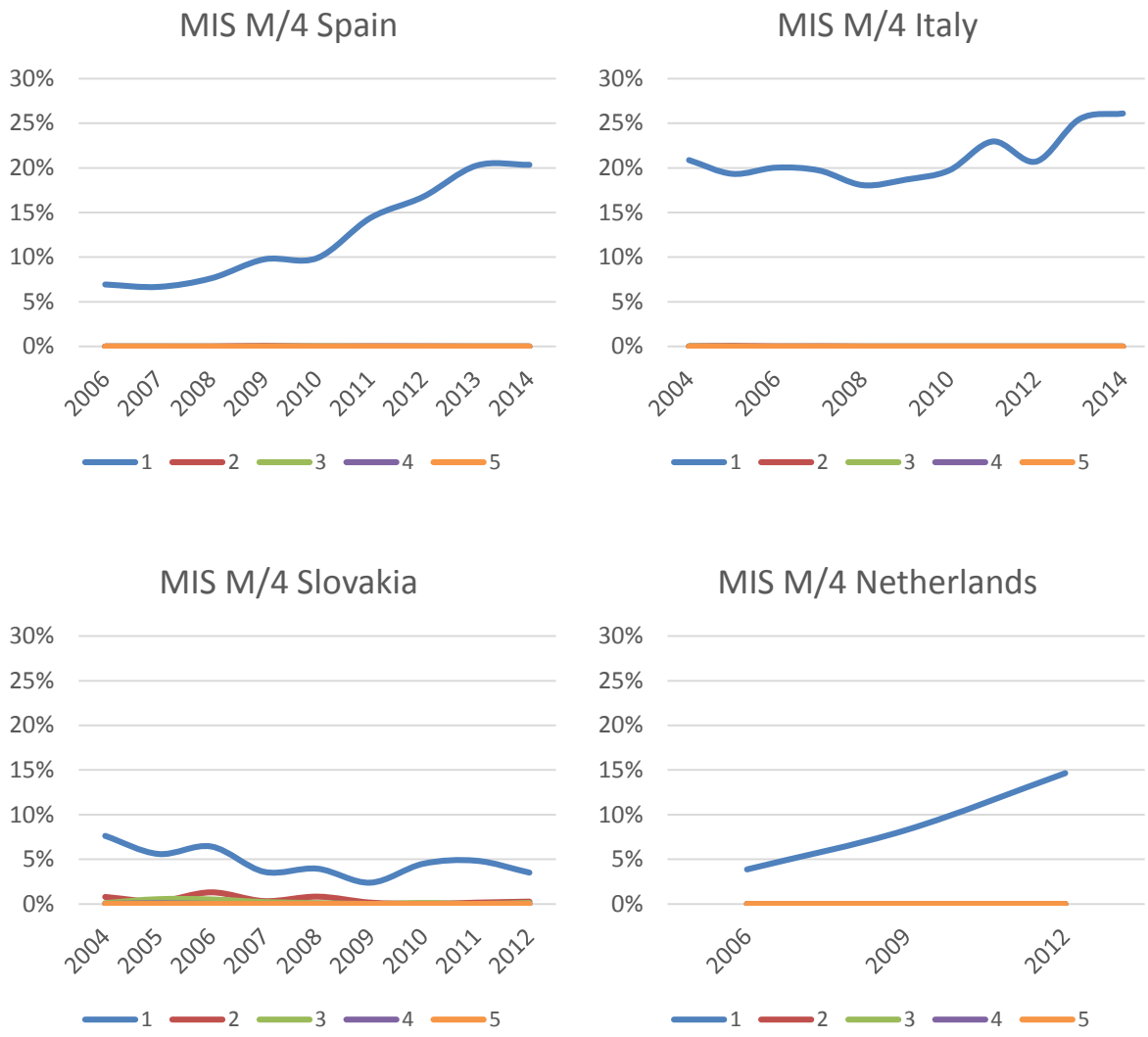
- ✓ MIS is simpler than LIHC;
- ✓ It shows a visible change over time;
- ✓ It gives a clear distinction between the different income groups; and
- ✓ It highlights a good representation of the reality.

Weaknesses

- × Shows a rather straight path for the higher income groups.

Reminder: the MIS M/2 metric classifies as energy poor the household that has its income after energy cost falling below half the median.

Figure 5-14: Overview 'MIS M/4 Minimum Income Standard Indicator' (Spain, Italy, Slovakia, and the Netherlands), with on X-axis time [Years] and on Y-axis Energy Poverty [%].



Strengths

✓ It shows a visible change over time.

Weaknesses

× The energy poverty is rather low for the lowest income group and is in this regard probably not representative for the reality.

Reminder: the MIS M/2 metric classifies as energy poor the household that has its income after energy cost falling below a quarter of the median.

5.2.3. Regressions

Comments and interpretation for the main results can be found in the main report.

Dependent variable: Energy poverty status (0/1)	MIS Low income				MIS M/2				MIS M/4				LIHC			
	NL	ESm	IT	SK	NL	ESm	IT	SK	NL	ESm	ITm	SK	NLm	ES	ITm	SK
Eq. income	.954***	.949***	.996***	.956***	.958***	.952***	.996***	.961***	0.965***	.942***	.996***	.975***	.995***	.987***	.999***	.975***
Social aid	.744***	.899	1.000***	1.001**	.796**	1.131	1.000**	1.003**	0.619**	1.085	1.000	1.000	1.033	.844*	.999	1.00*
Number of people	.437***	.701***	.662***	.892	.469***	.752***	.758**	.768	0.446***	.655***	.629***	1.145	.841***	.934*	.719***	1.012
Age of building	1.006**	.912	-	-	1.005	.637**	-	-	.996	.659	-	-	1.002***	.599***	-	-
Age of main provider	1.005	1.011**	-	-	1.007	1.002	-	-	.997	1.012	-	-	.981***	1.016***	-	-
Number of rooms	1.361***	1.289***	1.436***	-	1.175**	1.303***	1.464***	-	1.077**	1.349***	1.128	-	.992	1.278***	1.202***	-
Single parent	.876	.982	.796	1.585**	.776	.617	1.136	.724	0.844	.325***	.776	4.42***	1.591***	1.386	.915	1.638***
Leak	-	-	1.422*	-	-	-	1.085	-	-	-	.656	-	-	-	1.219***	-
Number of old people	-	-	.951	1.174	-	-	1.118	1.101	-	-	1.294	1.037	-	-	.272***	1.281**
Year	2012	2014	2014	2012	2012	2014	2014	2012	2012	2014	2014	2012	2012	2014	2014	2012
Country	NL	ES	IT	SK	NL	ES	IT	SK	NL	ES	IT	SK	NL	ES	IT	SK
Number of observations	60,191	21,925	19,501	4,704	60,191	21,925	19,501	4,704	60,191	21,925	19,501	4,704	60,191	21,925	19,501	4,704

5.3. Hidden Energy Poverty

5.3.1. Total Population

Figure 5-15: Overview 'Hidden Energy Poverty' Indicators Spain (HEP M/2, HEP M/4, HEP 5 EUR, HEP M/2 Exp, HEP M/4 Exp), with on X-axis time [Years] and on Y-axis Energy Poverty [%].

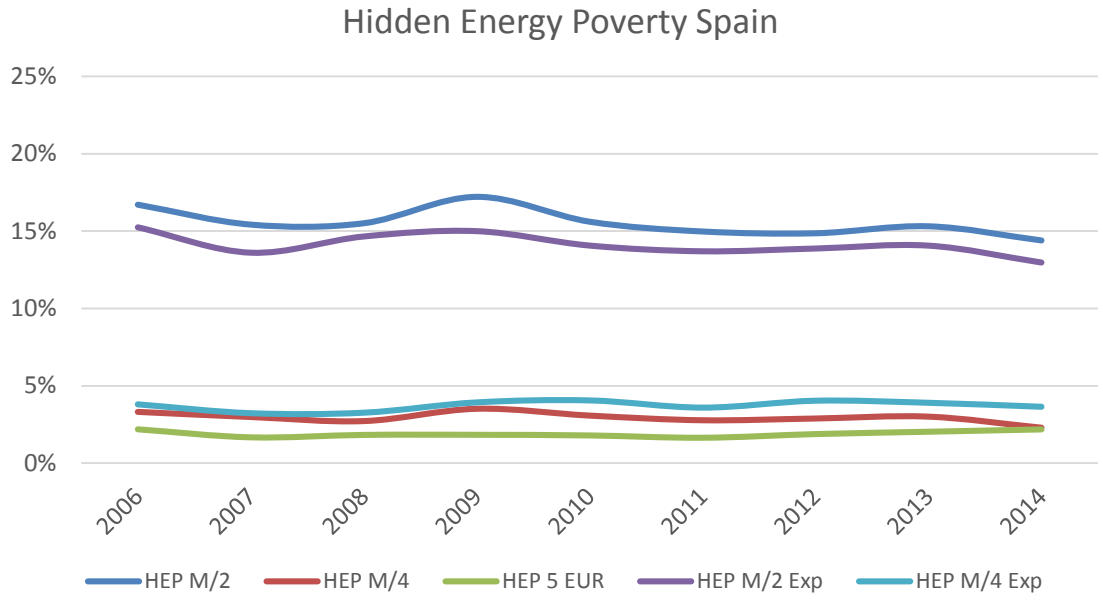


Figure 5-16: Overview 'Hidden Energy Poverty' Indicators Italy (HEP M/2, HEP M/4, HEP 5 EUR, HEP M/2 Exp, HEP M/4 Exp), with on X-axis time [Years] and on Y-axis Energy Poverty [%].

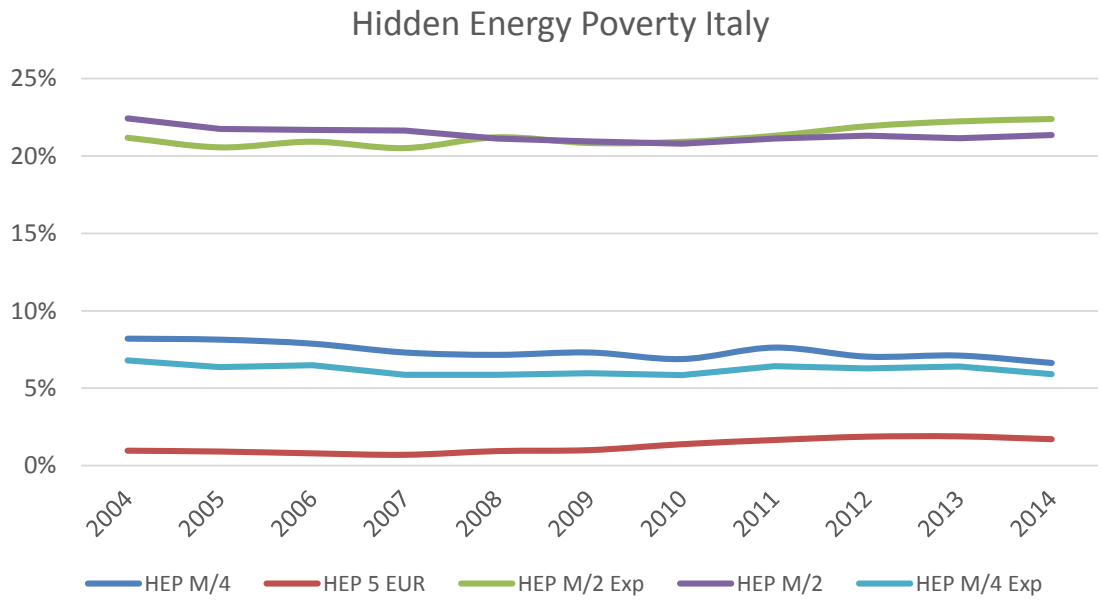


Figure 5-17: Overview 'Hidden Energy Poverty' Indicators Slovakia (HEP M/2, HEP M/4, HEP 5 EUR, HEP M/2 Exp, HEP M/4 Exp), with on X-axis time [Years] and on Y-axis Energy Poverty [%].

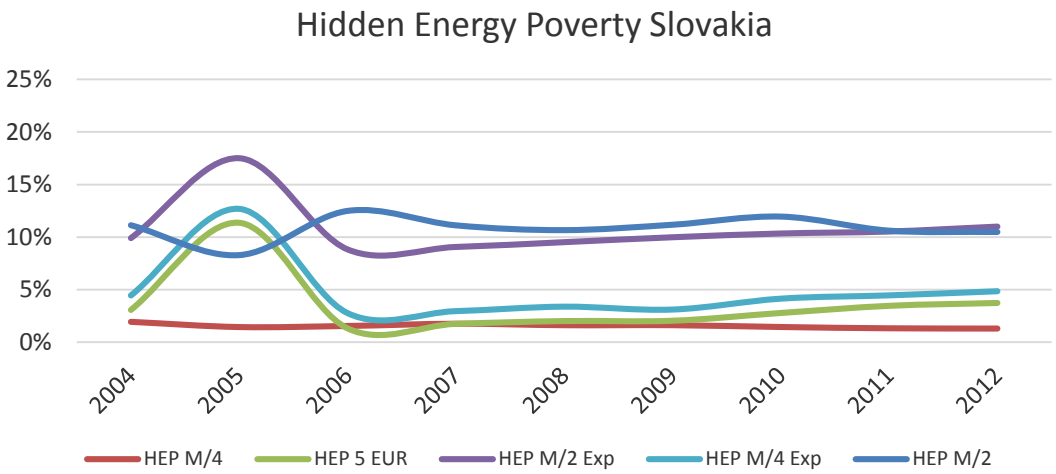
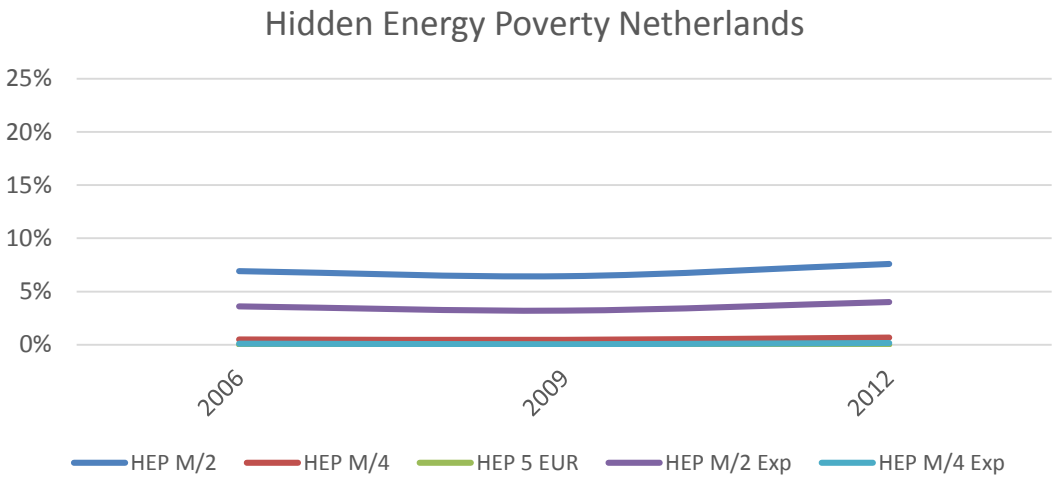


Figure 5-18: Overview 'Hidden Energy Poverty' Indicators the Netherlands (HEP M/2, HEP M/4, HEP 5 EUR, HEP M/2 Exp, HEP M/4 Exp), with on X-axis time [Years] and on Y-axis Energy Poverty [%].

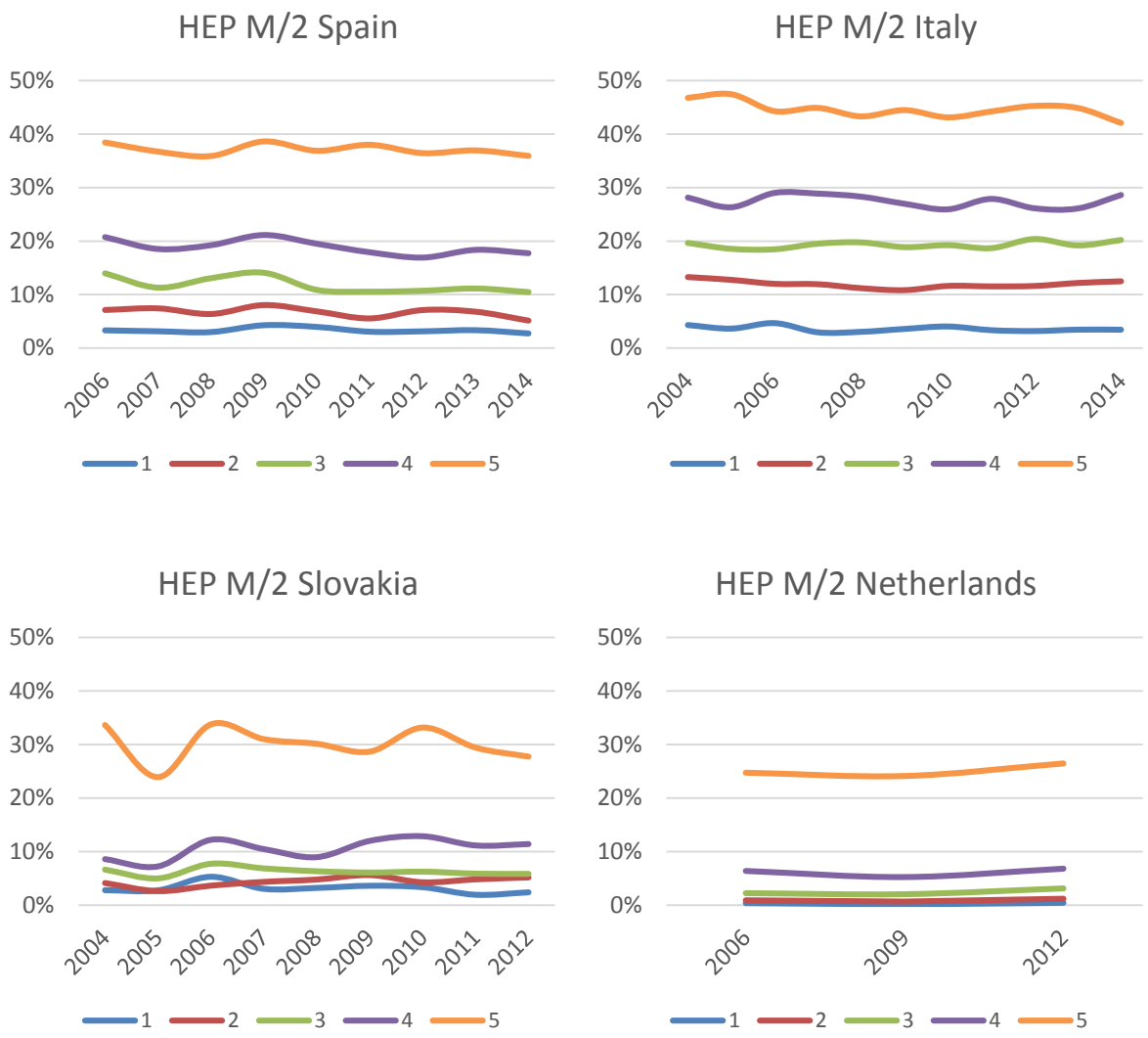


5.3.2. Per Income Group

In this section, the energy poverty for the different countries will be highlighted per income group for the 'Hidden Energy Poverty' measures.

Income group	Percentile in income distribution
1	0-20%
2	>20%-40%
3	>40%-60%
4	>60%-80%
5	>80%-100%

Figure 5-19: Overview 'HEP M/2' Indicator (Spain, Italy, Slovakia, and the Netherlands), with on X-axis time [Years] and on Y-axis Energy Poverty [%].



Strengths

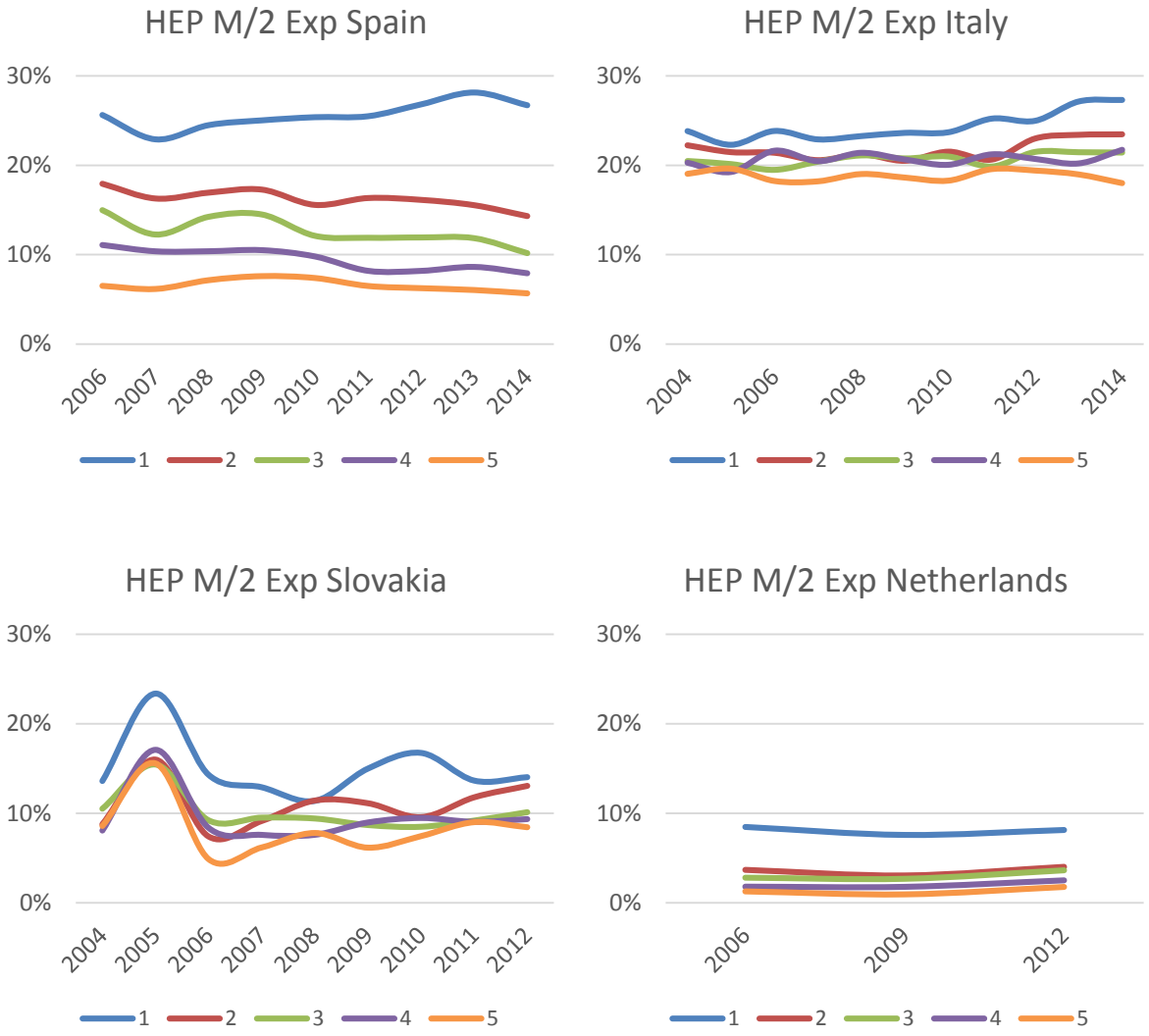
- ✓ There is a clear distinction between the different income groups.

Weaknesses

- × Follows a rather straight line;
- × The highest income group shows the highest energy poverty. In this regard, this measure is not a good representation of the reality.

Reminder: the HEP M/2 metric classifies as energy poor the household that has its share of income spent on energy below half the median share.

Figure 5-20: Overview 'HEP M/2 EXP' Indicator (Spain, Italy, Slovakia, and the Netherlands), with on X-axis time [Years] and on Y-axis Energy Poverty [%].



Strengths

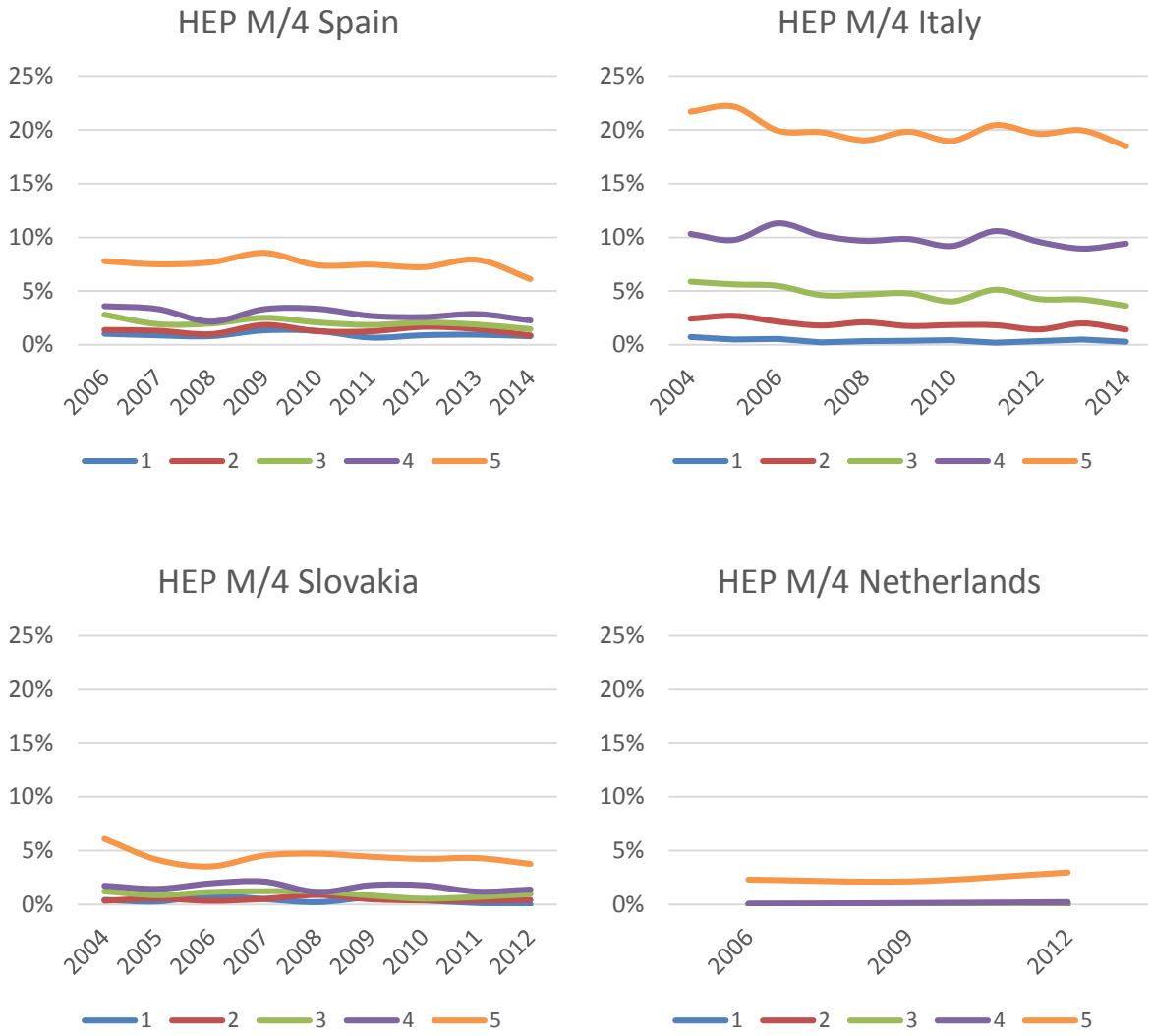
- ✓ It gives a clear distinction between the different income groups;
- ✓ The measure reflects how actual expenditures are not necessarily indicative of needs being met; and
- ✓ It highlights the absolute per capita spending on energy.

Weaknesses

- × The higher income groups also show a rather high percentage of energy poverty.

Reminder: the HEP M/2 Exp metric classifies as energy poor the household that has its equivalised energy expenditure below half the median equivalised energy expenditure.

Figure 5-21: Overview 'HEP M/4' Indicator (Spain, Italy, Slovakia, and the Netherlands), with on X-axis time [Years] and on Y-axis Energy Poverty [%].



Strengths

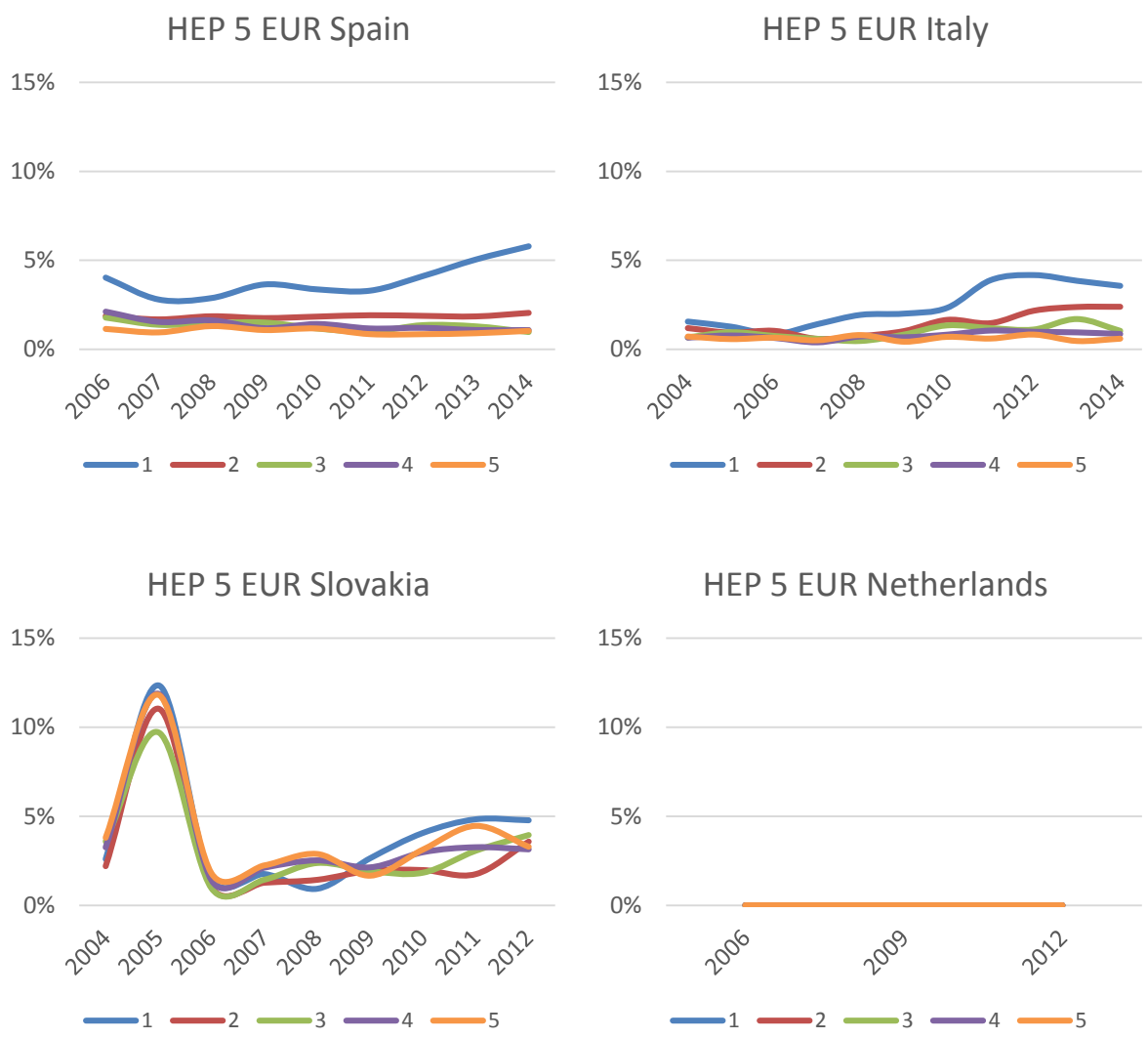
- ✓ Even more than HEP M/2, this metric focuses on households that have abnormally low consumption of energy.

Weaknesses

- × The highest income groups have the highest energy poverty; and
- × The share of energy expenses relative to the disposable income is not representative.

Reminder: the HEP M/4 metric classifies as energy poor the household that has its share of income spent on energy below 25% of the median share.

Figure 5-22: Overview 'HEP 5 EUR' Indicator (Spain, Italy, Slovakia, and the Netherlands), with on X-axis time [Years] and on Y-axis Energy Poverty [%].



Strengths

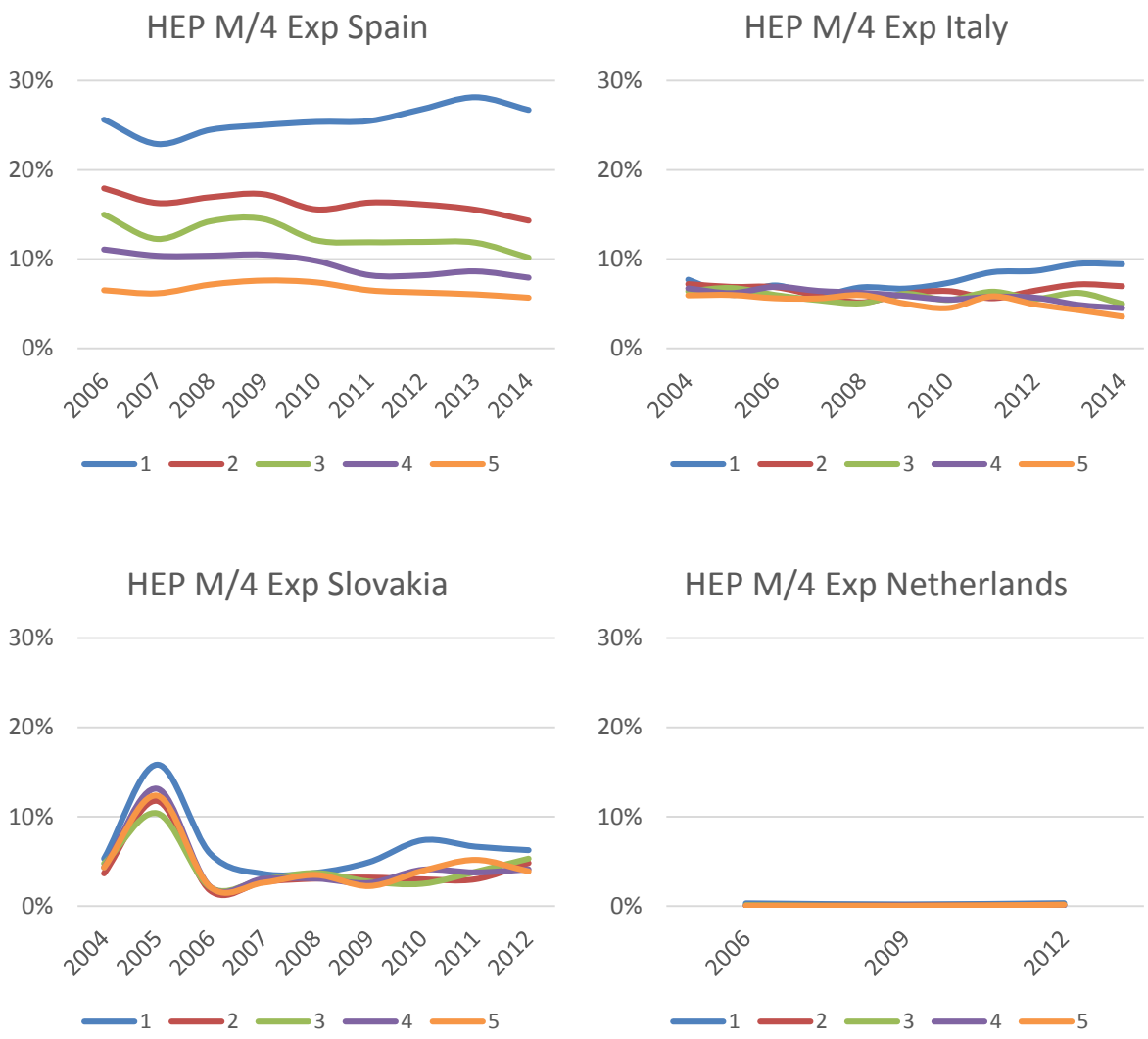
- ✓ Simple and easy to communicate.

Weaknesses

- × It is an arbitrary measure;
- × No clear distinction between the different income groups; and
- × No visible change over time.

Reminder: the HEP 5 euros metric classifies as energy poor the household that has its equivalised energy expenditure below 5 euros.

Figure 5-23: Overview 'HEP M/4 Exp' Indicator (Spain, Italy, Slovakia, and the Netherlands), with on X-axis time [Years] and on Y-axis Energy Poverty [%].



Strengths

✓ Visible change over time.

Weaknesses

× Shows a rather high percentage of energy poverty for the higher income groups.

Reminder: the HEP M/4 Exp metric classifies as energy poor the household that has its equivalised energy expenditure below 25% of the median equivalised energy expenditure.

5.3.3. Regressions

Comments and interpretation for the main results can be found in the main report.

	HEPhalf				HEP25pc				HEPhalfexp				HEPquarterexp				HEP5eur	
	NL	ES	IT	SK	NL	ES	IT	SK	NLm	ES	IT	SK	NLm	ES	IT	SK	IT	SK
Eq. income	1.001***	1.001***	1.000***	1.003***	1.001***	1.001***	1.000***	1.002***	.999***	.999***	.999	.999*	1.000	0.999***	.999***	.999***	.999***	.999**
Social aid	.714***	.910	.999**	.999**	.646*	.865	.999**	.996**	1.279***	1.220***	.999***	.997***	1.354	1.052	.999***	.995***	.999	.995***
Number of people	1.675***	1.250***	1.255***	1.445**	1.555***	1.220***	1.221***	2.331	2.047***	1.162***	1.306***	1.486**	1.796***	.961	1.252***	.763	.940	.405***
Age of building	.996***	1.475***	-	-	1.001	1.515***	-	-	.998	2.007***	-	-	1.006	2.102***	-	-	-	-
Age of main provider	.971***	.983***	-	-	.967***	.972***	-	-	.985***	.983***	-	-	.973**	.961***	-	-	-	-
Number of rooms	.643***	.826***	.709***	-	.766**	.847***	.690***	-	.634***	.791***	.733***	-	.749*	.759***	.714***	-	.810**	-
Single parent	.851	.833	.789***	1.149	.893	1.111	.693***	1.784	1.155	.966	1.150*	3.791***	.966	1.001	1.087**	4.531***	4.144***	3.652***
Leak	-	-	.875**	-	-	-	.929	-	-	-	..906*	-	-	-	.788***	-	.536***	-
Number of old people	-	-	.931**	.932	-	-	.871***	1.669	-	-	.908***	1.101	-	-	.877***	.748	.544***	.539**
Year	2012	2014	2014	2012	2012	2014	2014	2012	2012	2014	2014	2012	2012	2014	2014	2012	2014	2012
Country	NL	ES	IT	SK	NL	ES	IT	SK	NL	ES	IT	SK	NL	ES	IT	SK	IT	SK
Number of observations	60,191	21,925	19,501	4,704	60,191	21,925	19,501	4,704	60,191	21,925	19,501	4,704	60,191	21,925	19,501	4,704	19,501	4,704

5.4. Consensual Based Metrics

5.4.1. Total Population

Figure 5-24: Overview 'Consensual' Indicators Spain (Arrears, Severe Arrears, Warmth), with on X-axis time [Years] and on Y-axis Energy Poverty [%].

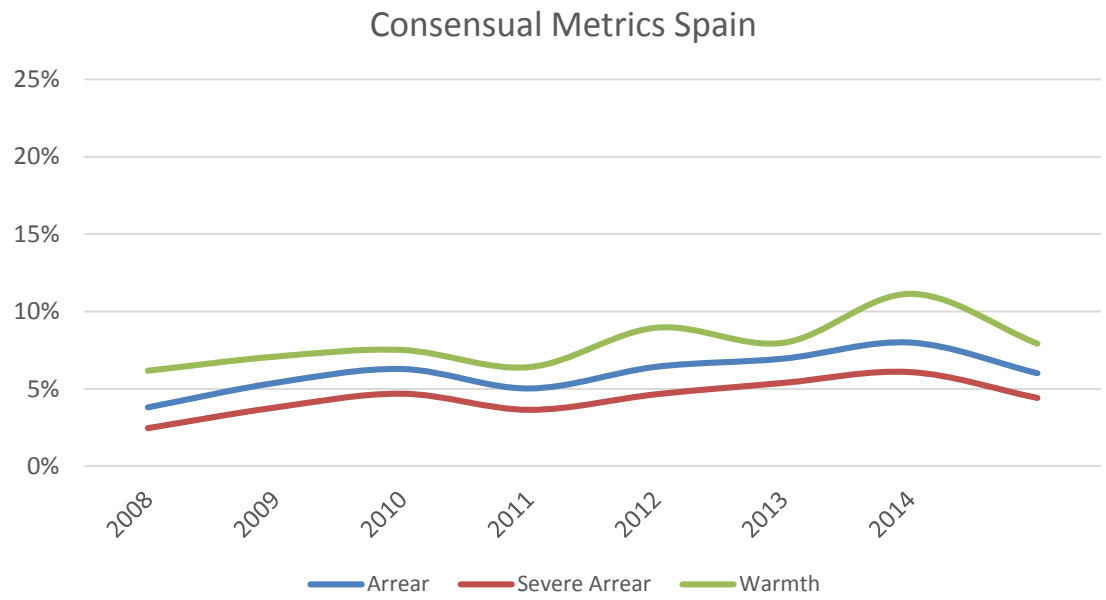


Figure 5-25: Overview 'Consensual' Indicators Italy (Arrears, Severe Arrears, Warmth), with on X-axis time [Years] and on Y-axis Energy Poverty [%].

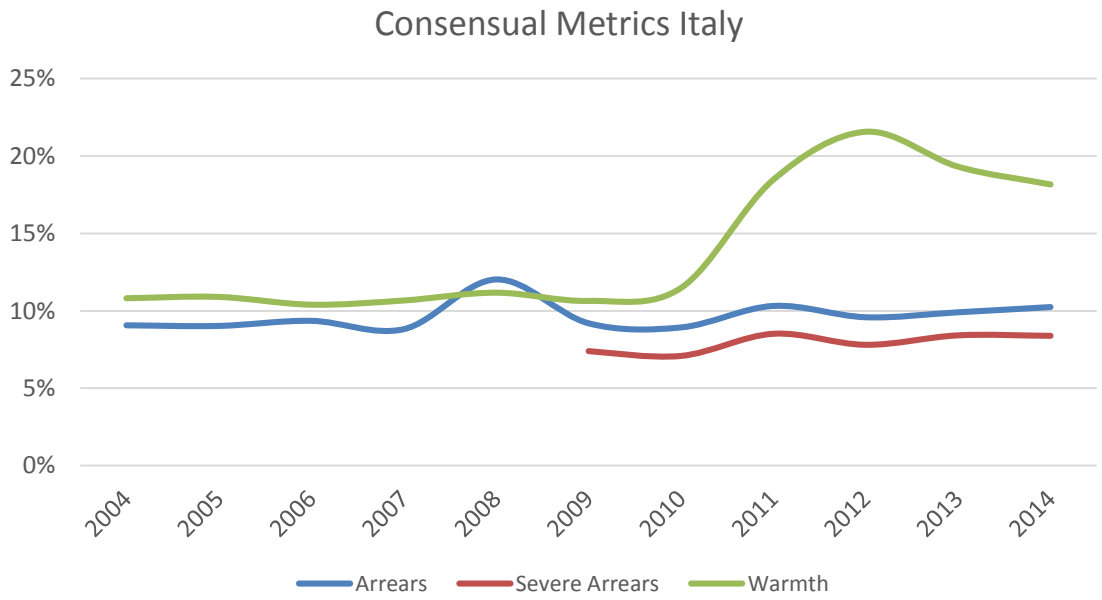


Figure 5-26: Overview 'Consensual' Indicators Slovakia (Arrears, Severe Arrears, Warmth), with on X-axis time [Years] and on Y-axis Energy Poverty [%].

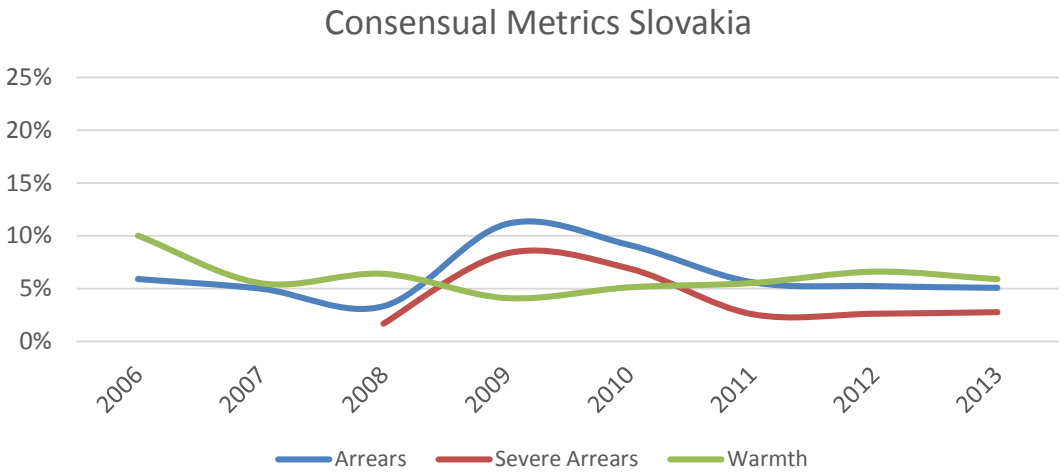
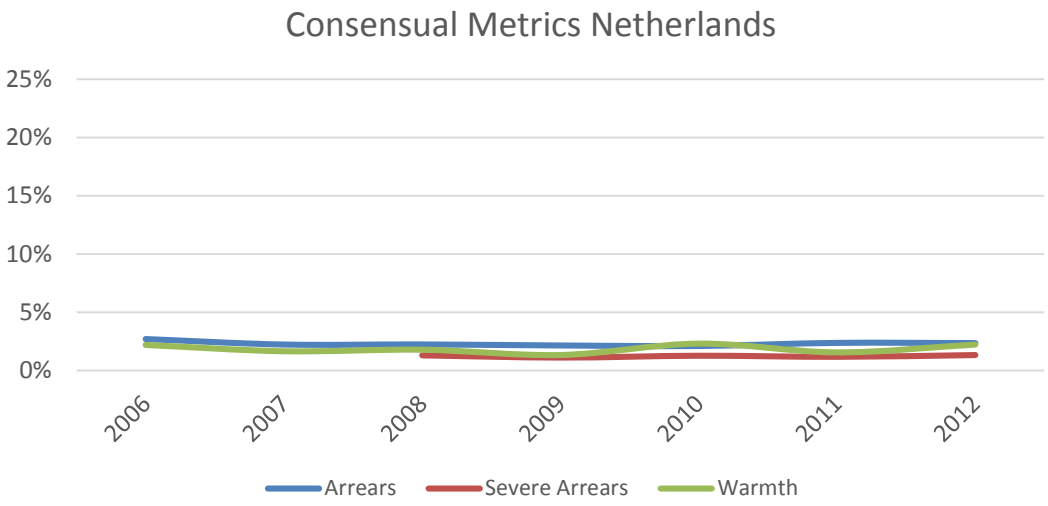


Figure 5-27: Overview 'Consensual' Indicators the Netherlands (Arrears, Severe Arrears, Warmth), with on X-axis time [Years] and on Y-axis Energy Poverty [%].

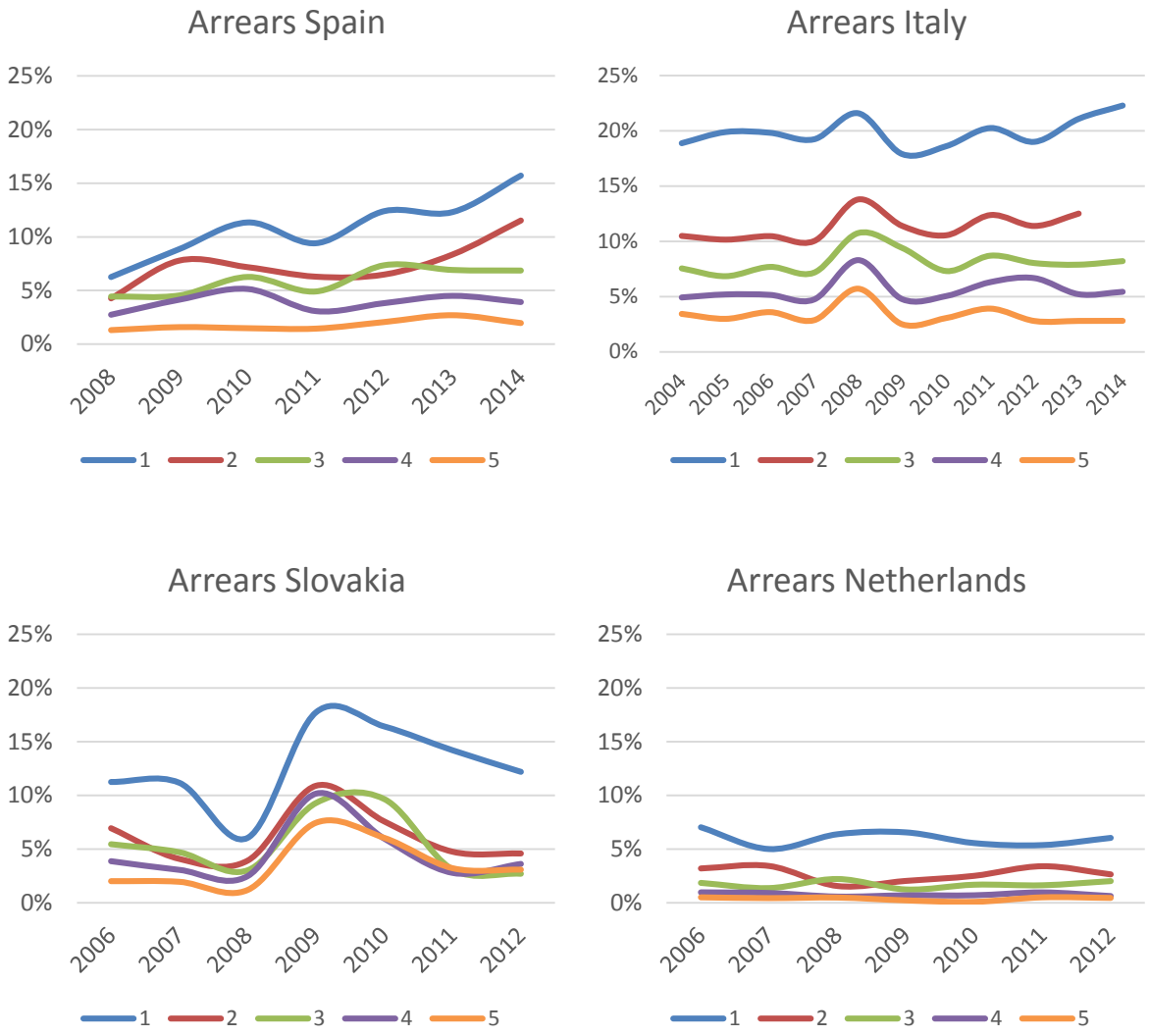


5.4.2. Per Income Group

In this section, the energy poverty for the different countries will be highlighted per income group for the 'Hidden Energy Poverty' measures.

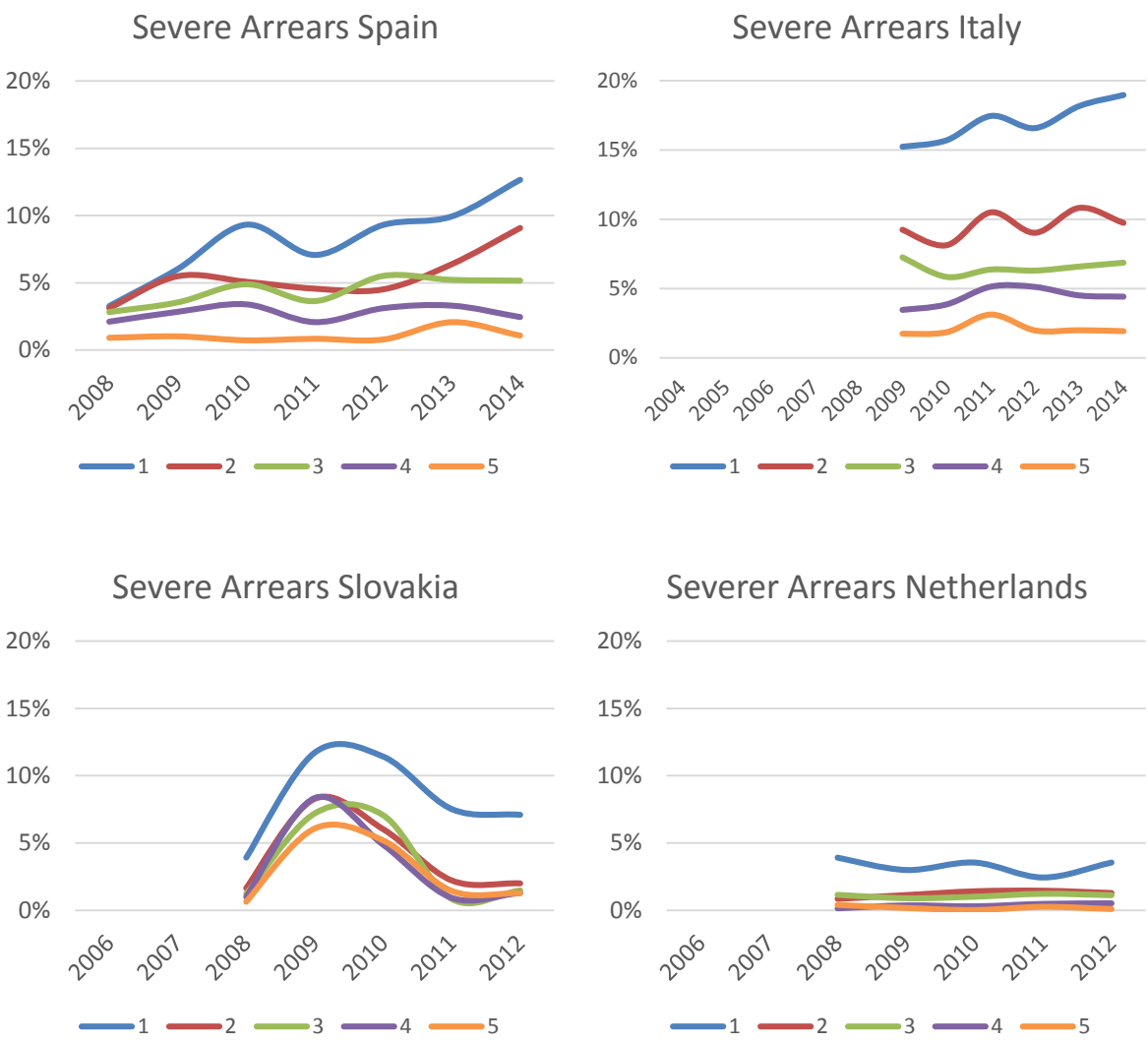
Income group	Percentile in income distribution
1	0-20%
2	>20%-40%
3	>40%-60%
4	>60%-80%
5	>80%-100%

Figure 5-28: Overview 'Arrears' Metrics (Spain, Italy, Slovakia, and the Netherlands), with on X-axis time [Years] and on Y-axis Energy Poverty [%].



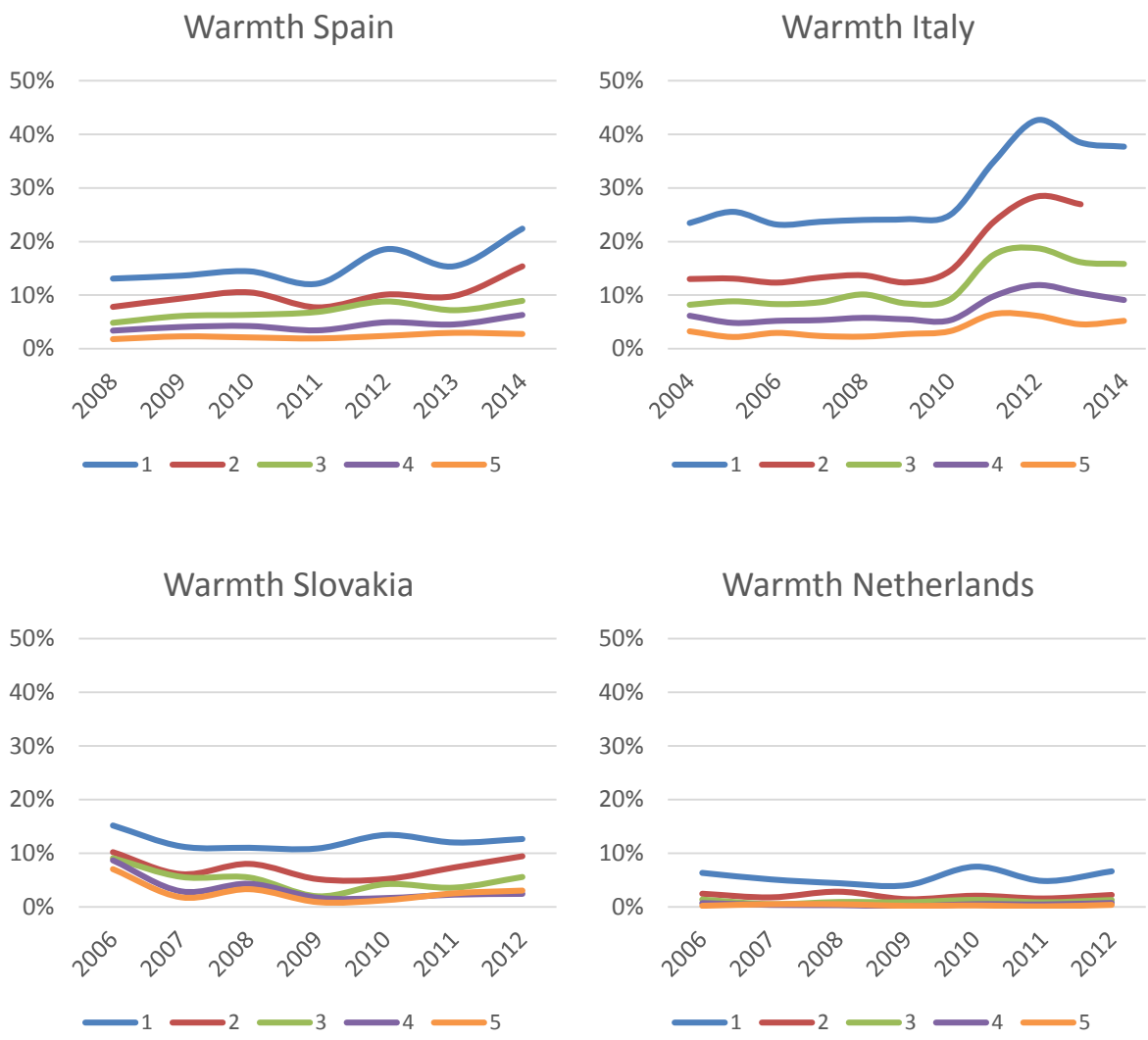
Reminder: the arrears metrics classifies as energy poor the household that declares having had arrears in utility bills at least once in that year.

Figure 5-29: Overview 'Severe Arrears' Metrics (Spain, Italy, Slovakia, and the Netherlands), with on X-axis time [Years] and on Y-axis Energy Poverty [%].



Reminder: the arrears metrics classifies as energy poor the household that declares having had arrears in utility bills more than once in that year.

Figure 5-30: Overview 'Warmth' Metrics (Spain, Italy, Slovakia, and the Netherlands), with on X-axis time [Years] and on Y-axis Energy Poverty [%].



Reminder: the warmth metric classifies as energy poor the household that declares not being able to warm up the house during the cold season.

The main results and interpretations are described in the main report.

Dependent variable: Eq. Energy Expenditure	NL	NL (pseudo panel) FE	NL (pseudo panel) RE	ES	ES (pseudo panel) FE	ES (pseudo panel) RE	IT	IT (pseudo panel) FE	IT (pseudo panel) RE	SK	SK (pseudo panel) FE	SK (pseudo panel RE
Eq. income		-.007**	-.136***	.009***	.010***	0.006***	.003***	.005***	.007***	.013***	.087***	.081***
Social aid		-17.249***	-18.754***	.320	12.603***	27.289***	.001***	-.0	.003**	.000***	.126***	.144***
Number of people		-22.729***	-26.627***	-4.976***	-2.503***	-6.058***	-107.85***	-52.81	-210.01***	-2.739***	195.281	132.400
Age of building		-.914	.0534	-	-	-2.662	-	-	-	-	-	-
Age of main provider		-.763	.188***	.154***	2.339***	.517***	-	-	-	-	-	-
Number of rooms		3.463	8.497***	6.016***	2.552***	5.315***	140.45***	109.18***	113.12***	-	-	-
Single parent		-34.876	-20.563	6.252***	8.050	4.402	120.13***	-78.45	-106.74	-.305	81.193	-130.639
Leak		-	-	-	-	-	81.08***	84.47***	61.33**	-	-	-
Number of old people		-	-	-	-	-	40.29***	-24.02	75.05***	5.126***	174.113	90.667
Energy price		1.694**	1.311***	-	-	-	-	-	-	-	-	-
Country		NL	NL	ES	ES	ES	IT	IT	IT	SK	SK	SK
Number of Observations		491	491	194243	166	166	222144	3096	3096	43683	250	250
Year		2006, 2009 and 2012	2006, 2009 and 2012	2006-2014	2006-2014	2006-2014	2004-2014	2004-2014	2004-2014	2006-2012	2006-2012	2006-2012

Hausman test p-value		0.000		0.000		0.000		0.47176

Dependent variable: Share of energy expenditure	NL	NL (pseudo panel) FE	NL (pseudo panel) RE	ES	ES (pseudo panel) FE	ES (pseudo panel) RE	IT	IT (pseudo panel) FE	IT (pseudo panel) RE	SK	SK (pseudo panel) FE	SK (pseudo panel) RE
Eq. income		-.000***	-.000***	-.000***	-.003***	-.003***	-.0***	-.000***	-.000***	-.000***	-.000*	-.000***
Social aid		-.143***	-.139***	.008***	2.053***	3.099***	.0***	-.0***	-.0**	.000***	.000***	.001***
Number of people		-.051***	-.0636***	-.005***	-.341***	-.676***	-.006***	.473	-2.09*	.001	6.201**	3.759***
Age of building		.0	.0	-	-	-.013	-	-	-	-	-	-
Age of main provider		.017*	.0	.000***	.190***	.035***	-	-	-	-	-	-
Number of rooms		.005	.019**	.005***	.435***	.754***	.007***	1.12***	1.233***	-	-	-
Single parent		-.122	.091	.014***	5.465***	3.811***	.018***	-.919	-2.346	.035***	2.560	1.938
Leak		-	-	-	-	-	.009***	.735	.443	-	-	-
Number of old people		-	-	-	-	-	.002***	-1.163**	-.482	.015***	5.713***	3.094***
Energy Price		-.005	.003***	-	-	-	-	-	-	-	-	-
Country		NL	NL	ES	ES	ES	IT	IT	IT	SK	SK	SK
Number of Observations		491	491	194243	166	166	222144	3096	3096	43683	250	250
Year		2006, 2009 and 2012	2006, 2009 and 2012	2006-2014	2006-2014	2006-2014	2004-2014	2004-2014	2004-2014	2006-2012	2006-2012	2006-2012
Hausman test p-value		0.0898			0.0000			0.0000			0.0577	

	Arrears				Severe Arrears				Warmth			
	NL	ES	IT	SK	NL	ES	IT	SK	NL	ES	IT	SK
Eq. income	.999	.999***	.999***	.999***	.999	.999***	.999***	.999***	.999	.999***	.999***	.999***
Social aid	1.000*	1.000	.999***	1	1.000	1.000	.999***	.999***	1.000**	1.000***	1.000	1.000***
Number of people	4.456***	1.262***	1.302***	1.233***	2.328***	1.264***	1.326***	1.126***	3.287***	1.078	1.033	1.058*
Age of building	-	-	-	-	-	-	-	-	-	-	-	-
Age of main provider	1.001	-	-	-	1.000	-	-	-	.997	-	-	-
Number of rooms	.843	-	.841***	.850***	.918	-	.827***	.861***	.971	-	.957	1.008
Single parent	-	.641**	.924	1.179*	-	.655*	.867	1.131	-	1.163	1.366***	1.802***
Leak	5.597***	1.871***	3.388***	2.388***	2.955***	1.772***	3.379***	2.243***	1.848*	2.152***	2.765***	3.242***
Number of old people	-	.676***	.873***	.921**	-	.686***	.856***	.952	-	.765***	.896***	.998
Year	2012	2014	2014	2014	2012	2014	2014	2014	2012	2014	2014	2014
Country	NL	ES	IT	SK	NL	ES	IT	SK	NL	ES	IT	SK
Number of observations	1196	11927	19501	26666	1088	11927	19501	26666	1167	11927	19501	26666

6. Discussion

Taking into account the information shown previously, it is clear that some indicators are a better representation of the reality compared to others. In this regard, the following sections of the report are based on six different indicators, which are selected after the analysis and evaluation of the previous chapter. This is a first division based on relevance and outcomes of previous analyses and excludes in this regard the indicators that are not found suitable. These are a combination of four main indicators and an additional two as complementary information. The following indicators were analysed:

- ✓ Main indicators (final suggestion)
  - LIHC
  - 2M
  - HEP M/2 Exp
  - Warmth
- ✓ Complementary indicators
  - 10%, 2M Exp
  - HEP M/2, HEP M/4, HEP 5 EUR
  - MIS M/4 Exp, MIS M/2 Exp
  - Arrears

Moreover, to put the indicators and the outcomes in perspective, Table 6-1 is added. It shows what were the median values that were used in order to calculate the thresholds. It is important to make clear how these figures were calculated: the median energy expenditure does not refer to the same household as the median income per month. Both were calculated separately. Moreover, they are calculated in equivalised terms. This explanation is important especially if one wishes to compare these figures with some statistics provided by Eurostat based on Household Budget Surveys. Eurostat provides, for example, data on the mean expenditure of the households in the 3rd quintile (40-60% in the income distribution). Though the values may be close to the ones in table 6-1, they are essentially different, as they are not equivalised and they are not median values. The comparison with income may reveal even more complicated, as different definitions exist for income. We tried to make clear how we define income in this report, enabling further researchers to reproduce our results if needed.

Table 6-1: Overview income and energy expenditure for Spain, Italy, the Netherlands, and Slovakia.

Country	Median Equivalised Energy Expenditure per month	Median Equivalised Income per month
Italy (2014)	€ 60.71	€ 1328.66
Spain (2014)	€ 47.61	€ 948.0
the Netherlands (2012)	€ 103.0	€ 1575.33
Slovakia (2012)	€ 66.34	€ 559.64

6.1. Energy Poverty per Province

6.1.1. Spain

If the data is broken down for the different provinces in Spain, then the province of Castilla la Mancha consistently has the highest percentage of energy poverty, as seen in Table 6-2, Table 6-3, and Table 6-4. However, the exact percentage varies across the different measures, with all measure in Table 6-2 and Table 6-3 providing higher values, and the measure in Table 6-4 providing more conservative estimates. In contrast, the province of Ceuta, while having among the lowest levels of energy poverty for the measures in Table 6-3, is among the highest rates according to the measures in Table 6-4. Overall, a much greater proportion of households in Spain suffer from expenditure-based energy poverty than consensual-based.

Following the data from the different provinces in Spain, all information analysed is combined in several maps. These maps, Figure 6-1 and Figure 6-2, highlight the different indicators that are selected after the analysis in Section 5.3.3. ‘Energy poverty per income group’.

Table 6-2: Overview Indicators (10%, 2M, 2M Exp) divided by provinces.

2014	Total households	% of households in 10%	% of households in 2M	% of households in 2M Exp	% of households with arrears	% of households with more than one arrear	% of households unable to keep homes warm
Andalucía	3,163,626	19%	19%	6%	11%	9%	16%
Aragón	539,641	22%	23%	23%	5%	4%	5%
Asturias	460,055	15%	15%	14%	6%	3%	14%
Baleares	443,347	16%	16%	13%	13%	9%	7%
Canarias	811,499	10%	10%	1%	12%	8%	0%
Cantabria	239,494	18%	18%	13%	4%	4%	8%
Castilla La Mancha	784,979	39%	40%	26%	8%	8%	14%
Castilla y León	1,030,708	26%	26%	25%	2%	2%	6%
Cataluña	2,944,454	17%	17%	16%	8%	5%	9%
Ceuta	25,481	3%	3%	0%	26%	26%	11%
Comunidad Valenciana	2,003,765	14%	14%	9%	12%	9%	18%
Extremadura	431,562	24%	24%	14%	4%	3%	8%
Galicia	1,076,582	20%	20%	14%	7%	4%	16%
La Rioja	129,101	24%	24%	24%	6%	3%	9%
Madrid	2,515,290	15%	15%	18%	6%	5%	8%
Melilla	25,342	10%	10%	3%	11%	8%	14%
Murcia	532,303	21%	21%	7%	11%	9%	18%
Navarra	251,888	20%	20%	22%	4%	3%	1%
País Vasco	894,060	10%	10%	13%	3%	3%	7%
Spain	***18,303,177***	**18%**	**18%**	**13%**	**8%**	**6%**	**11%**

Table 6-3: Overview Indicators (LIHC, MIS Low income, MIS M/2, MIS M/4) divided by provinces.

2014	Total households	% of households in MIS Low income	% of households in MIS M/2	% of households in MIS M/4	% of households in LIHC	% of households with arrears	% of households with more than one arrear	% of households unable to keep homes warm
Andalucía	3,163,626	29%	21%	7%	27%	11%	9%	16%
Aragón	539,641	13%	10%	3%	14%	5%	4%	5%
Asturias	460,055	15%	11%	2%	13%	6%	3%	14%
Baleares	443,347	16%	10%	3%	15%	13%	9%	7%
Canarias	811,499	31%	22%	5%	22%	12%	8%	0%
Cantabria	239,494	20%	13%	3%	20%	4%	4%	8%
Castilla La Mancha	784,979	31%	21%	5%	31%	8%	8%	14%
Castilla y León	1,030,708	17%	11%	3%	18%	2%	2%	6%
Cataluña	2,944,454	16%	11%	2%	15%	8%	5%	9%
Ceuta	25,481	31%	27%	7%	19%	26%	26%	11%
Comunidad Valenciana	2,003,765	21%	15%	5%	19%	12%	9%	18%
Extremadura	431,562	29%	19%	5%	27%	4%	3%	8%
Galicia	1,076,582	18%	12%	4%	16%	7%	4%	16%
La Rioja	129,101	14%	9%	3%	15%	6%	3%	9%
Madrid	2,515,290	13%	9%	2%	14%	6%	5%	8%
Melilla	25,342	31%	21%	9%	24%	11%	8%	14%
Murcia	532,303	30%	20%	8%	28%	11%	9%	18%
Navarra	251,888	12%	8%	2%	13%	4%	3%	1%
País Vasco	894,060	7%	4%	1%	8%	3%	3%	7%
Spain	***18,303,177***	**20%**	**14%**	**4%**	**19%**	**8%**	**6%**	**11%**

Table 6-4: Overview Indicators (HEP M/2, HEP M/2 Exp, HEP M/4, HEP 5 EUR, HEP M/4 Exp) divided by provinces.

2014	Total households	% of households in HEP M/2	% of households in HEP M/4	% of the households in HEP 5 EUR	% of the housholds in HEP M/2 Exp	% of households in HEP M/4 Exp	% of households with arrears	% of households with more than one arrear	% of households unable to keep homes warm
Andalucía	3,163,626	15%	3%	3%	18%	4%	11%	9%	16%
Aragón	539,641	11%	2%	2%	8%	3%	5%	4%	5%
Asturias	460,055	13%	1%	3%	9%	3%	6%	3%	14%
Baleares	443,347	16%	3%	3%	13%	4%	13%	9%	7%
Canarias	811,499	27%	6%	7%	37%	11%	12%	8%	0%
Cantabria	239,494	12%	1%	1%	7%	2%	4%	4%	8%
Castilla La Mancha	784,979	6%	1%	2%	8%	3%	8%	8%	14%
Castilla y León	1,030,708	10%	2%	2%	7%	3%	2%	2%	6%
Cataluña	2,944,454	14%	2%	2%	10%	3%	8%	5%	9%
Ceuta	25,481	35%	9%	9%	44%	16%	26%	26%	11%
Comunidad Valenciana	2,003,765	15%	2%	2%	17%	4%	12%	9%	18%
Extremadura	431,562	11%	1%	2%	16%	4%	4%	3%	8%
Galicia	1,076,582	13%	2%	2%	14%	4%	7%	4%	16%
La Rioja	129,101	10%	2%	1%	6%	2%	6%	3%	9%
Madrid	2,515,290	16%	2%	2%	7%	3%	6%	5%	8%
Melilla	25,342	25%	1%	2%	18%	3%	11%	8%	14%
Murcia	532,303	12%	2%	3%	15%	4%	11%	9%	18%
Navarra	251,888	9%	2%	1%	5%	1%	4%	3%	1%
País Vasco	894,060	17%	2%	1%	8%	2%	3%	3%	7%
Spain	***18,303,177***	**14%**	***13%***	***4%***	***2%***	***2%***	**8%**	**6%**	**11%**

Figure 6-1: Overview selected indicators (2M = EPM2, 10% = EP10pc, MIS M/2 = MIShalf) for the provinces in Spain.

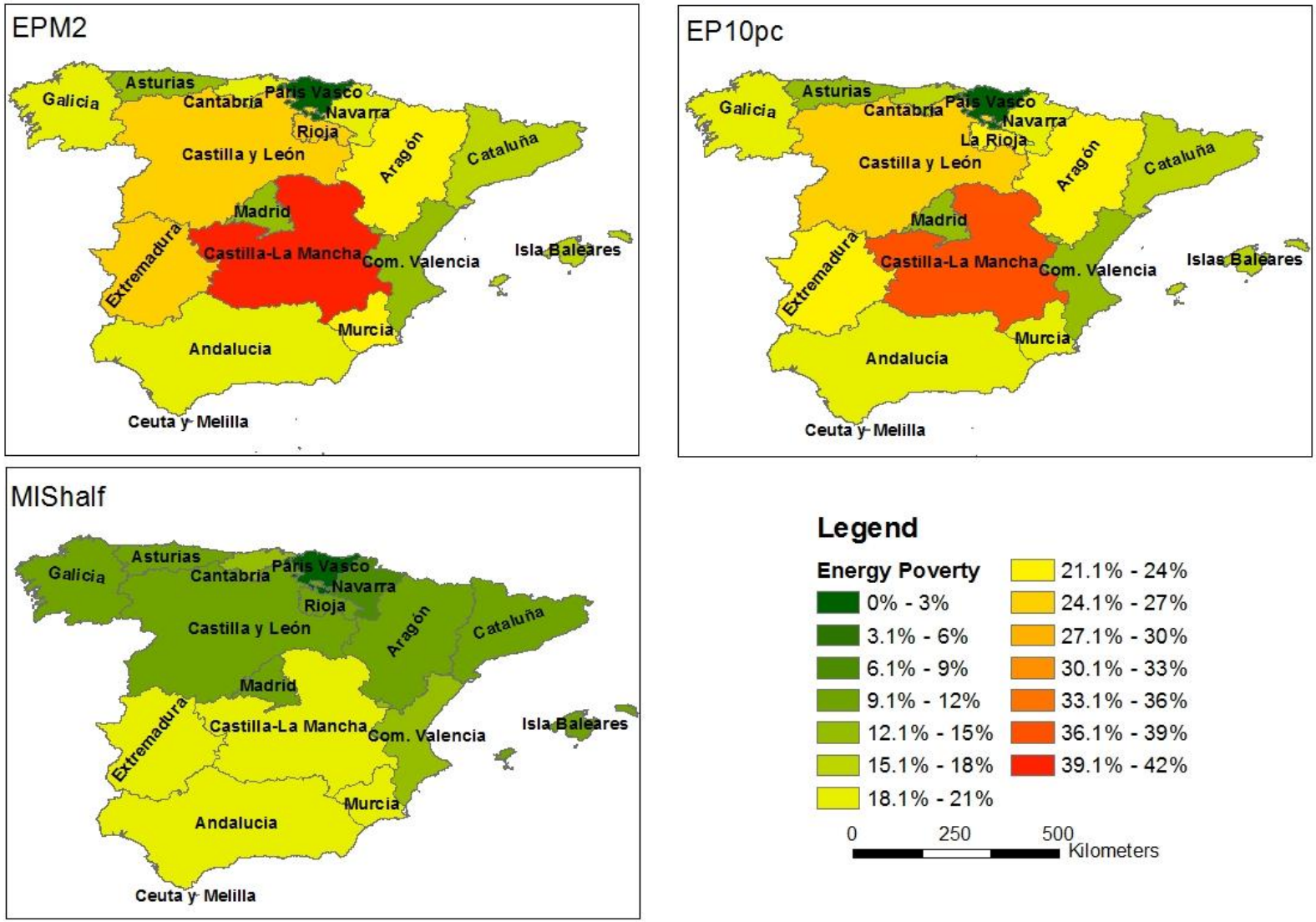
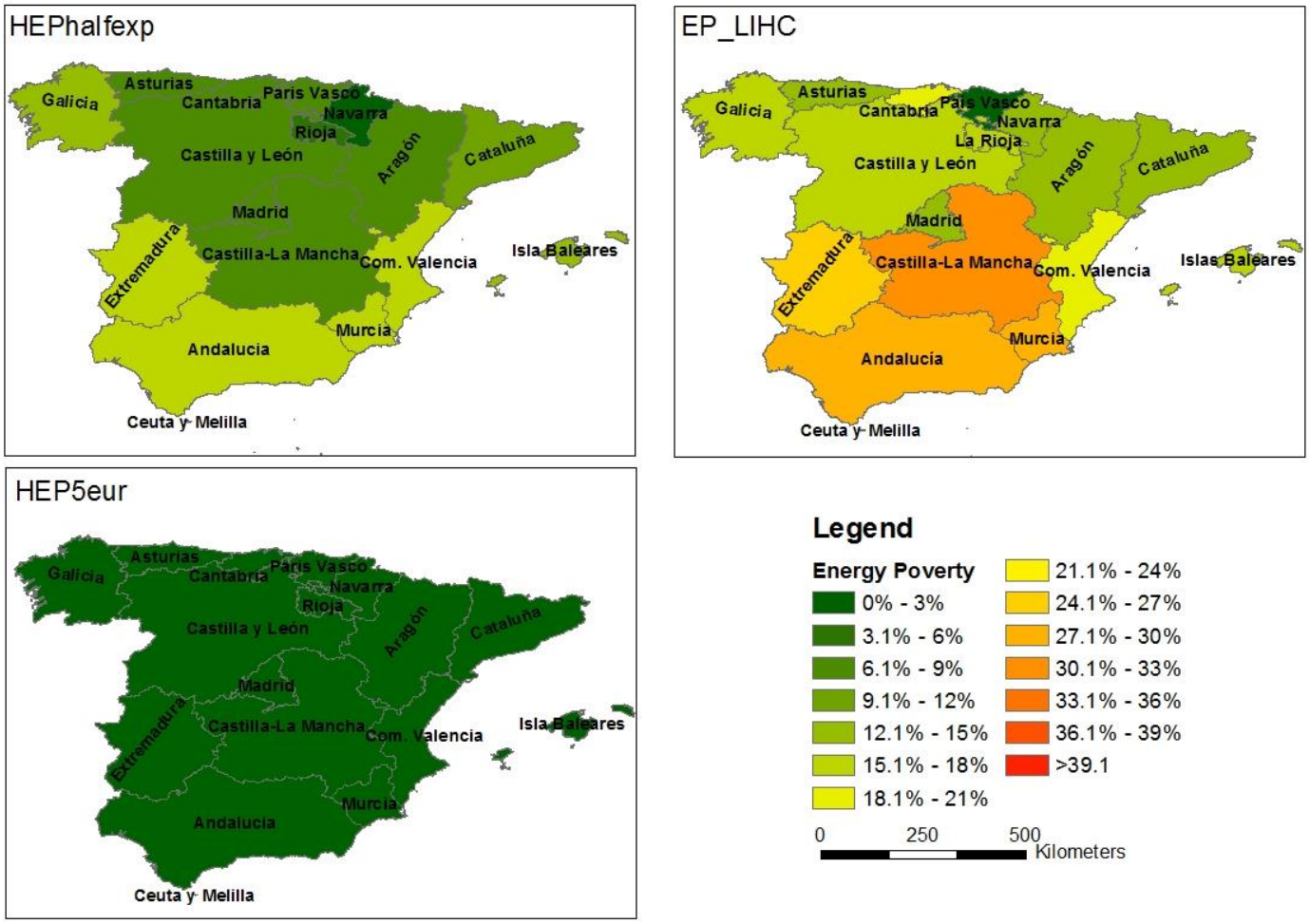


Figure 6-2: Overview selected indicators (HEP M/2 Exp = HEPhalfexp, LIHC = EP_LIHC, HEP 5 EUR = HEP5eur) for the provinces in Spain.



6.1.2. Italy

Following the results of Spain, an overview of Italy is shown in this section. It highlights the different indicators per province in the different tables and they are visualised in the maps of Figure 6-3 and Figure 6-4. Contrary to the results of Spain, there is no consistency in the outcomes of Italy. For example, in Table 6-5 2M shows the highest energy poverty for the province of Basilicata, whereas Sicilia shows the highest energy poverty in Table 6-6. Lastly, in Table 6-7 Liguria is the province with the highest energy poverty under the different indicators.

Table 6-5: Overview Indicators (10%, 2M, 2M Exp) divided by provinces.

2014	Total households	% of households in 10%	% of households in 2M	% of households in 2M Exp	% of households with arrears	% of households with more than one arrear	% of households unable to keep homes warm
Abruzzo	558,158	20%	25%	12%	8%	8%	16%
Basilicata	232,534	27%	31%	9%	6%	5%	23%
Bozen-Bolzano	212,424	8%	9%	14%	1%	1%	3%
Calabria	794,198	19%	22%	3%	19%	16%	26%
Campania	2,148,860	17%	20%	2%	18%	14%	25%
Emilia-Romagna	1,988,742	17%	19%	21%	10%	9%	11%
Friuli-Venezia Giulia	561,020	17%	20%	20%	9%	8%	12%
Lazio	2,633,516	15%	18%	8%	11%	9%	15%
Liguria	783,307	14%	16%	12%	7%	5%	16%
Lombardia	4,394,492	16%	20%	23%	8%	6%	12%
Marche	644,568	15%	19%	11%	9%	7%	15%
Molise	131,133	21%	25%	7%	8%	8%	24%
Piemonte	2,015,261	19%	22%	21%	6%	5%	9%
Puglia	1,578,480	10%	13%	4%	16%	12%	39%
Sardegna	712,418	22%	26%	13%	10%	8%	31%
Sicilia	2,033,892	22%	25%	5%	16%	13%	45%
Toscana	1,638,184	11%	15%	11%	6%	6%	10%
Trento	230,575	15%	20%	15%	4%	3%	4%
Umbria	381,156	19%	22%	15%	10%	9%	11%
Valle d'Aosta	61,357	21%	26%	26%	10%	8%	9%
Veneto	2,048,582	17%	22%	20%	5%	5%	10%
Italy	***25,782,857***	17%	20%	14%	10%	8%	18%

Table 6-6: Overview Indicators (LIHC, MIS Low income, MIS M/2, MIS M/4) divided by provinces.

2014	Total households	% of households in MIS Low income	% of households in MIS M/2	% of households in MIS M/4	% of households in LIHC	% of households with arrears	% of households with more than one arrear	% of households unable to keep homes warm
Abruzzo	558,158	26%	19%	6%	23%	8%	8%	16%
Basilicata	232,534	31%	21%	8%	31%	6%	5%	23%
Bozen-Bolzano	212,424	9%	5%	2%	9%	1%	1%	3%
Calabria	794,198	33%	25%	8%	30%	19%	16%	26%
Campania	2,148,860	37%	26%	12%	32%	18%	14%	25%
Emilia-Romagna	1,988,742	11%	8%	2%	11%	10%	9%	11%
Friuli-Venezia Giulia	561,020	11%	7%	2%	10%	9%	8%	12%
Lazio	2,633,516	20%	14%	5%	18%	11%	9%	15%
Liguria	783,307	17%	12%	5%	13%	7%	5%	16%
Lombardia	4,394,492	11%	8%	3%	11%	8%	6%	12%
Marche	644,568	15%	10%	3%	14%	9%	7%	15%
Molise	131,133	33%	26%	7%	34%	8%	8%	24%
Piemonte	2,015,261	14%	10%	4%	15%	6%	5%	9%
Puglia	1,578,480	24%	16%	4%	19%	16%	12%	39%
Sardegna	712,418	27%	20%	7%	26%	10%	8%	31%
Sicilia	2,033,892	39%	29%	14%	38%	16%	13%	45%
Toscana	1,638,184	13%	7%	3%	13%	6%	6%	10%
Trento	230,575	11%	7%	2%	12%	4%	3%	4%
Umbria	381,156	18%	13%	5%	18%	10%	9%	11%
Valle d'Aosta	61,357	11%	9%	3%	11%	10%	8%	9%
Veneto	2,048,582	16%	9%	2%	15%	5%	5%	10%
Italy	***25,782,857***	**20%**	**14%**	**5%**	**19%**	**10%**	**8%**	**18%**

Table 6-7: Overview Indicators (HEP M/2, HEP M/2 Exp, HEP M/4, HEP 5 EUR, HEP M/4 Exp) divided by provinces.

2014	Total households	% of households in HEP M/2	% of households in HEP M/4	% of the households in HEP 5 EUR	% of the housholds in HEP M/2 Exp	% of households in HEP M/4 Exp	% of households with arrears	% of households with more than one arrear	% of households unable to keep homes warm
Abruzzo	558,158	16%	6%	2%	21%	6%	8%	8%	16%
Basilicata	232,534	14%	4%	1%	20%	6%	6%	5%	23%
Bozen-Bolzano	212,424	20%	8%	3%	19%	6%	1%	1%	3%
Calabria	794,198	15%	3%	1%	23%	5%	19%	16%	26%
Campania	2,148,860	22%	6%	0%	33%	8%	18%	14%	25%
Emilia-Romagna	1,988,742	28%	12%	3%	28%	9%	10%	9%	11%
Friuli-Venezia Giulia	561,020	21%	6%	2%	17%	5%	9%	8%	12%
Lazio	2,633,516	22%	7%	2%	21%	5%	11%	9%	15%
Liguria	783,307	33%	12%	1%	35%	11%	7%	5%	16%
Lombardia	4,394,492	21%	7%	2%	17%	5%	8%	6%	12%
Marche	644,568	28%	9%	2%	26%	7%	9%	7%	15%
Molise	131,133	12%	3%	1%	21%	3%	8%	8%	24%
Piemonte	2,015,261	18%	6%	2%	17%	5%	6%	5%	9%
Puglia	1,578,480	28%	6%	1%	34%	5%	16%	12%	39%
Sardegna	712,418	10%	2%	0%	8%	1%	10%	8%	31%
Sicilia	2,033,892	13%	3%	4%	23%	6%	16%	13%	45%
Toscana	1,638,184	24%	9%	1%	21%	5%	6%	6%	10%
Trento	230,575	22%	9%	2%	22%	5%	4%	3%	4%
Umbria	381,156	18%	5%	2%	18%	4%	10%	9%	11%
Valle d'Aosta	61,357	12%	4%	2%	12%	5%	10%	8%	9%
Veneto	2,048,582	21%	6%	1%	19%	4%	5%	5%	10%
Italy	***25,782,857***	**21%**	***7%***	***2%***	***22%***	***6%***	**10%**	**8%**	**18%**

Figure 6-3: Overview selected Indicators (2M = EPM2, MIS M/2 = MIShalf, 10% = EP10pc) for the provinces in Italy.

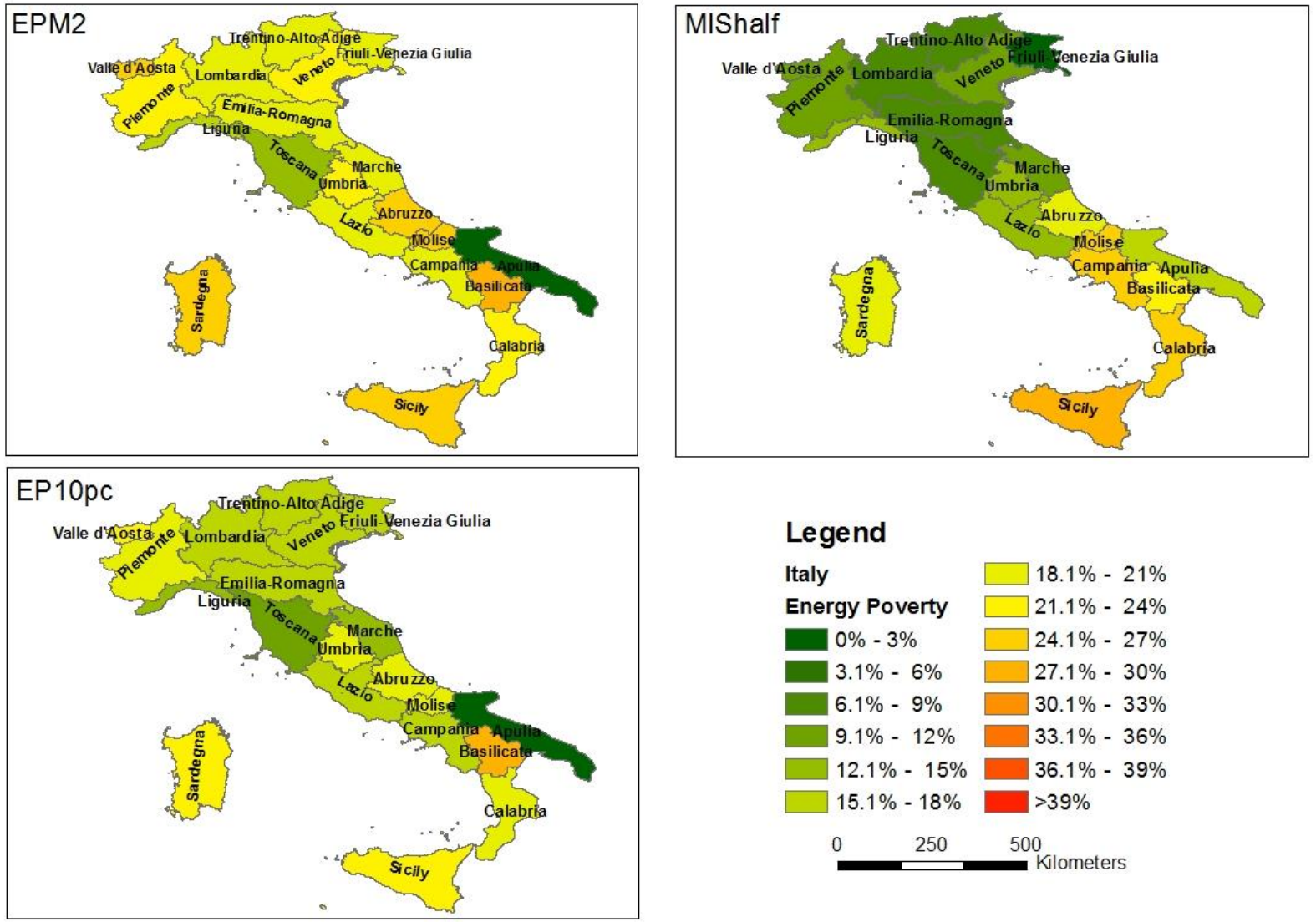
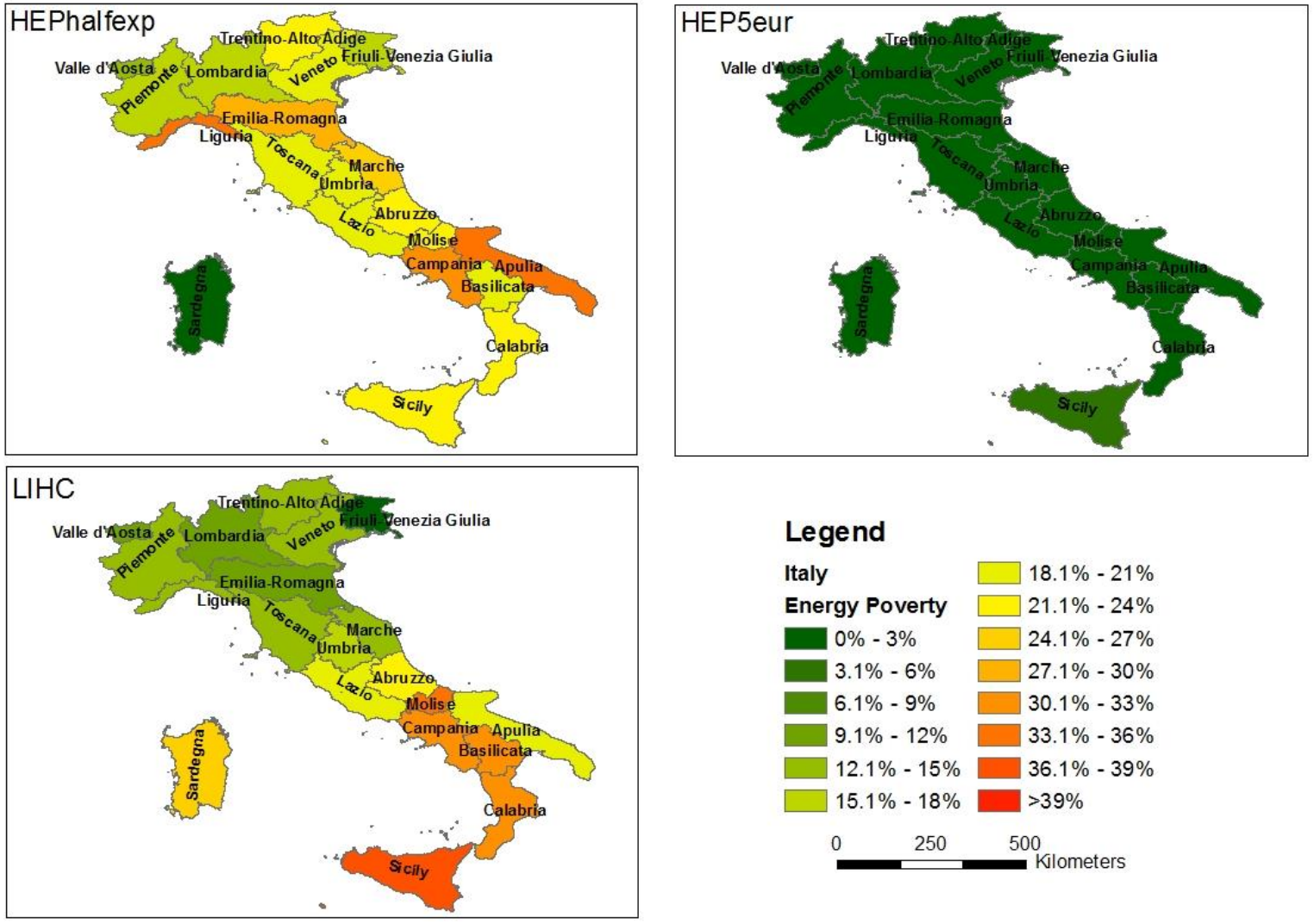


Figure 6-4: Overview selected Indicators (HEP M/2 Exp = HEPhalfexp, HEP 5 EUR = HEP5eur, LICH) for the provinces in Italy.



6.1.3. Slovakia

The following table shows the results for energy poverty in Slovakia. The Slovak Republic is divided in eight different provinces, called "kraj". Nitriansky kraj has the highest energy poverty for Table 6-8 and Table 6-9 but in Table 6-10, Žilinský kraj has the highest and Nitriansky kraj shows the lowest energy poverty percentage.

Table 6-8: Overview Indicators (10%, 2M, 2M Exp) divided by provinces

2012	Total households	% of households in 10%	% of households in 2M	% of households in 2M Exp	% of households with arrears	% of households with more than one arrear	% of households unable to keep homes warm
Babskobystrický kraj	246,511	62%	14%	5%	8%	8%	16%
Bratislavský kraj	235,239	46%	6%	5%	6%	5%	23%
Košický kraj	264,216	63%	16%	6%	1%	1%	3%
Nitriansky kraj	261,751	65%	17%	6%	19%	16%	26%
Prešovský kraj	248,693	60%	10%	3%	18%	14%	25%
Trenciansky kraj	212,965	53%	11%	4%	10%	9%	11%
Trnavský kraj	204,192	60%	15%	8%	9%	8%	12%
Žilinský kraj	238,097	51%	11%	8%	11%	9%	15%
Slovakia	***1,911,664***	58%	12%	5%	10%	8%	18%

Table 6-9: Overview Indicators (LIHC, MIS Low income, MIS M/2, MIS M/4) divided by provinces.

2012	Total households	% of households in MIS Low income	% of households in MIS M/2	% of households in MIS M/4	% of households in LIHC	% of households with arrears	% of households with more than one arrear	% of households unable to keep homes warm
Babskobystrický kraj	246,511	22%	7%	1%	19%	8%	8%	16%
Bratislavský kraj	235,239	10%	2%	0%	8%	6%	5%	23%
Košický kraj	264,216	25%	10%	1%	20%	1%	1%	3%
Nitriansky kraj	261,751	30%	11%	2%	26%	19%	16%	26%
Prešovský kraj	248,693	19%	5%	0%	17%	18%	14%	25%
Trenciansky kraj	212,965	17%	5%	0%	13%	10%	9%	11%
Trnavský kraj	204,192	22%	6%	1%	19%	9%	8%	12%
Žilinský kraj	238,097	17%	4%	0%	14%	11%	9%	15%
Slovikia	***1,911,664***	**20%**	**6%**	**1%**	**17%**	**10%**	**8%**	**18%**

Table 6-10: Overview Indicators (HEP M/2, HEP M/2 Exp, HEP M/4, HEP 5 EUR, HEP M/4 Exp) divided by provinces.

2012	Total households	% of households in HEP M/2	% of households in HEP M/4	% of the households in HEP 5 EUR	% of the housholds in HEP M/2 Exp	% of households in HEP M/4 Exp	% of households with arrears	% of households with more than one arrear	% of households unable to keep homes warm
Babskobystrický kraj	246,511	7%	0%	1%	6%	1%	8%	8%	16%
Bratislavský kraj	235,239	13%	2%	8%	11%	9%	6%	5%	23%
Košický kraj	264,216	11%	1%	4%	10%	5%	1%	1%	3%
Nitriansky kraj	261,751	6%	1%	6%	10%	7%	19%	16%	26%
Prešovský kraj	248,693	10%	2%	1%	11%	2%	18%	14%	25%
Trenciansky kraj	212,965	14%	2%	2%	14%	3%	10%	9%	11%
Trnavský kraj	204,192	9%	1%	4%	9%	5%	9%	8%	12%
Žilinský kraj	238,097	14%	2%	4%	17%	6%	11%	9%	15%
Slovakia	***1,911,664***	**10%**	***1%***	***4%***	***11%***	***5%***	**10%**	**8%**	**18%**

Figure 6-5: Overview selected Indicators (MIS M/2 = MIShalf, 10% = EP10pc, HEP 5 EUR = HEP5eur) for the provinces in Slovakia.

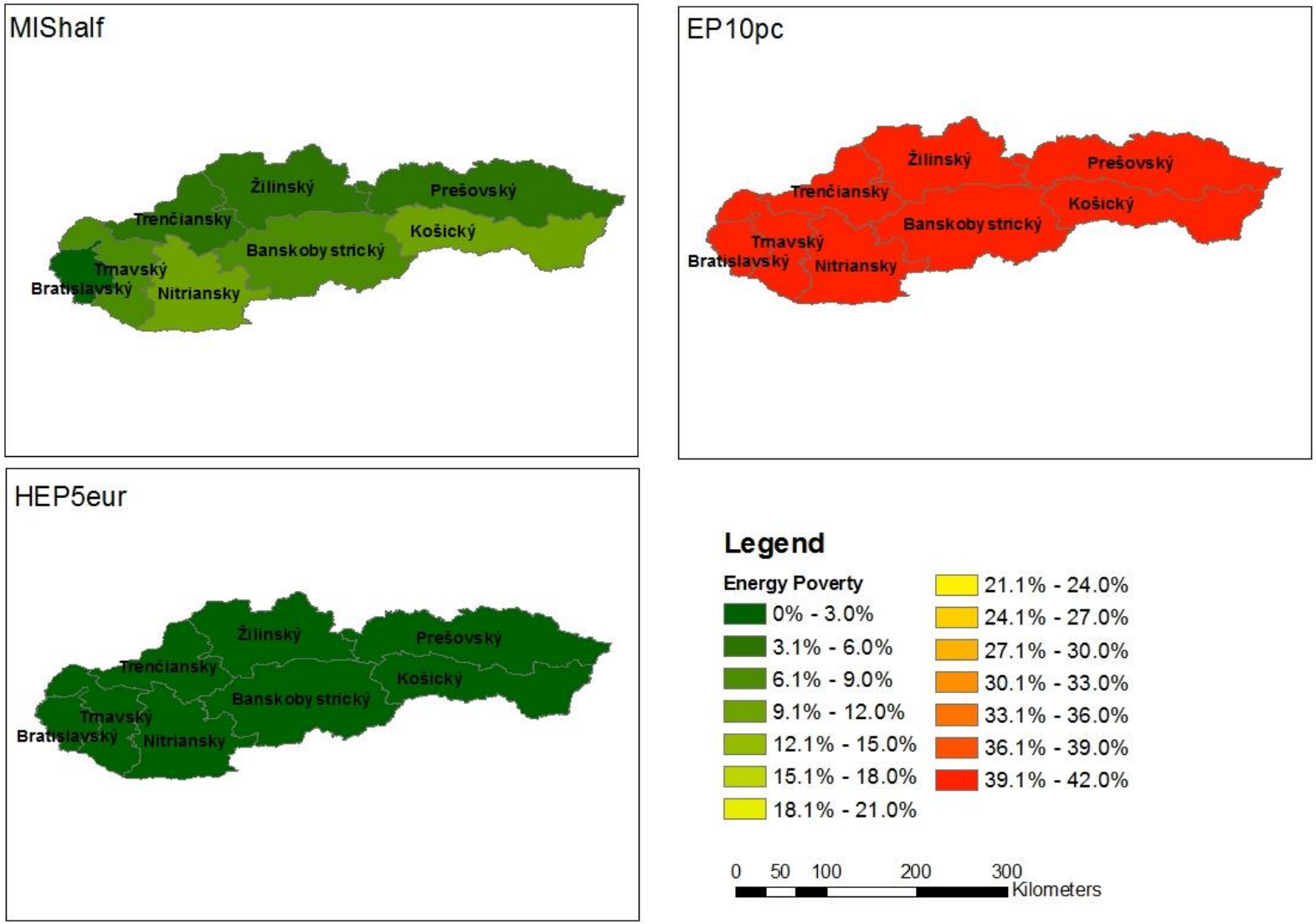
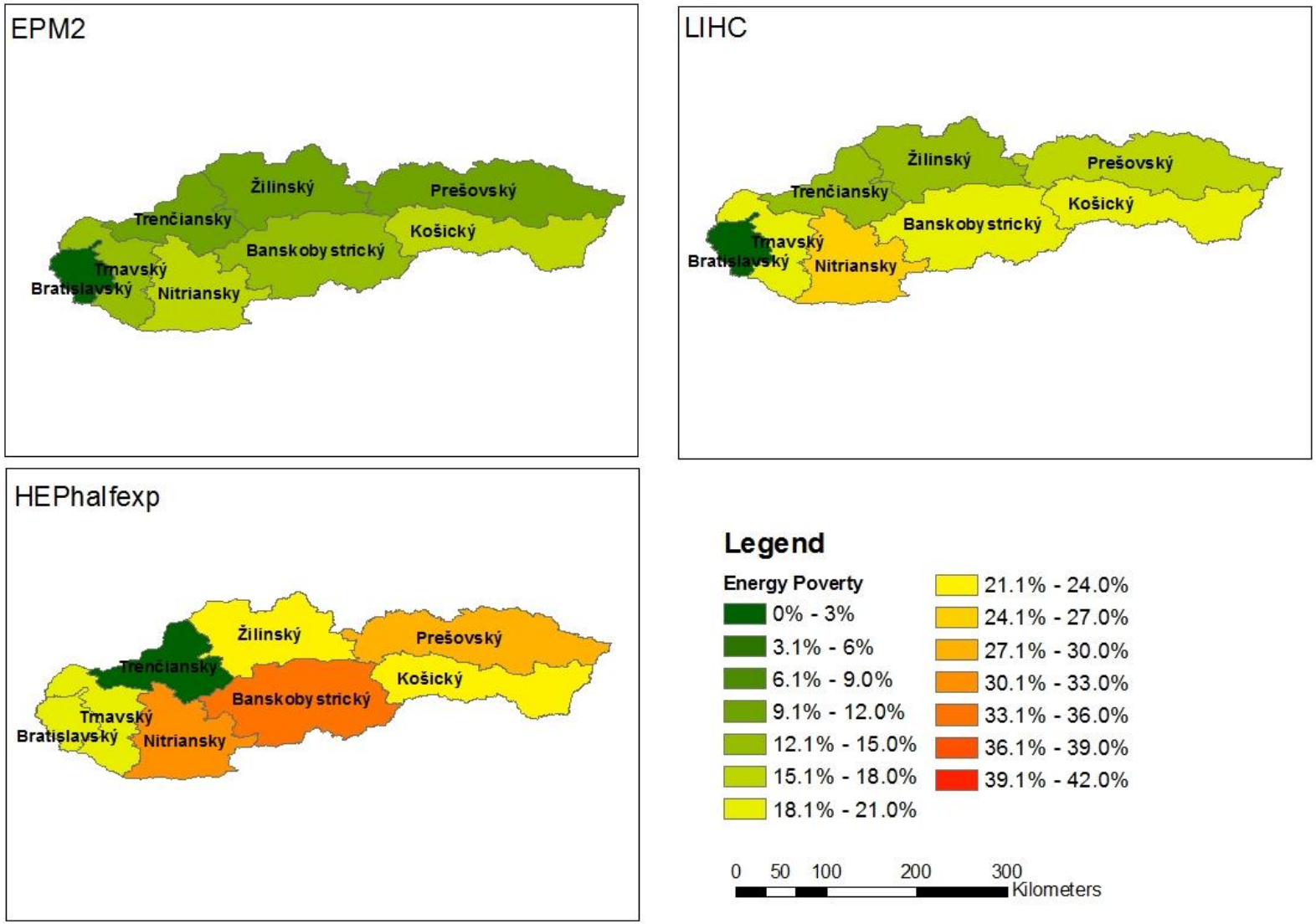


Figure 6-6: Overview selected Indicators (2M = EPM2, LIHC, HEP 2M Exp = HEPhalfexp) for the provinces of Slovakia.



6.1.4. The Netherlands

Among the four Member States that were investigated, the Netherlands is the one with the highest per capita income. In this sense, it is also a country with a low degree of energy poverty, even when relative thresholds are used. However, relative to Spain and Italy (and in this sense, similar to Slovakia), the 10% metric would capture a high number of households. This reflects the fact that, in general, energy expenditure in the Netherlands is higher than in these countries. The province of Groningen came out as a province that has a high share of energy poor households across all main metrics. However, hidden energy poverty is highest in Utrecht. However, it must be noted that hidden energy poverty, is especially problematic metric in the Netherlands, given a recent trend in building extremely energy efficient popular housing.

Table 6-11: Overview Indicators (10%, 2M, 2M Exp) divided by provinces

2012	Total households	% of households in 10%	% of households in 2M	% of households in 2M Exp	% of households with arrears	% of households with more than one arrear	% of households unable to keep homes warm
Drenthe	211,318	23%	11%	5%	8%	8%	16%
Flevoland	161,814	17%	8%	2%	6%	5%	23%
Friesland	283,943	23%	13%	5%	1%	1%	3%
Gelderland	868,199	20%	11%	6%	19%	16%	26%
Groningen	283,187	31%	19%	7%	18%	14%	25%
Limburg	512,663	25%	14%	7%	10%	9%	11%
Noord-Brabant	1,077,635	20%	11%	6%	9%	8%	12%
Noord-Holland	1,281,853	18%	11%	5%	11%	9%	15%
Overijssel	483,415	21%	11%	5%	7%	5%	16%
Utrecht	552,988	18%	12%	6%	8%	6%	12%
Zeeland	169,725	17%	8%	4%	9%	7%	15%
Zuid-Holland	1,628,319	18%	10%	4%	8%	8%	24%
the Netherlands	***7,515,060***	**20%**	**11%**	**5%**	**10%**	**8%**	**18%**

Table 6-12: Overview Indicators (LIHC, MIS Low income, MIS M/2, MIS M/4) divided by provinces.

2012	Total households	% of households in MIS Low income	% of households in MIS M/2	% of households in MIS M/4	% of households in LIHC	% of households with arrears	% of households with more than one arrear	% of households unable to keep homes warm
Drenthe	211,318	18%	6%	1%	13%	4%	2%	2%
Flevoland	161,814	21%	8%	2%	14%	4%	3%	3%
Friesland	283,943	22%	8%	2%	15%	1%	1%	1%
Gelderland	868,199	19%	8%	3%	13%	2%	2%	3%
Groningen	283,187	30%	16%	5%	24%	1%	0%	1%
Limburg	512,663	20%	8%	2%	15%	1%	1%	1%
Noord-Brabant	1,077,635	18%	7%	3%	13%	2%	1%	1%
Noord-Holland	1,281,853	21%	9%	4%	14%	3%	1%	1%
Overijssel	483,415	20%	8%	3%	14%	2%	1%	3%
Utrecht	552,988	18%	9%	3%	13%	5%	4%	4%
Zeeland	169,725	16%	5%	2%	11%	7%	1%	1%
Zuid-Holland	1,628,319	21%	9%	3%	15%	2%	1%	3%
the Netherlands	***7,515,060***	**20%**	**8%**	**3%**	**14%**	**2%**	**1%**	**2%**

Table 6-13: Overview Indicators (HEP M/2, HEP M/2Exp, HEP M/4, HEP 5 EUR, HEP M/4 Exp) divided by provinces.

2012	Total households	% of households in HEP M/2	% of households in HEP M/4	% of the households in HEP 5 EUR	% of the housholds in HEP M/2 Exp	% of households in HEP M/4 Exp	% of households with arrears	% of households with more than one arrear	% of households unable to keep homes warm
Drenthe	211,318	4%	0%	0%	2%	0%	8%	8%	16%
Flevoland	161,814	8%	0%	0%	6%	0%	6%	5%	23%
Friesland	283,943	4%	0%	0%	4%	0%	1%	1%	3%
Gelderland	868,199	7%	0%	0%	4%	0%	19%	16%	26%
Groningen	283,187	4%	0%	0%	3%	0%	18%	14%	25%
Limburg	512,663	4%	0%	0%	2%	0%	10%	9%	11%
Noord-Brabant	1,077,635	6%	0%	0%	3%	0%	9%	8%	12%
Noord-Holland	1,281,853	10%	1%	0%	5%	0%	11%	9%	15%
Overijssel	483,415	4%	0%	0%	3%	0%	7%	5%	16%
Utrecht	552,988	12%	1%	0%	4%	0%	8%	6%	12%
Zeeland	169,725	6%	0%	0%	3%	0%	9%	7%	15%
Zuid-Holland	1,628,319	10%	1%	0%	5%	0%	8%	8%	24%
the Netherlands	***7,515,060***	**8%**	***1%***	***0%***	***4%***	***0%***	**10%**	**8%**	**18%**

Figure 6-7: Overview selected Indicators (MIS M/2 = MIShalf, HEP M/2 Exp = HEPhalfexp, HEP 5 EUR = HEP5eur) for the provinces in the Netherlands.

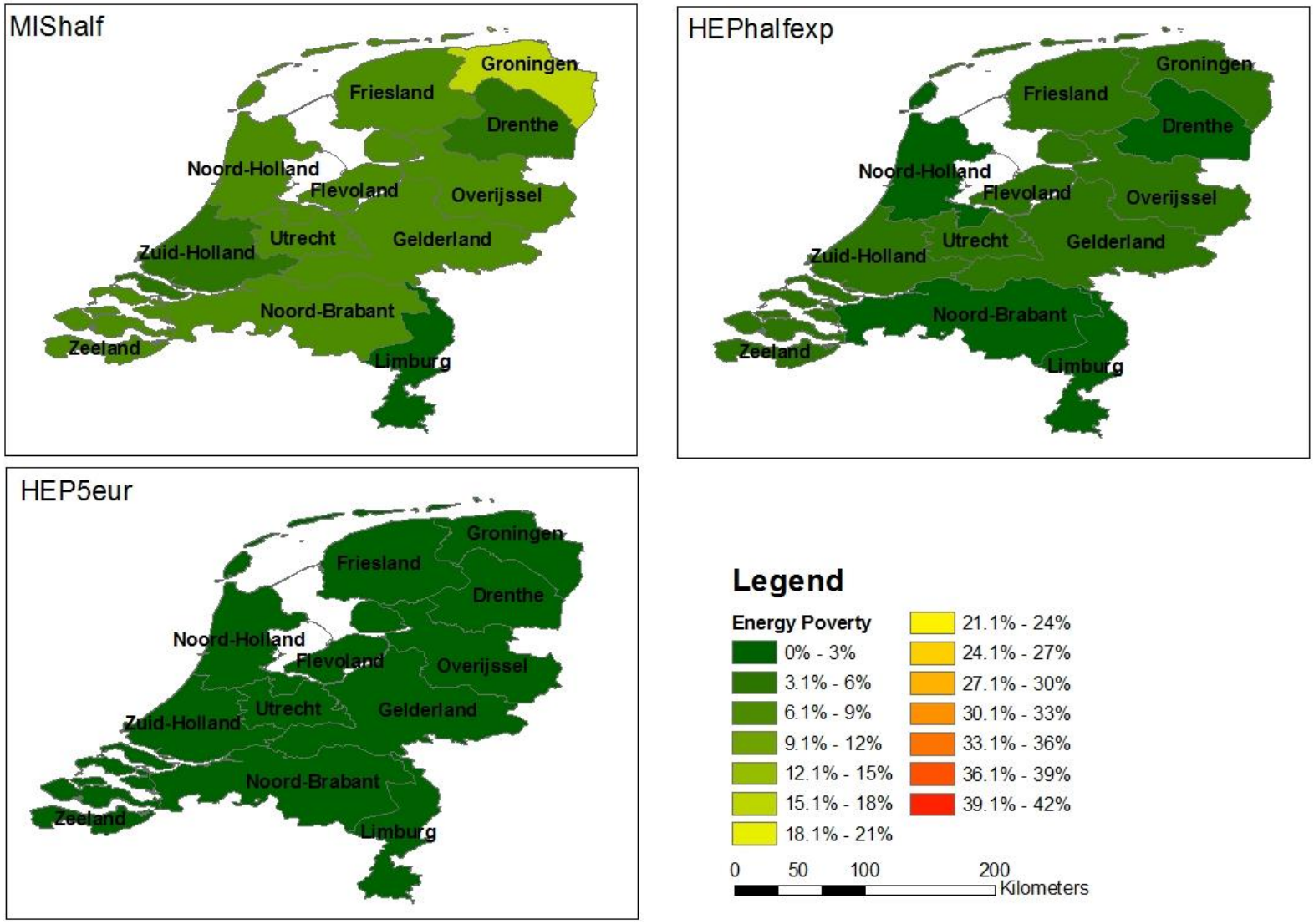
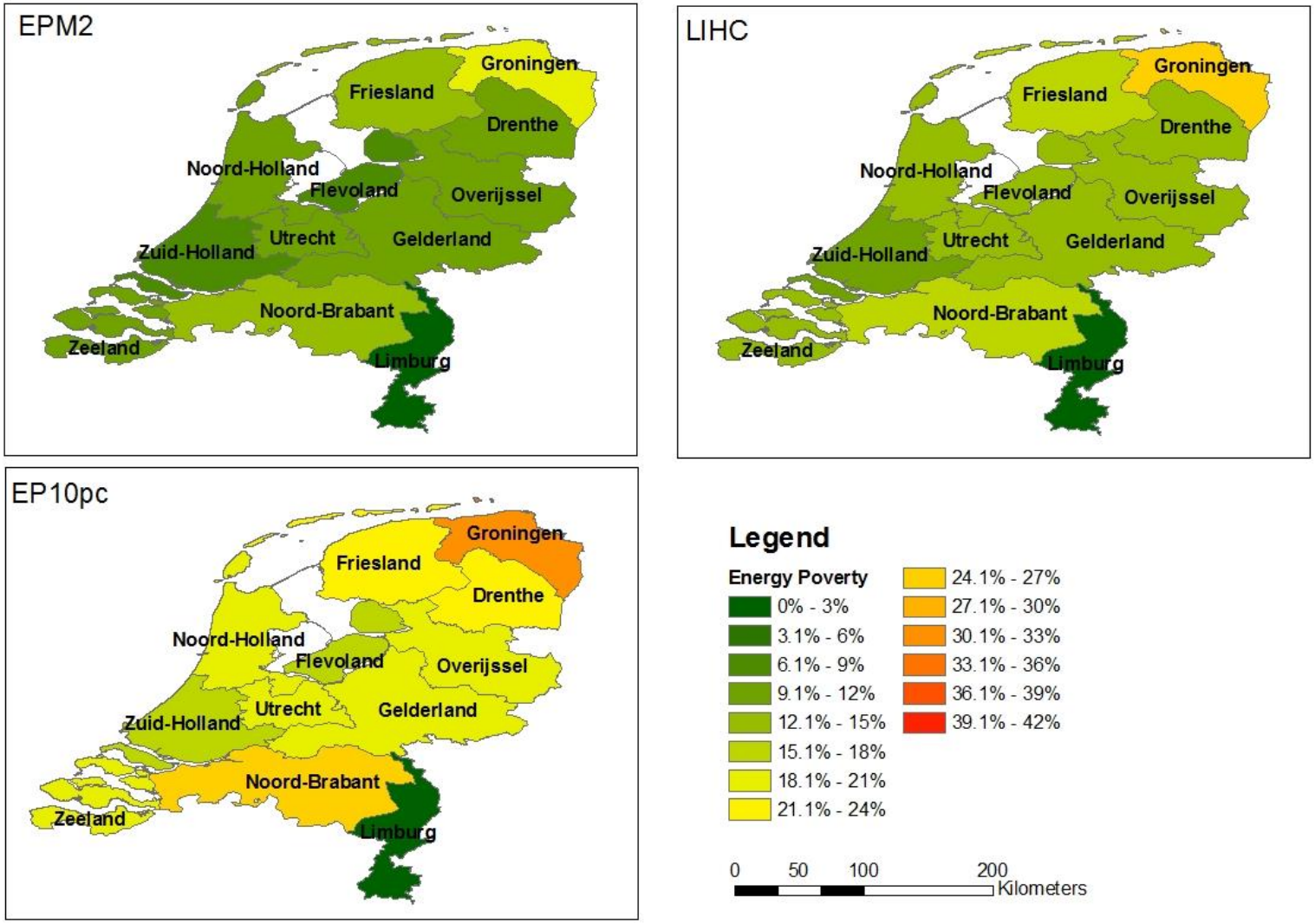


Figure 6-8: Overview selected Indicators (2M = EPM2, LIHC, 10% = EP10pc) for the provinces in the Netherlands.



6.2. Energy Poverty Gap

The energy poverty gap is a measure of the distance from the actual status of the family and the threshold of energy poverty. Therefore, it can measure the size of the problem in monetary terms, suggesting how much it would cost to solve it. This section highlights for each country, how much financial support is necessary to solve energy poverty for the different indicators. It is divided by the "Total gap per province" and the "Gap per capita". The total gap per provinces emphasizes how much money per month is needed for the whole province in a given country to overcome energy poverty, whereas the gap per capita shows how much money is needed per capita per month in the household to solve energy poverty.

Each metric of energy poverty gap has a different interpretation, as explained in the report. For example, for Spain, in order to solve the problem of hidden energy poverty, a quantity of €5.64 is needed per month for each individual. This means that the energy consumption per capita of the individuals in hidden energy poverty should increase by that amount. Another example is LIHC: in order to take all individuals that are currently energy poor according to LIHC out of energy poverty, it would require to increase everyone's income by €137.66 per month.

Table 6.2.2 shows the same results for Italy. In order to overcome energy poverty in Italy, an investment of between €7.4 per capita (HEP M/2 Exp) and €222 per capita (LIHC) is needed per month. This is between 0.02% and 0.71% of the GDP per capita in Italy. For the whole country, it would require €109.5 million for HEP and €2,450.4 million for LIHC per month.

Slovakia's results are shown in Table 6.2.3. For hidden energy poverty (HEP M/2 exp) € 9.16 per capita per month is needed to lift all individuals from that status, and €55.25 for LIHC. Furthermore, a total investment of € 6 million for HEP and €39.9 million for LIHC per month is needed for all individuals in those statuses to be lifted out of energy poverty.

Lastly, Table 6.2.4 shows results for energy poverty gap in the Netherlands. HEP M/2 Exp requires €11.44 per capita per month and MIS M/2 €437.43 per capita per month. It has to be noted that not LIHC, as in all the other countries but MIS M/2 requires the highest investment.

6.2.1. Spain

	Total Gap			Gap per capita		
	2M	LIHC	HEP M/2 Exp	2M	LIHC	HEP M/2 Exp
Andalucía	€ 18,678,764	€ 370,571,673	€ 8,598,457	**€ 12.41**	**€ 153.00**	**€ 5.25**
Aragón	€ 7,083,039	€ 31,678,697	€ 643,180	**€ 26.17**	**€ 149.21**	**€ 6.61**
Asturias	€ 2,759,109	€ 19,362,105	€ 655,376	**€ 21.02**	**€ 143.61**	**€ 6.81**
Baleares	€ 3,452,714	€ 24,928,747	€ 962,059	**€ 20.99**	**€ 132.98**	**€ 6.00**
Canarias	€ 1,792,823	€ 76,999,016	€ 4,964,115	**€ 10.18**	**€ 157.36**	**€ 6.19**
Cantabria	€ 1,699,914	€ 14,247,072	€ 208,554	**€ 18.13**	**€ 130.92**	**€ 5.02**
Castilal La Mancha	€ 19,247,367	€ 87,435,202	€ 1,165,240	**€ 24.61**	**€ 128.14**	**€ 6.47**
Castilla y León	€ 16,221,616	€ 59,987,771	€ 1,345,311	**€ 27.42**	**€ 126.62**	**€ 7.54**
Cataluña	€ 26,280,060	€ 150,663,219	€ 4,693,469	**€ 22.12**	**€ 123.38**	**€ 5.85**
Ceuta	€ 19,321	€ 3,039,668	€ 223,708	**€ 5.27**	**€ 156.07**	**€ 5.24**
Comunitat Valenciana	€ 9,696,005	€ 154,205,090	€ 4,534,229	**€ 14.75**	**€ 144.51**	**€ 5.02**
Extremadura	€ 4,479,631	€ 42,500,187	€ 1,059,876	**€ 17.18**	**€ 131.72**	**€ 5.15**
Galicia	€ 9,727,040	€ 58,541,305	€ 2,282,146	**€ 20.93**	**€ 127.34**	**€ 5.72**
La Rioja	€ 1,761,116	€ 6,318,933	€ 149,822	**€ 25.61**	**€ 123.33**	**€ 6.90**
Madrid	€ 16,964,569	€ 118,306,414	€ 2,963,530	**€ 19.63**	**€ 121.18**	**€ 5.74**
Melilla	€ 34,659	€ 3,901,795	€ 92,665	**€ 3.43**	**€ 165.79**	**€ 4.09**
Murcia	€ 3,522,110	€ 66,185,542	€ 1,322,313	**€ 11.73**	**€ 142.91**	**€ 5.46**
Navarra	€ 2,763,534	€ 10,745,785	€ 209,699	**€ 24.32**	**€ 120.36**	**€ 5.77**
País Vasco	€ 3,008,875	€ 18,027,398	€ 856,615	**€ 17.77**	**€ 107.76**	**€ 5.20**
Spain	***€ 149,192,264***	***€ 1,317,645,619***	***€ 36,930,364***	***€ 19.09***	***€ 137.66***	***€ 5.64***

6.2.2. Italy

	Total gap			Gap per capita		
	2M	LIHC	HEP M/2 Exp	2M	LIHC	HEP M/2 Exp
Abruzzo	€ 6,354,740	€ 69,820,749	€ 2,263,863	€ 22.3	€ 259.2	€ 7.4
Basilicata	€ 3,148,749	€ 33,966,967	€ 963,507	€ 20.6	€ 211.9	€ 8.0
Bozen-Bolzano	€ 1,387,911	€ 5,985,550	€ 767,389	€ 51.6	€ 171.8	€ 7.1
Calabria	€ 6,238,721	€ 132,648,561	€ 3,461,744	€ 17.3	€ 218.6	€ 6.4
Campania	€ 15,338,613	€ 436,658,333	€ 14,388,235	€ 14.7	€ 243.6	€ 6.7
Emilia-Romagna	€ 25,851,478	€ 99,658,333	€ 10,416,667	€ 37.9	€ 229.2	€ 8.4
Friuli-Venezia Giulia	€ 6,539,978	€ 18,800,000	€ 1,864,200	€ 34.0	€ 173.0	€ 9.1
Lazio	€ 21,439,687	€ 251,600,000	€ 9,290,281	€ 22.7	€ 253.9	€ 7.1
Liguria	€ 6,638,668	€ 50,492,532	€ 4,932,508	€ 32.4	€ 289.4	€ 8.8
Lombardia	€ 56,166,667	€ 208,500,000	€ 14,507,245	€ 37.7	€ 204.6	€ 7.9
Marche	€ 5,628,159	€ 33,681,063	€ 3,377,849	€ 28.6	€ 189.8	€ 8.1
Molise	€ 1,319,544	€ 21,107,625	€ 510,408	€ 19.6	€ 203.6	€ 6.1
Piemonte	€ 27,598,728	€ 138,325,000	€ 6,941,667	€ 33.0	€ 206.7	€ 8.6
Puglia	€ 7,970,670	€ 152,185,844	€ 10,568,016	€ 21.6	€ 193.9	€ 6.3
Sardegna	€ 12,593,838	€ 92,368,930	€ 891,183	€ 31.8	€ 203.0	€ 6.4
Sicilia	€ 18,827,918	€ 469,828,809	€ 9,074,991	€ 16.1	€ 240.3	€ 7.5
Toscana	€ 11,560,635	€ 84,613,989	€ 6,269,870	€ 27.9	€ 180.5	€ 7.5
Trento	€ 2,160,148	€ 10,700,706	€ 979,334	€ 25.6	€ 194.1	€ 7.4
Umbria	€ 4,354,584	€ 34,110,828	€ 1,179,966	€ 27.3	€ 209.3	€ 6.7
Valle d'Aosta	€ 1,154,612	€ 2,389,830	€ 139,176	€ 42.7	€ 197.6	€ 7.8
Veneto	€ 29,299,931	€ 102,965,837	€ 6,725,000	€ 35.9	€ 170.7	€ 7.4
Italy	***€ 271,573,977***	***€ 2,450,409,487***	***€ 109,513,098***	***€ 27.4***	***€ 222.0***	***€ 7.4***

6.2.3. Slovakia

	Total gap			Gap per capita		
	2M	LIHC	HEP M/2 Exp	2M	LIHC	HEP M/2 Exp
Babskobystrický kraj	€ 1,594,513	€ 5,592,072	€ 291,527	€ 22.52	€ 58.63	€ 6.81
Bratislavský kraj	€ 541,553	€ 1,535,762	€ 968,451	€ 24.87	€ 52.66	€ 19.52
Košický kraj	€ 2,620,685	€ 8,507,649	€ 888,925	€ 29.86	€ 59.95	€ 10.18
Nitriansky kraj	€ 2,263,679	€ 9,974,739	€ 862,160	€ 26.63	€ 65.34	€ 15.58
Prešovský kraj	€ 640,959	€ 4,613,430	€ 724,513	€ 15.15	€ 40.15	€ 5.74
Trenciansky kraj	€ 1,074,904	€ 2,677,936	€ 720,381	€ 30.32	€ 62.35	€ 6.68
Trnavský kraj	€ 1,302,137	€ 3,387,296	€ 611,445	€ 27.82	€ 50.25	€ 11.79
Žilinský kraj	€ 1,552,157	€ 3,599,308	€ 1,004,280	€ 30.80	€ 46.42	€ 7.08
Slovakia	***€ 11,590,588***	***€ 39,888,193***	***€ 6,071,681***	***€ 26.32***	***€ 55.25***	***€ 9.16***

6.2.4. The Netherlands

	Total gap			Gap per capita		
	2M	LIHC	HEP M/2 Exp	2M	LIHC	HEP M/2 Exp
Drenthe	€ 1,338,616	€ 10,202,242	€ 215,326	€ 44.59	€ 258.15	€ 15.71
Flevoland	€ 987,707	€ 11,032,232	€ 305,123	€ 54.47	€ 331.02	€ 11.19
Friesland	€ 2,645,696	€ 17,623,974	€ 319,998	€ 55.86	€ 283.43	€ 10.70
Gelderland	€ 7,928,553	€ 53,605,283	€ 1,267,765	€ 66.56	€ 324.50	€ 11.12
Groningen	€ 4,442,368	€ 31,823,539	€ 368,746	€ 67.70	€ 356.76	€ 11.07
Limburg	€ 5,441,294	€ 36,733,005	€ 354,715	€ 61.44	€ 332.88	€ 10.27
Noord-Brabant	€ 9,724,188	€ 62,859,556	€ 1,076,589	€ 63.58	€ 331.51	€ 11.03
Noord-Holland	€ 10,569,873	€ 90,744,588	€ 2,262,792	€ 64.60	€ 373.98	€ 11.29
Overijssel	€ 3,889,270	€ 32,098,668	€ 559,014	€ 57.41	€ 328.86	€ 9.85
Utrecht	€ 5,133,286	€ 34,061,856	€ 950,621	€ 67.39	€ 349.81	€ 12.69
Zeeland	€ 1,066,453	€ 8,092,546	€ 170,701	€ 57.76	€ 287.61	€ 9.54
Zuid-Holland	€ 11,981,056	€ 122,035,470	€ 3,194,934	€ 59.65	€ 378.37	€ 11.99
the Netherlands	***€ 65,148,361***	***€ 510,912,959***	***€ 11,046,324***	***€ 62.13***	***€ 345.75***	***€ 11.44***

6.2.5. Energy Poverty Gap as a percentage of GDP

MS	10%	2M	MIS M/2	LIHC	HEP M/2 Exp
Netherlands (2012)	*0.016%*	*0.010%*	*0.059%*	*0.079%*	*0.002%*
Slovakia (2013)	*0.085%*	*0.016%*	*0.016%*	*0.054%*	*0.008%*
Italy (2014)	*0.014%*	*0.017%*	*0.098%*	*0.152%*	*0.007%*
Spain (2014)	*0.014%*	*0.014%*	*0.074%*	*0.127%*	*0.004%*

Source: Eurostat, current value national GDP

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