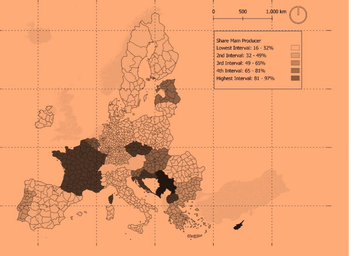
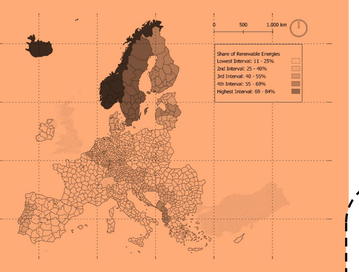
Unveiling Energy Poverty Risk: a multidimensional analysis of the heat-or-eat dilemma

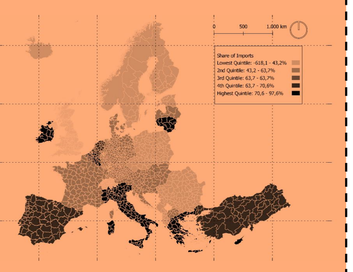
Martínez Görbig, Gerard*; Flacke, Johannes*; Reckien, Diana*; Sliuzas, Richard*
*Urban and Regional Planning and Geo-information Management, Faculty of Geo-Information Science and Earth Observation

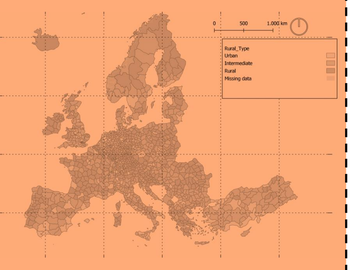
Objective

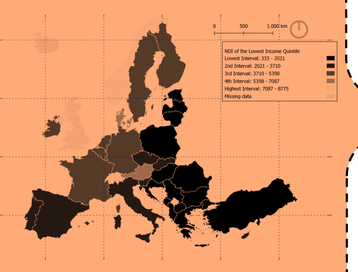
This research aims to understand **how citizens can be at risk of EP through the interactions between the energy and the food domain.** Thus, it embraces a lifestyle approach, primarily investigating how induced changes in food and energy expenditure patterns are related. It examines how interactions between basic services collide in citizens' lifestyles through the distribution of their expenses and compares it to the specific regional and socioeconomic context. Through a methodological proposal to analyse the heat-or-eat dilemma, the research operates on three scales to map the EP risk of European citizens caused by potential food domain changes: **(1) regional scale**, to understand in which regions the food and energy systems are more prone to suffer negative impacts from a low-carbon transition and, thus, expand them to households; **(2) expenditure patterns scale**, to understand how the distribution of resources of households in the food and energy domains condition their risk to be at EP; and **(3) socioeconomic and demographic scale**, to check how households characteristics shape their capacity to cope with such externalities. The results from the three scales are then used to build **the Heat-or-Eat Risk Index (HERI).** Ultimately, the analysis of the HERI and its components aims to inform the selection of more equitable and just measures in Europe.

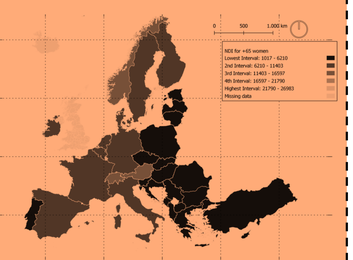

1. Share of energy produced by the main producer in the country.

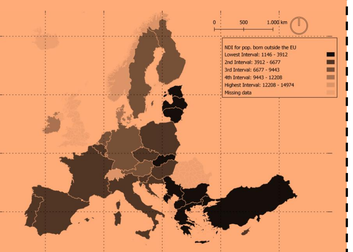

2. Share of Renewable energy in energy consumption.

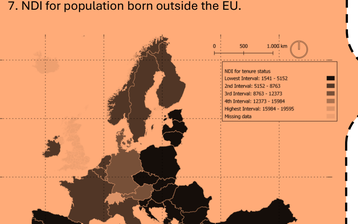

3. Share of energy imported.

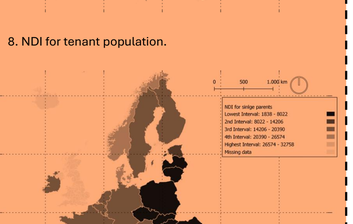

4. Rural – Urban Regions.

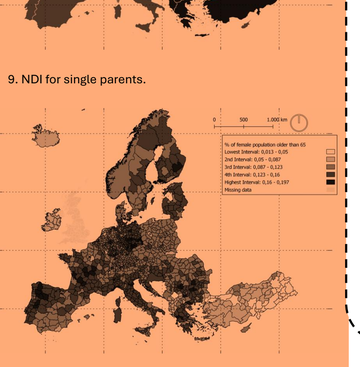

5. NDI for the lowest income quintile.

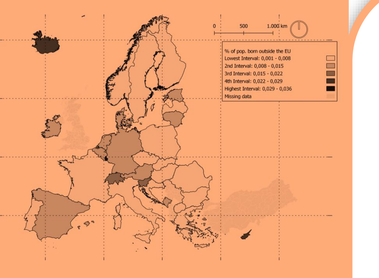

6. NDI for female population older than 65.

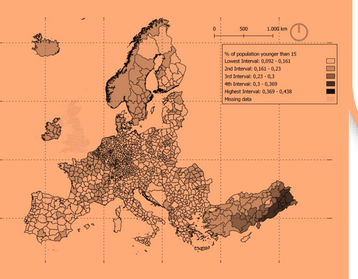

7. NDI for population born outside the EU.


8. NDI for tenant population.


9. NDI for single parents.

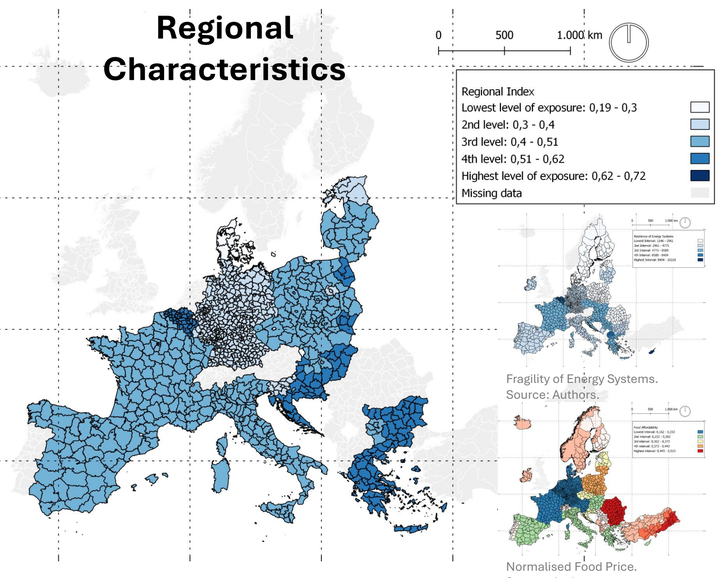

10. Percentage of population older than 65 years old.


11. Percentage of population born outside the EU.


12. Percentage of population younger than 15 years old.

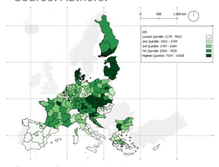
Regional Characteristics

The regional context defines the exposure of households to energy poverty. How the energy and other basic needs systems work are important to define how exposed are households to the side effects of energy transition. **Southern European regions are the ones that can afford fewer energy units**, while central European and Scandinavian regions are the ones affording most units. **Scandinavian and Baltic countries, followed by Poland and Romania, have the lowest risk of inducing EP through impacts on the energy system,** mainly due to their share of renewable energy and the high decentralisation of their energy systems.



Fragility of Energy Systems.
Source: Authors.

Normalised Food Price.
Source: Authors.

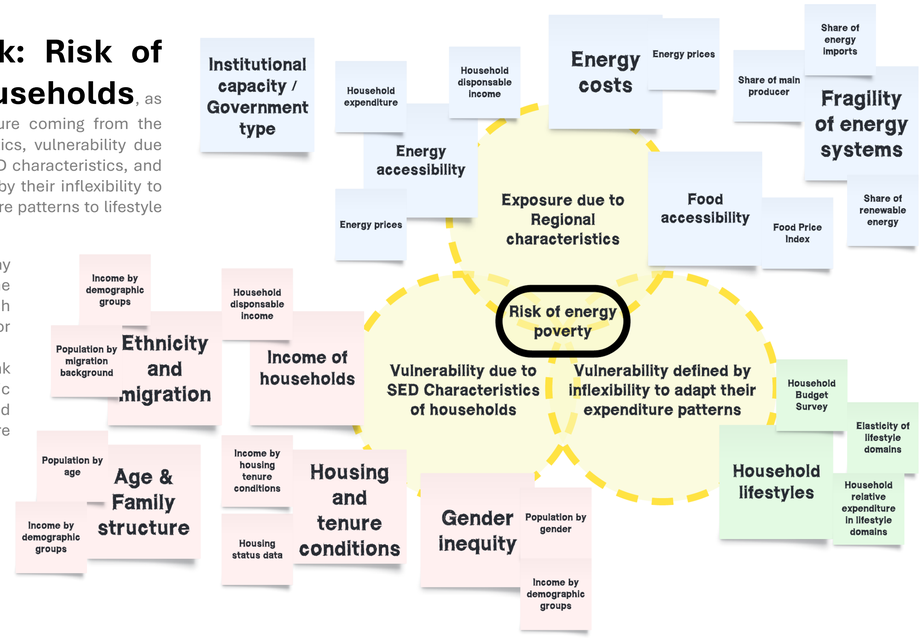

Energy Purchase Index.
Source: Authors.

Combining those results with the Food Security in each country unveils households in **Balkan countries as less pressured by the energy systems but suffering more to be able to afford food needs.**

The aggregated Regional Index discloses that the population in **Balkan and some northwestern European regions is typically more exposed to system changes, while central and northern Europe Regional Characteristics are safer**.

Framework: Risk of EP for households, as a function of exposure coming from the Regional characteristics, vulnerability due to their individual SED characteristics, and vulnerability defined by their inflexibility to adapt their expenditure patterns to lifestyle changes.

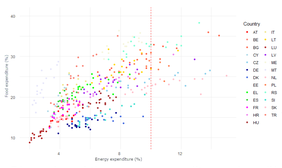
The stickers display the name of the indicators for each dimension: blue for regional characteristics, pink for socioeconomic characteristics, and green for expenditure patterns.

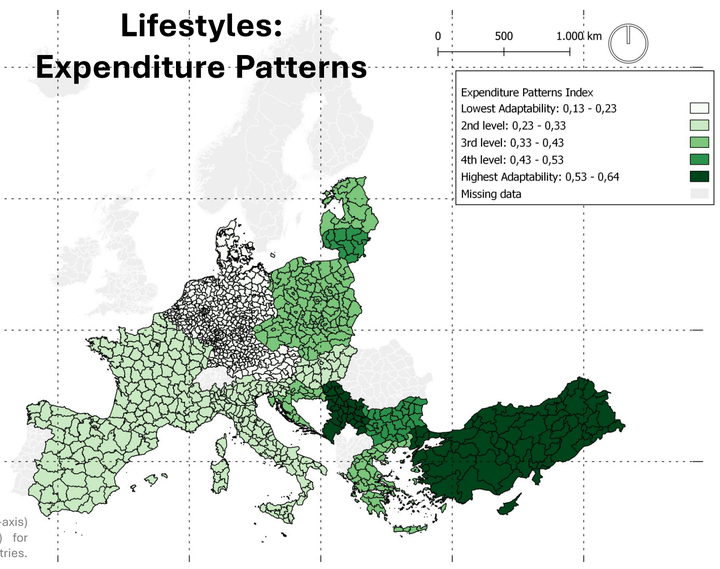


Energy poverty (EP) is one of the most frequent injustices of a low-carbon transition. It can be defined as "a lack of affordability of keeping the house warm" and "the inability of households to access basic energy services and products" [19], moving the definition towards a multidimensional and household-centred approach. **Households might suffer from EP not only due to a lack of energy accessibility but also due to difficulties in accessing other basic needs.** The heat-or-eat dilemma is a pertinent example of the issue, where households with less capacity to adapt might prioritise economic resources over their nutrition.

Lifestyles: Expenditure Patterns

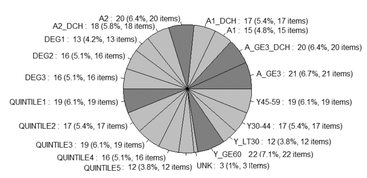
Citizens' lifestyles are central to analyse energy poverty due to its multidimensionality. The analysis of expenditure patters in basic lifestyles domains, unveil a **strong correlation between the expenditure of households in food and in energy.** The more a household spends on food, the more it spends on energy. Such correlation is crucial to understand different energy poverty forms, such as the heat-or-eat dilemma.


Dispersion of the energy expenditure values (X-axis) related to food expenditure values (Y-axis) for different household types for different countries. Each colour represents one country.



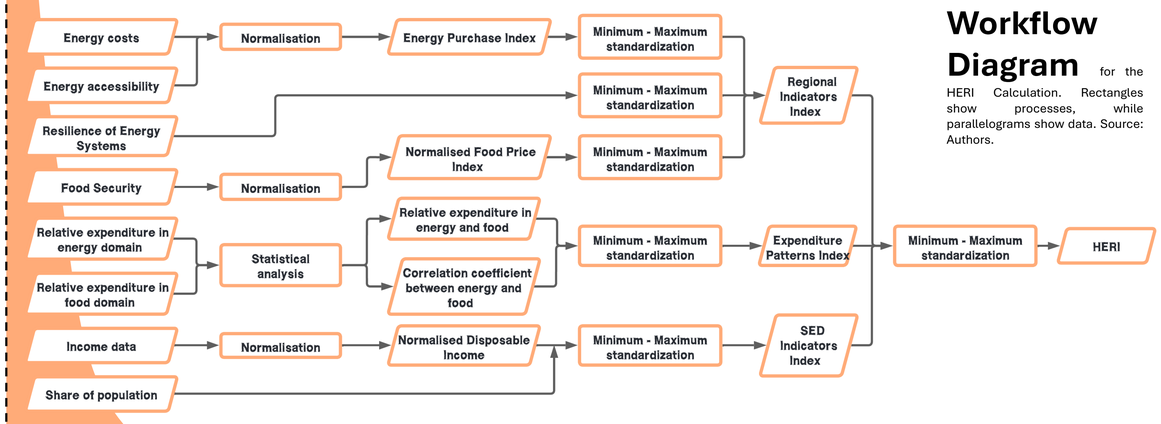
Having a **high expenditure** in basic needs means having **less capacity to cope with changes in accessibility** and affordability of basic services.

Population older than 60 years old, household structures with children, and those with low income have been identified as the groups spending more share of their expenses on food and energy. **Balkan and Baltic countries are typically spending more share of their resources on accessing food and energy**.



Household groups at higher within or above the heat-or-eat interval threshold.

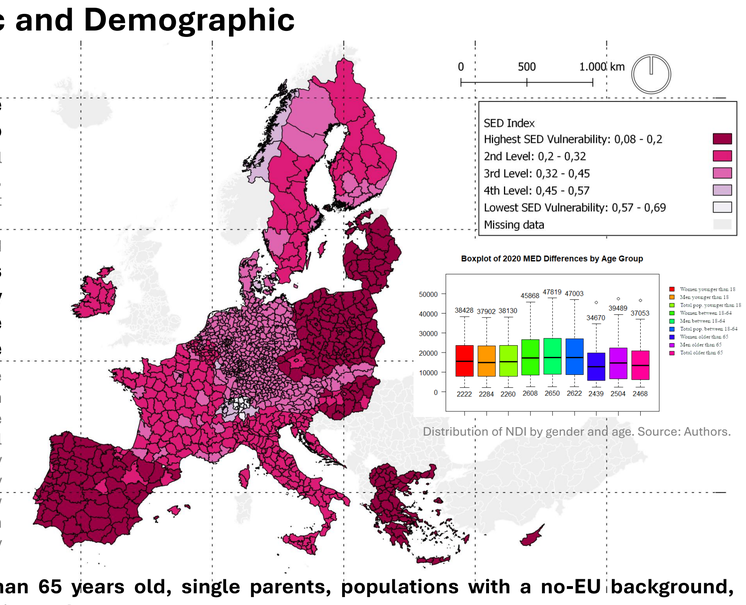
Workflow Diagram for the HERI Calculation. Rectangles show processes, while parallelograms show data. Source: Authors.



Socioeconomic and Demographic characteristics

Not all households are equally vulnerable to injustices. Individual characteristics such as gender, migration status, or age might define citizens' vulnerability.

The NDI (Normalised Disposable Income) **permits an analysis of EP risk by looking at income differences between the groups.** The NDI is the difference between a certain SED's median disposable income and 60% of the national median. It is strongly negatively correlated with energy expenditure, illustrating how lower NDIs are associated with high relative energy expenditures.



Distribution of NDI by gender and age. Source: Authors.

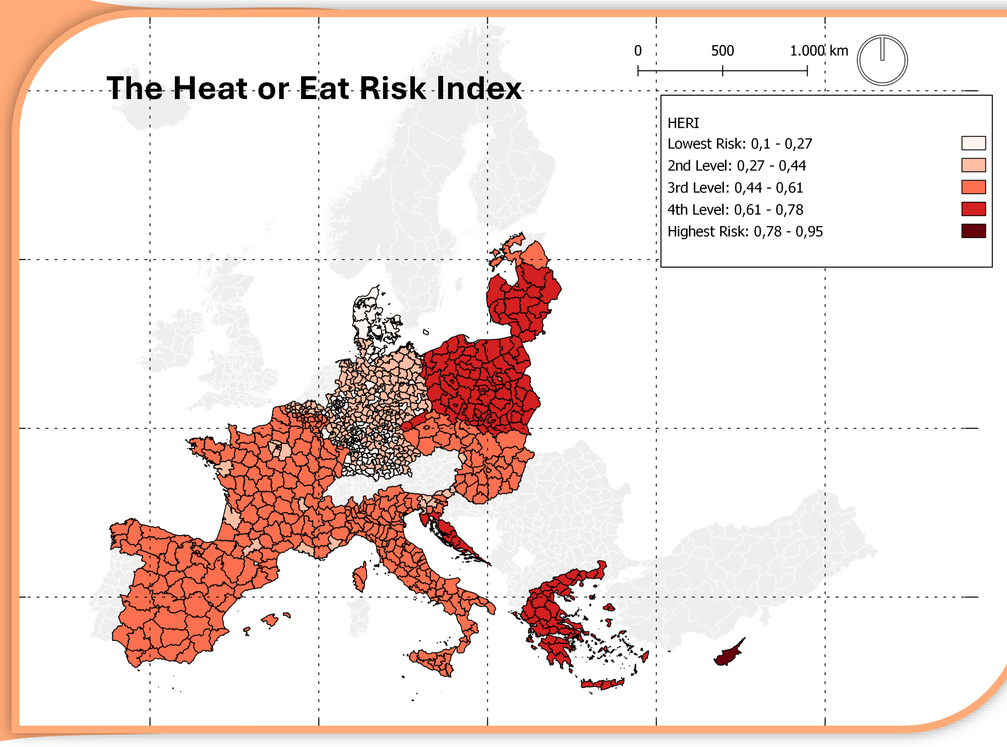
Women, people older than 65 years old, single parents, populations with a no-EU background, tenants and populations in rural areas are more vulnerable to energy poverty due to their individual characteristics.

The vulnerability level of such region regarding socioeconomic characteristics can be calculated mixing the NDI with the share of the vulnerable population in a region.

Southern European regions, Baltic and Balkan countries show the highest socioeconomic vulnerability index to EP. However, **the index comes mainly due to differences in the NDI**, as the share of populations is balances within regions, with only a few rural regions in southern Balkan countries with a high share of elderly people.

MULTICRITERIA ANALYSIS:
REGIONAL CJARACTERISTICS + EXPENDITURE PATTERNS
– SOCIOECONOMIC AND DEMOGRAPHIC CHARACTERISTICS

The Heat or Eat Risk Index

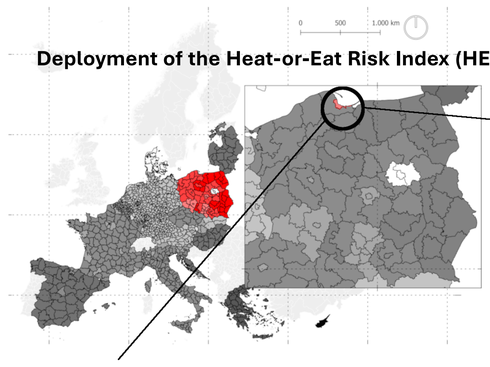


Conclusions

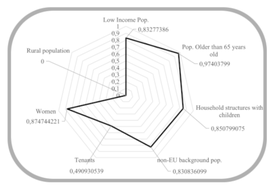
- The HERI Index show an overview of the regions **where the population is more at risk of suffering the heat-or-eat dilemma.**
- **Some countries showed greater variability** in their HERI levels within their regions such as France, Belgium, Croatia, Germany, and Slovenia. For the countries available, **the HERI shows higher in Balkan and Baltic countries**, following the trends already observed.
- The southern European region's values are at the same level as those of some central European regions, showing that **regional characteristics and expenditure patterns balance the negative values in SED characteristics. Metropolitan and urban regions show reduced HERI** in northern and northwestern Europe and regions close to metropolitan areas, potentially highlighting the wide difference between the Fragility of Energy Systems values in northern countries and the rest of the continent and the importance of the rural-urban type of regions.
- The step-by-step analysis provides **useful information for policy-making**, such as which are the vulnerable groups more prone in the region (SED Characteristics), how their relation with food and energy domains in economic terms (Expenditure Patterns), and their weaknesses in terms of Regional Characteristics.
- Compared to EP assessments like the EPAH report, **the HERI offers a multidimensional procedure that identifies EP beyond classical threshold approaches.**

Application: identification of EP causes for policy-makers

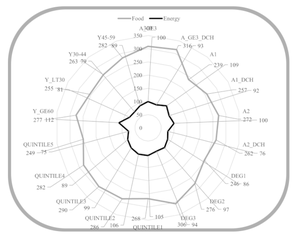
Deployment of the Heat-or-Eat Risk Index (HERI) in the Gdansk-Gdynia-Sopot (Trójmeski) Region

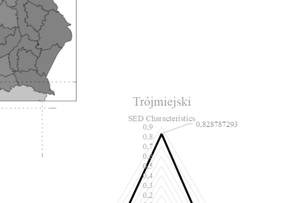


The analysis of the SED Index shows that in that particular region, women and populations older than 65 are the most representative vulnerable groups in the region.

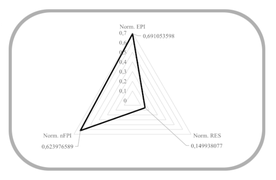


The deployment of the Expenditure Patterns per region shows which household groups are spending more on energy and food. In this case, Populations older than 60 spend a significantly higher relative expenditure than other groups, while household structures with children do it in food.





In the case of Regional Indicators, an in-depth analysis shows that the population of the region is more exposed to EP because of their energy affordability and food systems than from the Fragility of the Energy System.



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