

Spatial Inequality in the European ETS-2 Market

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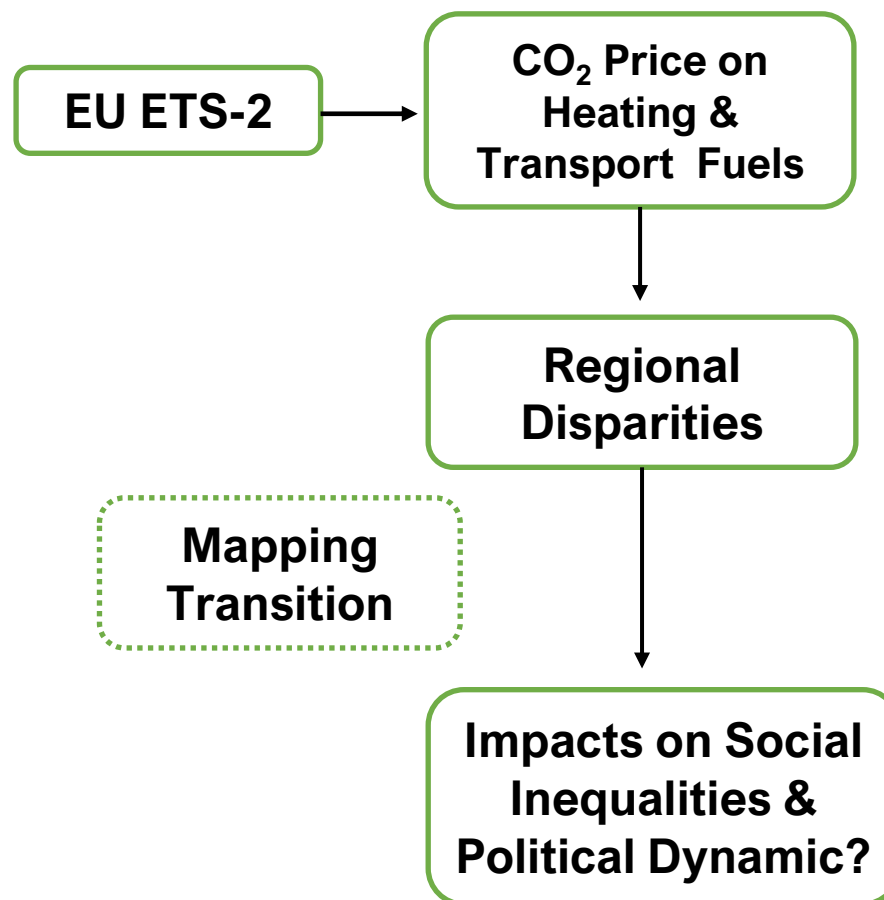


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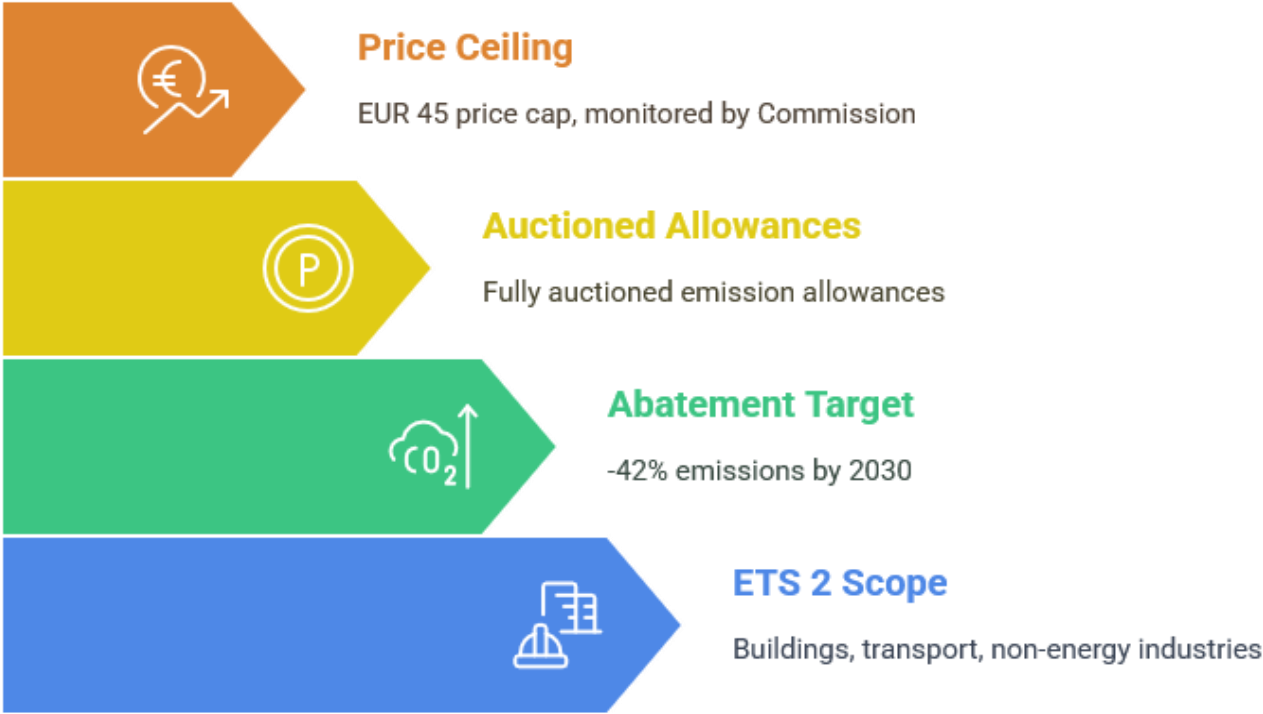
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- ✓ The EU energy transition has significant social impacts;
- ✓ Broad consensus that such policies impact regions and sectors differently;
- ✓ Persistent poverty and economic decay are the root of political populism;
- ✓ Game-changing policy.



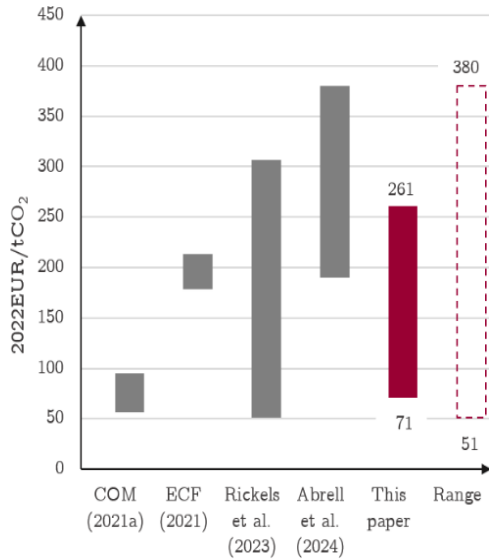
ETS 2 Framework



Methodological Approach

DIAMOND

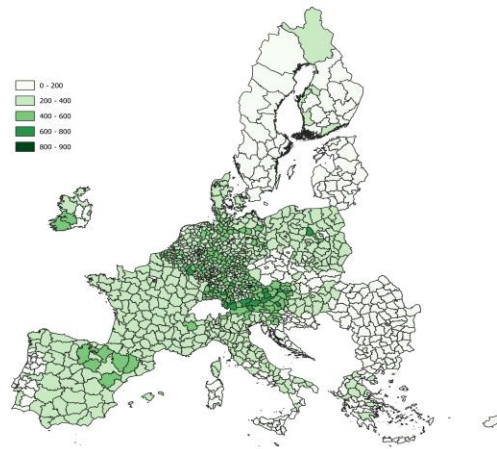
ETS-2
Assumption Price



ETS-2 Price Estimations

IEA Energy
Prices

iea
International
Energy Agency



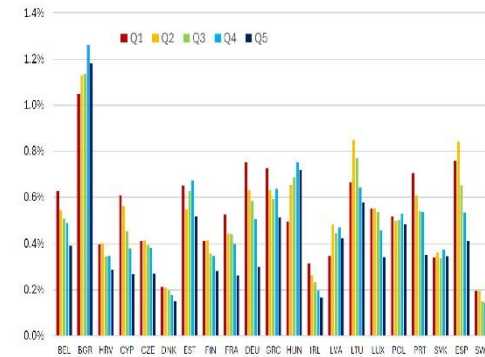
Eu
EU NUTS-3
Map



William
Survey Data



Impact on
Households



Econometric
Modelling



Geospatial
Analysis

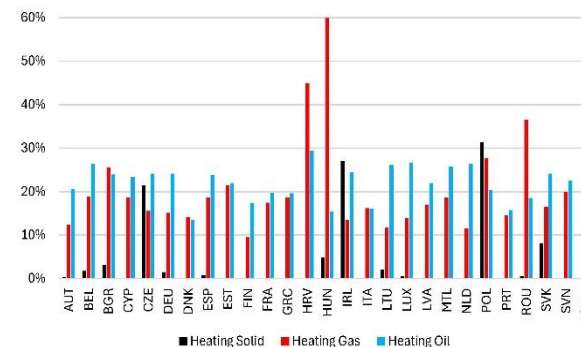


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ETS-2 Price and Energy Price Increase

- ETS-2 price = 100€ per ton of CO₂
- Households' Energy prices based on IEA statistics and year 2023 (including existing indirect taxation)



The Wiliam Survey: Household Budget Survey

- Work-done within **LOCOMOTION H2020** Project
- Data for year 2015
- 60 types of households for each Member State
 - Quintile
 - Rural *versus* Urban
 - Six household groups (single w/wo children, couple w/wo children....)

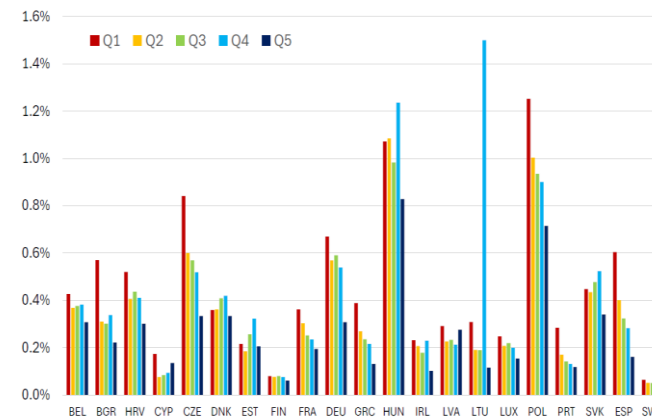


Table 5: Regression on heating expenditure ($\ln(E_H/HDD)$) with country-specific effects

Table 2: Data used in the regressions

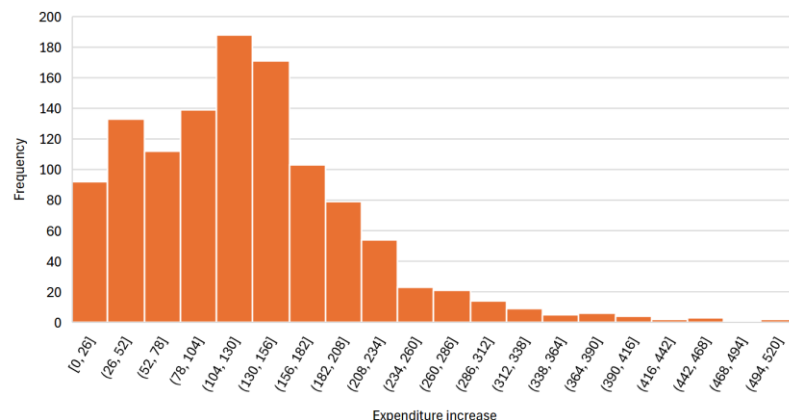
Variable	Description	Source	Unit
E_H	Heating fuel expenditure increase	WILIAM database	US \$ converted in € 2015
E_T	Transport fuel expenditure increase	WILIAM database	US \$ converted in € 2015
I	Disposable income	WILIAM database	US \$ converted in € 2015
U_r	Type of area	WILIAM databsse	Urban=1, Rural=0
F	Family composition	WILIAM database	†
HDD	Heating degree days (year 2015)	Eurostat	degree
F_j	Country specific effects		1 if the household lives in this country

†: Single=1; Single with children=1.5; Couple=2; Couple with children=2.5; Other=3; Other with children=3.5

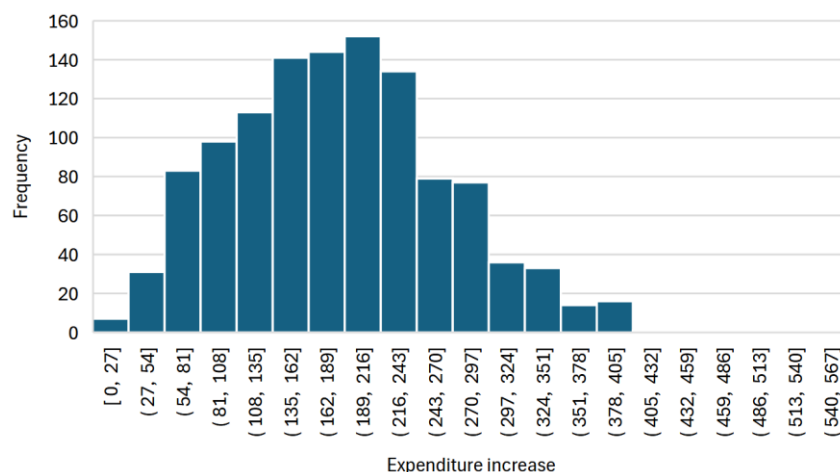
Variable	Coefficient	t-Statistic
$\ln(I)$	0.9311	16.4***
U_r	-0.3087	-8.6***
F	0.1079	3.8***
ESP	3.0267	25.9***
SVK	2.5954	21.1***
PRT	2.5345	21.3***
POL	3.4725	27.4***
LUX	2.2641	19.5***
LTU	1.6222	13.0***
LVA	1.7506	13.7***
IRL	1.8880	16.5***
HUN	3.5564	21.8***
GRC	2.5646	21.8***
DEU	2.6833	23.3***
FRA	2.6129	22.8***
FIN	0.3703	3.2***
EST	1.5615	12.3***
DNK	2.2902	19.9***
CZE	2.8976	22.9***
CYP	2.2462	19.4***
HRV	2.8953	22.6***
BGR	2.1830	14.7***
BEL	2.5949	22.6***
$Const$	-15.5312	-26.7***
R-squared	0.70	
F-Statistic	1258	
Degrees of freedom	1255	

Significantly different from 0 at *** 1%, *** 5%, * 10%

- 1160 European regions
- Data coming from Eurostat
- Extensive harmonization and consolidation work to fill missing variables, changes in region definition, etc.



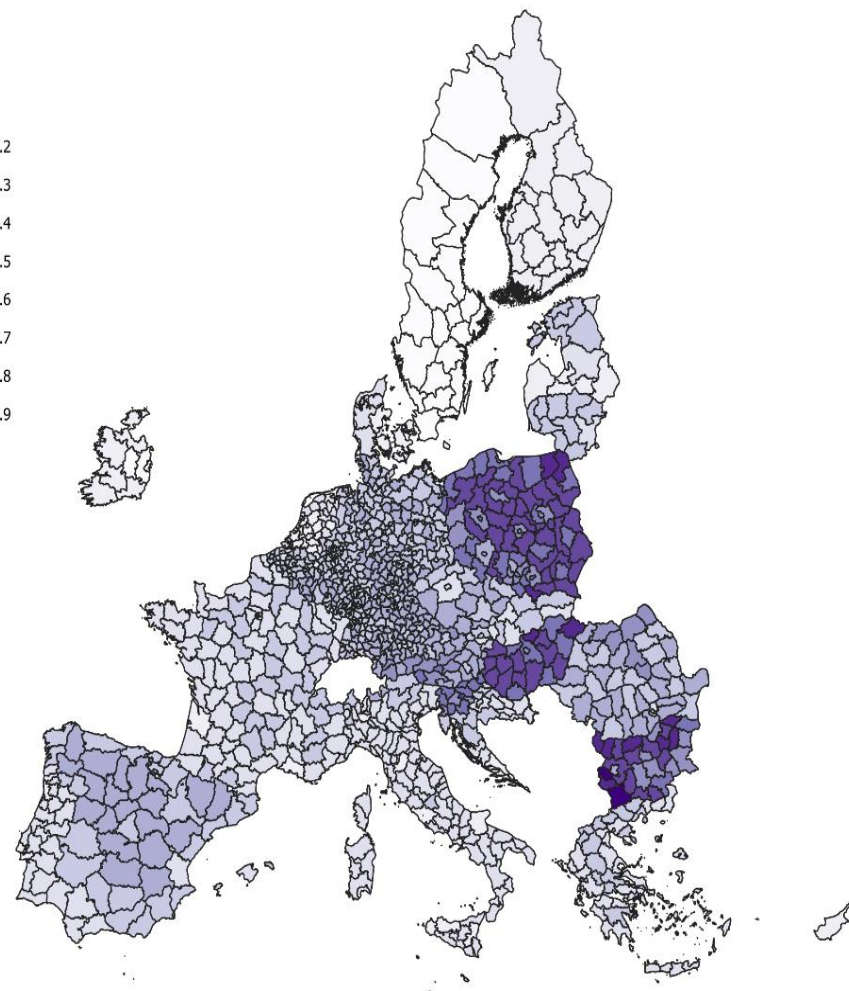
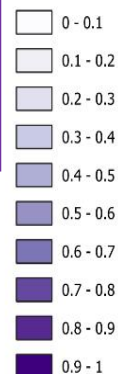
Heating expenditure
Min=0 € Max=511 €
Average=125 €

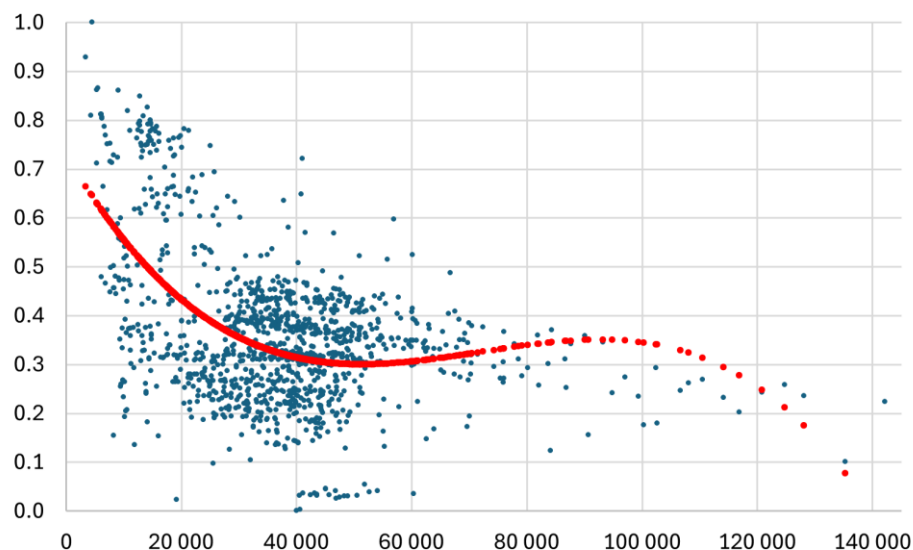


Transport expenditure
Min=17 € Max=511 €
Average=185 €

$$\text{Exposure : } E_r = \frac{\text{Total expenditure increase}}{\text{Disposable Income}}$$

$$\text{Exposure Index: } I_r = \frac{E_r - E_{Min}}{E_{Max} - E_{Min}}$$





Relationship between Exposure & Income per-capita in €

- **Blue point** → computed exposure index
- **Red point** → estimated exposure index with polynomial degree 3

Table 10: Top exposed regions by country

	Top 10%	Top 20%	Top 30%	Number of regions
Austria	6	19	26	35
Belgium	0	5	12	44
Bulgaria	22	27	28	28
Croatia	0	0	0	21
Cyprus	0	0	0	1
Czech Republic	0	1	6	14
Denmark	0	0	0	11
Estonia	0	0	0	5
Finland	0	0	0	19
France	0	0	0	96
Germany	0	42	125	400
Greece	0	0	0	52
Hungary	19	20	20	20
Ireland	0	0	0	8
Italy	0	1	1	107
Latvia	0	0	0	5
Lithuania	0	0	0	10
Luxembourg	0	0	0	1
Malta	0	0	0	2
Netherlands	0	0	0	40
Poland	57	73	73	73
Portugal	0	0	0	26
Romania	2	22	25	42
Slovakia	0	0	0	8
Slovenia	10	12	12	12
Spain	0	10	20	59
Sweden	0	0	0	21
EU27	116	232	348	1160

- 💎 **The regressive nature of ETS-2 disproportionately affects lower-income households;**
- 💎 **Regions with fossil fuel reliance and limited low-carbon infrastructure face high burdens;**
- 💎 **Regions from Bulgaria, Hungary, and Poland are the most exposed regions;**
- 💎 **Vulnerable regions need direct subsidies and renewable energy incentives --- Rethinking about Social Climate Fund;**
- 💎 **Long-term solutions include energy-efficient housing and better public transport;**

Thank You

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