Contradictions and challenges in the energy policy of the European Union and Hungary - is the sustainable energy transition possible?

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SOCIETY – ECONOMY – NATURE: SYNERGIES IN SUSTAINABLE DEVELOPMENT

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Agenda

- What are main energy and climate goals? Where do we want to get to?
- Where are we now? Pre-Covid vs. post-Covid era? How is the energy transition going?
- How do we want to achieve the goals (strategies – European Green Deal, ‘Fit for 55’ and REPowerEU)?
- What are the main challenges? Energy transition in the European Union – how to be green, sustainable, fair, rapid, transparent, broad and affordable at the same time? Or how the EU does not fit for ‘Fit for 55’?
- What should be the priorities?
- Conclusions and policy recommendations

What are main energy and climate goals? Where do we want to get to?

Energy and climate goals in the EU

Key targets for 2030 (valid EC documents - 2030 climate & energy framework, 2018):

- At least 40% cuts in greenhouse gas emissions (from 1990 levels)

→ 55% (2030 Climate Target Plan)

  - becoming a climate neutral continent by 2050

- At least 32% share for renewable energy → 40% (EC amendment - RED) → 45% (REPowerEU)
- At least 32.5% improvement in energy efficiency (a final energy consumption of 956 Mtoe and/or primary energy consumption of 1,273 Mtoe in the EU by 2030)

→ 787 Mtoe in final and 1023 Mtoe in primary energy consumption – July 2021 (36% and 39% energy efficiency targets for final and primary energy consumption)

→ 750 Mtoe in final and 980 Mtoe in primary energy consumption - REPowerEU

Where are we now? Pre-Covid vs. post-Covid era? How is the energy transition going?

Millennium Development Goals (2000-2015) - UN

Source: https://www.humanosphere.org/basics/2014/07/millennium-development-goals-accomplish-anything/ https://www.humanosphere.org/basics/2014/07/millennium-development-goals-accomplish-anything/

Sustainable Development Goals (2016-2030) - UN

Source: http://www.undp.org/content/dam/undp/library/corporate/brochure/SDGs_Booklet_Web_En.pdf

Progress towards SDG7 and SDG13, EU27

	SDGs	Long-term trend (past 15 years – 2004-2019)	Short-term trend (past 5 years – 2014-2019)	2020 EU-target	2030 EU-target
Primary energy consumption (TOE per capita)	SDG7	Moderate progress towards the EU target	Insufficient progress towards the EU target	totally 1,312 Mtoe for EU27	-32.5% (-39%)
Final energy consumption (TOE per capita)	SDG7	Moderate progress towards the EU target	Movement away from the EU target	-20% (totally 959 Mtoe for EU27)	-32.5% (-36%)
Final energy consumption in households per capita (KGOE)	SDG7	Moderate progress towards SD objectives	Significant progress towards SD objectives	-	-
Energy productivity (EUR per KGOE)	SDG7	Significant progress towards SD objectives	Significant progress towards SD objectives	-	-
Energy import dependency (%)	SDG7	Moderate movement away from SD objectives	Significant movement away from SD objectives	-	-
Population unable to keep home adequately warm (%)	SDG7	-	Significant progress towards SD objectives	-	-
Greenhouse gas emissions intensity of energy consumption (2000=100%)	SDG7, SDG13	Moderate progress towards SD objectives	Moderate progress towards SD objectives	-	-
Share of renewable energy in gross final energy consumption (%)	SDG7, SDG13	Significant progress towards the EU target	Significant progress towards the EU target	20%	32% (40%, 45%)
Greenhouse gas emissions (in CO2 equivalent, 1990=100%)	SDG13	Moderate progress towards the EU target	Insufficient progress towards the EU target	-20%	-55%
Average CO2 emissions from new passenger cars (Gram of CO2 per km)	SDG13	Moderate progress towards the EU target	Insufficient progress towards the EU target	-	-
Population covered by the Covenant of Mayors for Climate and Energy signatories	SDG13	-	Significant progress towards SD objectives	-	-

Source: own compilation based on (Eurostat 2020b, 138; European Commission 2017; 2021a; 2014; Eurostat 2020a)

Progress towards 2020 energy targets in 2019 and in 2020

	Energy efficiency				Share of renewable energy in gross final energy consumption		Emission	
	Final energy consumption		Primary energy consumption					
	2019	2020	2019	2020	2019	2020	2019	2020
EU-27	⊗	✓	⊗	✓	⊗	✓	✓	✓
Belgium	⊗	⊗	⊗	⊗	⊗	✓	⊗	✓
Bulgaria	⊗	⊗	⊗	⊗	✓	✓	✓	⊗
Czechia	✓	✓	✓	✓	✓	✓	✓	✓
Denmark	✓	✓	✓	✓	✓	✓	⊗	✓
Germany	⊗	⊗	⊗	✓	⊗	✓	⊗	⊗
Estonia	⊗	✓	✓	✓	✓	✓	✓	✓
Ireland	⊗	✓	⊗	✓	⊗	✓	⊗	⊗
Greece	✓	✓	✓	✓	✓	✓	✓	✓
Spain	✓	✓	✓	✓	⊗	✓	⊗	✓
France	⊗	✓	⊗	✓	⊗	⊗	⊗	✓
Croatia	✓	✓	✓	✓	✓	✓	✓	✓
Italy	✓	✓	✓	✓	✓	✓	⊗	✓
Cyprus	✓	✓	⊗	✓	✓	✓	⊗	⊗
Latvia	✓	✓	✓	✓	✓	✓	✓	✓
Lithuania	⊗	⊗	✓	✓	✓	✓	✓	✓
Luxembourg	⊗	✓	⊗	✓	⊗	✓	⊗	✓
Hungary	⊗	✓	✓	✓	⊗	✓	✓	✓
Malta	⊗	✓	⊗	✓	⊗	✓	✓	⊗
Netherlands	✓	✓	⊗	✓	⊗	✓	⊗	✓
Austria	⊗	⊗	⊗	✓	⊗	✓	⊗	✓
Poland	⊗	✓	⊗	⊗	✓	✓	✓	✓
Portugal	✓	✓	✓	✓	⊗	✓	✓	✓
Romania	✓	✓	✓	✓	✓	✓	✓	✓
Slovenia	✓	✓	✓	✓	⊗	✓	✓	✓
Slovakia	⊗	✓	✓	✓	✓	✓	✓	✓
Finnland	✓	✓	✓	✓	✓	✓	⊗	⊗
Sweeden	⊗	⊗	⊗	✓	✓	✓	⊗	✓

Energy efficiency			
FEC		PEC	
'19	'20	'19	'20
13/27	21/27	15/27	24/27

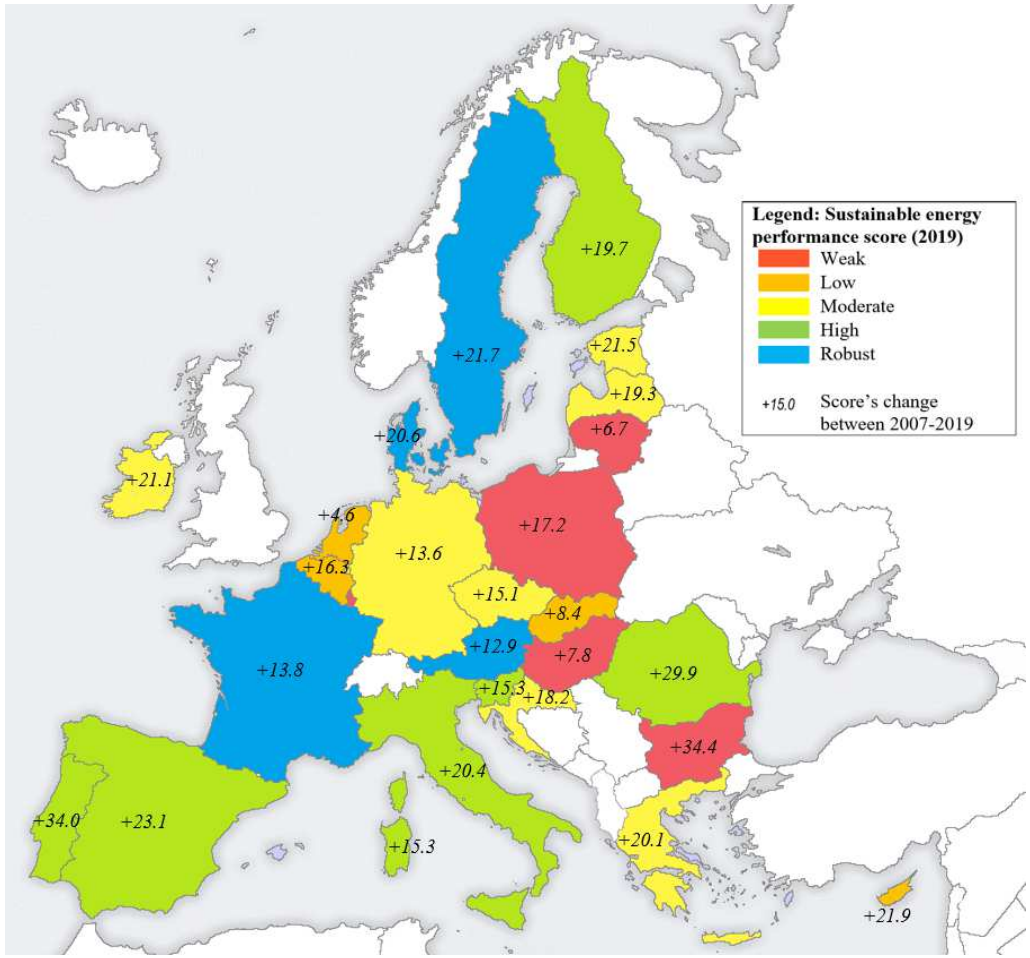
RES		Emission	
'19	'20	'19	'20
15/27	26/27	14/27	21/27

Number of successful completions

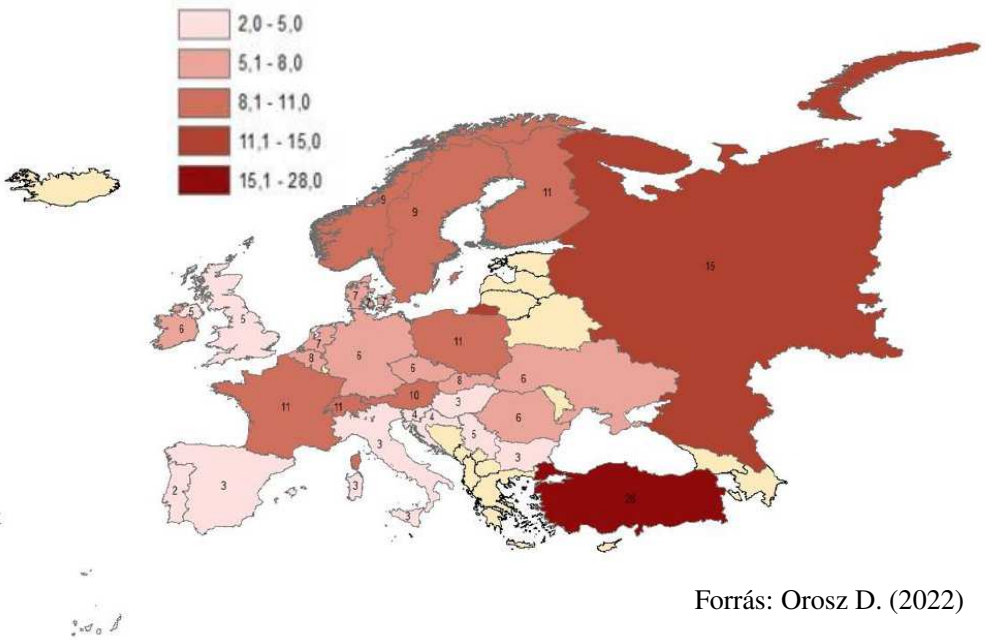
Source: EEA, 2022

Energy transition of EU Member States

Geographical distribution of sustainable energy performance score (2019) and its change between 2007-2019



Average rate of energy renovation in Europe (2011 and 2020)



Forrás: Orosz D. (2022)

- Composite indicator.
- Results show significant differences which do not follow the usual East-West division of the integration.
- Both convergence and divergence can be revealed.
- All EU Member States improved their sustainable energy performance between 2007-2019.

Source: Szép T., Pálvölgyi T., Kármán-Tamus É. (2022): Indicator-based assessment of sustainable energy performance in the European Union. INTERNATIONAL JOURNAL OF SUSTAINABLE ENERGY PLANNING AND MANAGEMENT 34 pp. 107-124., 18 p.

Structural Change Indexes (SCIs) – Moore, NAV and modified LILIEN index

- Research goal: to measure the degree of change in the national and household energy mix.
- Hypothesis: the progress of the sustainable energy transition can be measured but its' degree is stagnating or even declining.
- Method: Structural change Indexes (SCIs) – Moore (M), NAV (or Stoikov, or Michaely index), modified Lilien index
  - It measures the degree of structural change.
  - It is "based on the fact that the structure of output in any period can be described by a vector whose coordinates are the quantities of outputs which form the basis for calculating the index numbers" (Song 2019; Zhang and Pu 2015; Moore 1978, 106). The change of the energy mix is showed by the cosine of the angle between vectors $\cos\alpha = M_t^+$, $\alpha = \text{arc cos } M_t^+$. The higher α, the higher the rate of the change of the energy mix. The unit of measure is degree.

$$M = \sum_{i=1}^{n} W_{i,t} * W_{i,t+1} / \left[\left(\sum_{i=1}^{n} W_{i,t}^2 \right)^{1/2} * \left(\sum_{i=1}^{n} W_{i,t+1}^2 \right)^{1/2} \right]$$

$$NAV = \frac{1}{2} \sum_{i=1}^{n} \left| W_{i,t+1} - W_{i,t} \right| \qquad W_{i,t} > 0, W_{i,t+1} > 0$$

$$MLI = \sqrt{\sum_{i=1}^{n} W_{i,t} * W_{i,t+1} * \left[ln \frac{W_{i,t+1}}{W_{i,t}} \right]^2},$$

where $W_{i,t}$ is the share of energy expenditure by energy sources in the household sector (i = electricity, natural gas, liquid fuels, solid fuels, district heating and renewables) in t period; $W_{i,t+1}$ is the share of energy expenditure by energy sources in the household sector in t+1 period.

Changes of the energy mix (final energy consumption by sources, 2000-2020, EU-27)

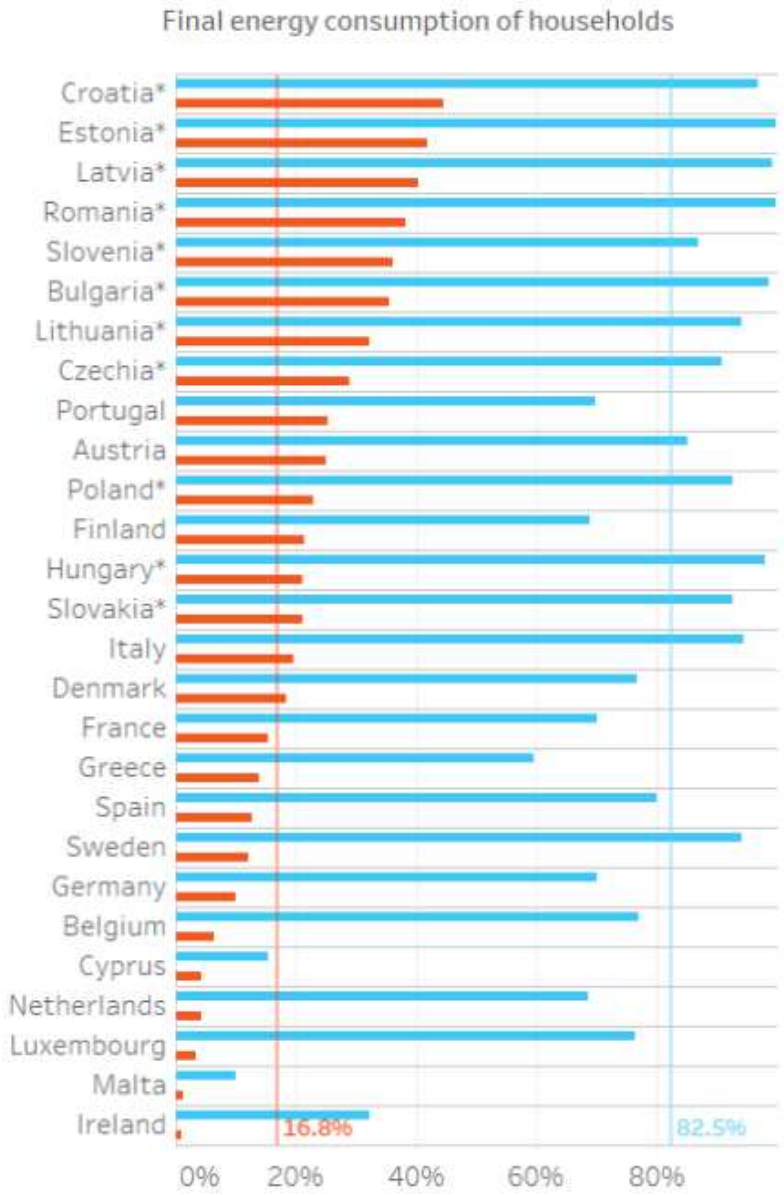
	2000-2005			2005-2010			2010-2015			2015-2020		
	Moore	NAV	MLI	Moore	NAV	MLI	Moore	NAV	MLI	Moore	NAV	MLI
EU-27	2.438	0.027	0.024	4.494	0.037	0.044	2.241	0.021	0.02	3.38	0.027	0.031
Old member states & Ciprus and Malta												
BE	1.468	0.015	0.014	4.076	0.04	0.043	1.757	0.017	0.017	5.377	0.048	0.053
DK	2.135	0.021	0.021	5.574	0.055	0.054	3.923	0.036	0.036	2.362	0.02	0.022
DE	5.623	0.060	0.061	4.844	0.039	0.049	1.737	0.016	0.015	3.496	0.033	0.031
IE	1.037	0.015	0.013	4.251	0.056	0.059	4.17	0.047	0.055	3.603	0.04	0.04
GR	2.623	0.033	0.033	4.368	0.058	0.064	6.356	0.08	0.089	3.766	0.043	0.046
ES	4.197	0.044	0.049	4.087	0.048	0.046	3.171	0.031	0.036	3.748	0.036	0.042
FR	3.646	0.035	0.038	4.911	0.047	0.049	1.972	0.02	0.018	3.767	0.033	0.037
HR	1.952	0.019	0.021	3.719	0.031	0.036	4.145	0.04	0.038	3.471	0.035	0.035
LU	5.213	0.074	0.070	3.259	0.046	0.051	1.539	0.021	0.02	3.753	0.053	0.059
MT	0.418	0.004	0.005	3.429	0.034	0.042	1.751	0.02	0.026	5.233	0.055	0.07
NL	2.951	0.026	0.030	2.652	0.025	0.027	4.808	0.049	0.048	3.153	0.034	0.031
AT	2.569	0.026	0.027	7.967	0.067	0.078	2.317	0.021	0.021	2.171	0.019	0.019
PT	4.778	0.062	0.054	5.907	0.062	0.072	5.375	0.051	0.058	3.543	0.033	0.037
SI	3.165	0.035	0.033	2.146	0.024	0.023	4.211	0.038	0.043	4.008	0.038	0.041
SK	8.281	0.089	0.074	5.513	0.05	0.05	9.716	0.09	0.079	9.159	0.084	0.071
SE	5.983	0.056	0.056	6.15	0.055	0.057	9.848	0.074	0.087	7.905	0.057	0.07
Post-communist countries												
BG	4.272	0.038	0.036	8.262	0.086	0.068	4.864	0.043	0.041	5.231	0.049	0.046
CZ	10.296	0.072	0.078	6.239	0.042	0.048	6.723	0.058	0.052	3.185	0.024	0.024
EE	4.903	0.047	0.040	6.248	0.057	0.051	5.988	0.054	0.052	3.482	0.034	0.029
IT	3.688	0.044	0.040	6.591	0.061	0.069	2.396	0.022	0.023	6.813	0.056	0.064
CY	3.286	0.039	0.052	4.462	0.063	0.067	1.902	0.026	0.025	7.274	0.086	0.108
LV	5.131	0.033	0.043	3.396	0.033	0.028	5.879	0.057	0.05	1.778	0.017	0.015
LT	5.341	0.053	0.047	1.405	0.013	0.013	6.892	0.062	0.06	4.677	0.036	0.044
HU	3.268	0.031	0.031	8.972	0.081	0.085	7.194	0.06	0.062	2.739	0.024	0.025
PL	5.071	0.043	0.039	2.754	0.02	0.021	4.969	0.039	0.038	9.584	0.079	0.076
RO	9.955	0.072	0.080	8.083	0.068	0.065	6.984	0.064	0.057	3.693	0.036	0.033
FI	3.293	0.029	0.028	4.931	0.04	0.042	5.684	0.046	0.048	5.385	0.042	0.046

Note: red – slow down, green – speed up
Source: own calculation

Changes of the residential energy mix (2000-2020, EU-27)

	2000-2005			2005-2010			2010-2015			2015-2020		
	Moore	NAV	MLI	Moore	NAV	MLI	Moore	NAV	MLI	Moore	NAV	MLI
EU-27	3.795	0.033	0.031	7.734	0.054	0.063	4.415	0.039	0.036	1.965	0.019	0.017
Old member states & Ciprus and Malta												
BE	4.967	0.046	0.052	9.514	0.081	0.097	3.564	0.031	0.036	1.475	0.015	0.014
DK	8.722	0.056	0.072	7.95	0.07	0.069	7.022	0.059	0.062	3.069	0.025	0.027
DE	4.345	0.040	0.039	7.783	0.061	0.069	3.181	0.031	0.028	2.684	0.027	0.025
IE	5.298	0.057	0.054	2.269	0.024	0.021	7.945	0.068	0.08	5.696	0.053	0.059
GR	4.044	0.044	0.046	14.449	0.142	0.166	11.418	0.093	0.115	4.18	0.037	0.04
ES	9.894	0.090	0.089	11.112	0.09	0.101	5.1	0.041	0.047	5.985	0.059	0.059
FR	3.340	0.029	0.031	8.951	0.086	0.076	5.406	0.047	0.049	4.642	0.043	0.042
HR	3.654	0.033	0.034	4.572	0.042	0.044	6.043	0.065	0.067	4.29	0.04	0.043
LU	6.468	0.053	0.068	8.337	0.066	0.088	4.163	0.044	0.047	10.467	0.086	0.113
MT	11.623	0.116	0.163	5.747	0.062	0.054	1.823	0.025	0.031	7.256	0.073	0.093
NL	1.510	0.024	0.027	1.371	0.017	0.021	4.607	0.065	0.08	2.786	0.035	0.044
AT	9.534	0.072	0.076	8.902	0.066	0.072	6.495	0.057	0.053	2.474	0.021	0.02
PT	8.112	0.083	0.080	14.529	0.117	0.139	15.508	0.123	0.149	2.037	0.018	0.02
SI	4.274	0.036	0.040	7.365	0.06	0.067	12.028	0.103	0.118	8.368	0.069	0.083
SK	9.690	0.103	0.119	3.515	0.034	0.039	6.718	0.071	0.076	24.4	0.224	0.212
SE	4.989	0.044	0.052	7.722	0.066	0.085	7.12	0.069	0.077	0.885	0.01	0.012
Post-communist countries												
BG	7.565	0.066	0.036	7.813	0.081	0.075	2.982	0.031	0.031	4.244	0.046	0.042
CZ	6.500	0.058	0.078	5.859	0.053	0.05	10.761	0.077	0.088	6.647	0.052	0.057
EE	4.155	0.045	0.040	11.458	0.097	0.113	2.1	0.02	0.021	1.063	0.011	0.01
IT	8.856	0.084	0.040	10.577	0.089	0.111	3.156	0.031	0.031	1.631	0.015	0.017
CY	13.408	0.128	0.052	14.226	0.129	0.158	6.252	0.05	0.067	7.813	0.065	0.08
LV	4.183	0.041	0.043	7.568	0.081	0.091	2.511	0.024	0.025	1.835	0.019	0.016
LT	2.959	0.033	0.047	3.574	0.043	0.036	3.731	0.03	0.034	5.034	0.053	0.048
HU	5.215	0.061	0.031	11.802	0.108	0.125	8.124	0.072	0.081	10.471	0.087	0.107
PL	10.537	0.071	0.039	6.281	0.047	0.055	4.783	0.041	0.042	16.927	0.119	0.134
RO	16.255	0.129	0.080	12.206	0.115	0.119	6.458	0.068	0.062	5.036	0.044	0.048
FI	3.500	0.027	0.028	5.075	0.044	0.047	3.925	0.037	0.04	8.396	0.067	0.08

Note: red – slow down, green – speed up
Source: own calculation



Share of household biomass use in the residential energy consumption (EU27, %, 2020)

- The sustainable energy transition can only be achieved if we avoid the traditional biomass trap.
  - Many times traditional biomass is produced in unsustainable way even in the European Union.
  - The carbon neutrality of the traditional biomass may be questioned.
  - Even if traditional biomass is used, higher added value is needed (cascading principle).

share of household primary solid biomass use: in renewable energy, in all energy sources

EU27 average * in CEE region

Source: Habitat for Humanity, 2022

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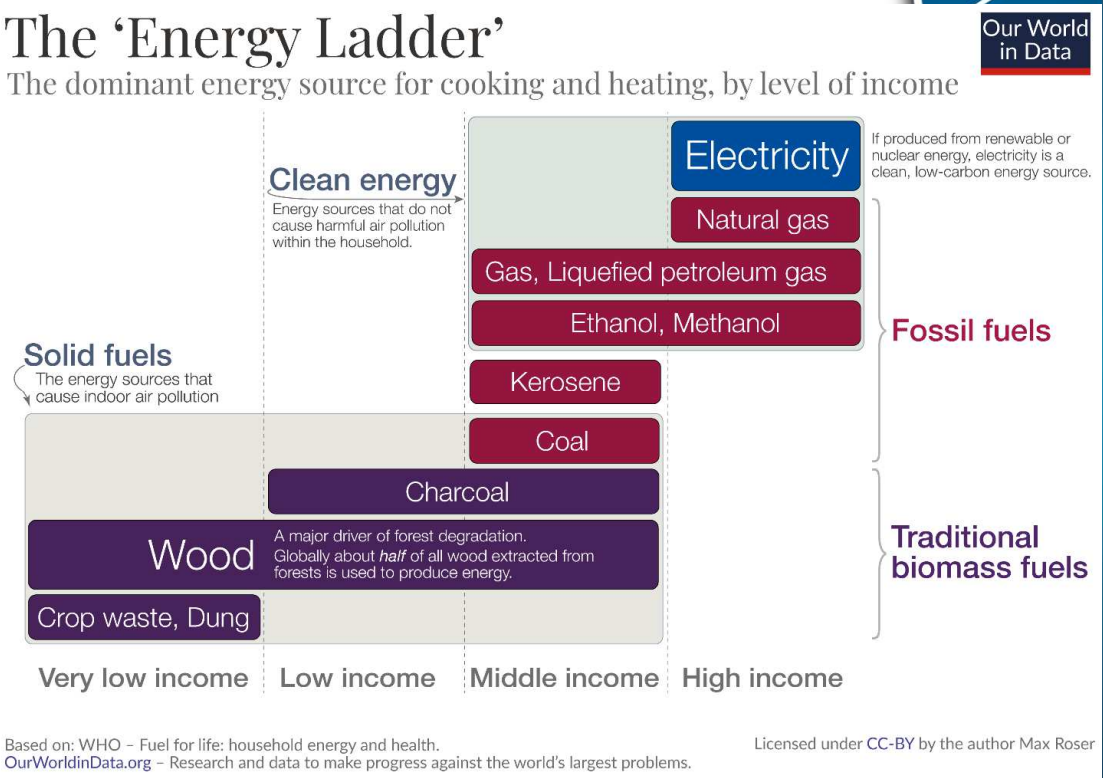
Slow progress of energy transition in the household sector

- CEE: bad combination of high energy costs, inadequate household income and obsolete housing stock.
- Solid fuel users are more exposed to energy vulnerability and they are the most affected by energy poverty.
- Energy ladder and energy stacking theory → multiple fuel use is more likely → it may slow down the energy transition.
- Renewable energy mix → a clear distinguish should be made and the traditional biomass has to be separated from modern renewable energy sources.

Shielding policies for energy poor households are critically important, however the new Social Climate Fund maybe not provide enough support.



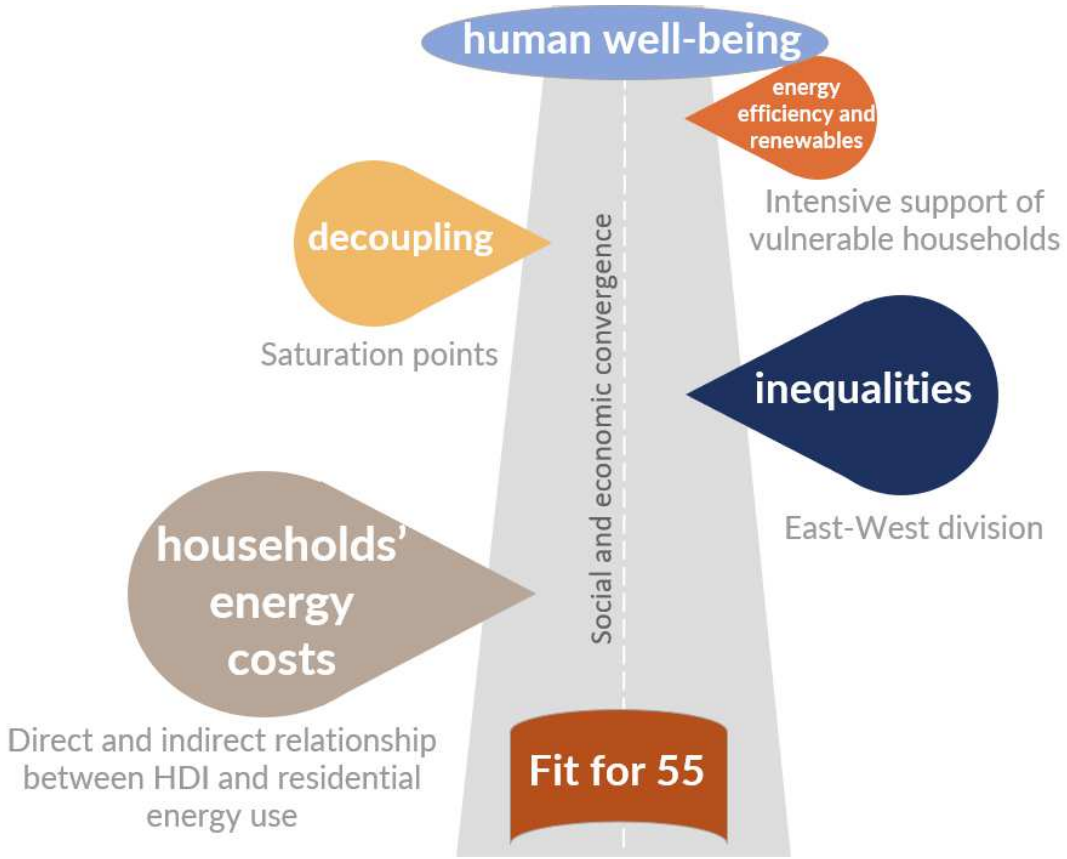
https://ourworldindata.org/energy-ladder

How do we want to achieve the goals (strategies – European Green Deal, ‘Fit for 55’ and REPowerEU)?

European Green Deal, 'Fit for 55' and REPowerEU

- European Green Deal: turning the EU into the first climate neutral continent by 2050 (to reduce emissions by at least 55% by 2030, compared to 1990 levels).
  - supporting vulnerable citizens by tackling inequality and energy poverty, and strengthening the competitiveness of European companies.
- How to deliver it? → 'Fit for 55'
  - It's a package and a set of proposals to revise and update EU legislation.
    - ensures a just and socially fair transition; maintains and strengthens innovation and competitiveness of EU industry while ensuring a level playing field vis-à-vis third country economic operators; underpins the EU's position as leading the way in the global fight against climate change
    - Expanding the ETS to buildings and road transport → *higher energy costs for households*
- But! The war changed everything, or not? → REPowerEU
  - Double goal: ending the EU's dependence on Russian fossil fuels and tackling the climate crisis
  - How? energy savings, diversification of energy supplies, and accelerated roll-out of renewable energy to replace fossil fuels

What are the main challenges? Energy transition in the European Union – how to be green, sustainable, fair, rapid, transparent, broad and affordable at the same time? Or how the EU does not fit for ‘Fit for 55’?



Rapid polling - Question:

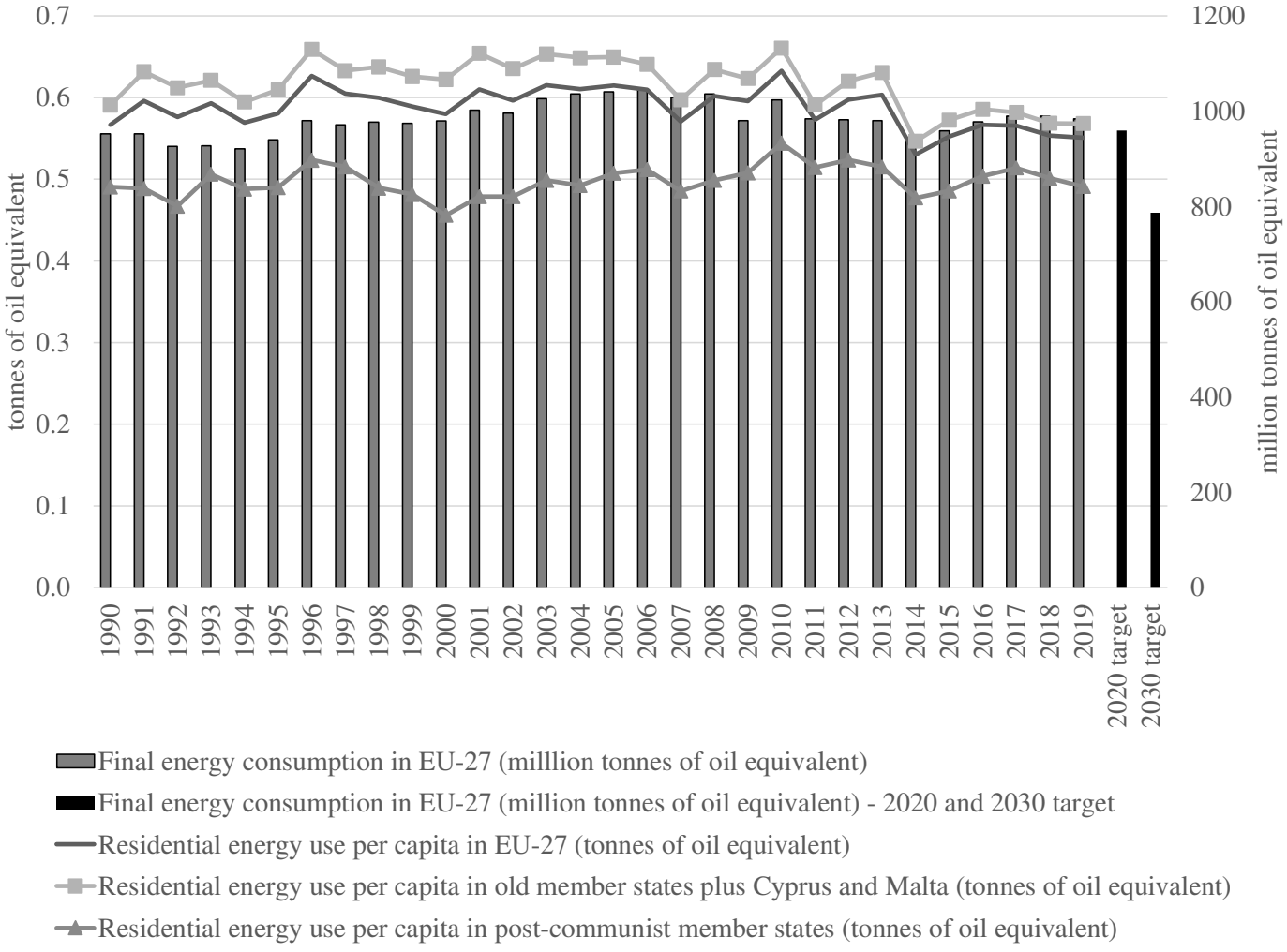
Can we say that achieving convergence is one of the EU's most important long-term goals?

Convergence (economic and human well-being), inequalities and decoupling – a systemic approach

- The key benefit of EU membership is convergence
  - What does it mean? → higher living standard with higher GDP and social rights (education, income, housing)
- The economic and social convergence results in higher level of human well-being (HDI).
  - But! Strong correlation between the residential energy consumption and HDI until the saturation point → Beyond this point, the correlation becomes very weak and decoupling happens.
    - *Increasing energy use beyond this level does not necessarily contribute to a higher development stage, and higher levels of well-being can be sustained with declining energy consumption.*
  - In practice: the member states below the saturation points (HDI is coupled with residential energy consumption) need more energy in the household sector to increase their HDI.
- Energy convergence in the European Union, to achieve human development convergence, is an unresolved policy challenge → huge inequalities in the energy use.

We question the policy assumption of 'Fit for 55' that decreasing household energy consumption (and increasing energy costs) can be neutral or even beneficial for households in most post-communist member states (PCMS) in the short timeframe up to 2030.

Regional inequalities in the residential energy use I.



Residential energy use per capita (toe), final energy consumption (Mtoe) and energy efficiency targets (2020 and 2030, Mtoe) in the European Union (1990-2019)

Source: LaBelle M. C., Tóth G., Szép T. (2022): Not Fit for 55: The HDI spatial injustice of residential energy consumption in the European Union. Energies, 15, 6687.

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Regional inequalities in the residential energy use II. – Gini and Hoover

Gini coefficients and Hoover-index results in the EU member states (2000, 2010 and 2020)

	2000		2010		2020	
Index compared to the residential energy use per capita	Gini	Hoover (%)	Gini	Hoover (%)	Gini	Hoover (%)
Population	0.621	51.329	0.627	51.429	0.626	50.903
GDP per capita	0.332	23.468	0.275	20.041	0.287	20.585
Final consumption expenditure of households per capita	0.291	22.977	0.256	18.122	0.212	15.870

Source: Szép T., Tóth G., LaBelle M. C. (2022): Farewell to the European Union's east-west divide: Decoupling energy lifts the well-being of households, 2000–2018. REGIONAL STATISTICS 12 : 3, 33 p.

Nearly 23% of the residential energy use per capita would need to be redeployed among the EU member states to match the characteristics of the final consumption expenditure of households per capita and create territorial equality.

- The territorial distribution and spatial inequalities of residential energy consumption per capita are consistent with the differences in economic development and show moderate and declining differences → the households' energy use is consistent with their economic development.
- Considering the Hoover index and rank correlation results, most redistribution (declining inequalities) occurred among predefined country groups and not within groups.
- The spatial economic inequality within the EU is echoed in the inequality in energy use.

Critical role of energy use in human well-being

2000				
HDI	H_FENUSEcap	H_FCEXcap	GDPcap	
1,0000	0,6977	0,8525	0,8602	HDI
	1,0000	0,5927	0,7176	H_FENUSEcap
		1,0000	0,9736	H_FCEXcap
			1,0000	GDPcap
2010				
HDI	H_FENUSEcap	H_FCEXcap	GDPcap	
1,0000	0,7041	0,8158	0,7577	HDI
	1,0000	0,5663	0,6511	H_FENUSEcap
		1,0000	0,9547	H_FCEXcap
			1,0000	GDPcap
2020				
HDI	H_FENUSEcap	H_FCEXcap	GDPcap	
1,0000	0,5254	0,7940	0,7144	HDI
	1,0000	0,5667	0,5383	H_FENUSEcap
		1,0000	0,9055	H_FCEXcap
			1,0000	GDPcap
2000-2020				
HDI	H_FENUSEcap	H_FCEXcap	GDPcap	
1,000	0,516	0,799	0,74	HDI
	1,000	0,525	0,585	H_FENUSEcap
		1,000	0,943	H_FCEXcap
			1,000	GDPcap

Correlation coefficients (EU member states, cross-sectional data* for 2000, 2010, 2020 and panel data for the period of 2000–2020)**

- The growth of HDI relies on a range of actions, but the correlation with energy consumption is well-established.
- The minimum quantity of energy (thresholds or minimum levels) needed to achieve a certain level of human development.

Source: Szép T., Tóth G., LaBelle M. C. (2022): Farewell to the European Union's east-west divide: Decoupling energy lifts the well-being of households, 2000–2018. REGIONAL STATISTICS 12 : 3, 33 p.

Correlation coefficients of HDI and residential energy use per capita (toe) in EU member states, using the observations 2000– 2020

Correlation coefficients (cases with negative coefficients) - Group 3		Correlation coefficients (cases with positive coefficients) - Group 4	
old member states plus Cyprus and Malta - Group 1			
Scandinavian			
Denmark	-0.549	Finland	0.405
Sweden	-0.711		
Western			
Austria	-0.469		
Belgium	-0.884		
France	-0.742		
Germany	-0.829		
Ireland	-0.748		
Luxembourg	-0.893		
Netherlands	-0.778		
Mediterranean			
Greece	-0.473	Cyprus	0.634
Malta	-0.053	Italy	0.160
Portugal	-0.440		
Spain	-0.277		

post-Communist member states - Group 2			
V4			
Slovakia	-0.696	Czechia	0.073
		Hungary	0.109
		Poland	0.696
Baltics			
		Estonia	0.471
		Latvia	0.005
		Lithuania	0.894
later joiners			
		Bulgaria	0.867
		Romania	0.763
former Yugoslavia			
Croatia	-0.226		
Slovenia	-0.739		

Source: own edition

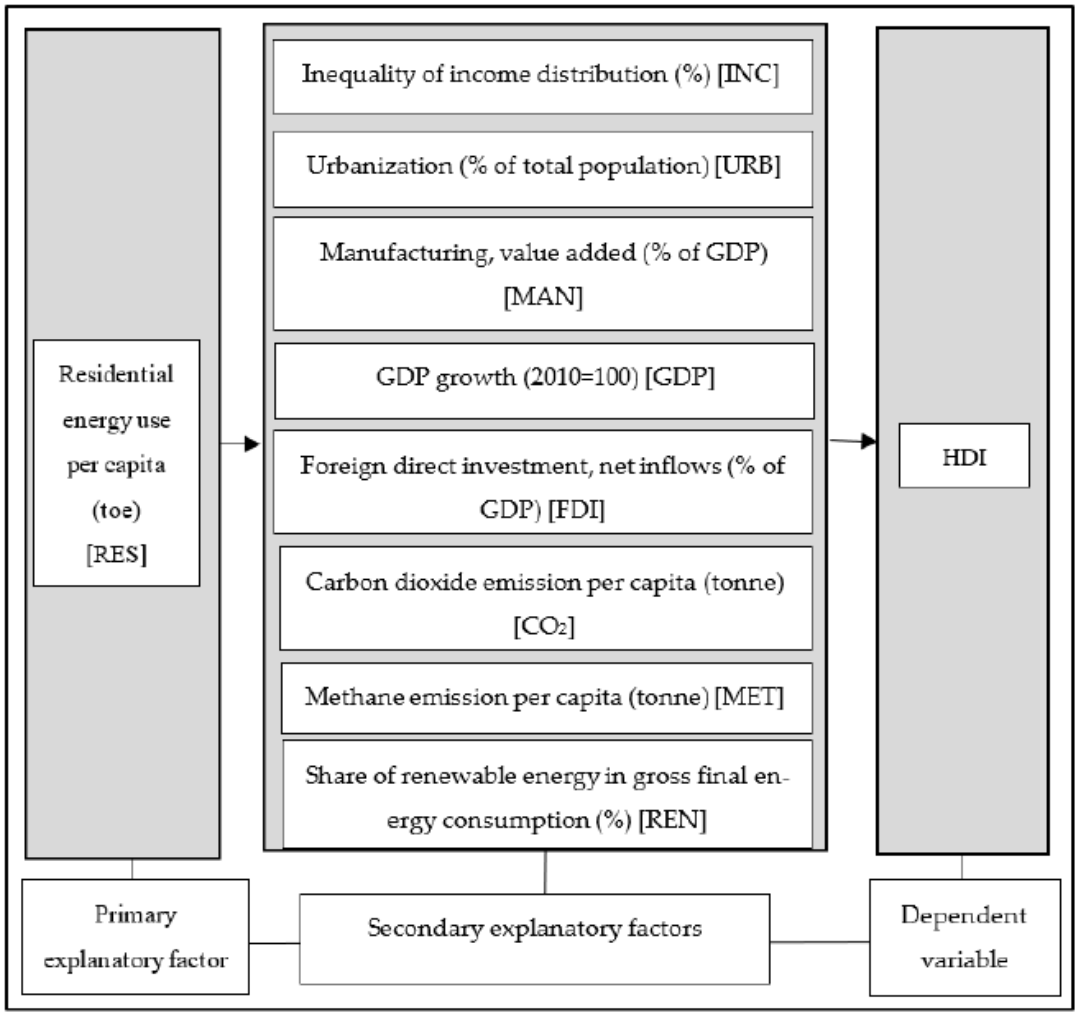
Critical role of energy use in human well-being – direct and indirect relationship (path analysis)

RQ1: Can a significant relationship be identified between residential energy use and HDI in the European Union? If so, what are the most significant indicator(s) of this direct and indirect relationship?
RQ2: Does the increasing residential energy use have a positive (push) effect on HDI?

The higher the residential energy use per capita, the higher the HDI.

Data and method: EU27, 2000, 2008, 2018, path analysis to assess both the direct and indirect relationship between residential energy consumption per capita and HDI up to 2018.

Causality relations of the groups of explanatory variables



Source: LaBelle M. C., Tóth G., Szép T. (2022): Not Fit for 55: The HDI spatial injustice of residential energy consumption in the European Union. Energies, 15, 6687.

Critical role of energy use in human well-being – results

Highlights

- Both direct and indirect relationships of residential energy consumption and HDI are identified.
  - It can be stated that, if a larger residential energy use growth would be realized in the European Union, the effect would be appeared in the short term or vica versa, reducing energy use puts at risk the human well-being achieved.
    - *A certain threshold of energy consumption enables decoupling, but until that point, energy and economic growth go hand-in-hand to deliver improved human well-being.*
- The PCMS are expected to catch up to OMS higher HDI.
- HDI growth in the East requires more energy consumption in the household sector.
- Lack of energy convergence jeopardizes the 'Fit for 55' implementation plan.
- Equitable distribution of residential energy consumption is necessary for 'Fit for 55'.

The policy challenge in the 'Fit for 55' plan is to ensure further HDI growth (and human development convergence) in PCMS but reduce residential energy use through policies that assist the #decoupling and the #reduction of inequalities in energy use.

Scenario analysis

1. Energy equilibrium: OMS households reduce energy consumption to the PCMS level and PCMS consumption remains constant but with no energy–HDI uncoupling and no HDI convergence;
2. HDI-Energy disequilibrium: Energy consumption of both OMS and PCMS is jointly reduced, with a HDI decline in PCMS;
3. **HDI equilibrium: PCMS energy consumption is allowed to increase so HDI converges on a reducing OMS energy path, thereby achieving an EU equilibrium for households.**
    - But! increasing PCMS residential energy consumption runs counter to 'Fit for 55' policy projections. Stagnation or decline of human well-being seems an unlikely policy objective by PCMS politicians.

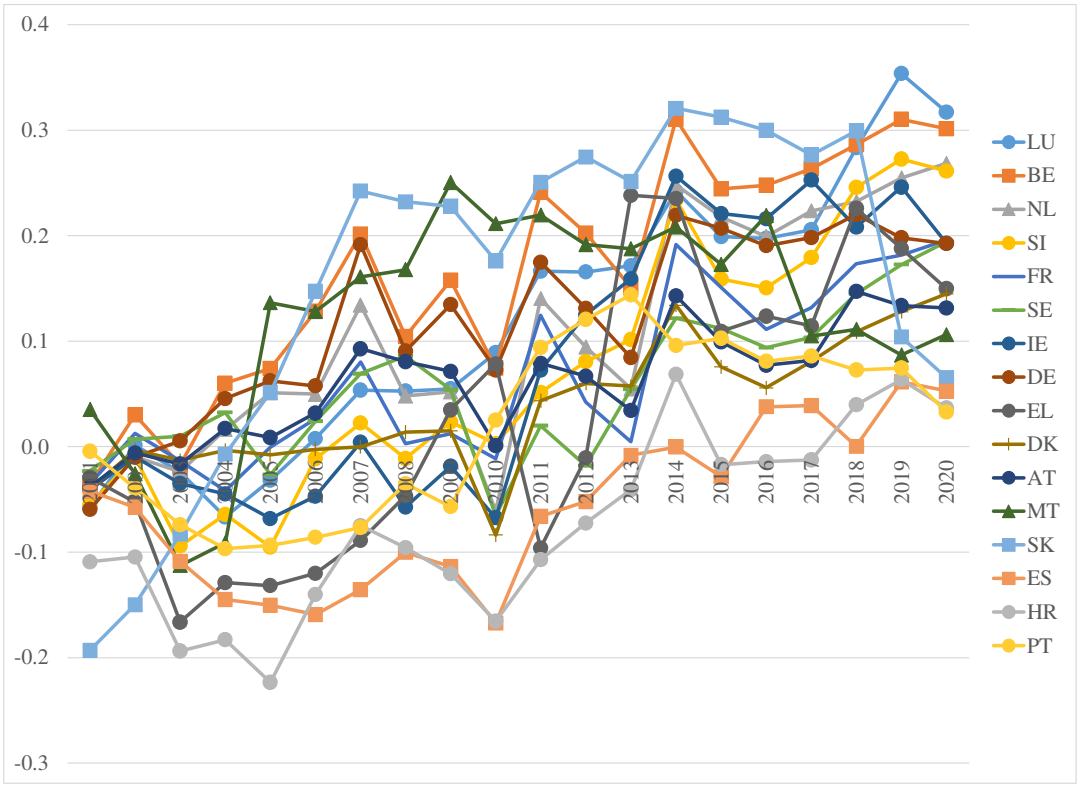
<u>This is why 'Fit for 55' is not fit for EU economic and social convergence.</u>

- Solution: The convergence of well-being in the European Union will either:

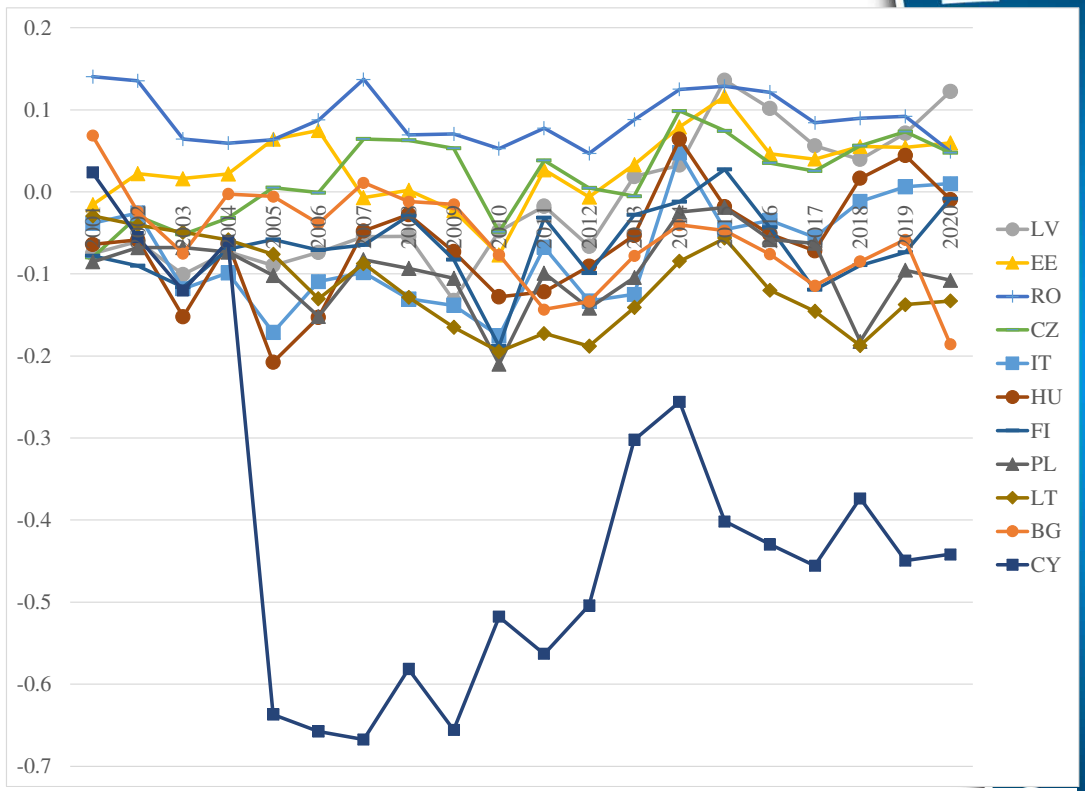
(1) need to be fueled by expanded renewable energy production (at an affordable level) and even higher, and more aggressive, levels of investments in energy efficiency and a greater reduction of income inequality;

(2) or household energy consumption and HDI in PCMS remain below the OMS households; citizens need to accept the spatial inequality in well-being.

Decoupling factors (HDI and residential energy use per capita, EU-27, 2000-2020)



Note: correlation coefficients - cases with negative coefficients, 2000-2020 panel data, HDI and residential energy use per capita



Note: correlation coefficients - cases with positive coefficients, 2000-2020 panel data, HDI and residential energy use per capita

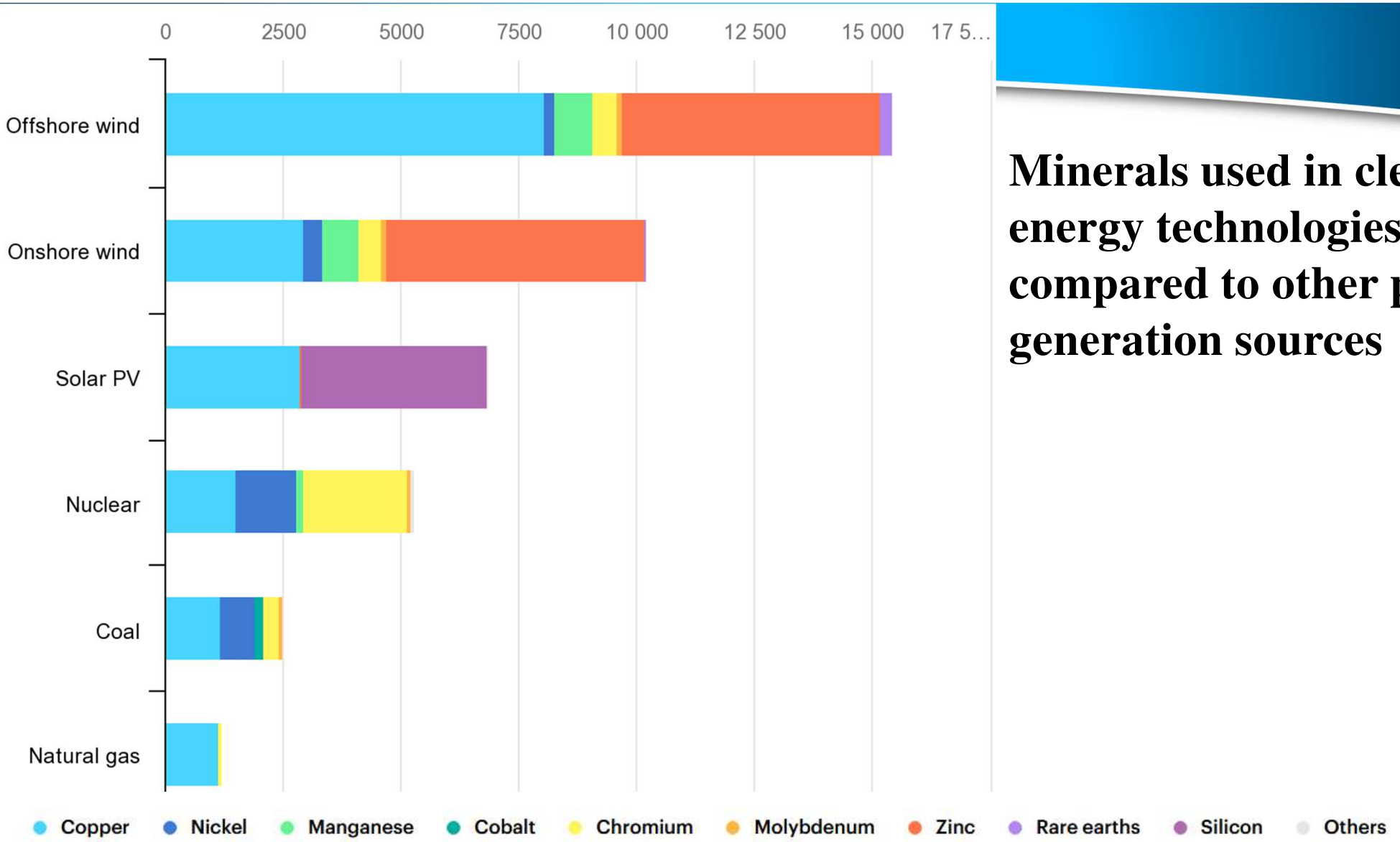
Source: Szép T., Tóth G., LaBelle M. C. (2022): Farewell to the European Union's east-west divide: Decoupling energy lifts the well-being of households, 2000–2018. REGIONAL STATISTICS 12 : 3, 33 p.

Saturation points

- Twenty member states of the EU have reached the saturation point.
- Non-decoupling cases: Hungary, Bulgaria, Cyprus, Finland, Italy, Lithuania, Poland
- In the EU27 the decoupling points were identified with an average HDI level of 0.85. Decoupling cannot happen with a lower HDI level than 0.72. However, the maximum HDI was 0.92.
- The strength of the relationship between HDI and residential energy use is declining.
- The distribution of residential energy use does not follow the East-West divide.

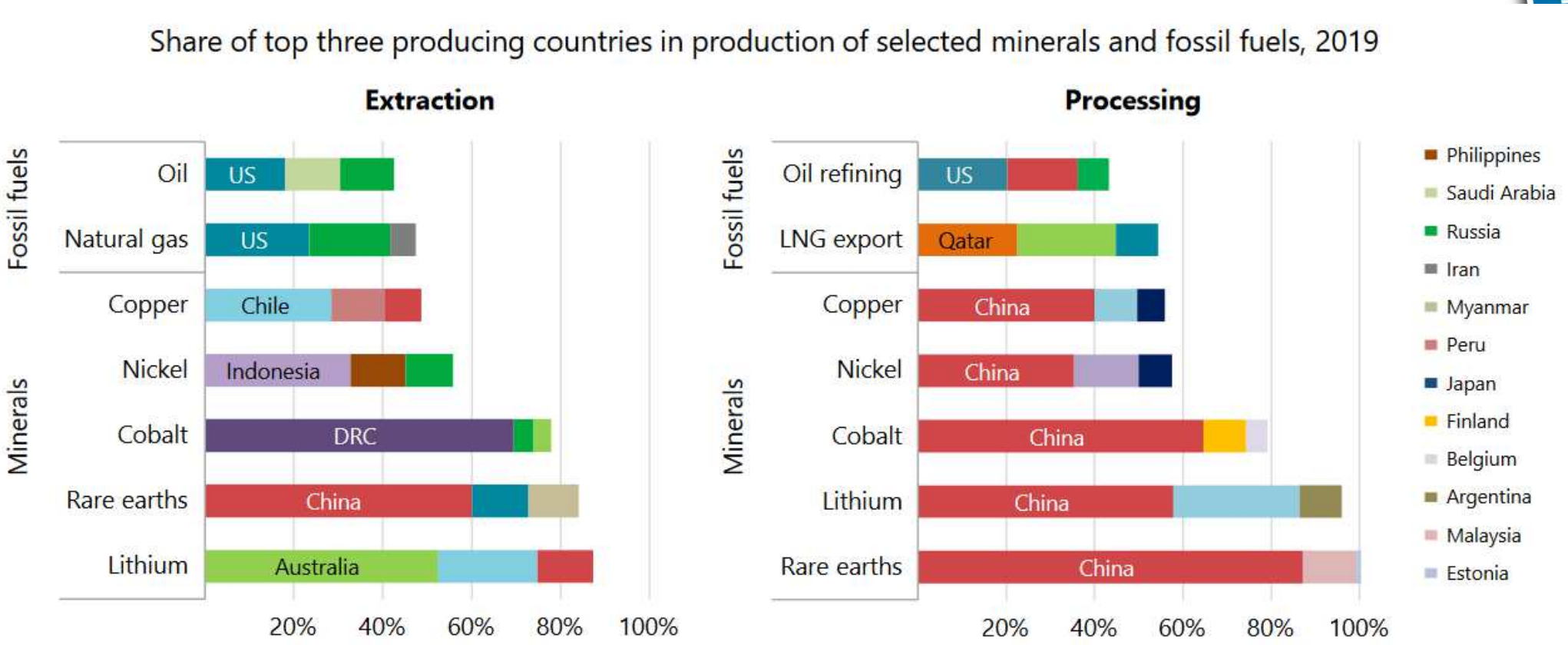
	year	HDI	GDPcap [Current prices, EUR per capita]	H_FCEXcap [Current prices, EUR per capita]	H_FENUSEcap		
					[TOE]	[GJ]	[GJ] climate corrected
Group 3							
Belgium	2006	0.896	30 830	15 120	0.855	35.797	41.771
France	2006	0.865	29 050	15 230	0.670	28.052	34.010
Germany	2003	0.889	27 120	14 860	0.809	33.871	34.371
Austria	2004	0.849	29 670	15 440	0.790	33.076	30.560
Netherlands	2004	0.886	32 510	15 820	0.679	28.428	31.295
Luxembourg	2006	0.884	71 490	23 420	1.101	46.097	51.650
Ireland	2011	0.894	37 310	16 980	0.606	25.372	27.906
Denmark	2011	0.922	44500	20630	0.809	33.871	34.783
Sweden	2002	0.903	31 600	14 380	0.824	34.499	26.844
Greece	2013	0.858	16 480	11 210	0.347	14.528	19.993
Malta	2005	0.828	12 730	7 810	0.179	7.494	8.734
Portugal	2010	0.822	16 990	10 890	0.281	11.765	13.815
Spain	2017	0.891	24 970	14 320	0.314	13.147	16.376
Slovakia	2005	0.794	7 310	3 950	0.473	19.804	18.970
Slovenia	2012	0.876	17 630	9 970	0.593	24.828	26.993
Group 4							
Estonia	2002	0.799	5 660	3 050	0.662	27.717	23.228
Latvia	2013	0.834	11 350	6 890	0.626	26.209	23.152
Croatia	2018	0.856	12880	9170	0.560	23.446	29.826
Czechia	2001	0.806	7 370	3 640	0.685	28.680	27.363
Romania	2001	0.715	N/A	N/A	0.325	13.607	14.276

Minerals used in clean energy technologies compared to other power generation sources



IEA (2021), *The Role of Critical Minerals in Clean Energy Transitions*, IEA, Paris

Many mineral supply chains lack diversity



IEA (2021), *The Role of Critical Minerals in Clean Energy Transitions*, IEA, Paris

Conclusion

- Slow energy transition in the household sector – the traditional biomass is still dominant:
  - Traditional biomass trap (energy stacking theory) or dual fuel trap (?)
- Controversial targets: inequalities in residential energy use, decoupling, declining energy use, higher energy prices/costs ↔ human development convergence (energy use is still an important driver of HDI)
- Soaring energy prices → the vulnerable social groups (needy) have to be protected, but! Who are they exactly?
- State interventions? How long? Other measures (price caps)? → Hungarian example (utility cost reduction programme)
- Accelerate energy transition! It sounds well, but!:
  - Huge inflation
  - Inefficient support system
  - Material requirements (CRM shortages, supply chain disruptions, etc.)
  - Labor shortage

The only option is boosting the energy efficiency investments!

Thanks for your attention!

Related publications and co-authors:

- Szép T., Pálvölgyi T., Kármán-Tamus É. (2022): "Landscape" of Energy Burden: role of solid fuels in Central-European residential heating. (under publishing)
- LaBelle M. C., Tóth G., Szép T. (2022): Not Fit for 55: The HDI spatial injustice of residential energy consumption in the European Union. Energies, 15, 6687.
- LaBelle M. C., Szép T. (2022): Green Economy: Energy, Environment, and Sustainability. In: László, Mátyás (editor) Emerging European Economies after the Pandemic: Stuck in the Middle Income Trap? Vienna, Austria : Springer International Publishing, 610 p., pp. 325-364., 40 p.
- Szép T., Tóth G., LaBelle M. C. (2022): Farewell to the European Union's east-west divide: Decoupling energy lifts the well-being of households, 2000–2018. REGIONAL STATISTICS 12 : 3, 33 p.
- Szép T., Pálvölgyi T., Kármán-Tamus É. (2022): Indicator-based assessment of sustainable energy performance in the European Union. INTERNATIONAL JOURNAL OF SUSTAINABLE ENERGY PLANNING AND MANAGEMENT 34 pp. 107-124., 18 p.
- Szlávik J., Szép T. (2022): A Framework of Risks in the Context of Industry 4.0, Related to Sustainability. WORLD FUTURES 2022 Paper: 2012875, 24 p.
- Weiner, Cs.; Szép, T. (2022): The Hungarian utility cost reduction programme: An impact assessment. ENERGY STRATEGY REVIEWS, 40 Paper: 100817, 20 p.