SUPPLEMENTARY INFORMATION

The impacts of decarbonization pathways on Sustainable Development Goals in the European Union

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Supplementary Information for the article: The impacts of decarbonization pathways on Sustainable Development Goals in the European Union

Supplementary Discussion

The following paragraphs provide elaborations on the results per SDG.

SDG 1 – No Poverty

Our results suggest that poverty prevalence in the EU+ decreases in *Current Policies* due to the combined effect of rising *per capita* GDP levels and decreasing inequality (Palma ratio). In 2050 it reaches 0.12% with Italy (0.61%) being the worst performer. In the net zero scenarios, the poverty prevalence slightly increases with respect to *Current Policies* because increased policy costs decrease *per capita* GDP levels offsetting the moderate decrease of inequality rates. The countries undergoing the highest rise in poverty prevalence are Italy (0.26% to 0.28%) and Spain (0.11% to 0.13%) due to the combined effect of increased abatement costs and in rising inequality levels.

SDG 2 – Zero Hunger

The undernourishment prevalence indicator undergoes a slight increase at EU+ level in *Current Policies* rising from 2.2% in 2020 to 2.4% in 2050 due to policy costs decreasing *per capita* GDP and mitigation policies reducing agricultural output. Differentiated impacts are observed among EU+ countries with Germany and Greece facing the biggest surge. These effects become more evident in the net zero scenarios as policy costs increase even more.

Food prices in the EU+ increase 8%, 40%, and 22% with respect to 2020 values in *Current Policies*, *NZE Policy Standard* and *NZE Benchmark* scenarios respectively. As a results of the required sectoral emissions cutbacks, *NZE Policy Standard* relies more on bioenergy for mitigation purposes increasing land competition and therefore also food prices.

Crop yield losses due to ozone exposure are reduced from 6.4% to 5.1% in *Current Policies* in 2050 with respect to 2020. Net zero scenarios, however, are not able to further reduce these damages due to a more intensive use of bioenergy releasing additional methane to the atmosphere and contributing to the formation of ozone molecules.

SDG 3 – Good Health and Well-being

As a result of currently implemented policies, the healthy life expectancy of the population in EU+ would rise from 70.5 years in 2020 to 71.8 years in 2050 due to the rise in *per capita* education, increased health expenditure and reduced exposure to urban atmospheric pollutants. Increased healthy life expectancies in net zero scenarios with respect to *Current Policies* is a result of local pollutant reductions.

The mortality figures due to air pollutants at EU+ level are also drastically reduced already in *Current Policies* (by 83%) with respect to 2020 values and even more in *NZE Benchmark* and *NZE Policy Standard* (by 87%-88%) due to air pollution drops. Hungary and Romania would be the most benefitted countries even in *Current Policies*. On the other hand, Italy and Greece would still show persistent mortality rates due to air pollution even in net zero scenarios.

SDG 4 – Quality Education

EU+-average secondary education completion rate increases from 72.7% to 85.1% in 2050 in *Current Policies* as a result of increasing *per capita* education expenditure and urbanisation.

Countries such as Czech Republic and Poland already reach 100% completion rate before 2040. Increases observed in net zero scenarios with respect to *Current Polices* are only minor (0.4% - 0.5%). Secondary education completion rates rise are driven by the increase in tax revenues (mainly through carbon taxation) driving increased government expenditure in education. Finland and Sweden have historically devoted a high share of their government expenditure to education; therefore, they would benefit the most from mitigation scenarios.

SDG 6 – Clean Water and Sanitation

The results for freshwater withdrawals are characterised by a certain heterogeneity derived from the fact the two models used, GCAM and ICES-XPS, account for different drivers in water consumption. Net zero scenarios in ICES-XPS forecast a reduction in the water pressure in EU+ driven by a reduction in water consumption in the heavy industry, energy intensive and residential sectors, which the rising demand in the renewable electricity sectors does not offset. This reduction in water reduction would also bring a reduction in water prices thanks to the decrease in water pressure.

GCAM, on the other hand, forecasts a small increase in water withdrawals resulting from the rising electricity demand supplied by thermal power stations (mainly, nuclear and biomass-fuelled) in *NZE Policy Standard*. In any case, despite this surge in water demands, water prices are reduced in net zero scenarios thanks to a decrease in water demanding traditional crops which the rise in water needs for nuclear and bioenergy production does not offset. The decrease of water demand in the net zero scenarios coexists with the increase of water withdrawals because the allocation of electric power plants is assumed to be guided by their current disposition and, unlike in the agricultural sector, no spatial optimisation based on water scarcity is assumed. Therefore, the spatial combination of increasing water demand in scarce areas can account for the increase in withdrawals.

SDG 7 – Affordable and Clean Energy

Primary energy intensity in the EU decreases in *Current Policies* by 43% in 2050 with respect to 2020 due to a stable primary energy use and a rising GDP. Along with EU+, all countries follow the same trend with national values ranging from -54% in Croatia to -23% in Malta. Net zero scenarios only show moderate primary energy intensity improvements with respect to *Current Policies* due to the impact of the climate policy costs on GDP. Concerning the renewable electricity share, the baseline values for EU+ in 2020 are rather conservative considering the actual values (34% vs 38% (Agora Energiewende and Ember, 2021)). In any case, *Current Policies* manages to increase this share in 2050 up to 58% with Cyprus and Malta showing the best relative increases. Net zero pathways would further support this trend and increase it up to 81% in *NZE Benchmark* with many Members States reaching 100% but also with laggards such as are Czech Republic, France, Hungary, Slovenia, and Slovakia with shares between 53% and 60%.

The expenditure share dedicated to energy in the residential sector decreases from 6.1% at EU+ level to 3.6% in 2050 in *Current Policies* with even lower shares in the deep decarbonisation scenarios reaching 2.6% in *NZE Benchmark*. In *Current Policies*, these expenditure shares in Hungary, Slovenia, Bulgaria and Poland would still be above 8% in 2050, however, all of them would manage to keep them below 6% in net zero scenarios except Hungary (8.2%).

SDG 8 – Decent Work and Economic Growth

Current Policies forecasts an increase in *per capita* GDP at EU+ level of 50% in 2050 with respect to 2020. As a result of the cost incurred due to climate policies, net zero scenarios suggest a 4% reduction in *per capita* GDP with respect to *Current Policies* in 2050. Cyprus (+1.8%), Slovakia (1.7%) and Lithuania (+1.3%) would benefit in 2050 from climate mitigation, but other countries like Malta (-6.9%), Slovenia (-4.8%), Portugal (-3.8%), and Bulgaria (-3.4%) would incur in additional *per capita* GDP drops with respect to *Current Policies*.

Concerning the GDP per person employed indicator in EU+, it increases up to 60% in 2050 with respect to 2020 in *Current Policies*. Like the trend observed in *per capita* GDP, GDP per person employed would also decrease in deep decarbonisation but considerably less (0.4% with respect to *Current Policies*).

SDG 9 – Industry, Innovation and Infrastructure

The drastic CO_2 emission reductions happening already in *Current Policies* drive the 53% drop in emission intensity in 2050 with respect to 2020 with Bulgaria, Estonia, Greece, and Cyprus showing the largest drops due to their high baselines. Net zero-aligned policies manage to completely decarbonize national sectors effectively and uniformly reaching negative values by 2050 due to widespread use of CCS technologies in the power sector.

Because expenditure targets are not imposed upon models, policy costs in *Current Policies* reduce investments in research and development by 15% in the EU+ with respect to 2020. The low carbon intensity of the research and development sector and the increased demand of products in the renewable energy sectors positively impact on this indicator and increase expenditure shares in net zero scenarios with respect to *Current Policies*.

SDG 10 – Reduced Inequalities

Between-country Gini coefficient is computed to capture inequalities between EU+ countries. Results suggest that all the designed mitigation scenarios including *Current Policies* and the net zero scenarios decrease Gini coefficient by 24% therefore reducing the inequality gaps among EU+ countries.

Concerning the within country inequality captured through the Palma ratio, *Current Policies* reduce it by 22% in 2050 with respect to 2020 as a result of the generalised rise in education expenditure share and industrial value added along with the drop in unemployment. Improvements in net zero scenarios in EU+ are only marginal with respect to *Current Policies* with Greece showing the largest improvement due to a higher education expenditure share and higher industrial value added and Spain, Italy and Poland showing a moderate deterioration of this indicator (with respect to *Current Policies*) due to the drop in industrial value added which the higher expenditure share in education is not able to offset.

SDG 11 – Sustainable Cities and Communities

The reduction in emission intensity in the residential and commercial sector in EU+ is already noticeable in *Current Policies* with a 25% drop in 2050 with respect to 2020 as a consequence of reductions both of energy consumption and energy-related emissions. In Greece, Estonia and Romania, however, CO_2 intensity is increased in *Current Policies*, since national GHG emissions targets implemented in the Effort Sharing Regulation (ESR) sectors for these counties are not constraining in 2030. CO_2 intensity reductions at EU+ level with respect to 2020 values are even more prominent in the net zero scenarios. *NZE Policy Standard* (-84%) would imply higher emission intensity reductions than *NZE Benchmark* (-73%) suggesting that the most cost-efficient pathway would target other sectors rather than the building sectors.

The baseline in 2020 of the CO_2 intensity in the transport sector at EU+ level is more than twice as high as in the building sector and *Current Policies* only achieves a relatively marginal reduction (-22%). Some transport sectors like the aviation, aside from having growing projected demands, will require further technological development to be decarbonized and the forecasted rapid road transport decarbonization is only partially able to compensate for these effects. Results also suggest that countries would achieve different levels of decarbonization with Sweden and Germany leading the performance and Cyprus, Greece, Malta and UK lagging. Net zero scenario show higher intensity reductions at EU+ level reaching -50% with similar reduction achieved between both net zero scenarios. A large heterogeneity in the results is observed in this indicator due to the abatement alternatives available in each model for the transport sector. In this case, Austria, Czech Republic and Hungary would the most benefitted from net zero policies as they would reach the lowest intensity values across all EU+ countries.

Already in *Current Policies*, exposure to fine particulate matter is nearly halved in 2050 with respect to 2020 at EU+ level with Finland and Sweden achieving the lowest values. Further reductions would be achieved if the ambition of the mitigation policies would be increased to reach the net zero targets. *NZE Policy Standard* would be more effective in reducing exposure to fine particulate matter since it would specifically target the sectors emitting most of the PM2.5 precursors (NO_x, NH_3).

SDG 12 – Responsible Consumption and Production

In *Current Policies* at EU+ level energy intensity is reduced by 22% in 2050 with respect to 2020. Energy intensity reductions at EU+ in the net zero scenarios varies from 38% in 2050 with respect to 2020, with similar intensity levels achieved for both net zero scenarios. At country level, *Current Policies* already manages to substantially cut back energy intensities across the most energy intensive countries allowing EU countries to achieve similar decarbonization rates in the industrial sector. Only marginal further reductions are observed across net zero scenarios showing that the decarbonisation of the industrial sectors takes place mainly through fuel substitution.

A 32% reduction of energy intensity is forecasted for 2050 in *Current Policies* at EU+ level with respect to 2020 while net zero scenarios project reductions ranging between 69% (*Benchmark*) and 85% (*Policy Standard*). *Current Policies* is particularly effective in countries with high emission intensity in 2020 (Cyprus and Slovakia). Net zero scenarios achieve a large homogenization in the reduction rates bringing CO_2 emission intensity in the industrial sector close to zero in most of countries.

In 2050 *Current Policies* reduce residential emissions per capita by 29% at EU+ level with respect to 2020. Net zero scenarios further reduce this residential carbon footprint by between 78% and 97% depending on the model. Looking at the assessment at country level, *Current Policies* has a differentiated impacts across countries given the different burden sharing of the mitigation targets in the ESR sector. *Per capita* CO_2 emissions in Romania and Greece, on the one side, would increase in 2050 with respect to the 2020 value while they would reduce by more than 40% in other counties such as Luxembourg, Denmark, Finland, and Poland. Net zero scenarios, however, would bring down all countries' emissions close to zero.

The reduction in material intensity projected in *Current Policies* across all EU+ countries is particularly sharp until 2030 where less than half of the intensity observed in 2020 is projected. Only marginal further reductions are observed thereafter. As a result of the drops in GDP projected in net zero scenarios, material intensities increase across all EU+ countries despite the marginal decreases in mineral materials used. It is important to note, however, that the only model capable of capturing this indicator, ICES-XPS, is also the one projecting the highest policy costs in net zero scenarios.

SDG 13 – Climate Action

In 2020 EU+ results suggest that emissions levels are already over 30% below 1990 levels and the current policies already implemented would bring these reductions down to -57% in 2050. Nevertheless, these targets are not enough to achieve a climate neutral continent by mid-century, which would only be achieved with net zero mitigation policies (achieving values in the range of -97% to -102%). *Current Policies* would bring down all emissions generated in each country with respect to 1990 irrespective of their individual baseline value.

Since the mitigation targets assumed are specifically aimed at reducing emissions, it is not surprising to see large CO_2 emissions intensity reduction figures already in *Current Policies* (-59% in 2050 with respect to 2020) and even further reductions in the net zero scenarios both at EU+ level (-102%) and for each individual country reaching negative values due to the penetration of negative emissions technologies. *Current Policies* would be sufficient to bring down CO_2 emissions intensity levels in countries such as Estonia, Poland and Czech Republic with higher baseline values than the 2020 EU+ average.

SDG 14 – Life Below Water

Due to the limited capacity of the model ensemble to capture this dimensions, one single value is obtained for ocean pH without any regional variations, and it captures drop in emissions at global level, as GCAM also projects climate policies for all countries outside EU+. In 2020 the ocean pH was 8.11, but both *Current Policies* and the net zero scenarios would reduce this value until 8.04.

SDG 15 – Life on Land

The share of natural land cover in 2020 at EU+ level reaches almost 59% with substantial differences among MS: Ireland is over 79% while Denmark stays slightly above 36%. *Current Policies* brings the EU+ value down to 57% in 2050 and *NZE Policy Standard* to 54%. *NZE Benchmark*, on the other side, would achieve natural land increases at EU+ level with respect to *Current Policies* but again with differentiated impacts across countries: Natural land cover would increase in most countries, especially in Estonia and Latvia (4.4% and 4.2% respectively), but it would also be reduced in Poland and Ireland (2.4% and 1.2% respectively).

The evolution forecasted for the share of land covered by forests differs depending on the model. GCAM relies in *Current Policies* more on land mitigation and suggests a slight increase in the share of land covered by forests while ICES-XPS projects a reduction of forest cover share driven by an increase in the supply of forestry products in Sweden, Finland, France, and Spain offsetting the forest share increase in Germany. Ambitious abatement targets in the net zero scenarios as interpreted by the ICES-XPS model would imply increasing forest cover shares due to their role as carbon sinks. In GCAM, however, mitigation pathways rely on substantially on increasing biomass share thereby reducing the land share covered by forest.

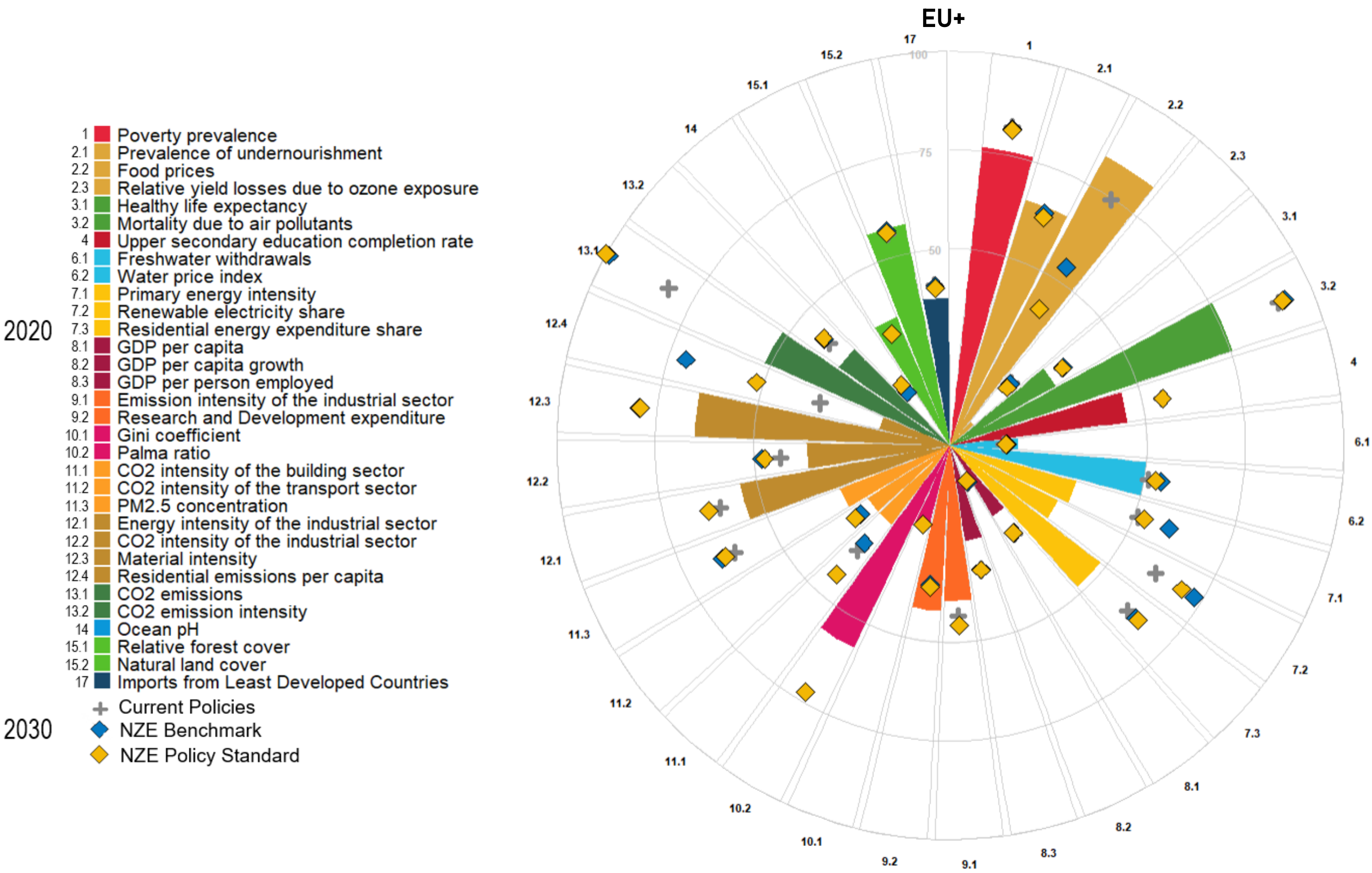
SDG 17 – Partnership for the Goals

In *Current Policies*, the share of imports from Least Developed Countries (LCDs) with respect to total imports at EU+ level almost doubles from 7.5% in 2020 to 14.1% in 2050. Net zero scenarios assume efforts which reduce the output of polluting sectors inside the EU+, and so the demand share of imported goods increases. These impacts result in further increases in the imports share from LDCs with increases between 2% and 3% with respect to *Current Policies.*

EU+ SDG performance in 2030 vs 2020

As it can be concluded from the evolution of the SDG outcomes between 2020 and 2030, the changes projected are happening in the same direction as the ones projected in 2050. No exponential evolution or major overshoot in performance would therefore be expected between 2020 and 2050. For most of the indicators analysed, minor changes are projected when compared with the evolution trends between 2050 and 2020 (Fig. 2 in the main text). One exception to this are CO_2 emissions, whose increased performance in 2030 with respect to 2050 can be derived from the fact that they account for different upper bounds reflecting the different objectives detailed in the EU Climate Law (see Supplementary Table S1). This would mean that EU climate mitigation strategies are in a very good position to reach 2030 targets but would fall slightly shorter in achieving climate neutrality targets in 2050. Other indicators with considerable evolution with respect to 2020 are residential emissions per capita, mortality due to air pollutants, renewable electricity share, residential energy expenditure share and Palma ratio. Their evolution can be derived from the fact that the achievement levels reached in 2050 are also very substantial and they start to improve already before the end of this decade.

Supplementary Fig. S1: SDG indicator performance comparison in the EU+ between the *NZE Benchmark*, *NZE Policy Standard* and *Current Policies* in 2030 against values in 2020



Coloured bars show 2020 results, while grey, blue, and yellow symbols represent 2030 values in the three analysed scenarios. Results are normalised to show comparable goal progress or recession across indicators. Progress towards the value 100 implies getting closer to goal achievement, independently of whether this means an increase or decrease in the absolute value of the specific indicator (see Methods section for further details on benchmark rationale and values). For Gini coefficient, 2020 value replaces the values in 2030 for all scenarios, as only values in 2020 and 2050 were computed for this indicator.

Supplementary Methods

The following tables present methodological elaborations on the indicators and the calculations.

Supplementary Table S1: SDG indicators covered by the model ensemble along with their units and models capable of covering them (ESDR stands for the "Europe Sustainable Development Report 2022" by UN Sustainable Development Solutions Network (UNSDSN)). Credit (symbols): United Nations. Please note the content of this figure and study has not been approved by the United Nations and does not reflect the views of the United Nations or its officials or Member States.

SDGs	Indicator	Unit	Model coverage	Upper bound	Lower bound	Source
1	Poverty prevalence	% of population	ICES - XPS	0	1.5	UB: SDG1.1 LB: EU sim. results
2	Prevalence of undernourishment	% of population	ICES - XPS	0	6	UB: SDG2.1 LB: EU sim. results
	Food prices	% change w.r.t 2020	GCAM	-5	25	UB/LB: Obersteiner et al. (2016)
	Relative yield losses due to ozone exposure	%	GCAM	0	7	UB/LB: sim. results
3	Healthy life expectancy	Years	ICES - XPS	83	65	UB: ESDR LB: EU sim. results
	Mortality due to air pollutants (PM2.5 and O_3)	Years of life lost (per 100 000 population)	GCAM	0	2000	UB: *Zero Pollution Action Target;* LB: EU sim. results
4	Upper secondary education completion rate	% of population 25+ years	ICES - XPS	100	50	UB/LB: EU sim. results
6	Freshwater withdrawals	% of internal renewable water	ICES - XPS, GCAM	1	20	UB: ESDR*;* LB: EU sim. results
	Water price	Normalised (=100) w.r.t. 2020	GCAM, ICES-XPS	0	200	UB/LB: EU sim. results
7	Renewable electricity share	% electricity production	NEMESIS, ICES-XPS, GCAM, EU-TIMES, GEMINI-E3	65 (100 in 2050)	15	UB: *Fit for 55* EU; LB: EU sim. Results
	Primary energy intensity	MJ/$2010 PPP	NEMESIS, ICES-XPS, EU-TIMES, GEMINI-E3, GCAM	0	4	UB/LB: EU sim. results
	Residential energy expenditure share	%	NEMESIS, ICES-XPS, GEMINI-E3	2	10	UB: *Soergel et al.(2021);* LB: EU sim. results
	GDP *per capita*	$ 2010 PPP	GEMINI-E3, ICES-XPS, NEMESIS	110.000	20.000	UB/LB: EU sim. results

GDP *per capita* growth	% change w.r.t 2020	GEMINI-E3, ICES-XPS, NEMESIS	150	0	UB/LB: EU sim. results
GDP per person employed	$ 2010 PPP	NEMESIS	250.000	50.000	UB/LB: EU sim. results
Emission intensity of the industrial sector	$kgCO_2$/$ 2010 PPP	NEMESIS, EU-TIMES, ICES-XPS and GEMINI-E3	-2	2	UB/LB: EU sim. results
Research and Development (R&D) expenditure	% of GDP	ICES-XPS	3.3	1	UB: ESDR; LB: EU sim. results
Palma ratio (within country)	-	ICES-XPS	0.9	1.5	UB: ESDR; LB: EU sim. results
Gini coefficient in EU (between countries)	-	NEMESIS	0.1	0.2	UB/LB: EU sim. results
CO_2 intensity of building sector	gCO_2/MJ	EU-TIMES, FORECAST, GCAM, GEMINI-E3, ICES-XPS, NEMESIS	0	40	UB/LB: EU sim. results
CO_2 intensity of the transport sector	gCO_2/MJ	EU-TIMES, ALADIN, GCAM, GEMINI-E3, ICES-XPS, NEMESIS	0	90	UB/LB: EU sim. results
PM2.5	$\mu g/m^3$	GCAM	2	12	UB/LB: EU sim. results
Energy intensity of the industrial sector	MJ/$2010 PPP	GEMINI-E3, ICES-XPS, NEMESIS, FORECAST, EU-TIMES	0	8	UB/LB: EU sim. results
CO_2 intensity of industrial sector	gCO_2/MJ	EU-TIMES, FORECAST, GCAM, GEMINI-E3, ICES-XPS, NEMESIS	-20	60	UB/LB: EU sim. results
Material intensity	kg/$ PPP2011	ICES-XPS	0	1.1	UB/LB: EU sim. results
Residential emissions *per capita*	Tonnes of CO_2/yr	GCAM, EU-TIMES, ICES-XPS, NEMESIS, FORECAST	0	2	UB/LB: EU sim. results
CO_2 emissions	% change w.r.t 1990	EU-TIMES, GCAM, GEMINI-E3, ICES-XPS, NEMESIS	-55 (-100 in 2050)	0 (-55 in 2050)	UB: *Fit for 55* EU LB: EU sim. results
CO_2 emissions intensity	$kgCO_2$/$ 2010 PPP	GEMINI-E3, GCAM, EU-TIMES, ICES-XPS, NEMESIS	-0.5	0.5	UB/LB: EU sim. results

14	Ocean pH	-	GCAM	8.04	8.1	UB/LB: EU sim. results
15	Relative forest cover	% of total land	ICES-XPS, GCAM	80	10	UB/LB: EU sim. results
	Natural land cover	% of total land	GCAM	80	30	UB/LB: EU sim. results
17	Imports from Least Developed Countries	% of total imports	ICES-XPS	20	0	UB/LB: EU sim. results

Supplementary Table S2: Member State aggregation by indicator. Member States separated by ";" are nationally disaggregated, while groups of Member States separated by "_" are regionally aggregated. AT=Austria; BE=Belgium; BG=Bulgaria; CY=Cyprus; CZ=Czechia; DE=Germany; DK=Denmark; EE=Estonia; ES=Spain; FI=Finland; FR=France; GR=Greece; HR=Croatia; HU=Hungary; IE=Ireland; IT=Italya; LU=Luxembourg; LT=Lithuania; LV=Latvia; MT=Malta; NL=Netherlands; PL=Poland; PT=Portugal; RO=Romania; SE=Sweden; SI=Slovenia; SK=Slovakia; UK=United Kingdom

Indicator	Aggregation level
Poverty prevalence	AT_DK_EE_HU_IE_LV_LT_MT_PT_SK_SI_BG_HR_RO; BE_LU_NL; CZ; DE; ES; FI; FR; GR; IT; PL; SE; UK;
Prevalence of undernourishment	AT_DK_EE_HU_IE_LV_LT_MT_PT_SK_SI_BG_HR_RO; BE_LU_NL; CZ; DE; ES; FI; FR; GR; IT; PL; SE; UK;
Food prices	EU+
Relative yield losses due to ozone exposure	EU+
Healthy life expectancy	AT_DK_EE_HU_IE_LV_LT_MT_PT_SK_SI_BG_HR_RO; BE_LU_NL; CZ; DE; ES; FI; FR; GR; IT; PL; SE; UK;
Mortality due to air pollutants (PM2.5 and O_3)	AT_SI_LT; BE_LU_NL; GR_CY; CZ_SK; DE; SE_DK; PL_EE_LV_LT; ES_PT; FI; FR; GR_CY; HR; HU; UK_IE; IT_MT; RO
Upper secondary education completion rate	AT_DK_EE_HU_IE_LV_LT_MT_PT_SK_SI_BG_HR_RO; BE_LU_NL; CZ; DE; ES; FI; FR; GR; IT; PL; SE; UK;
Freshwater withdrawals	AT; BE; BG; CY; CZ; DE; DK; EE; ES; FI; FR; GR; HR; HU; IE and LT from AT_DK_EE_HU_IE_LV_LT_MT_PT_SK_SI_BG_HR_RO; IT; LU; LV; MT; NL; PL; PT; RO; SE; SI; SK; UK
Water price	AT; BE; BG; CY; CZ; DE; DK; EE; ES; FI; FR; GR; HR; HU; IE and LT from AT_DK_EE_HU_IE_LV_LT_MT_PT_SK_SI_BG_HR_RO; IT; LU; LV; MT; NL; PL; PT; RO; SE; SI; SK; UK
Renewable electricity share	AT; BE; BG; CY; CZ; DE; DK; EE; ES; FI; FR; GR; HU; IT; LU; LV; MT; NL; PL; PT; RO; SE; SI; SK; UK
Primary energy intensity	AT; BE; BG; CY; CZ; DE; DK; EE; ES; FI; FR; GR; HU; IT; LU; LV; MT; NL; PL; PT; RO; SE; SI; SK; UK
Residential energy expenditure share	AT; BE; BG; CY; CZ; DE; DK; EE; ES; FI; FR; GR; HU; IT; LU; LV; MT; NL; PL; PT; RO; SE; SI; SK; UK

GDP *per capita*	AT; BE; BG; CY; CZ; DE; DK; EE; ES; FI; FR; GR; HR, IE and LT from AT_DK_EE_HU_IE_LV_LT_MT_PT_SK_SI_BG_HR_RO; HU; IT; LU; LV; MT; NL; PL; PT; RO; SE; SI; SK; UK
GDP *per capita* growth	AT; BE; BG; CY; CZ; DE; DK; EE; ES; FI; FR; GR; HR, IE and LT from AT_DK_EE_HU_IE_LV_LT_MT_PT_SK_SI_BG_HR_RO; HU; IT; LU; LV; MT; NL; PL; PT; RO; SE; SI; SK; UK
GDP per person employed	AT; BE; BG; CY; CZ; DE; DK; EE; ES; FI; FR; GR; HU; IT; LU; LV; MT; NL; PL; PT; RO; SE; SI; SK; UK
Emission intensity of the industrial sector	AT; BE; BG; CY; CZ; DE; DK; EE; ES; FI; FR; GR; HR, IE and LT from AT_DK_EE_HU_IE_LV_LT_MT_PT_SK_SI_BG_HR_RO; HU; IT; LU; LV; MT; NL; PL; PT; RO; SE; SI; SK; UK
Research and Development (R&D) expenditure	AT_DK_EE_HU_IE_LV_LT_MT_PT_SK_SI_BG_HR_RO; BE_LU_NL; CZ; DE; ES; FI; FR; GR; IT; PL; SE; UK;
Palma ratio (within country)	AT_DK_EE_HU_IE_LV_LT_MT_PT_SK_SI_BG_HR_RO; BE_LU_NL; CZ; DE; ES; FI; FR; GR; IT; PL; SE; UK;
Gini coefficient in EU (between countries)	EU+
CO_2 intensity of building sector	AT; BE; BG; CY; CZ; DE; DK; EE; ES; FI; FR; GR; HR; HU; IE; IT; LT; LU; LV; MT; NL; PL; PT; RO; SE; SI; SK; UK
CO_2 intensity of the transport sector	AT; BE; BG; CY; CZ; DE; DK; EE; ES; FI; FR; GR; HR; HU; IE; IT; LT; LU; LV; MT; NL; PL; PT; RO; SE; SI; SK; UK
PM2.5	AT_SI_LT; BE_LU_NL; GR_CY; CZ_SK; DE; SE_DK; PL_EE_LV_LT; ES_PT; FI; FR; GR_CY; HR; HU; UK_IE; IT_MT; RO
Energy intensity of the industrial sector	AT; BE; BG; CY; CZ; DE; DK; EE; ES; FI; FR; GR; HR; HU; IE; IT; LT; LU; LV; MT; NL; PL; PT; RO; SE; SI; SK; UK
CO_2 intensity of industrial sector	AT; BE; BG; CY; CZ; DE; DK; EE; ES; FI; FR; GR; HR; HU; IE; IT; LT; LU; LV; MT; NL; PL; PT; RO; SE; SI; SK; UK
Material intensity	AT_DK_EE_HU_IE_LV_LT_MT_PT_SK_SI_BG_HR_RO; BE_LU_NL; CZ; DE; ES; FI; FR; GR; IT; PL; SE; UK;
Residential emissions *per capita*	AT; BE; BG; CY; CZ; DE; DK; EE; ES; FI; FR; GR; HR; HU; IE; IT; LT; LU; LV; MT; NL; PL; PT; RO; SE; SI; SK; UK
CO_2 emissions	AT; BE; BG; CY; CZ; DE; DK; EE; ES; FI; FR; GR; HU; IT; LU; LV; MT; NL; PL; PT; RO; SE; SI; SK; UK
CO_2 emissions intensity	AT; BE; BG; CY; CZ; DE; DK; EE; ES; FI; FR; GR; HU; IT; LU; LV; MT; NL; PL; PT; RO; SE; SI; SK; UK
Ocean pH	Global

Relative forest cover	AT_DK_EE_HU_IE_LV_LT_MT_PT_SK_SI_BG_HR_RO; BE_LU_NL; CZ; DE; ES; FI; FR; GR; IT; PL; SE; UK;
Natural land cover	AT; BE; BG; CY; CZ; DE; DK; EE; ES; FI; FR; GR; HR; HU; IT; LU; LV; MT; NL; PL; PT; RO; SE; SI; SK; UK
Imports from Least Developed Countries	AT_DK_EE_HU_IE_LV_LT_MT_PT_SK_SI_BG_HR_RO; BE_LU_NL; CZ; DE; ES; FI; FR; GR; IT; PL; SE; UK;

Supplementary Table S3: Poverty prevalence regression

	Ln(POV)
L.Ln(GDPPPP pc)	-2.418***
	(-12.30)
L.Ln(Palma)	1.981***
	(7.69)
Constant	6.632***
	(10.38)
Country FE	Yes
R^2	0.828
N	1394

t statistics in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001

Supplementary Table S4: Undernutrition prevalence regression

	Malnutrition
L.Ln(GDPPPP pc)	-27.36***
	(-4.92)
L.Ln(GDPPPP pc)^2	3.467***
	(3.81)
L.Ln(Palma)	5.244
	(1.76)
L.Ln(Agri prod pc)	-6.008*
	(-2.51)
Constant	82.94***
	(6.04)
Country FE	Yes
R2	0.399
N	2116

t statistics in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001

Supplementary Table S5: HALE regression

	Ln(HALE)
L.Ln(physicians)	0.0153*
	(2.03)
L.Ln(Edu Exp pc)	0.0491***
	(5.23)
L.Ln(PM2.5)	-0.0904***
	(-3.68)
Constant	4.296***
	(35.20)
Country FE	Yes
R2	0.459
N	256

t statistics in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001

Supplementary Table S6: secondary education completion rate regression

	(1) SEdu rate
L.Ln(Edu Exp pc)	8.504***
	(3.93)
L.Urban share	1.325***
	(6.71)
Constant	-32.62*

	(-2.55)
Country FE	Yes
R2	0.393
N	1569

t statistics in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001

Supplementary Table S7: Palma ratio regression

	Ln(Palma)
L.Ln(ManuVA share)	-0.0890**
	(-3.08)
L.Ln(HIndVA share)	-0.0897*
	(-2.14)
L.Ln(AgriVA share)	-0.0855**
	(-2.70)
L.Ln(PEdu Exp pc)	-0.0717
	(-1.84)
L.Ln(Unemployment)	0.0786***
	(3.50)
Corruption control	-0.133**
	(-3.26)
Year	-0.00819***
	(-5.29)
Constant	17.54***
	(5.58)
Country FE	Yes
R2	0.238
N	1362

t statistics in parentheses
* *p* < 0.05, ** *p* < 0.01, *** *p* < 0.001