Supplement S1. Country lists of decoupling states

COUNTRY	EL*	2019-2020	2020-2021	2021-2022	2022-2023
Albania	UM	Recessive	Negative	Decoupling	Decoupling
Algeria	LM	Recessive	Negative	Negative	
Angola	LM	Recessive	Negative	Negative	
Argentina	UM	Negative recessive	Decoupling	Negative	
Armenia	UM	Negative recessive	Negative	Decoupling	
Australia	H	Recessive	Decoupling	Decoupling	Negative
Austria	H	Recessive	Negative	Decoupling	Recessive
Azerbaijan	UM	Negative recessive	Negative	Negative	
Bahrain	H	Negative recessive	Decoupling	Decoupling	
Bangladesh	LM	Decoupling	Negative	Decoupling	
Belarus	UM	Recessive	Decoupling	Recessive	
Belgium	H	Recessive	Decoupling	Decoupling	Decoupling
Benin	LM	Negative	Decoupling	Decoupling	
Plurinational State of Bolivia	LM	Recessive	Negative	Negative	
Bosnia and Herzegovina	UM	Negative recessive	Decoupling	Decoupling	
Botswana	UM	Recessive	Decoupling	Decoupling	
Brazil	UM	Recessive	Negative	Decoupling	Decoupling
Brunei Darussalam	H	Negative	Negative recessive	Recessive	
Bulgaria	UM	Recessive	Negative	Negative	Decoupling
Cambodia	LM	Negative recessive	Decoupling	Decoupling	
Cameroon	LM	Negative	Decoupling	Decoupling	
Canada	H	Recessive	Decoupling	Decoupling	Decoupling
Chile	H	Recessive	Decoupling	Decoupling	Decoupling
People's Republic of China	UM	Decoupling	Decoupling	Decoupling	
Colombia	UM	Negative recessive	Decoupling	Decoupling	Decoupling
Republic of the Congo	LM	Negative recessive	Negative	Negative	
Costa Rica	UM	Recessive	Negative	Decoupling	Decoupling
Cote d'Ivoire	LM	Negative	Negative	Negative	
Croatia	H	Negative recessive	Decoupling	Decoupling	Decoupling
Cuba	UM	Recessive	Negative	Decoupling	
Cyprus	H	Recessive	Decoupling	Decoupling	Decoupling
Czech Republic	H	Recessive	Negative	Decoupling	Recessive
Democratic Republic of the Congo	L	Negative	Decoupling	Negative	
Denmark	H	Recessive	Decoupling	Decoupling	Decoupling
Dominican Republic	UM	Negative recessive	Decoupling	Negative	
Ecuador	UM	Recessive	Negative	Negative	
Egypt	LM	Negative	Negative	Decoupling	
El Salvador	LM	Recessive	Negative	Negative	
Equatorial Guinea	UM	Recessive	Negative	Negative	
Estonia	H	Recessive	Negative	Negative recessive	Recessive
Ethiopia	L	Decoupling	Negative	Decoupling	
Finland	H	Recessive	Decoupling	Decoupling	Recessive
France	H	Recessive	Negative	Decoupling	Decoupling
Gabon	UM	Recessive	Negative	Negative	
Georgia	UM	Negative recessive	Decoupling	Negative	Decoupling
Germany	H	Recessive	Negative	Decoupling	Recessive
Ghana	LM	Negative	Negative	Decoupling	
Greece	H	Recessive	Decoupling	Decoupling	Decoupling
Guatemala	UM	Recessive	Negative	Decoupling	
Guyana	UM	Decoupling	Decoupling	Decoupling	
Haiti	L	Recessive	Negative recessive	Recessive	
Honduras	LM	Negative recessive	Decoupling	Decoupling	
Hungary	H	Negative recessive	Decoupling	Decoupling	Recessive
Iceland	H	Recessive	Negative	Decoupling	Decoupling
India	LM	Recessive	Negative	Negative	
Indonesia	UM	Recessive	Negative	Negative	
Islamic Republic of Iran	UM	Decoupling	Negative	Decoupling	
Iraq	UM	Negative recessive	Negative	Negative	
Ireland	H	Decoupling	Decoupling	Decoupling	Recessive
Israel	H	Recessive	Decoupling	Decoupling	Decoupling
Italy	H	Recessive	Negative	Decoupling	Decoupling
Jamaica	UM	Recessive	Negative	Negative	
Japan	H	Recessive	Decoupling	Decoupling	Decoupling
Jordan	UM	Recessive	Decoupling	Negative	
Kazakhstan	UM	Negative recessive	Negative	Decoupling	Decoupling
Kenya	LM	Recessive	Negative	Decoupling	Decoupling
Korea	H	Recessive	Decoupling	Decoupling	Decoupling
Kosovo	UM	Negative recessive	Decoupling	Decoupling	Decoupling
Kuwait	H	Negative recessive	Negative	Decoupling	
COUNTRY	**EL***	**2019-2020**	**2020-2021**	**2021-2022**	**2022-2023**

Kyrgyzstan	LM	Recessive	Negative	Decoupling	
Lao People's Democratic Republic	LM	Decoupling	Negative	Negative	
Latvia	H	Recessive	Decoupling	Decoupling	Negative recessive
Lebanon	UM	Negative recessive	Recessive	Recessive	
Libya	UM	Negative recessive	Decoupling	Negative	
Lithuania	H	Recessive	Decoupling	Decoupling	Recessive
Luxembourg	H	Recessive	Decoupling	Decoupling	Recessive
Madagascar	L	Recessive	Negative	Negative	
Malaysia	UM	Negative recessive	Decoupling	Decoupling	
Malta	H	Negative recessive	Decoupling	Negative	Decoupling
Mauritius	H	Negative recessive	Negative	Decoupling	
Mexico	UM	Recessive	Decoupling	Decoupling	Decoupling
Republic of Moldova	LM	Negative recessive	Decoupling	Recessive	Decoupling
Mongolia	LM	Recessive	Negative	Decoupling	
Montenegro	UM	Negative recessive	Decoupling	Decoupling	Negative
Morocco	LM	Negative recessive	Negative	Decoupling	Decoupling
Mozambique	L	Recessive	Negative	Negative	
Myanmar	LM	Negative recessive	Negative recessive	Decoupling	
Namibia	UM	Negative recessive	Negative	Decoupling	
Nepal	LM	Negative recessive	Decoupling	Decoupling	
Netherlands	H	Recessive	Decoupling	Decoupling	Decoupling
New Zealand	H	Recessive	Decoupling	Decoupling	Decoupling
Nicaragua	LM	Recessive	Negative	Decoupling	
Niger	L	Decoupling	Negative	Negative	
Nigeria	LM	Recessive	Negative	Decoupling	
Republic of North Macedonia	UM	Recessive	Decoupling	Negative	Decoupling
Norway	H	Recessive	Decoupling	Decoupling	Decoupling
Oman	H	Recessive	Negative	Negative	
Pakistan	LM	Negative recessive	Decoupling	Decoupling	
Panama	H	Recessive	Decoupling	Decoupling	
Peru	UM	Recessive	Negative	Negative	
Philippines	LM	Negative recessive	Negative	Decoupling	
Poland	H	Recessive	Negative	Decoupling	Decoupling
Portugal	H	Recessive	Decoupling	Decoupling	Decoupling
Qatar	H	Negative recessive	Negative	Negative	
Romania	H	Recessive	Negative	Decoupling	Decoupling
Russian Federation	UM	Recessive	Negative	Recessive	Decoupling
Rwanda	L	Recessive	Negative	Negative	
Saudi Arabia	H	Negative recessive	Decoupling	Decoupling	
Senegal	LM	Decoupling	Negative	Negative	
Serbia	UM	Negative recessive	Decoupling	Decoupling	Decoupling
Singapore	H	Negative recessive	Decoupling	Decoupling	
Slovak Republic	H	Recessive	Negative	Decoupling	Decoupling
Slovenia	H	Recessive	Decoupling	Decoupling	Decoupling
South Africa	UM	Negative recessive	Decoupling	Decoupling	
Spain	H	Recessive	Negative	Decoupling	Decoupling
Sri Lanka	LM	Recessive	Decoupling	Recessive	
Sudan	L	Recessive	Negative recessive	Recessive	
Suriname	UM	Negative recessive	Negative recessive	Negative	
Sweden	H	Recessive	Negative	Decoupling	Negative recessive
Switzerland	H	Recessive	Decoupling	Decoupling	Decoupling
Syrian Arab Republic	L	Recessive	Decoupling		
Tajikistan	L	Negative	Decoupling	Decoupling	
United Republic of Tanzania	LM	Decoupling	Negative	Negative	
Thailand	UM	Negative recessive	Decoupling	Negative	
Togo	L	Negative	Decoupling	Decoupling	
Trinidad and Tobago	H	Recessive	Recessive	Negative	
Tunisia	LM	Negative recessive	Negative	Decoupling	Decoupling
Turkmenistan	UM	Decoupling	Negative	Negative	
Uganda	L	Decoupling	Negative	Decoupling	
Ukraine	LM	Recessive	Decoupling	Recessive	
United Arab Emirates	H	Negative recessive	Decoupling	Decoupling	
United Kingdom	H	Recessive	Decoupling	Decoupling	Decoupling
United States	H	Recessive	Negative	Decoupling	Decoupling
Uruguay	H	Negative recessive	Negative	Decoupling	
Uzbekistan	LM	Negative	Negative	Decoupling	
Viet Nam	LM	Negative	Decoupling	Decoupling	
Zambia	LM	Negative recessive	Decoupling	Negative	
Zimbabwe	LM	Recessive	Negative	Negative	

Note: *EL: Economic Level. H: High Income, UM: Upper Medium Income, LM: Lower Medium Income, L: Low Income.

Supplement S2. Comparision analysis of 2022-2023

Table S1. Share of the shifts in the decoupling states from 2021-2022 to 2022-2023.

Decoupling states 2021-2022 → 2022-2023	Countries	Share	Breakdown by income levels			
			High	Upper Medium	Lower Medium	Low
Decoupling → Decoupling	36	66.67%	46.30%	14.81%	5.56%	0.00%
Decoupling → Recessive decoupling	8	14.81%	14.81%	0.00%	0.00%	0.00%
Decoupling → Negative decoupling	2	3.70%	1.85%	1.85%	0.00%	0.00%
Decoupling → Negative recessive decoupling	2	3.70%	3.70%	0.00%	0.00%	0.00%
Recessive decoupling → Decoupling	1	1.85%	0.00%	0.00%	1.85%	0.00%
Recessive decoupling → Recessive decoupling	0	0.00%	0.00%	0.00%	0.00%	0.00%
Recessive decoupling → Negative decoupling	0	0.00%	0.00%	0.00%	0.00%	0.00%
Recessive decoupling → Negative recessive decoupling	0	0.00%	0.00%	0.00%	0.00%	0.00%
Negative decoupling → Decoupling	4	7.41%	1.85%	5.56%	0.00%	0.00%
Negative decoupling → Recessive decoupling	0	0.00%	0.00%	0.00%	0.00%	0.00%
Negative decoupling → Negative decoupling	0	0.00%	0.00%	0.00%	0.00%	0.00%
Negative decoupling → Negative recessive decoupling	0	0.00%	0.00%	0.00%	0.00%	0.00%
Negative recessive decoupling → Decoupling	0	0.00%	0.00%	0.00%	0.00%	0.00%
Negative recessive decoupling → Recessive decoupling	1	1.85%	1.85%	0.00%	0.00%	0.00%
Negative recessive decoupling → Negative decoupling	0	0.00%	0.00%	0.00%	0.00%	0.00%
Negative recessive decoupling → Negative recessive decoupling	0	0.00%	0.00%	0.00%	0.00%	0.00%
Total	54	100.00%	70.37%	22.22%	7.41%	0.00%

Table S2. Shifts in the decoupling states and their average effects on CO_2 emissions in case of shift from 2021-2022 to 2022-2023.

Decoupling state shift	Period	CO_2	CI	FD	EE	EA	Pop
Decoupling → Decoupling	2021-2022	-1.66%	0.74%	-0.05%	-6.21%	3.51%	0.35%
	2022-2023	-4.56%	-0.62%	-2.12%	-3.78%	1.33%	0.64%

Table S1 shows the decoupling shifts for countries for which data was available up to 2023. Of these, almost all countries had desirable decoupling in 2021-2022. Also, among the countries that had desirable decoupling in 2021-2022, most of them had desirable changes in 2022-2023. The countries that had desirable decoupling in 2021-2022 and 2022-2023 included Upper Medium and Lower Medium income countries.

Table S2 suggests the average effects on CO_2 emissions in case of a shift from 2021-2022 to 2022-2023 calculated by LMDI and standardized by CO_2 emission in 2021. It could be said that CI and FD drove CO_2 emissions in 2022-2023 compared with 2021-2022. On the other hand, EE is slowing down. However, it is still safe to say that to improve decoupling states, lowering technical factors (CI, FD, and EE) is the key, and especially the former two factors showed a large impact on it.

However, it should be emphasized that this group does not include a sufficient number of countries to show a worldwide trend.