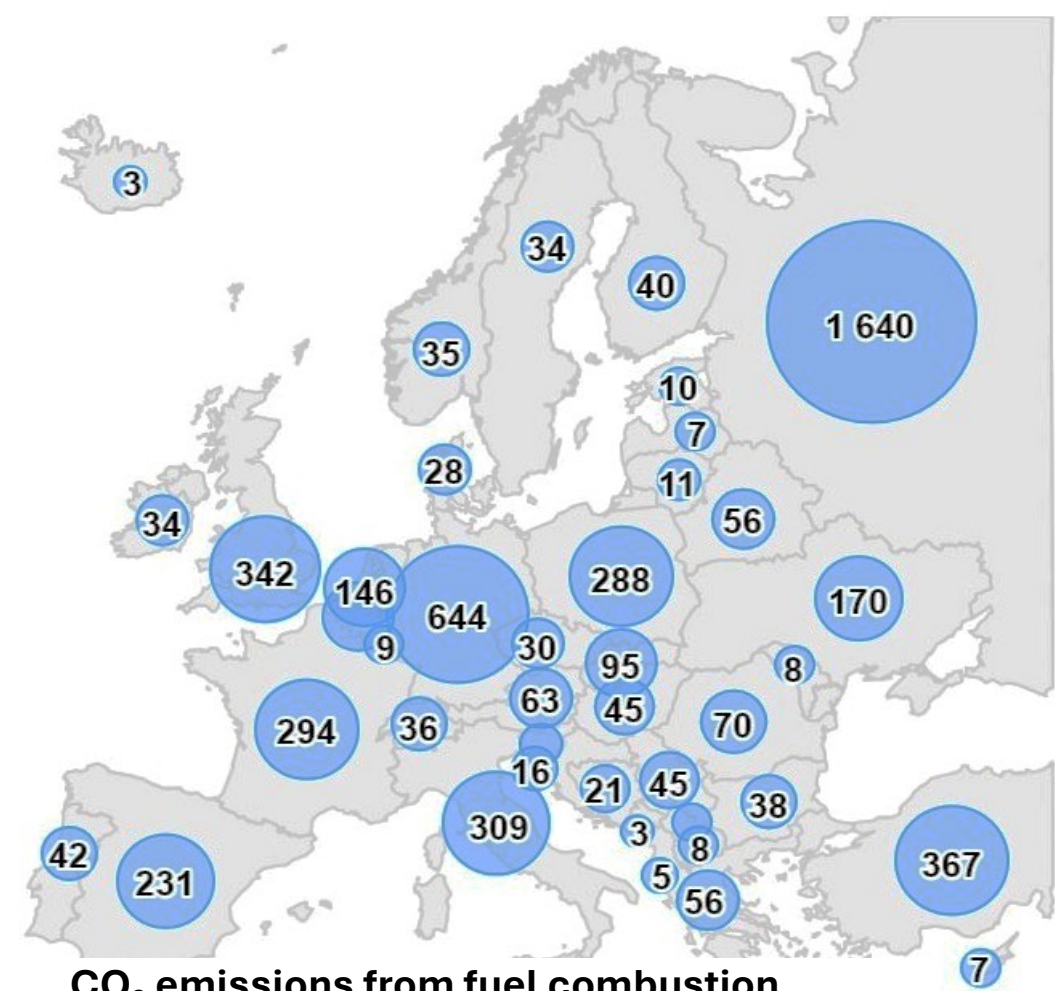


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Climate change mitigation policy spillovers in the EU's neighbourhood

The case of Switzerland



CO₂ emissions from fuel combustion and industrial processes in 2020 (Mt CO₂/yr.)

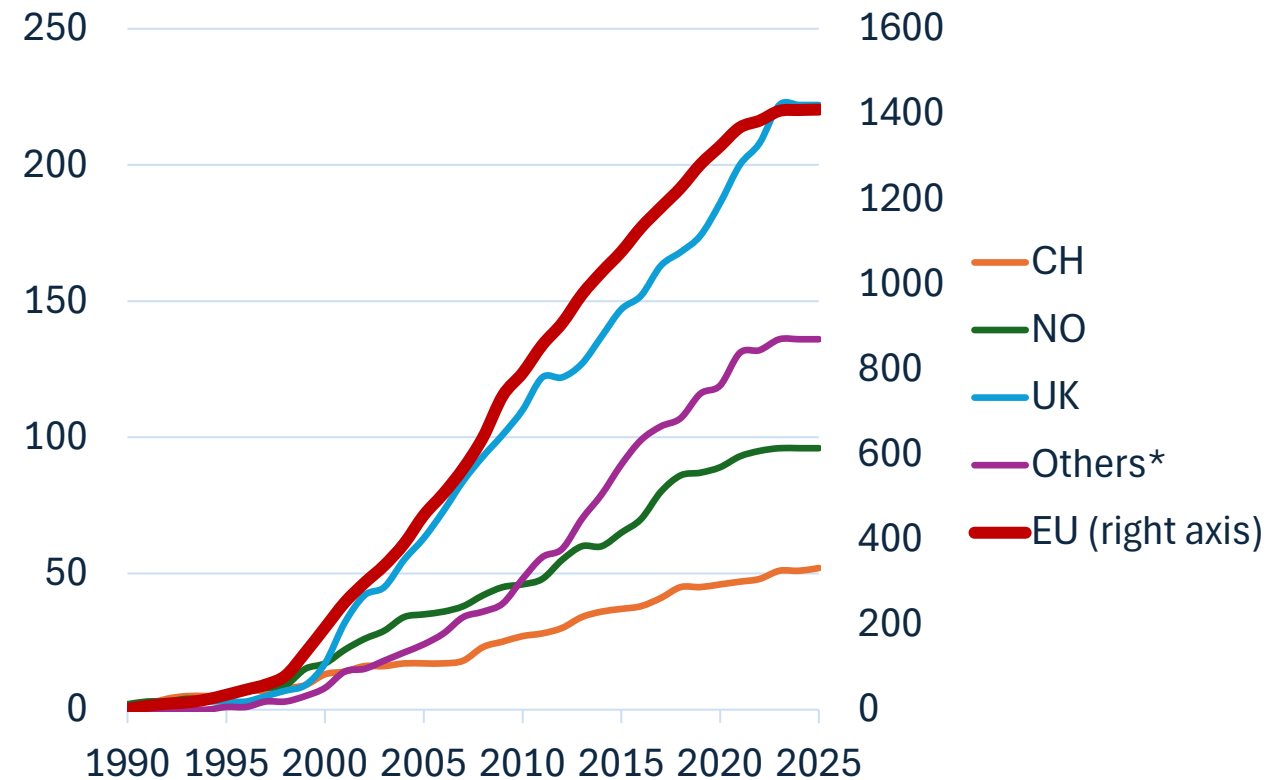
Evangelos Panos, Meixi Zhang, Russell McKenna

17th IAMC Annual Meeting 2024, Yonsei University, Seoul, South Korea, November 4-6, 2024

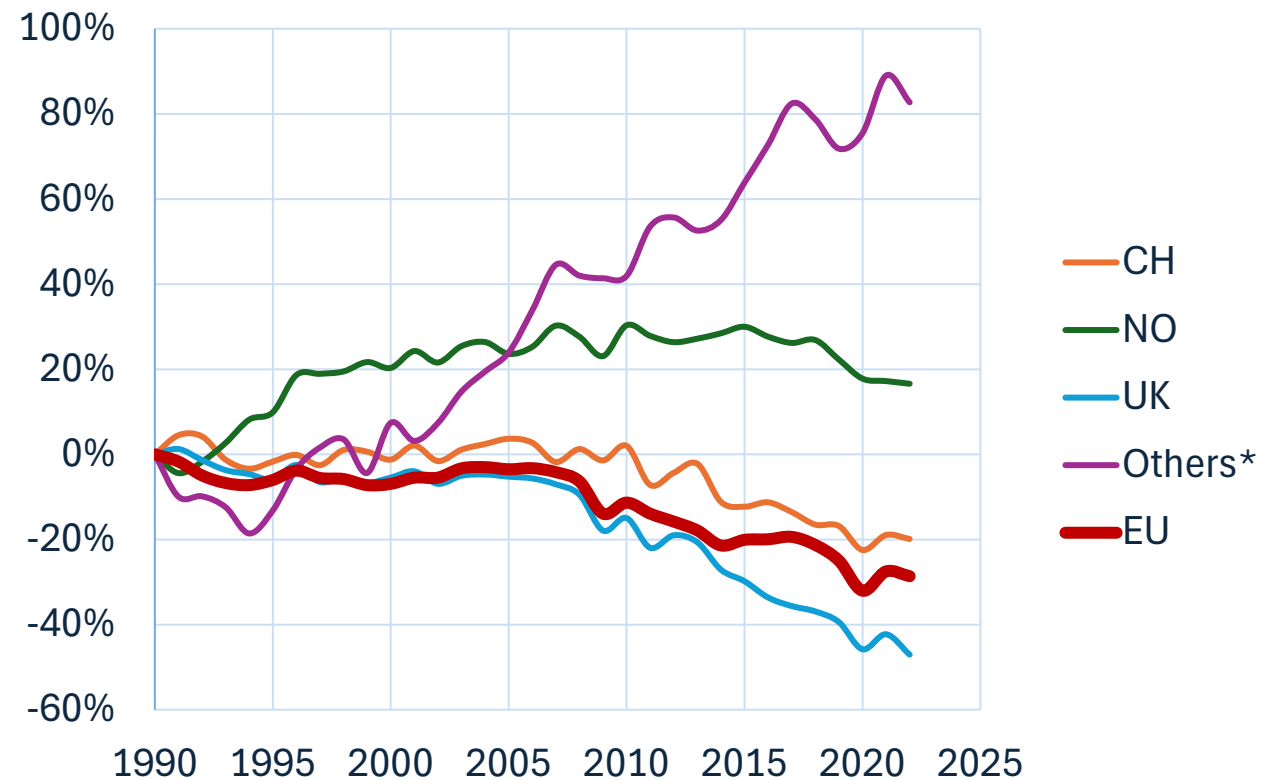
EU neighbours made progress in introducing emissions reductions policies, but many lag the EU in this regard



Cumulative energy and climate policies from 1990



Cumulative CO₂ emissions reductions from 1990

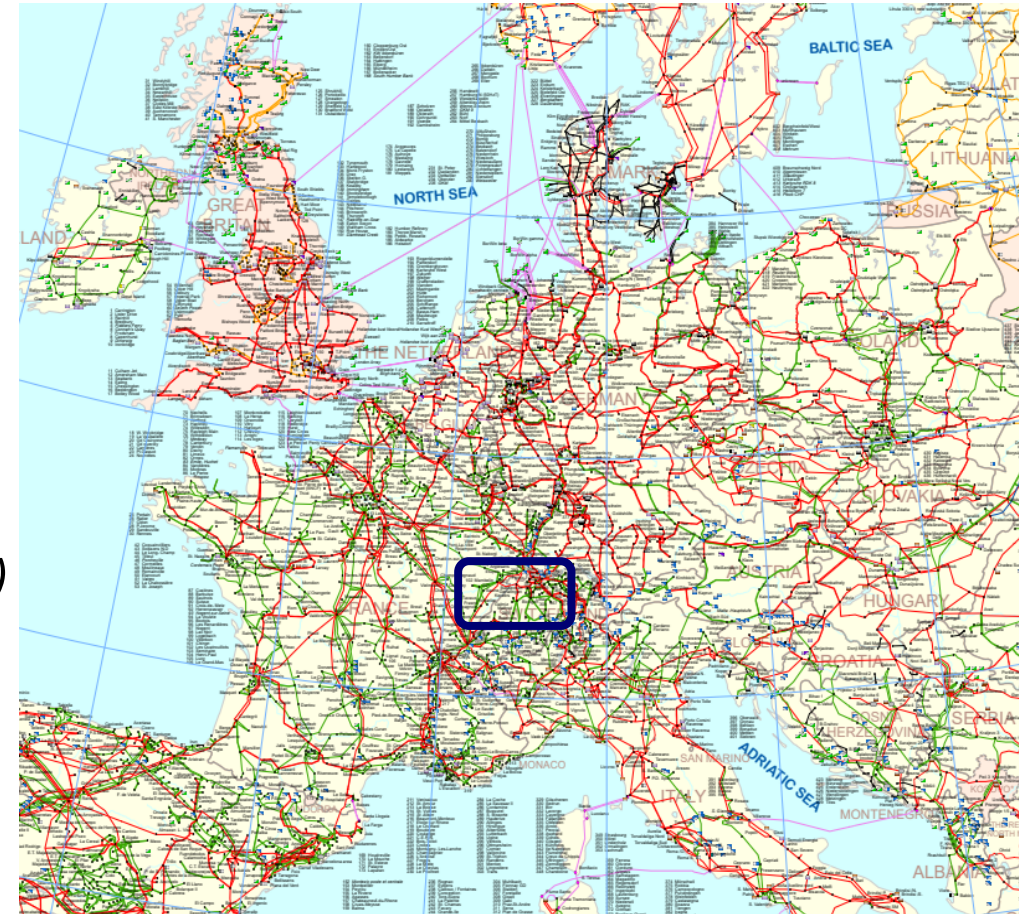


* Others: Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, Serbia, Turkey

Switzerland: a country strongly interconnected with the EU energy market, adopting also many of the EU policies

Policies in Switzerland with close relation to the EU policies:

- CO₂ Tax (since 2008)
- Vehicle Emissions Standards (since 2012)
- ETS - Emissions Trading Scheme (since 2020)
- ReFuelEU Aviation (since 2023)
- *Possibly: ETS-2 buildings & transport (introduction unknown)*



Electricity transmission grid (ENTSO-E)

 Switzerland

Questions:

1. Is the current Swiss climate policy more effective than the EU climate policy?
2. Are there any spillovers from the EU policies to the Swiss emissions?
3. If yes, how much are these spillovers and how do they evolve until 2050?

This work was inspired by a similar analysis from OECD (Cevik et. al., 2023)

1. Econometric analysis

- Dynamic estimation of impacts
- Polynomial Distribution Lags

$$y_t = c + a \sum_{\gamma=\gamma_1}^{\gamma_2} \beta_{\gamma} x_{t-\gamma} + \varepsilon_t$$

$y(t)$ dependent variable

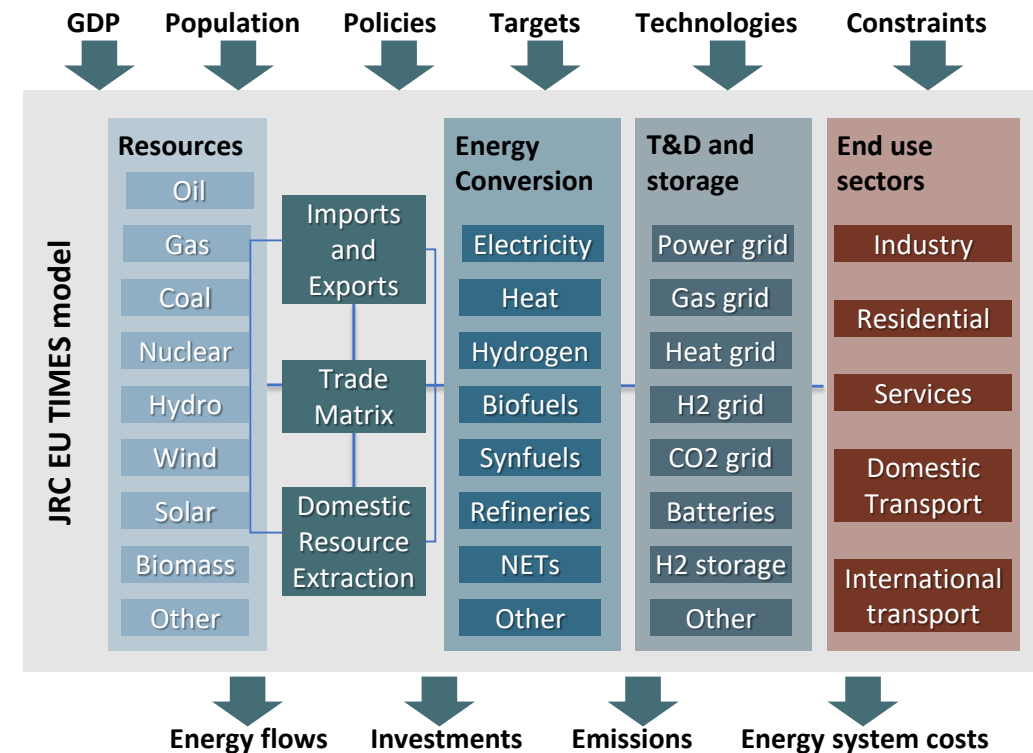
$x(t)$ explanatory variable

c constant

β_{γ} coefficient of a polynomial of degree γ

a coefficient of the polynomial distributed lag

2. Energy systems modelling: JRC EU TIMES



- Full energy system representation
- 36 European countries
- Time horizon 2020 – 2050+

Swiss policy not “as effective as” the EU policy

Estimated model:
$$CO2_emissions_{r,t} = c_r + a_r \sum_{\gamma_r=\gamma_{r,1}}^{\gamma_{r,2}} \beta_{c,\gamma_c} \#New_Policies_{r,t-\gamma_r} + d_{2021} + \varepsilon_{r,t}$$

r=EU

Variable	Coefficient
c	3368.8
D_2021	122.01 (***)
PDL	-1.42 (**)
AR(1)	0.98 (***)
R-square	0.94
<i>PDL is linear with 2 lags, far</i>	

r=CH

Title	Title
c	51.4
D_2021	0.96 (*)
PDL	-0.28 (**)
AR(1)	0.60 (***)
R-square	0.82
<i>PDL is square with 10 lags, both</i>	


With **red in the tables** is the estimated average CO₂ reduction (Mt) per newly introduced policy

*** p<0.01 , ** p<0.05, * p<0.1

There is evidence of spillovers between the emissions reductions in CH and the stringency of the EU policy

Estimated Model:

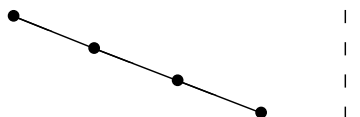
$$\log\left(\frac{CO2_t}{Pop_t}\right) = c + a \cdot \log(GDP_t) + \beta \cdot \sum_{\gamma=\gamma_1}^{\gamma_2} (\omega_\gamma \cdot EU_Stringency_{t-\gamma}) + \delta \cdot Regulatory_Quality_{t-4} + \varepsilon_{r,t}$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(GDP_CAP_CH*POP_CH)	0.436815	0.016514	26.45182	0.0000
REG_CH(-4)	-0.214768	0.075953	-2.827627	0.0143
 PDL01	-0.098573	0.005648	-17.45207	0.0000
R-squared	0.972982	Mean dependent var	1.577334	
Adjusted R-squared	0.968825	S.D. dependent var	0.135510	
S.E. of regression	0.023926	Akaike info criterion	-4.460330	
Sum squared resid	0.007442	Schwarz criterion	-4.315470	
Log likelihood	38.68264	Hannan-Quinn criter.	-4.452912	
Durbin-Watson stat	1.961109			

10 percentage points increase in the EU climate change stringency is associated with an additional 2% reduction in CO₂ emissions in Switzerland



Between 2000 and 2020, the EU environmental stringency policy has doubled:

→ potentially -20% of the achieved Swiss emissions reductions in this decade can be attributed to the EU-CH interaction

Lag Distribution of EU_S...	i	Coefficient	Std. Error	t-Statistic
	0	-0.13143	0.00753	-17.4521
	1	-0.09857	0.00565	-17.4521
	2	-0.06572	0.00377	-17.4521
	3	-0.03286	0.00188	-17.4521
Sum of Lags		-0.32858	0.01883	-17.4521

A similar model was used in (Cevik et. al., 2023)

“Baseline” Scenario

Region	Policies as of 1.1.2024 or already decided to be implemented
	<ul style="list-style-type: none"> • EED energy efficiency (EU2023/1791) • EPBD buildings performance standards (EU2018/844) • ETS (all revisions up to EU2023/959) / EU-ETS-2 from 2030 • EU RED III renewable targets (EU2023/2413) • GHG effort sharing (EU2023/857) • Vehicle emissions standards (EU2019/631, EU2023/851, EU2019/1242) • RefuelEU Aviation (EU2023/2405) & FuelEU Maritime (EU2023/1805) • Coal phase out 2030 in DE, DK, FI, GR, HU, IE, IT, NL, PT, SI, SK, ES • + 8GW new nuclear power (BG, CZ, RO, SI, SK, FI, FR) • NTC electricity capacities as in ENTSO-E TYNDP 2022 plan
	<ul style="list-style-type: none"> • Lifetime of existing reactors 60yrs; no new reactors • Swiss ETS coupled with the EU-ETS / EU-ETS2 as variant • Intra-EEA flights covered by the EU-ETS • SR 730.00 Energy Act (EnG) as of 1.1.2024 • SR 730.03 EnFV renewable subsidies as in 1.1.2024 • Buildings programme HFM 2015 • SR 641.71 CO2 Gesetz • SR 641.61 MinöStG fossil fuel taxes • SR 641.81 on PSVA and LSVA for heavy vehicles • MuKen 2014 buildings performance standards • Solarexpress and Windexpress • Electricity grid expansion plans of Swissgrid 2025 network

Sensitivity Analyses

a) Independently “remove” & “replace”

an EU policy adopted by Switzerland is replaced by the similar Swiss policy that was there before the adoption of the EU policy

- EU-ETS → replaced by Swiss ETS
- Veh standards → replaced by Swiss standards
- ETS2 → replaced by CO₂ Levy for heating fuels
- RefuelEU Aviation → no replacement

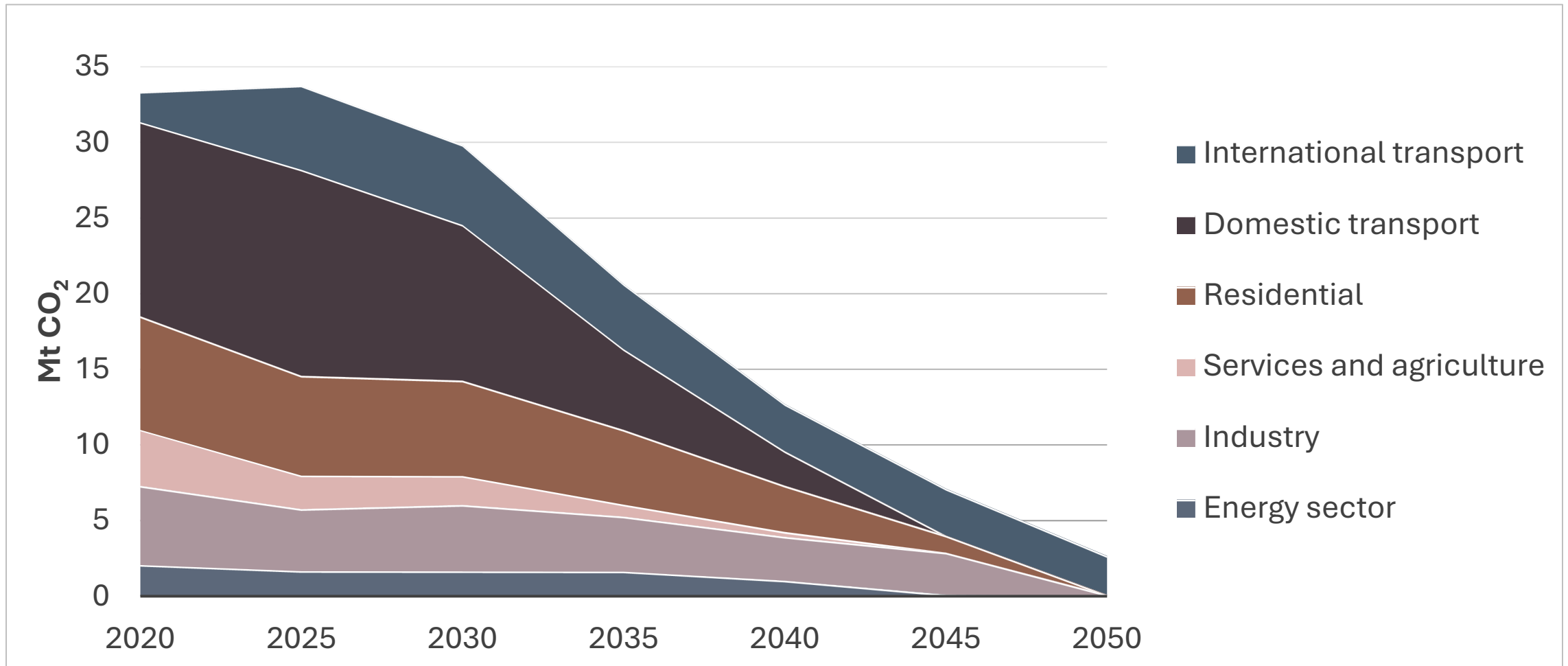
b) Simultaneously “remove” & “replace”

As in (a) but accounting for policy interaction effects

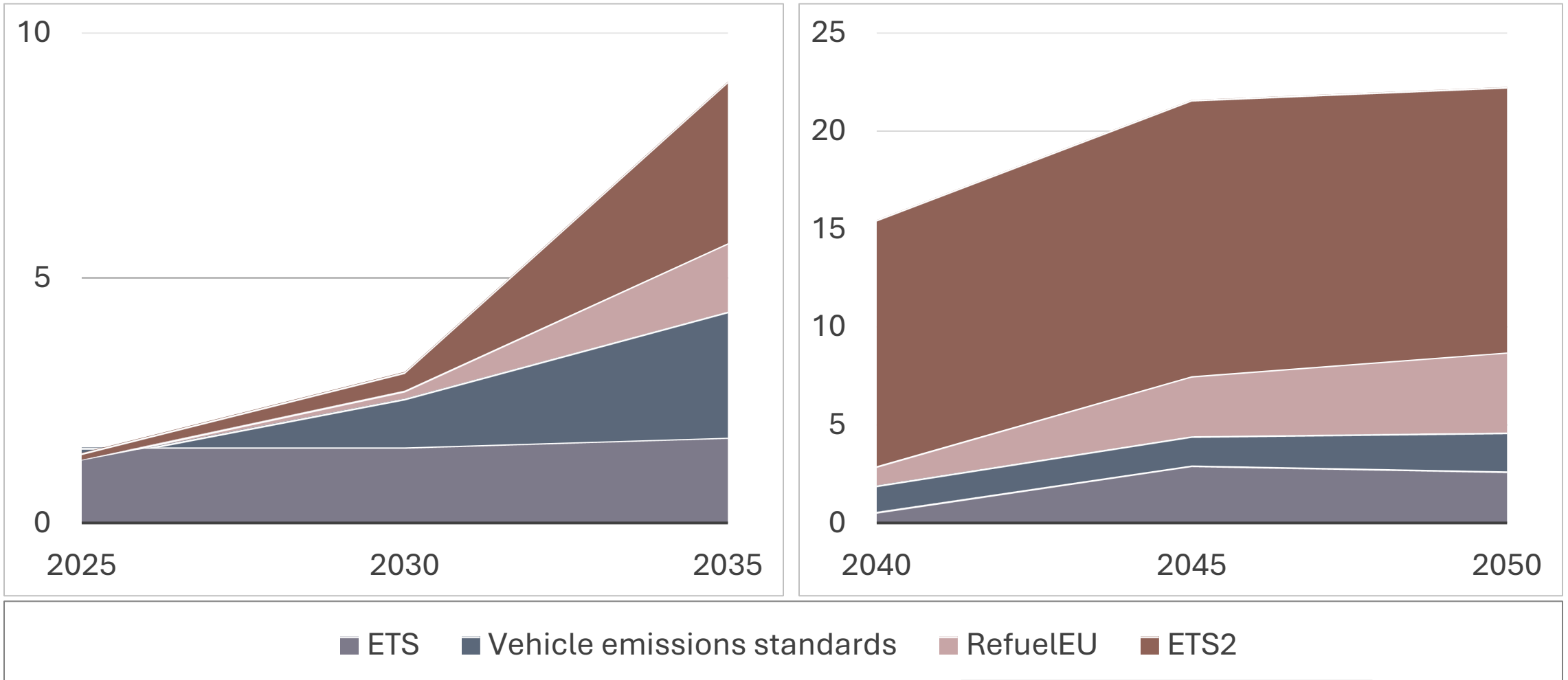
* EU-ETS cap is set to -62% in 2030 from 2005 levels, thereafter gradually towards to 0

** EU-ETS2 cap is set to -21% in 2030, -42% in 2035, and -95% in 2050 (all from 2005 levels)

Evolution of the Swiss CO₂ emissions from fuel combustion and industrial processes under the “Baseline” Scenario

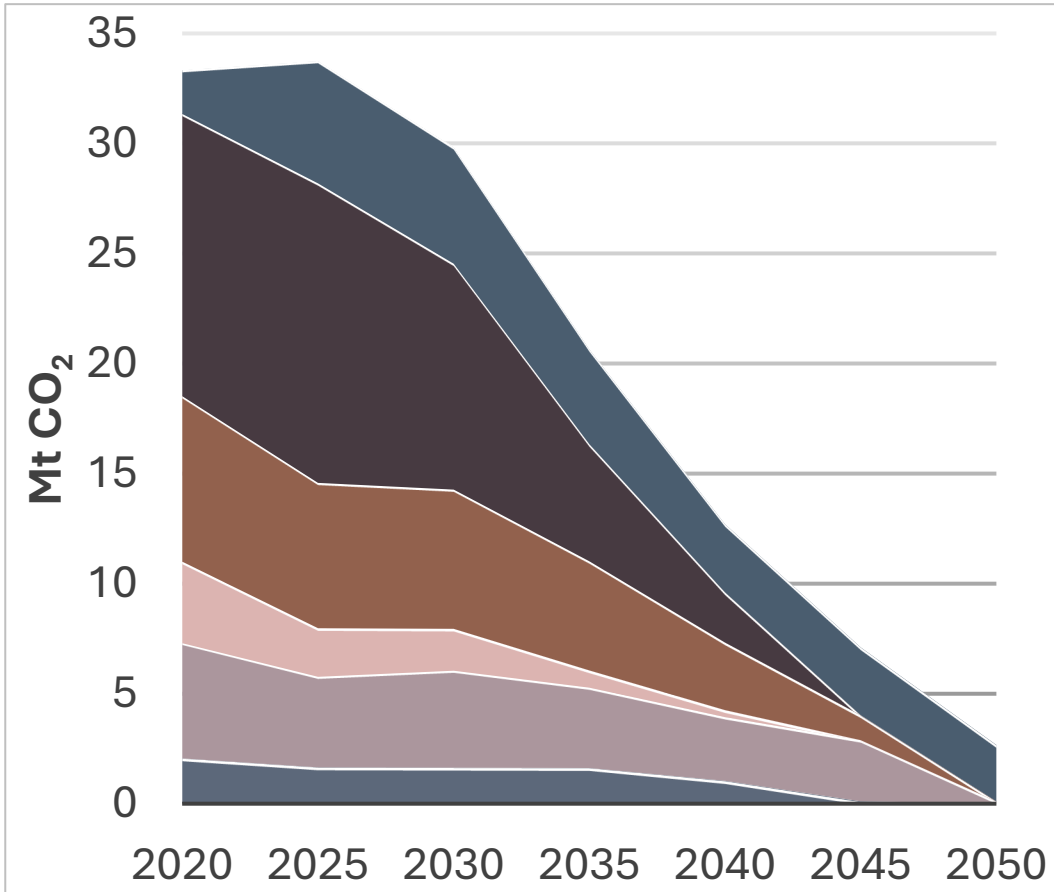


CO₂ emissions increases from the “Baseline” (in Mt) by independently “removing and replacing” policies

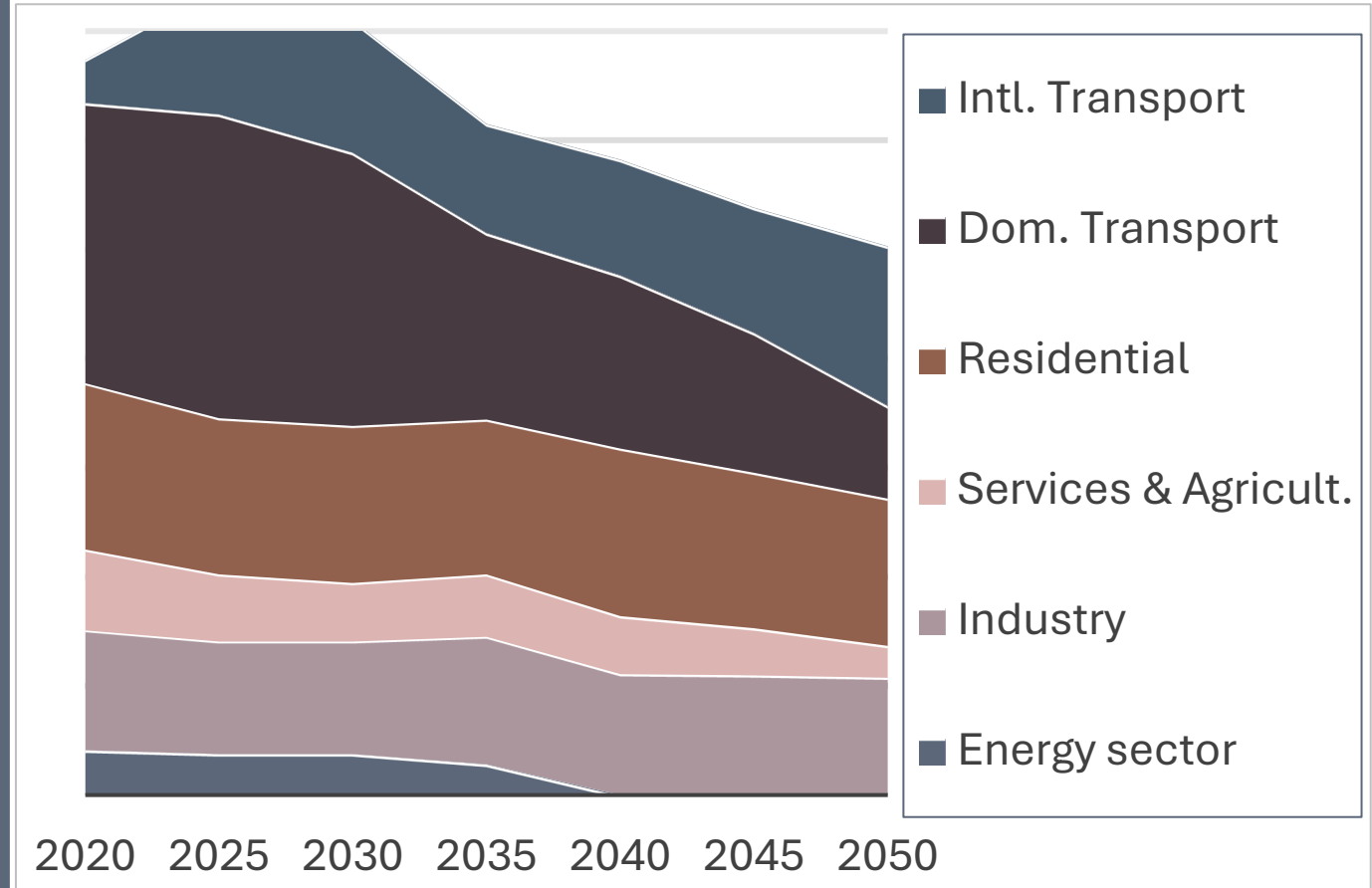


CO₂ emissions increases from the “Baseline” (in Mt) by simultaneously “removing and replacing” policies

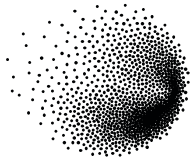
Baseline scenario



Counterfactual scenario without the EU-related policies



- **Effectiveness of the current Swiss policy seems to lag the EU's**
 - *an introduced policy in CH results in average -0.3 Mt CO₂ compared to -1.4 Mt CO₂ in the EU*
 - But we should ack that Switzerland starts from a less carbon-intensive system than the EU
- **Evidence of spillovers in Swiss emissions from the stringency of the EU climate policy**
 - *In the past two decades a 10pp increase in the EU policy stringency was associated with 1% reduction in the Swiss emissions*
- **These spillovers will be accentuated as Swiss policy is integrated into the EU policy**
 - *A possible adoption of ETS2 by Switzerland could lead to a decarbonised building sector*
 - *Two distinct periods of spillovers of different intensity: pre- and post-2035*
- **Without harmonization of the Swiss policies to the EU-policies, Switzerland might fail its climate neutrality target** → *this also speaks for integration of Switzerland with the EU energy market*
- **Extension of the work to also include an analysis of other spillovers beyond CO2 emissions**



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Thank you for your attention

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- Cevik et. al., 2023. Climate change mitigation and policy spillovers in the EU's immediate neighborhood, IMF, WP23/246 ([link](#))
- European Commission, 2024. Environmental policy Stringency Index ([link](#))
- OECD 2020: Measuring Environmental Policy Stringency in OECD Countries: A Composite Index Approach ([link](#))
- World Bank, 2024. State and Trends of Carbon Pricing Dashboard ([link](#))
- World Bank, 2024. Regulatory Quality ([link](#))
- Our World in Data ([link](#))

Back up slides

EU Stringency Composite Index

