



ENVIRONMENTAL POLICY STRINGENCY AND CO2 EMISSIONS

- EVIDENCE FROM CROSS-COUNTRY SECTOR DATA

Frohm, D'Arcangelo, Kruse, Pisu, Sila
Economics Department - OECD
Friday 13th October 2023



Summary

Motivation: limited cross-country evidence on the effects of overall environmental policies

This project: estimates the effects of environmental policy on CO₂-emissions

- Using the updated OECD Environmental Policy Stringency Index (EPS) from [Kruse et al. \(2022\)](#)
- Including a large sample of OECD countries (30) and sectors (54)

Results: increasing the EPS lowers CO₂-emissions

- Fossil fuel intensive sectors most affected

Analytical use: for cross-country and within-country analysis



OECD's Environmental Policy Stringency (EPS) index – an attempt to capture environmental policies

The EPS allows cross-country comparison of policy stringency focusing on:

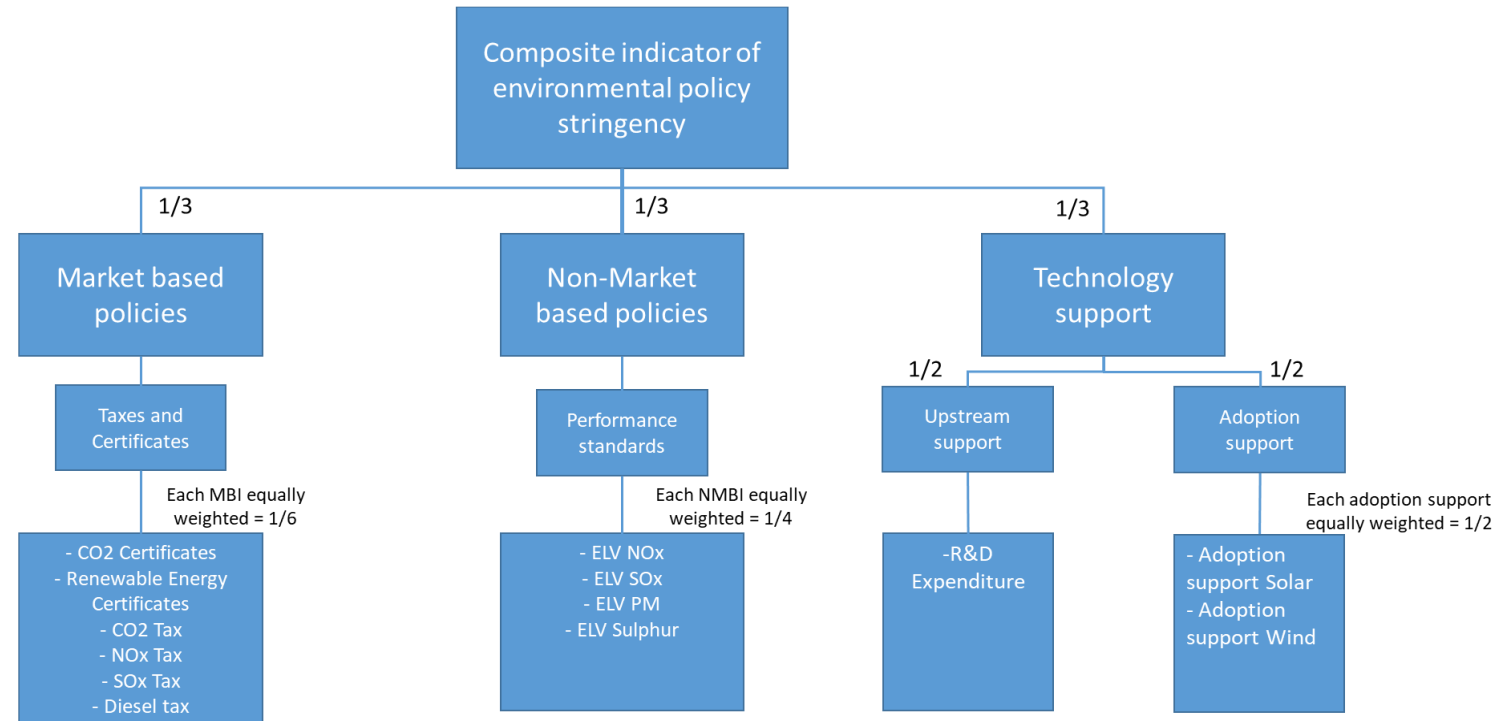
- Climate-, energy- and air pollution policies

The indicator ranges from 0 (least stringent) to 6 (most stringent policies), covering

- 13 policy instruments,
- across 40 countries
- over three decades from 1990-2020

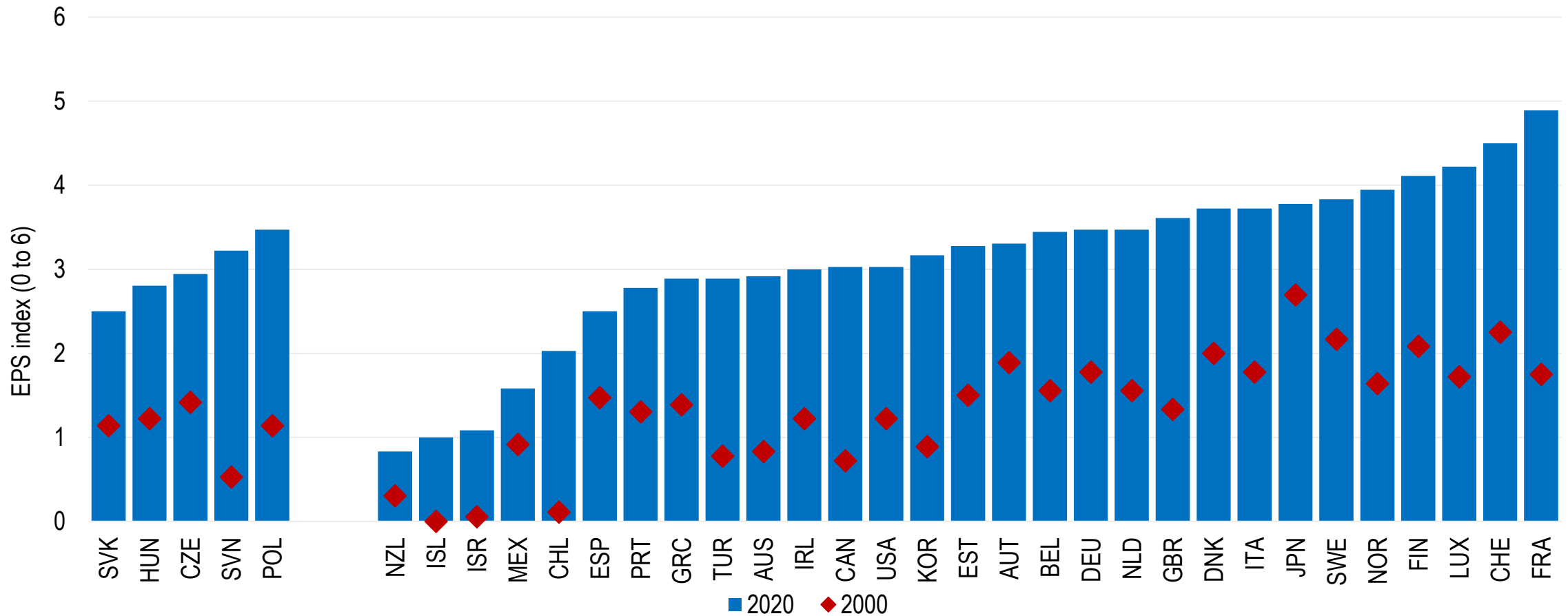
Based on three equally-weighted sub-indices:

- market based policies,
- non-market based policies
- technology support policies





Environmental policies have become more stringent



Source: OECD.



Method

$$\ln(CO2_{cs,t}) = \sum_{k=0}^{10} \beta_k EPS_{c,t-k} + \sum_{k=0}^{10} \theta_k (EPS_{c,t-k} \times \bar{S}_{cs}) + C + \alpha_{cs} + \delta_t + \varepsilon_{cs,t}$$

$CO2_{cs,t}$: CO2 emissions in country c , sector s at year t .

$EPS_{c,t}$: the Environmental Policy Stringency Index.

\bar{S}_{sc} : the average share of fossil fuels in energy use

(coal, fuel oil, gasoline, diesel, natural gas, other gases and other petroils)

C : country-sector controls (contemporaneous and t-1).

- real gross output.

country/sector controls.

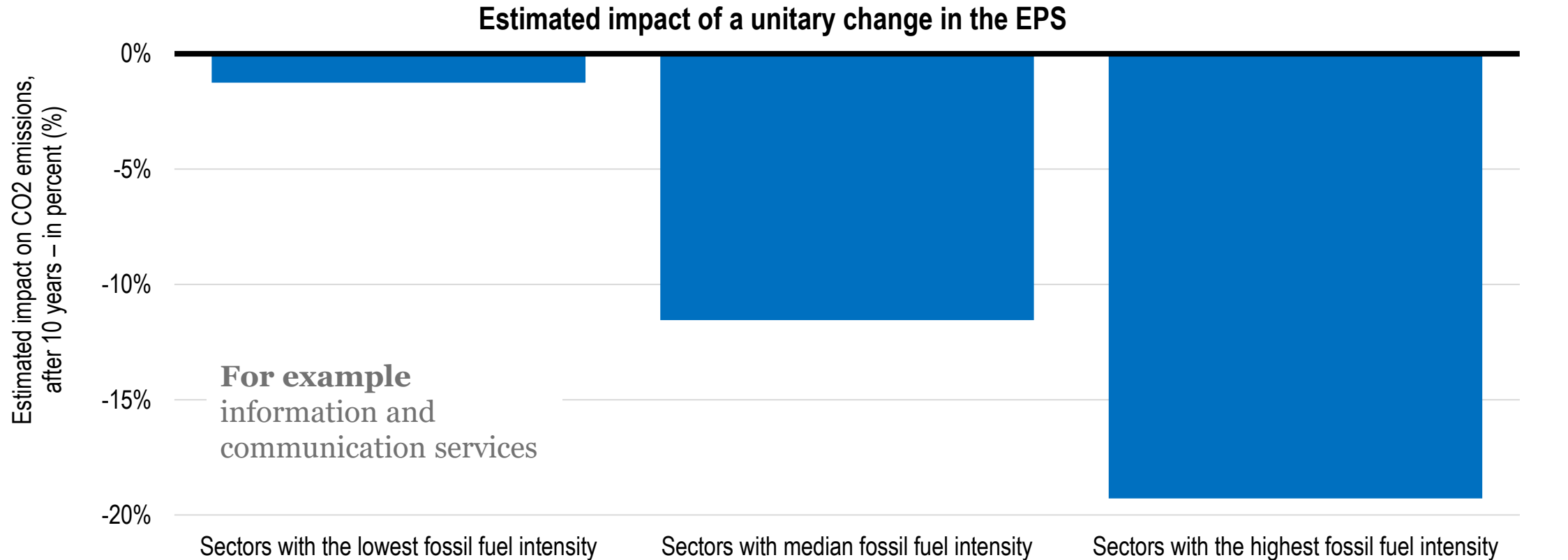
- real GDP (contemporaneous and t-1)

- linear country-year and sector-year time-trends.

α_{cs} and δ_t : country-sector fixed effects and year fixed effects.



Stricter policies can significantly reduce emissions in fossil fuel-intensive sectors



Source: “Environmental Policy Stringency and CO2 emissions – Evidence from cross-country sectoral data” Frohm, D’Arcangelo, Kruse, Pisu and Sila (forthcoming).

For example
transport, manufacturing of metals and coke and petroleum, pharmaceuticals and chemicals.

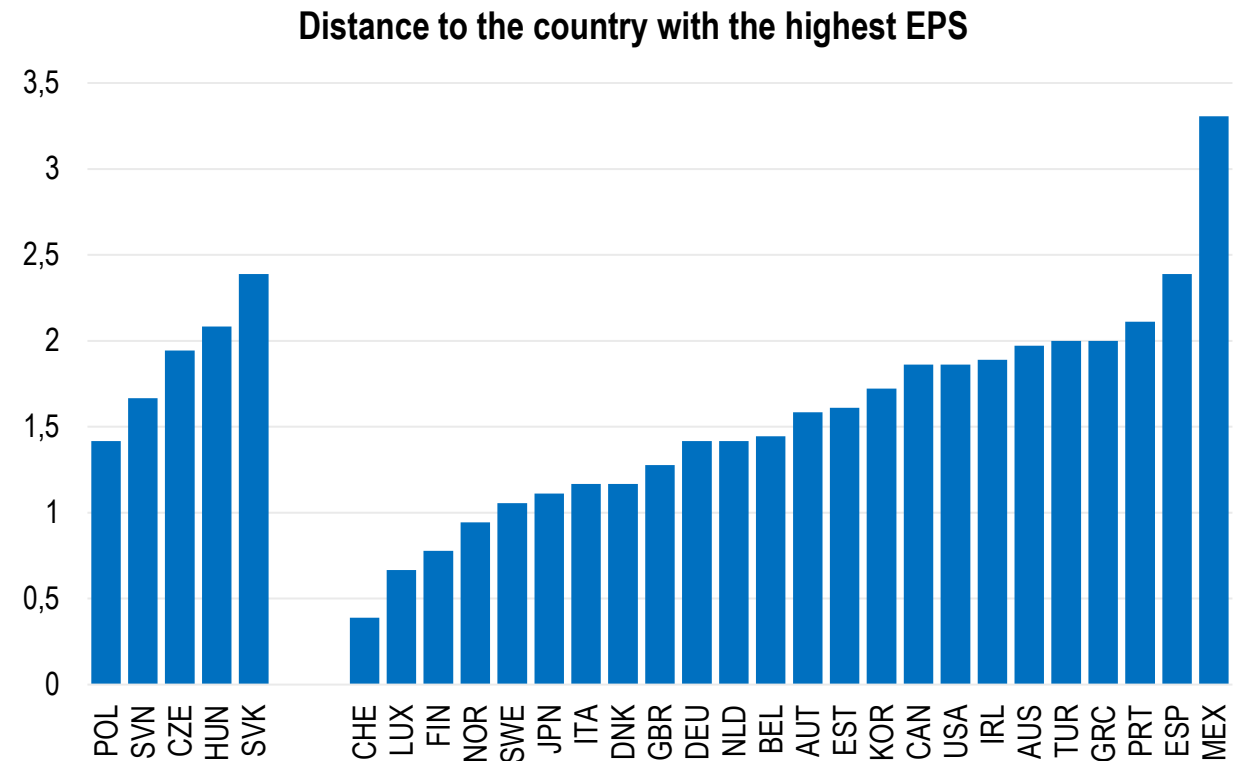


Emissions reduction potential from increasing the EPS?

Moving EPS to “best in class”.

Aggregate results by country, using:

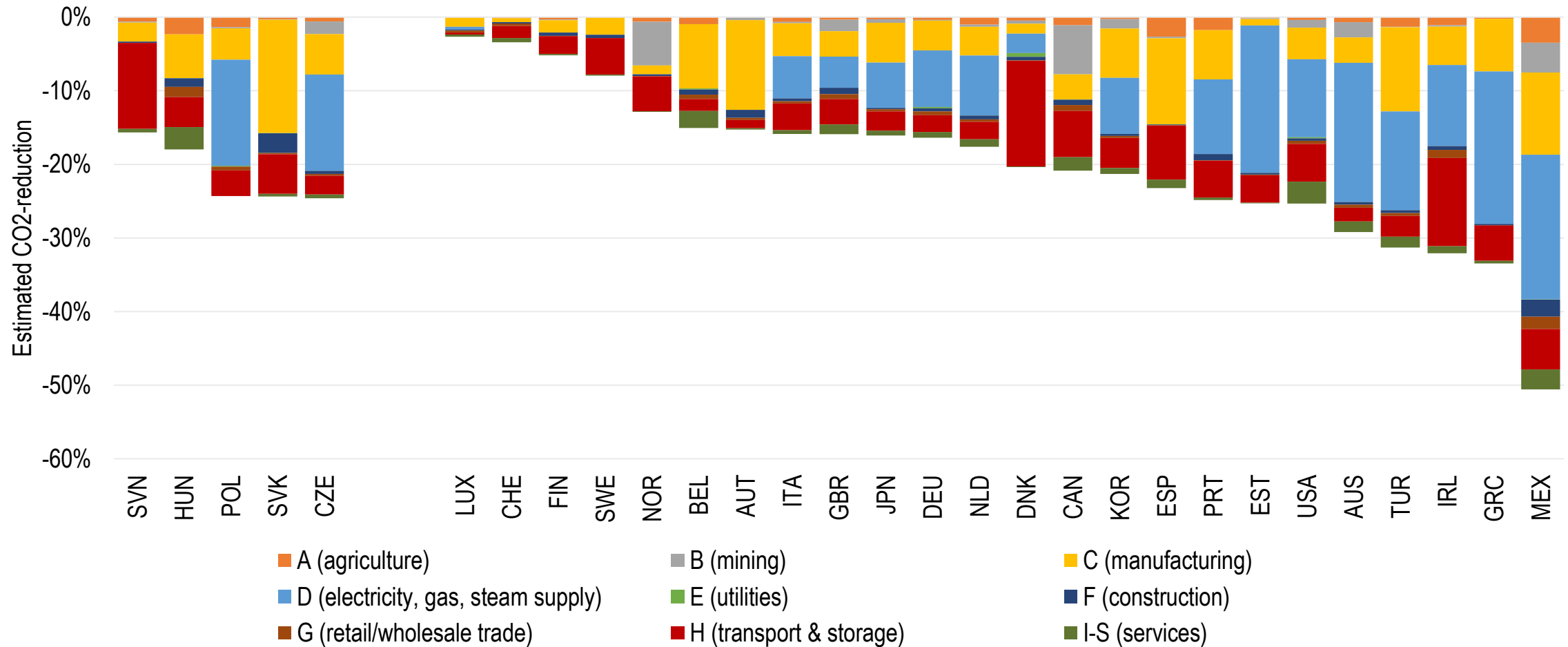
- Sectoral fossil fuel shares (averages)
- Sectoral CO₂ shares (in 2016)
- “Distance” to the French EPS (in 2020)



Source: OECD calculations.



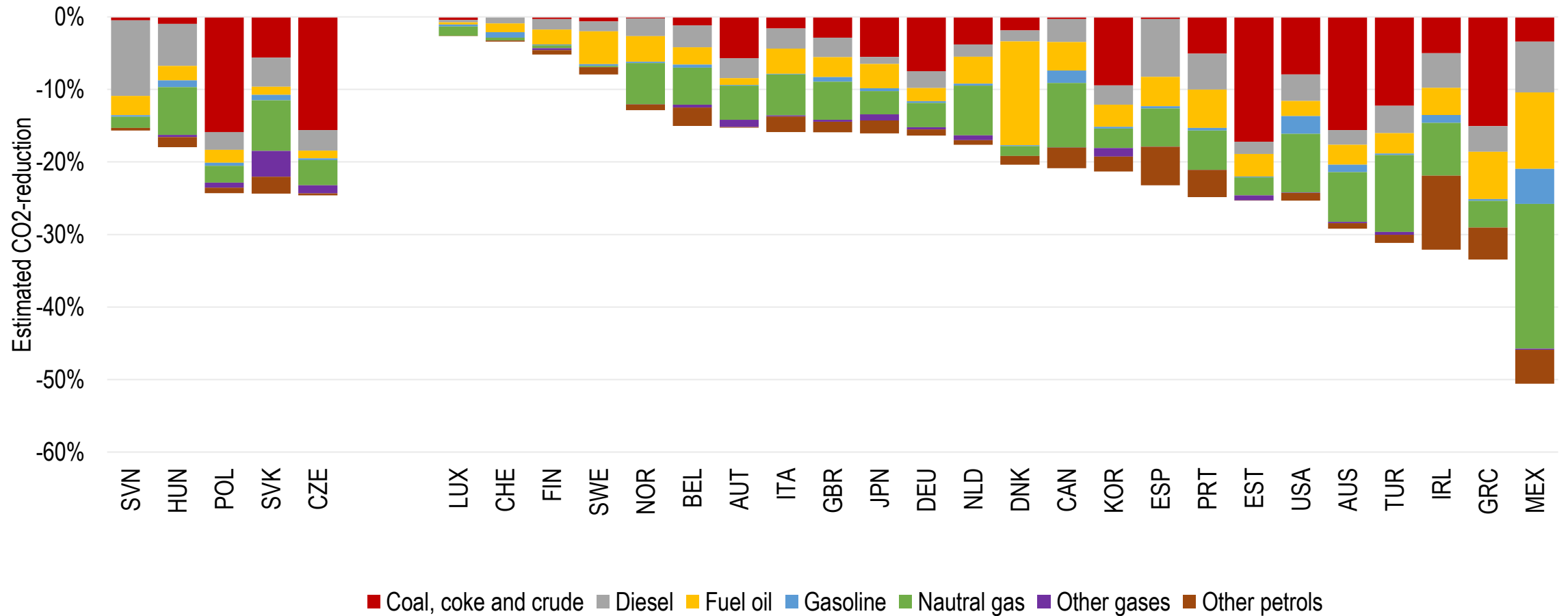
Emissions reduction potential – sectors



Source: OECD calculations.



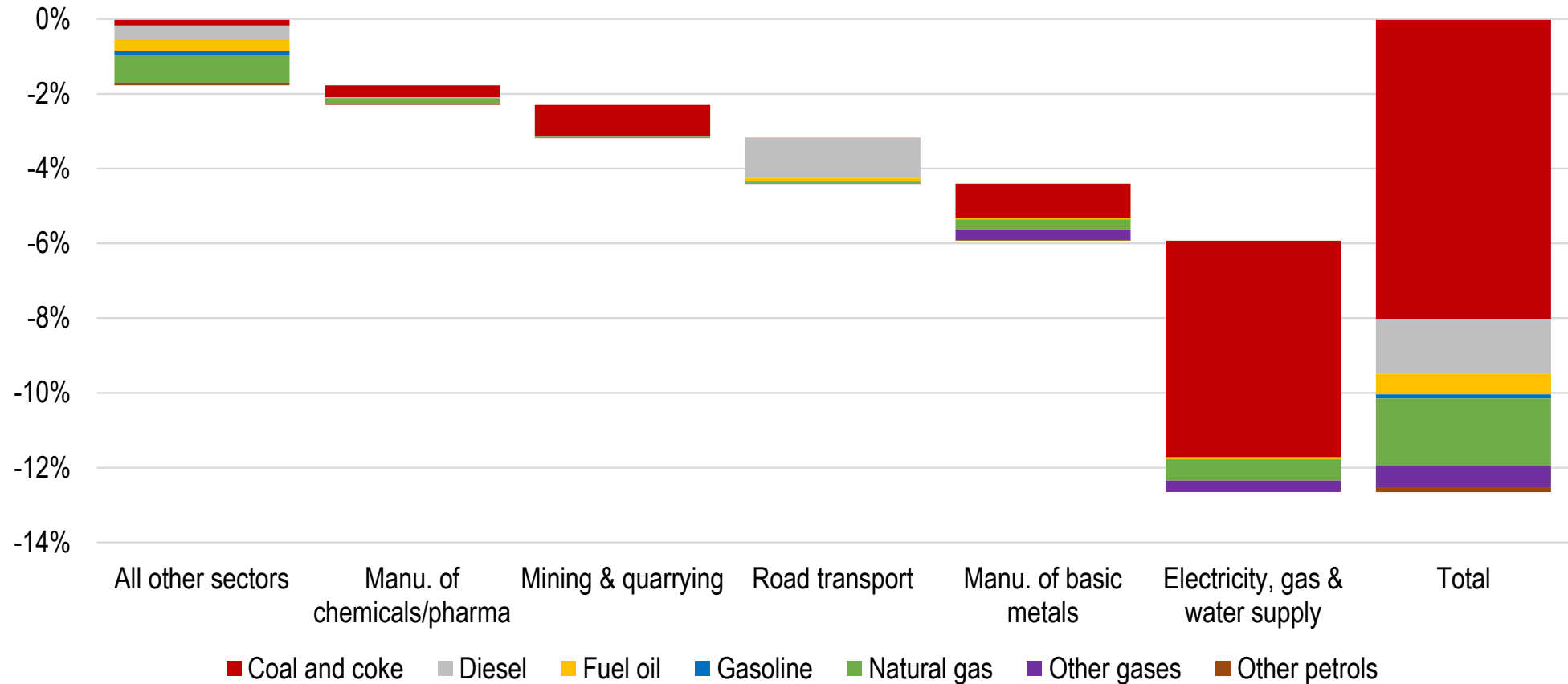
Emissions reduction potential – fuels



Source: OECD calculations.



CZE: emission reductions can be achieved by phasing out coal in energy and heating



Source: OECD calculations.



Key takeaways

Higher EPS is associated with lower CO₂ emissions

- Impact increases with sectors' fossil fuel intensity

Rich data, covering many countries, industries and fossil fuels

Post-estimation analysis can be used to illustrate “what if’s?”

- Enables cross-country comparisons, and
- detailed within-country sectoral analysis

Useful complement and benchmarking for country-specific policy analysis



Thank you for listening!



SUPPLEMENTARY MATERIAL



Data sources:

1. [WIOD Socio-Economic Accounts \(SEA\)](#)
2. [WIOD Environmental Accounts](#)
3. [OECD Environmental Policy Stringency \(EPS\) index](#)

Final dataset:

23,700 country-sector observations, across 54 sectors in 30 OECD countries (2000-2014; latest available data).



Results are robust

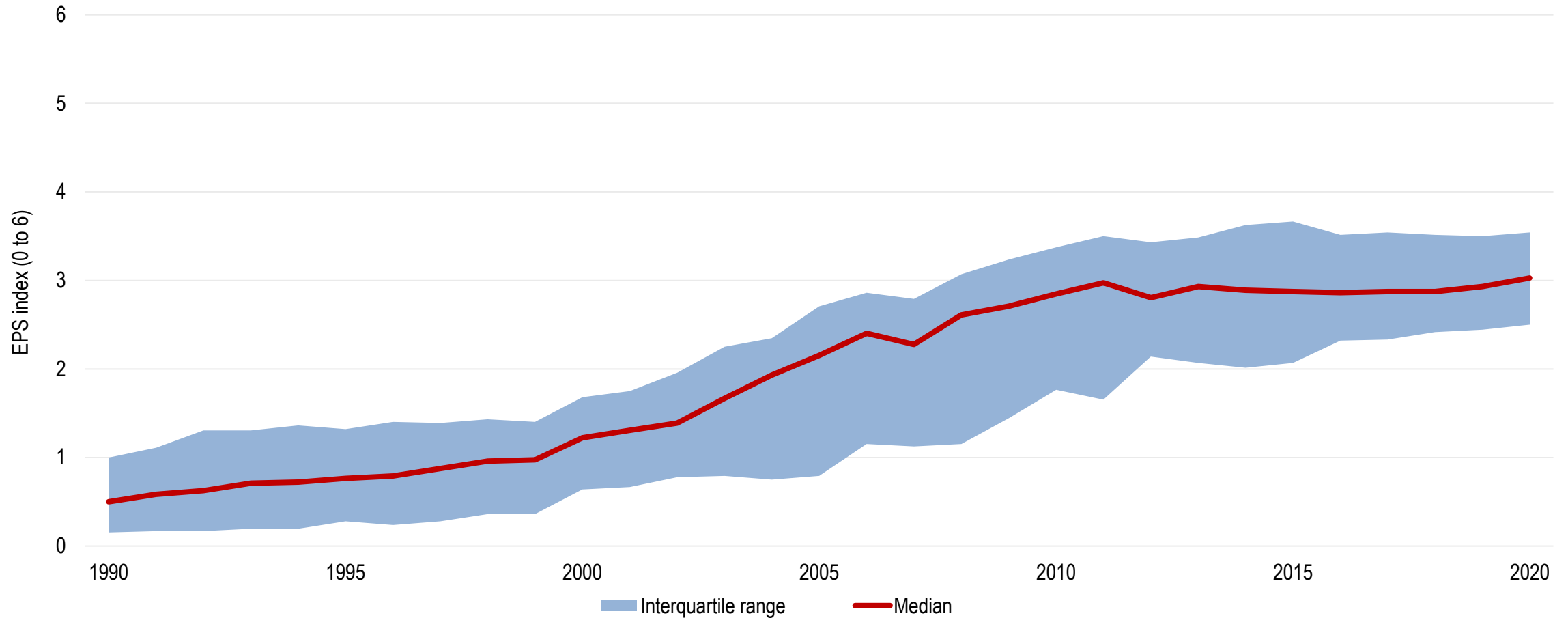
Estimated impact of the EPS on CO₂-emissions after 10 years

Robustness check	Lowest fossil fuel intensity (10 th percentile)	Highest fossil fuel intensity (90 th percentile)
Baseline estimates	-1%	-19%***
1) Pre-sample fossil fuel intensity	-6%	-23%***
2) More fixed effects (country-year, sector-year)	-9%*	-25%*
3) Other controls for demand		
a) No controls	-2%	-19%***
b) DVA in foreign final demand	-3%	-17%***
c) Foreign import demand	-2%	-18%***
4) Only including lags of explanatory variables	-2%	-17%***
5) Excluding sectors with highest CO ₂ shares	6%	-22%***
6) Quadratic time trends	-1%	-19%***
7) Effects of non-environmental policies		
a) PMR above median (less competitive markets)	-2%	-13%**
b) PMR below median (more competitive markets)	0%	-27%***

Notes: *, ** and *** denotes statistical significance at 10%, 5% and 2.5%. Standard errors are clustered at country-sector level. The low/high shares are fossil fuels in total energy use and are computed as percentiles across the full sample. 1) constructs the fossil fuel shares for the year 2000 and this year is dropped from the estimation. 2) includes country-year and sector-year fixed effects. 3) excludes sectors with shares in a country's CO₂ emissions above the 75th percentile (per country). 4) Swaps linear time-trends for quadratic time-trends. 5) Swaps the aggregate EPS for one of the three sub-indices of the EPS.



Environmental policies have become more stringent



Source: OECD.



EPS and estimated impact

