

How do fossil fuel subsidies create an effective negative carbon price?

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Why the GIS-IF model?



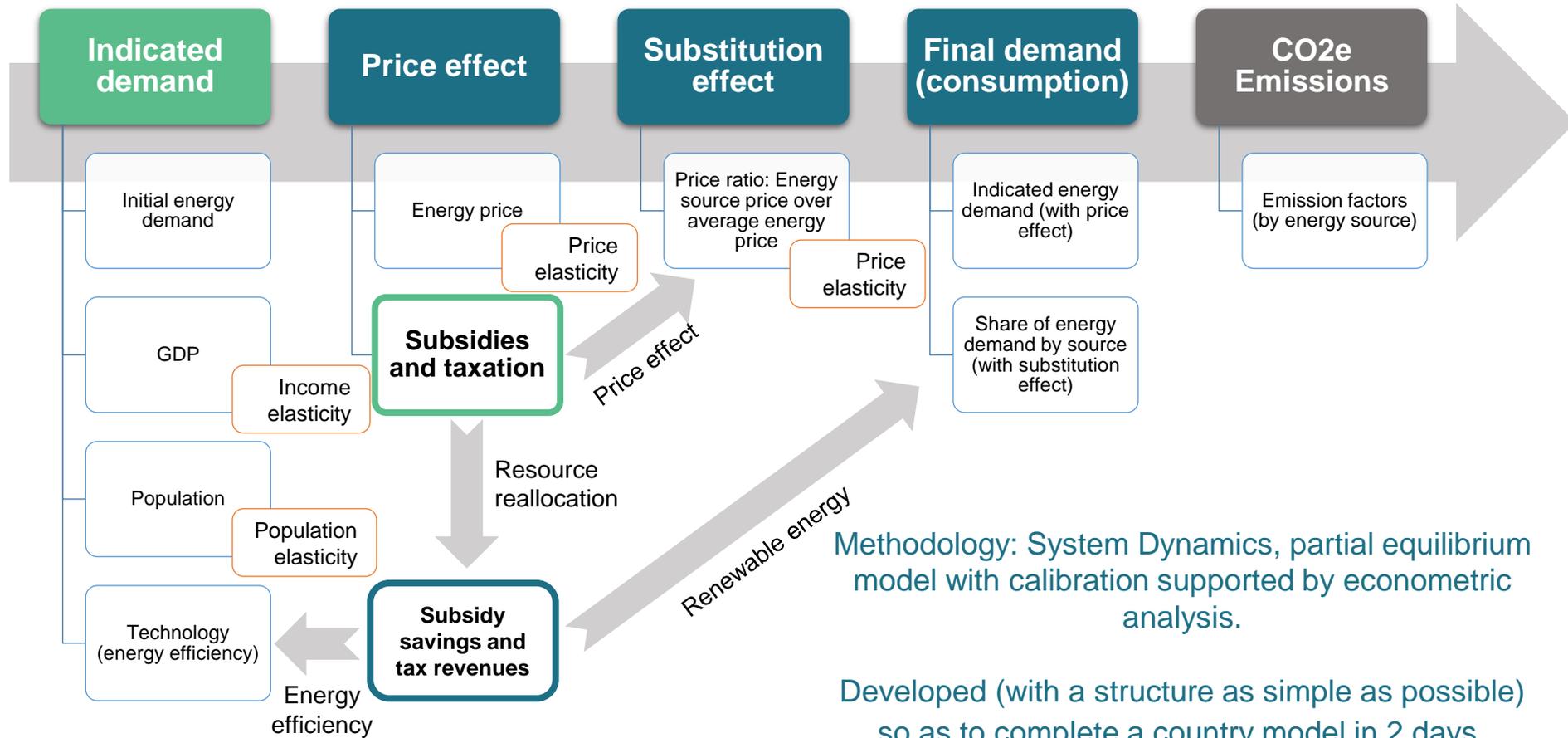
The GSI Integrated Fiscal (GSI-IF) Model was created to analyse the effects of **(i) fossil fuel subsidy reform**, **(ii) fuel taxation** and **(iii) resource reallocation to energy efficiency and renewable energy** (from subsidy removal and taxation) on greenhouse gas emissions to support national level planning and enable international reporting.

The model performs four key functions:

1. Estimates the impact of fossil fuel subsidy reform scenarios on GHG emissions;
2. Evaluates the effect of changes from energy taxation on GHG emissions;
3. Evaluates the fiscal savings from subsidy reductions and increased taxation; and
4. Explores the impacts on GHG emissions of reallocation of subsidy savings and tax revenues to other programmes including energy efficiency and renewable energy promotion.

Model results are currently available for 26 countries: *Algeria, Bangladesh, Brazil, China, Egypt, Germany, Ghana, India, Indonesia, Iran, Iraq, Mexico, Morocco, Myanmar, Nigeria, Pakistan, Russia, Saudi Arabia, South Africa, Sri Lanka, Tunisia, UAE, USA, Venezuela, Vietnam, Zambia.*

GIS-IF model



How do fossil fuel subsidies create an effective negative carbon price?

Key characteristics



- **Boundaries:** energy consumption and emissions from energy use (the current version does not include emissions from other sectors, e.g. land cover).
- **Granularity:** the model is customized to represent national energy consumption, and it is not disaggregated spatially at the sub-national level. On the other hand, it includes energy consumption from the (1) residential, (2) commercial, (3) industrial and (4) transport sectors, disaggregated into (a) coal, (b) petroleum products, (c) natural gas, (d) biofuels and waste, and (e) electricity.
- **Time horizon:** the model is built to analyze medium to long-term trends. Simulations start in 1990 and extend up to 2040.

Key assumptions

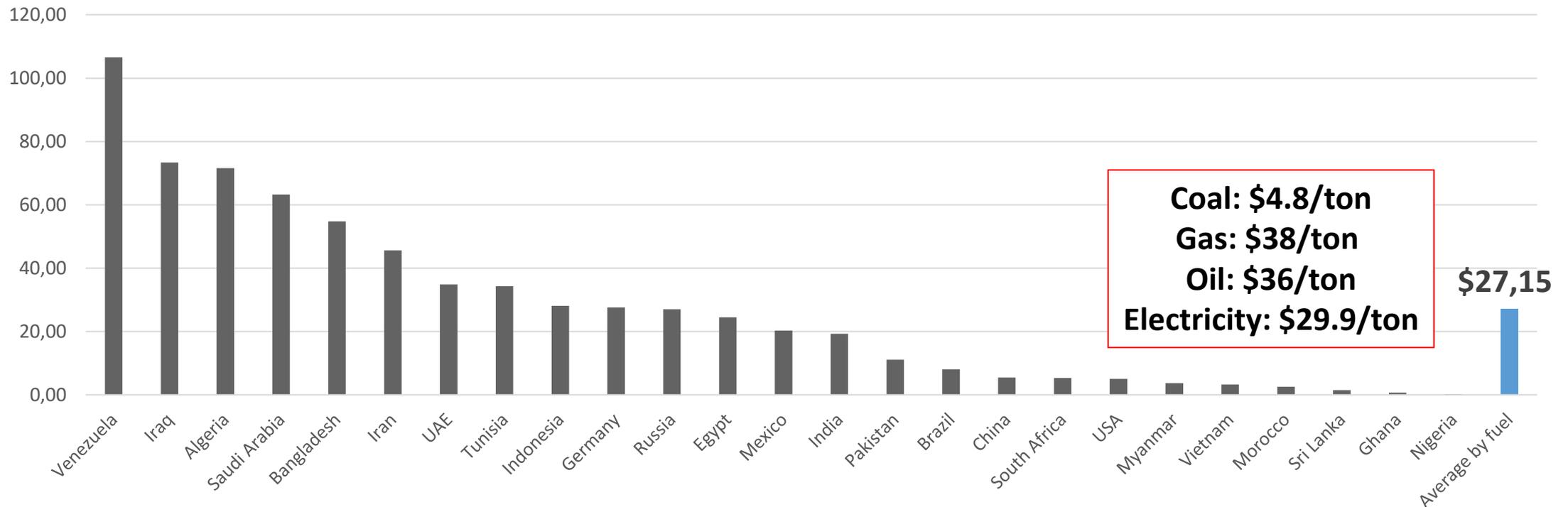


- External (user-driven) inputs:
 - **The future growth of GDP**, currently based on the IMF World Economic Outlook.
 - **The future growth of population**, currently based on the UN World Population Prospects database (medium variant).
 - **Future energy prices**, oil is currently assumed to follow the 10-year historical trend; coal and natural gas, biofuels and waste energy prices are assumed to remain constant in real terms; and the electricity generation cost is assumed to be directly influenced by the price of the energy sources used to generate electricity.
 - **Baseline energy efficiency improvement**, currently projected to improve by 1.5% every year.

Subsidies per Ton of CO2: Method 1



- Approach based on data (2017)
 - Step 1: estimation of subsidy, by country and energy source (\$/TJ)
 - Step 2: CO2 emissions by energy source (Ton/TJ)
 - Step 3: calculation of the subsidy per ton of CO2 (\$/Ton)



How do fossil fuel subsidies create an effective negative carbon price?

Subsidies per Ton of CO₂: Method 2



- Approach based on model results
 - Step 1: simulation of baseline scenario
 - Step 2: simulation of FFSR scenario and estimation of (i) subsidy savings and (ii) avoided emissions
 - Step 3: calculation of the subsidy per ton of CO₂ avoided (\$/Ton), over time (for 2025 and 2030)
- Results:
 - Average value of \$93.4 across countries, considering all subsidies and all fuels, through 2030.

Subsidies per Ton of CO2: Method 2



	Subsidy share of GDP	CO2e reduction relative to BAU			
		FFSR		TAX	
		2025	2030	2025	2030
Venezuela	5.8%	-35.68%	-33.08%	0.00%	-1.93%
Iraq	3.2%	-28.49%	-31.37%	0.00%	-4.01%
Saudi Arabia	5.5%	-19.46%	-18.89%	0.00%	-3.05%
Algeria	6.5%	-14.88%	-13.90%	0.00%	-2.45%
UAE	2.1%	-11.55%	-11.84%	0.00%	-2.75%
Iran	7.2%	-10.37%	-9.91%	0.00%	-2.43%
Bangladesh	0.4%	-8.64%	-9.58%	0.00%	-2.52%
Egypt	2.4%	-5.60%	-5.18%	0.00%	-2.73%
Russia	2.5%	-5.55%	-5.65%	0.00%	-2.24%
Tunisia	2.5%	-3.89%	-4.79%	0.00%	-2.74%
Indonesia	2.0%	-3.57%	-3.75%	0.00%	-2.10%
Mexico	1.0%	-1.93%	-2.25%	0.00%	-2.49%
Zambia	11.5%	0.94%	1.34%	0.00%	-0.10%
South Africa	1.2%	-1.81%	-1.78%	0.00%	-2.16%
Pakistan	0.5%	-1.51%	-1.43%	0.00%	-1.44%
India	0.7%	-1.14%	-1.02%	0.00%	-2.38%
China	0.4%	-1.10%	-1.11%	0.00%	-2.41%
Morocco	0.3%	-0.53%	-0.34%	0.00%	-3.64%
USA	0.1%	-0.59%	-0.52%	0.00%	-2.35%
Myanmar	0.2%	-0.48%	-0.38%	0.00%	-1.24%
Germany	0.1%	-0.05%	-0.04%	0.00%	-2.12%
Sri Lanka	0.1%	-0.22%	-0.15%	0.00%	-2.21%
Brasil	0.1%	-0.01%	0.01%	0.00%	-0.67%
Vietnam	0.1%	-0.22%	-0.27%	0.00%	-2.58%
Ghana	0.1%	-0.07%	-0.05%	0.00%	-1.42%
Nigeria	0.0%	0.00%	0.00%	0.00%	-0.28%
Average		-6.02%	-6.00%	0.00%	-2.17%

How do fossil fuel subsidies create an effective negative carbon price?

Subsidies per Ton of CO2: Method 2



	Subsidy share of GDP	CO2e reduction relative to BAU				EE total	
		FFSR		TAX		2025	2030
		2025	2030	2025	2030		
Venezuela	5.8%	-35.68%	-33.08%	0.00%	-1.93%	-9.02%	-10.65%
Iraq	3.2%	-28.49%	-31.37%	0.00%	-4.01%	-5.55%	-7.27%
Saudi Arabia	5.5%	-19.46%	-18.89%	0.00%	-3.05%	-6.51%	-6.60%
Algeria	6.5%	-14.88%	-13.90%	0.00%	-2.45%	-6.49%	-7.17%
UAE	2.1%	-11.55%	-11.84%	0.00%	-2.75%	-3.32%	-3.87%
Iran	7.2%	-10.37%	-9.91%	0.00%	-2.43%	-3.71%	-4.01%
Bangladesh	0.4%	-8.64%	-9.58%	0.00%	-2.52%	-2.10%	-2.42%
Egypt	2.4%	-5.60%	-5.18%	0.00%	-2.73%	-2.61%	-2.74%
Russia	2.5%	-5.55%	-5.65%	0.00%	-2.24%	-2.07%	-3.02%
Tunisia	2.5%	-3.89%	-4.79%	0.00%	-2.74%	-2.53%	-3.51%
Indonesia	2.0%	-3.57%	-3.75%	0.00%	-2.10%	-2.27%	-2.95%
Mexico	1.0%	-1.93%	-2.25%	0.00%	-2.49%	-1.83%	-3.51%
Zambia	11.5%	0.94%	1.34%	0.00%	-0.10%	-3.79%	-3.58%
South Africa	1.2%	-1.81%	-1.78%	0.00%	-2.16%	-1.05%	-2.46%
Pakistan	0.5%	-1.51%	-1.43%	0.00%	-1.44%	-0.46%	-1.06%
India	0.7%	-1.14%	-1.02%	0.00%	-2.38%	-0.66%	-1.67%
China	0.4%	-1.10%	-1.11%	0.00%	-2.41%	-0.60%	-2.18%
Morocco	0.3%	-0.53%	-0.34%	0.00%	-3.64%	-0.44%	-2.41%
USA	0.1%	-0.59%	-0.52%	0.00%	-2.35%	-0.20%	-1.64%
Myanmar	0.2%	-0.48%	-0.38%	0.00%	-1.24%	-0.14%	-0.47%
Germany	0.1%	-0.05%	-0.04%	0.00%	-2.12%	-0.26%	-2.37%
Sri Lanka	0.1%	-0.22%	-0.15%	0.00%	-2.21%	-0.15%	-1.21%
Brasil	0.1%	-0.01%	0.01%	0.00%	-0.67%	-0.18%	-1.93%
Vietnam	0.1%	-0.22%	-0.27%	0.00%	-2.58%	-0.03%	-1.08%
Ghana	0.1%	-0.07%	-0.05%	0.00%	-1.42%	-0.10%	-1.69%
Nigeria	0.0%	0.00%	0.00%	0.00%	-0.28%	0.00%	-0.18%
Average		-6.02%	-6.00%	0.00%	-2.17%	-2.16%	-3.14%

How do fossil fuel subsidies create an effective negative carbon price?

Subsidies per Ton of CO2: Method 2



	Subsidy share of GDP	CO2e reduction relative to BAU				EE total		RE total	
		FFSR		TAX		2025	2030	2025	2030
		2025	2030	2025	2030				
Venezuela	5.8%	-35.68%	-33.08%	0.00%	-1.93%	-9.02%	-10.65%	-4.62%	-7.15%
Iraq	3.2%	-28.49%	-31.37%	0.00%	-4.01%	-5.55%	-7.27%	-2.90%	-4.63%
Saudi Arabia	5.5%	-19.46%	-18.89%	0.00%	-3.05%	-6.51%	-6.60%	-2.91%	-3.66%
Algeria	6.5%	-14.88%	-13.90%	0.00%	-2.45%	-6.49%	-7.17%	-3.96%	-5.46%
UAE	2.1%	-11.55%	-11.84%	0.00%	-2.75%	-3.32%	-3.87%	-1.97%	-2.66%
Iran	7.2%	-10.37%	-9.91%	0.00%	-2.43%	-3.71%	-4.01%	-2.19%	-2.68%
Bangladesh	0.4%	-8.64%	-9.58%	0.00%	-2.52%	-2.10%	-2.42%	-1.05%	-1.37%
Egypt	2.4%	-5.60%	-5.18%	0.00%	-2.73%	-2.61%	-2.74%	-1.52%	-1.86%
Russia	2.5%	-5.55%	-5.65%	0.00%	-2.24%	-2.07%	-3.02%	-1.39%	-2.36%
Tunisia	2.5%	-3.89%	-4.79%	0.00%	-2.74%	-2.53%	-3.51%	-1.60%	-2.50%
Indonesia	2.0%	-3.57%	-3.75%	0.00%	-2.10%	-2.27%	-2.95%	-1.15%	-1.58%
Mexico	1.0%	-1.93%	-2.25%	0.00%	-2.49%	-1.83%	-3.51%	-1.13%	-2.22%
Zambia	11.5%	0.94%	1.34%	0.00%	-0.10%	-3.79%	-3.58%	-1.10%	-1.24%
South Africa	1.2%	-1.81%	-1.78%	0.00%	-2.16%	-1.05%	-2.46%	-0.42%	-0.97%
Pakistan	0.5%	-1.51%	-1.43%	0.00%	-1.44%	-0.46%	-1.06%	-0.28%	-0.66%
India	0.7%	-1.14%	-1.02%	0.00%	-2.38%	-0.66%	-1.67%	-0.30%	-0.71%
China	0.4%	-1.10%	-1.11%	0.00%	-2.41%	-0.60%	-2.18%	-0.25%	-0.84%
Morocco	0.3%	-0.53%	-0.34%	0.00%	-3.64%	-0.44%	-2.41%	-0.25%	-1.14%
USA	0.1%	-0.59%	-0.52%	0.00%	-2.35%	-0.20%	-1.64%	-0.12%	-0.89%
Myanmar	0.2%	-0.48%	-0.38%	0.00%	-1.24%	-0.14%	-0.47%	-0.09%	-0.30%
Germany	0.1%	-0.05%	-0.04%	0.00%	-2.12%	-0.26%	-2.37%	-0.17%	-1.33%
Sri Lanka	0.1%	-0.22%	-0.15%	0.00%	-2.21%	-0.15%	-1.21%	-0.08%	-0.57%
Brasil	0.1%	-0.01%	0.01%	0.00%	-0.67%	-0.18%	-1.93%	-0.15%	-1.43%
Vietnam	0.1%	-0.22%	-0.27%	0.00%	-2.58%	-0.03%	-1.08%	-0.02%	-0.51%
Ghana	0.1%	-0.07%	-0.05%	0.00%	-1.42%	-0.10%	-1.69%	-0.07%	-0.97%
Nigeria	0.0%	0.00%	0.00%	0.00%	-0.28%	0.00%	-0.18%	0.00%	-0.07%
Average		-6.02%	-6.00%	0.00%	-2.17%	-2.16%	-3.14%	-1.14%	-1.91%

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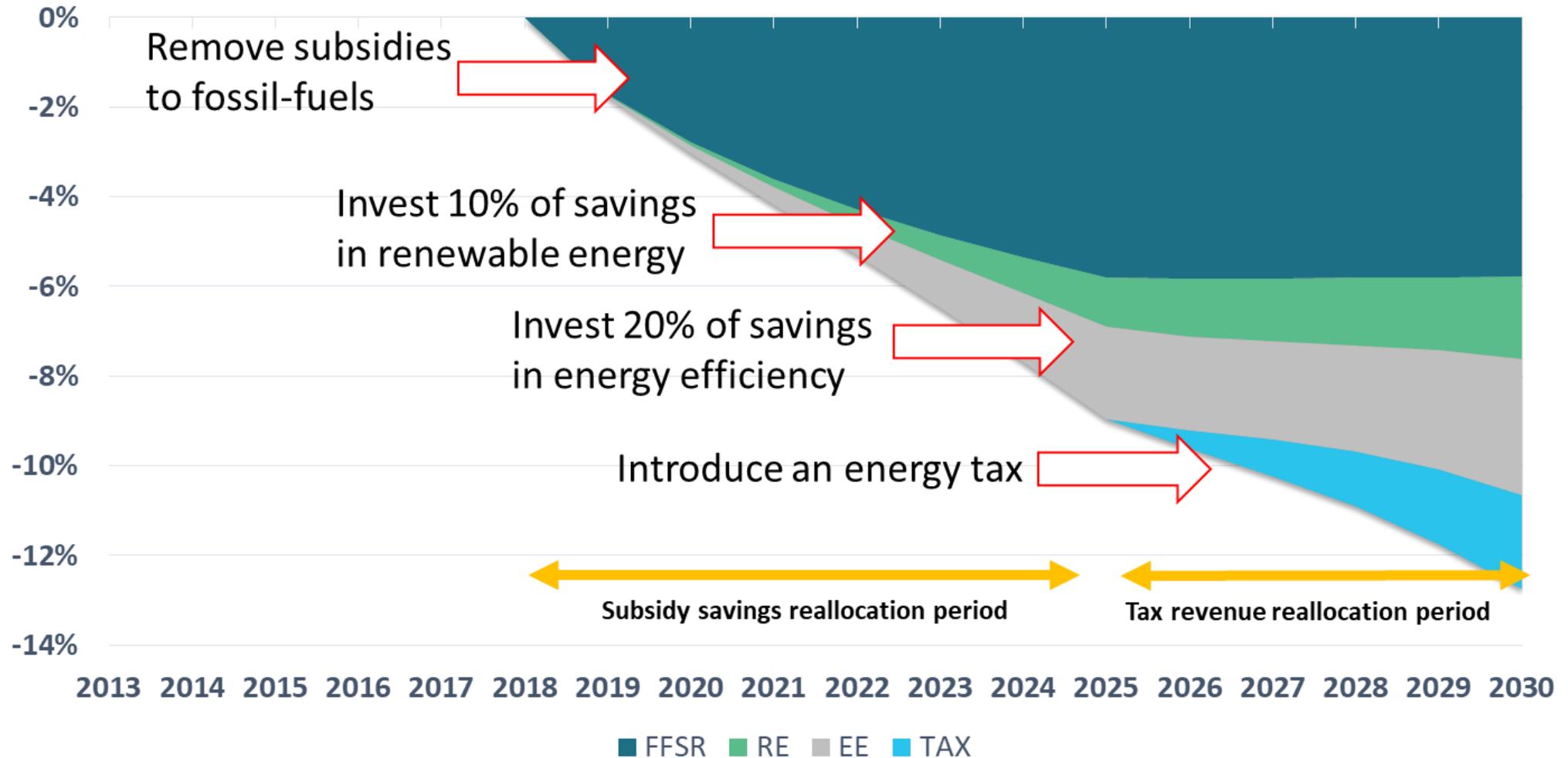
Subsidies per Ton of CO2: Method 2



	Subsidy share of GDP	CO2e reduction relative to BAU				EE total		RE total		Total CO2e reduction (FFSR and TAX, with EE and RE)	
		FFSR		TAX		2025	2030	2025	2030	2025	2030
		2025	2030	2025	2030						
Venezuela	5.8%	-35.68%	-33.08%	0.00%	-1.93%	-9.02%	-10.65%	-4.62%	-7.15%	-49.31%	-52.81%
Iraq	3.2%	-28.49%	-31.37%	0.00%	-4.01%	-5.55%	-7.27%	-2.90%	-4.63%	-36.95%	-47.27%
Saudi Arabia	5.5%	-19.46%	-18.89%	0.00%	-3.05%	-6.51%	-6.60%	-2.91%	-3.66%	-28.89%	-32.20%
Algeria	6.5%	-14.88%	-13.90%	0.00%	-2.45%	-6.49%	-7.17%	-3.96%	-5.46%	-25.32%	-28.99%
UAE	2.1%	-11.55%	-11.84%	0.00%	-2.75%	-3.32%	-3.87%	-1.97%	-2.66%	-16.84%	-21.12%
Iran	7.2%	-10.37%	-9.91%	0.00%	-2.43%	-3.71%	-4.01%	-2.19%	-2.68%	-16.27%	-19.02%
Bangladesh	0.4%	-8.64%	-9.58%	0.00%	-2.52%	-2.10%	-2.42%	-1.05%	-1.37%	-11.79%	-15.90%
Egypt	2.4%	-5.60%	-5.18%	0.00%	-2.73%	-2.61%	-2.74%	-1.52%	-1.86%	-9.72%	-12.50%
Russia	2.5%	-5.55%	-5.65%	0.00%	-2.24%	-2.07%	-3.02%	-1.39%	-2.36%	-9.01%	-13.27%
Tunisia	2.5%	-3.89%	-4.79%	0.00%	-2.74%	-2.53%	-3.51%	-1.60%	-2.50%	-8.03%	-13.54%
Indonesia	2.0%	-3.57%	-3.75%	0.00%	-2.10%	-2.27%	-2.95%	-1.15%	-1.58%	-6.99%	-10.39%
Mexico	1.0%	-1.93%	-2.25%	0.00%	-2.49%	-1.83%	-3.51%	-1.13%	-2.22%	-4.89%	-10.46%
Zambia	11.5%	0.94%	1.34%	0.00%	-0.10%	-3.79%	-3.58%	-1.10%	-1.24%	-3.96%	-3.57%
South Africa	1.2%	-1.81%	-1.78%	0.00%	-2.16%	-1.05%	-2.46%	-0.42%	-0.97%	-3.29%	-7.37%
Pakistan	0.5%	-1.51%	-1.43%	0.00%	-1.44%	-0.46%	-1.06%	-0.28%	-0.66%	-2.25%	-4.59%
India	0.7%	-1.14%	-1.02%	0.00%	-2.38%	-0.66%	-1.67%	-0.30%	-0.71%	-2.11%	-5.78%
China	0.4%	-1.10%	-1.11%	0.00%	-2.41%	-0.60%	-2.18%	-0.25%	-0.84%	-1.95%	-6.53%
Morocco	0.3%	-0.53%	-0.34%	0.00%	-3.64%	-0.44%	-2.41%	-0.25%	-1.14%	-1.22%	-7.53%
USA	0.1%	-0.59%	-0.52%	0.00%	-2.35%	-0.20%	-1.64%	-0.12%	-0.89%	-0.91%	-5.41%
Myanmar	0.2%	-0.48%	-0.38%	0.00%	-1.24%	-0.14%	-0.47%	-0.09%	-0.30%	-0.72%	-2.39%
Germany	0.1%	-0.05%	-0.04%	0.00%	-2.12%	-0.26%	-2.37%	-0.17%	-1.33%	-0.48%	-5.87%
Sri Lanka	0.1%	-0.22%	-0.15%	0.00%	-2.21%	-0.15%	-1.21%	-0.08%	-0.57%	-0.46%	-4.13%
Brasil	0.1%	-0.01%	0.01%	0.00%	-0.67%	-0.18%	-1.93%	-0.15%	-1.43%	-0.34%	-4.03%
Vietnam	0.1%	-0.22%	-0.27%	0.00%	-2.58%	-0.03%	-1.08%	-0.02%	-0.51%	-0.26%	-4.43%
Ghana	0.1%	-0.07%	-0.05%	0.00%	-1.42%	-0.10%	-1.69%	-0.07%	-0.97%	-0.24%	-4.12%
Nigeria	0.0%	0.00%	0.00%	0.00%	-0.28%	0.00%	-0.18%	0.00%	-0.07%	-0.01%	-0.52%
Average		-6.02%	-6.00%	0.00%	-2.17%	-2.16%	-3.14%	-1.14%	-1.91%	-9.32%	-13.22%

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Subsidies per Ton of CO2: Method 2



How do fossil fuel subsidies create an effective negative carbon price?

Considerations



- The countries with the highest per cent reduction in emissions are Venezuela, Iraq, Saudi Arabia, Algeria and the UAE, with an average emission reduction above 20% in the year 2030.
- These countries are characterized by the highest relative amounts of subsidies as a share of GDP among the ones considered for this study.
- As a result, FFSR leads to large price changes in these countries, which affects energy demand and fuel switching.
- Further, the presence of large subsidies implies, in our scenarios, that a large amount of funding would be reallocated to energy efficiency and renewable energy. Still, the largest component of emission reduction in these countries is fossil fuel subsidy removal.

Considerations



- The countries with the largest absolute reduction in emissions are China, USA, India, Saudi Arabia, Russia and Indonesia.
- These are countries characterized by high energy intensity and consumption, relatively low or affordable energy prices, and/or high carbon intensity (and hence high reliance on subsidized fossil fuels).
- It results that for these countries FFSR is not the largest contributor to emission reduction. Energy taxes and energy efficiency often lead to larger emission reduction than FFSR in countries like China, USA and India due to the relatively larger impact that a 10% tax has on fuel prices than subsidy removal, and the comparatively larger amount of resources reallocated to energy efficiency (due to the disproportionately higher demand compared to other countries).



Thank you

More information

www.iisd.org/gsi

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