Trade and competitiveness spillovers of decarbonization policies

Eddy Bekkers, Lee Humphreys, Kirti Jhunjhunwala, Ayse Nihal Yilmaz

Economic Research and Statistics Division, WTO Secretariat

GTAP Conference Kigali June 2025

Disclaimer: The views expressed in this presentation do not necessarily reflect the views of WTO Members and are without prejudice to their rights and obligations under the WTO.

Introduction

- Two key policy instruments to promote climate change mitigation:
  - Carbon pricing / taxation which makes carbon more expensive
  - Green subsidies which makes the use of renewable energy cheaper.
- There is a small literature on the economic cross-border spillover effects of the two approaches in CGE models. For example:
  - Chateau, Jaumotte and Schwerhoff (2024) compare different approaches to realize an emission reduction target but focus more on effectiveness of different policies than cross border spillover effects
  - Fournier, Tannous, Masterson, Paret and Thube (2024) analyse the cross border spillover effects of climate policies within Northern America finding limited trade effects
- ***Research Question: What are the trade spillover effects if some economies choose carbon pricing and other economies choose green subsidies?***

Model, Data and Calibration

- We employ the WTO Global Trade Model combined with GTAP-RD-Power and extended with diffusion of ideas.
- We calibrate the model to GTAP v11 with 23 regions and 22 sectors
- The trade balance is fixed and we assume upward sloping labour supply
- Ideas diffusion generates a recursive law of motion for region-sector specific technology parameters
  - Technology growth is a function of the intermediate trade weighted average of the level of technology in trading partners
  - This implies that a larger share of intermediate imports from regions with high productivity levels generates higher productivity growth
- We introduce either carbon pricing (in individual regions; no emissions trading) or green subsidies, which are modelled as output subsidies on the production of solar energy or wind energy generating electricity
- Carbon policies are in place from 2023 until 2030

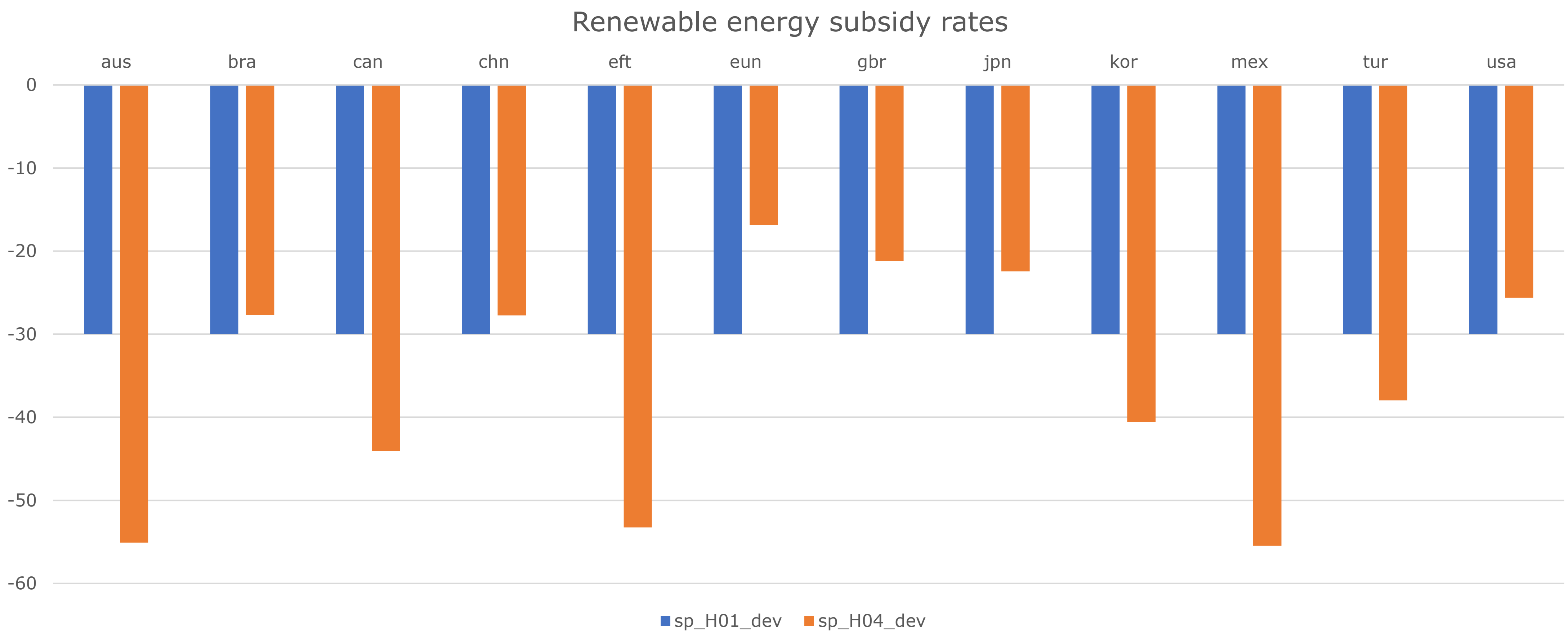
Introduction of Stylized Scenarios

- We introduce stylized scenarios with two groups of regions using either carbon pricing or green subsidies
  - These groups are based on the World Bank Carbon Pricing Dashboard for carbon prices and the World Bank database of industrial subsidies.
- The (stylized) groups are defined as follows:
  - **Carbon pricing (CP) group**: Australia, Canada, China, the EU, EFTA and the UK.
  - **Green subsidy group**: Brazil, Japan, Korea, Mexico, Türkiye and USA.
  - There is also a set of regions not introducing policies which are not further considered in the analysis

Specification of Stylized Scenarios

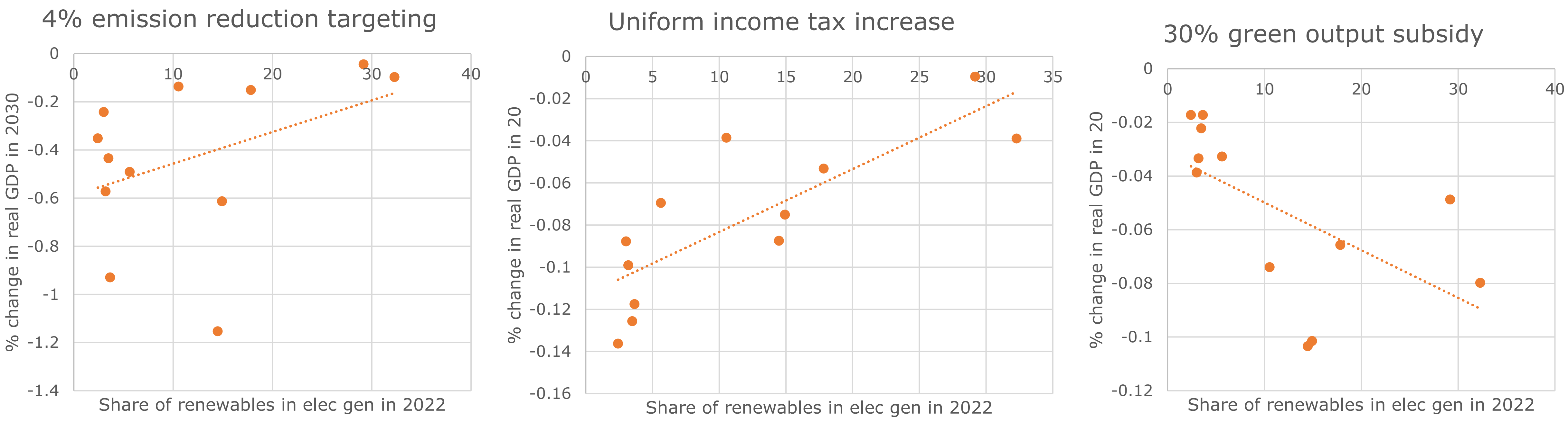
Approach 1	Approach 2
Regional emission reductions based on the formula of the global carbon pricing framework targeting a 4% global emissions reduction	Regional emission reductions equivalent to green subsidies across all regions paid by a uniform increase in the income tax rate of 0.16pp
To reach regional emission reductions, two scenarios:	To reach regional emission reductions, two scenarios:
1. Both CP group and subsidy group do carbon pricing	1. Both CP and subsidy group do carbon pricing
2. CP group does carbon pricing and subsidy group does subsidies	2. CP group does CP and subsidy group does subsidies

Calibration of subsidy rates



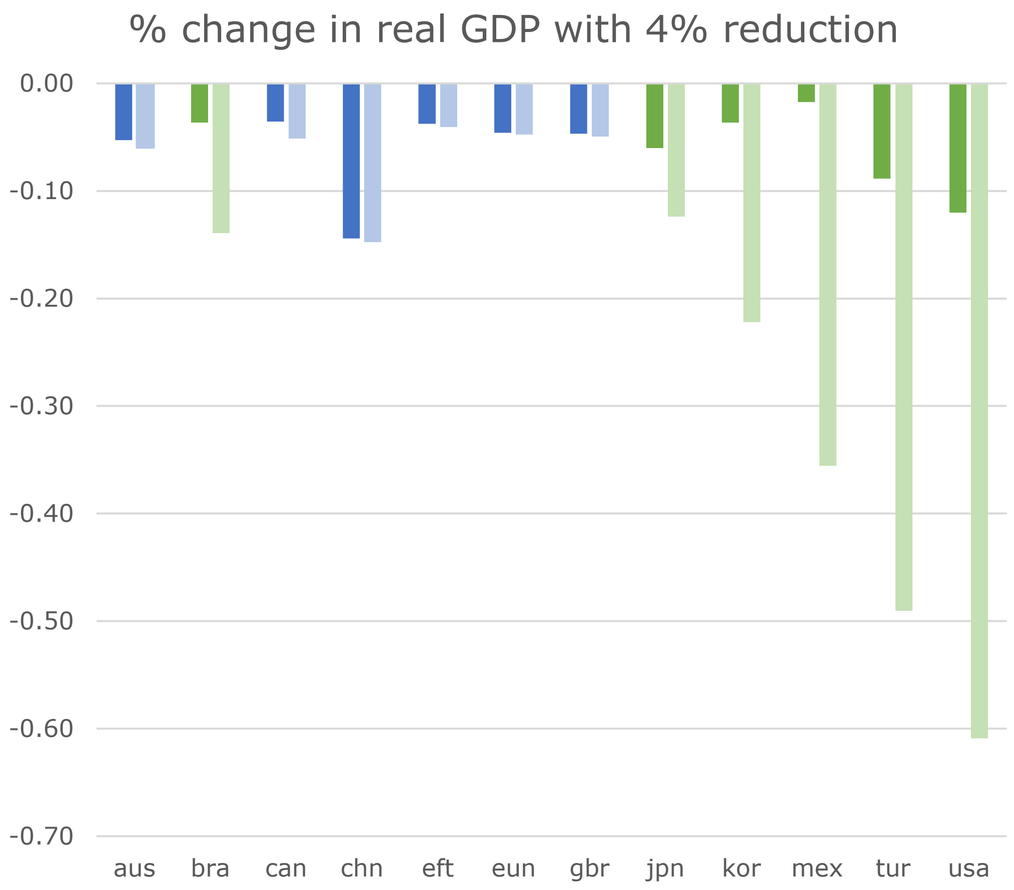
- We compare the output subsidy rates for a 30% uniform subsidy with the subsidy rates of a uniform 0.16pp income tax increase across all subsidizing regions

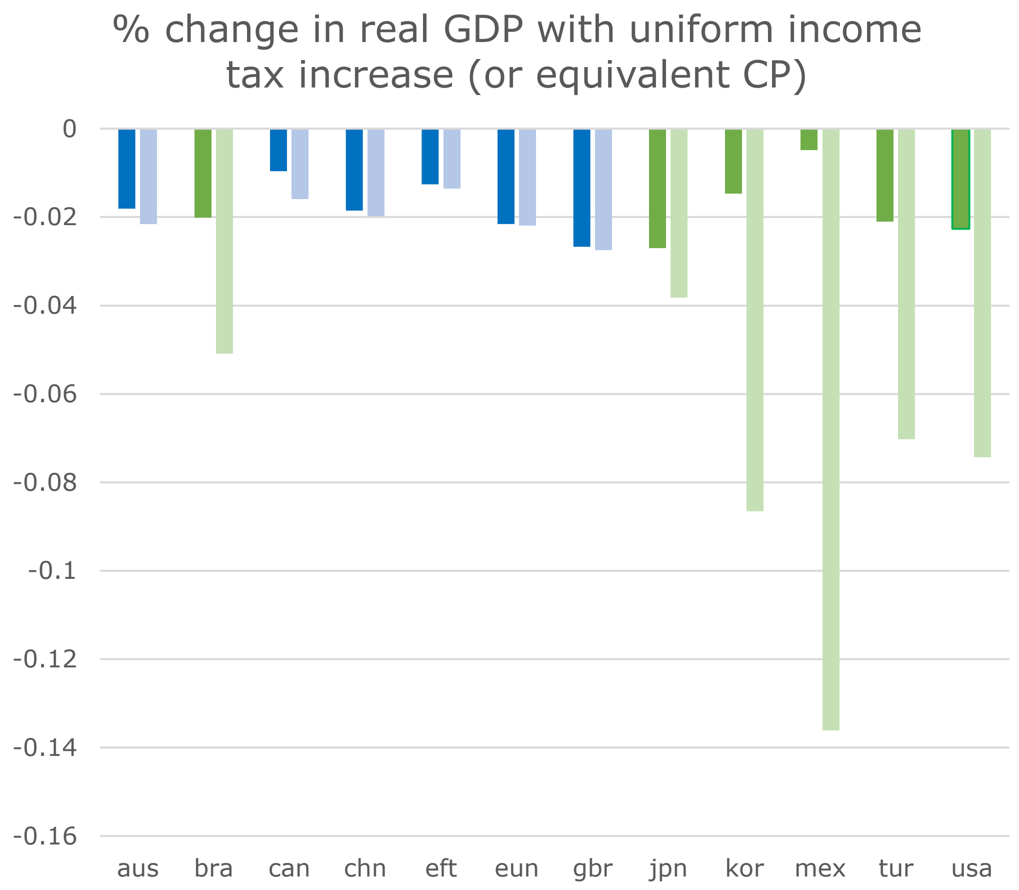
Calibration issue: renewables share vs GDP impacts



- The larger the baseline share of renewables, the smaller the GDP loss for emission reduction targeting (Approach 1) and uniform income tax increase (Approach 2).
- If we target a uniform green (renewable energy) subsidy rate, regions with higher initial shares would lose out more (right panel)

Macro impacts

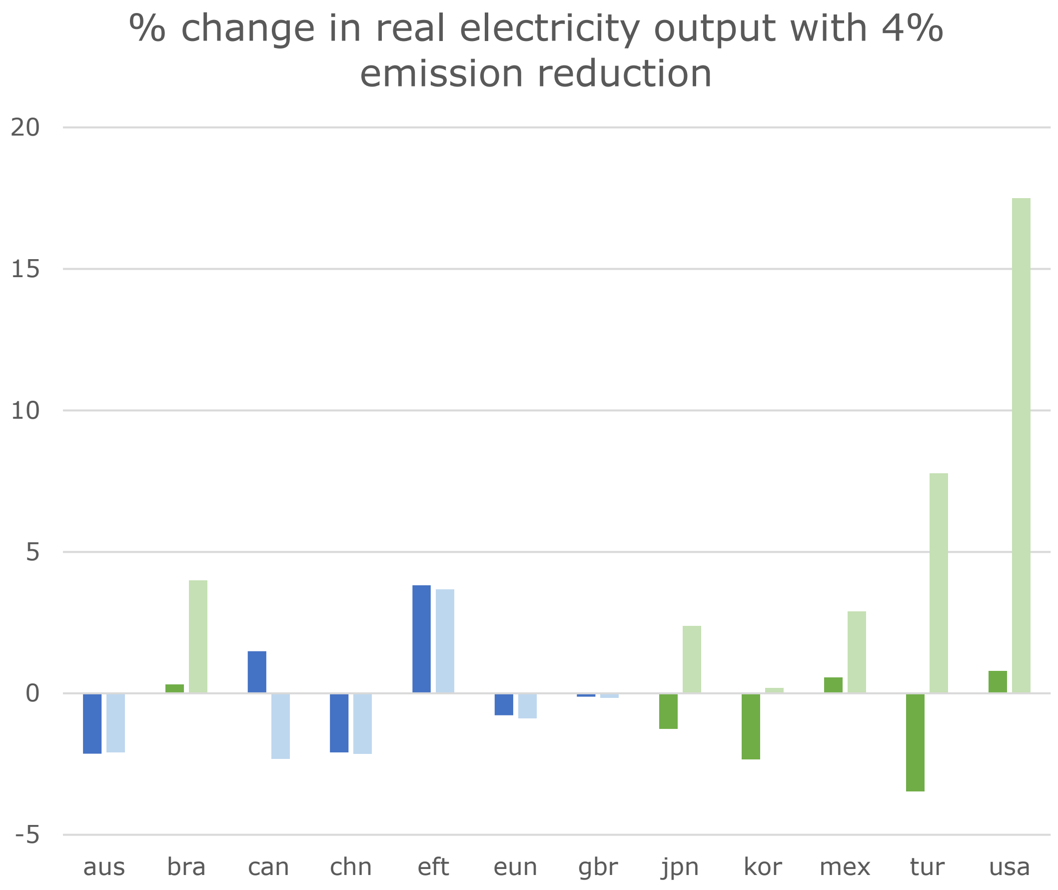


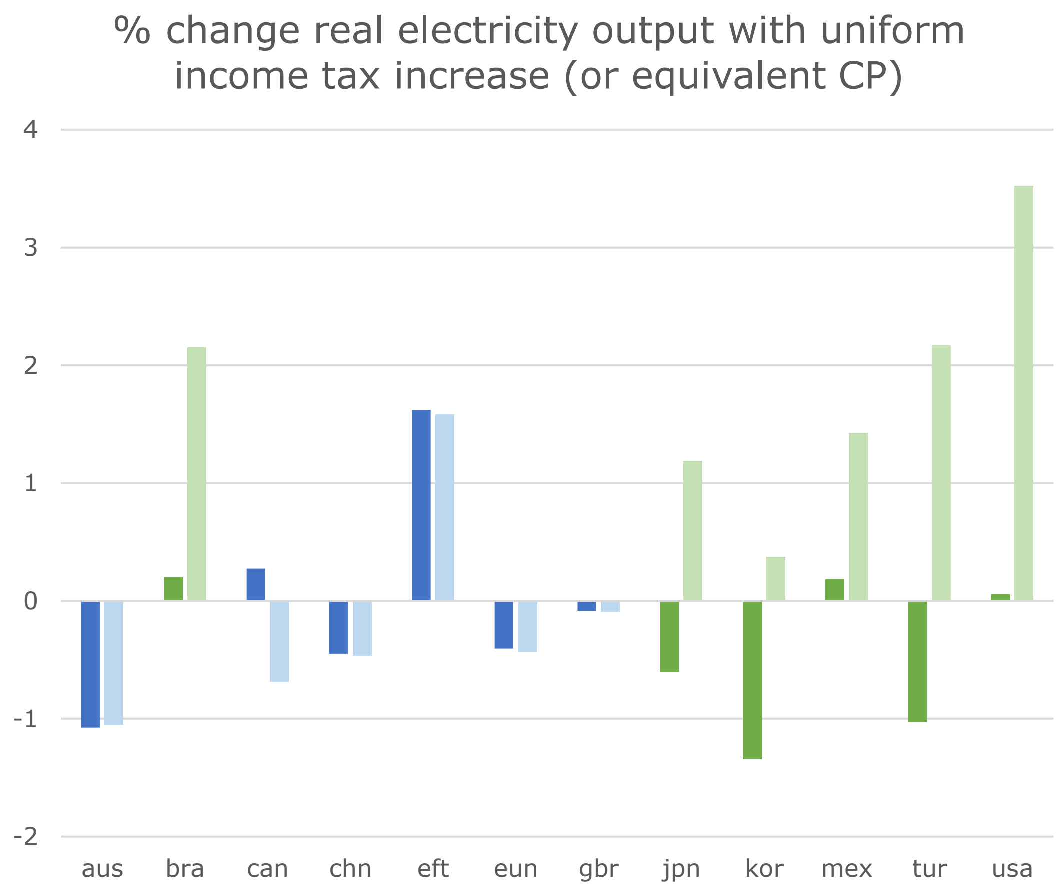


Blue: carbon pricing group; Green: green subsidies group. Dark shaded: Scenario 1 (both groups doing carbon pricing); Light shaded: Scenario 2 (carbon pricing group doing carbon pricing and green subsidies group doing green subsidies).

- Green subsidies regions (green) are projected to see a much larger reduction in real GDP than carbon pricing regions (blue) when switching to green subsidies (light bars)
- Impacts are similar for regions always choosing carbon pricing (light and dark blue bars)

Production impacts - electricity

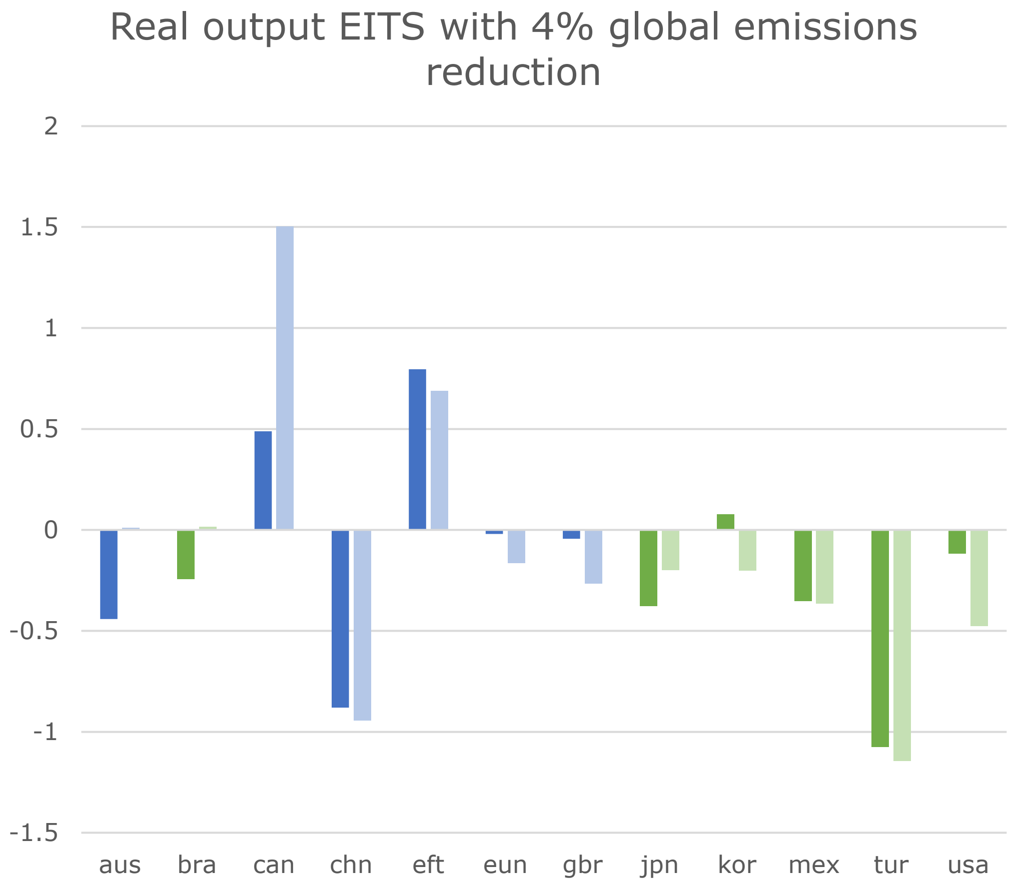


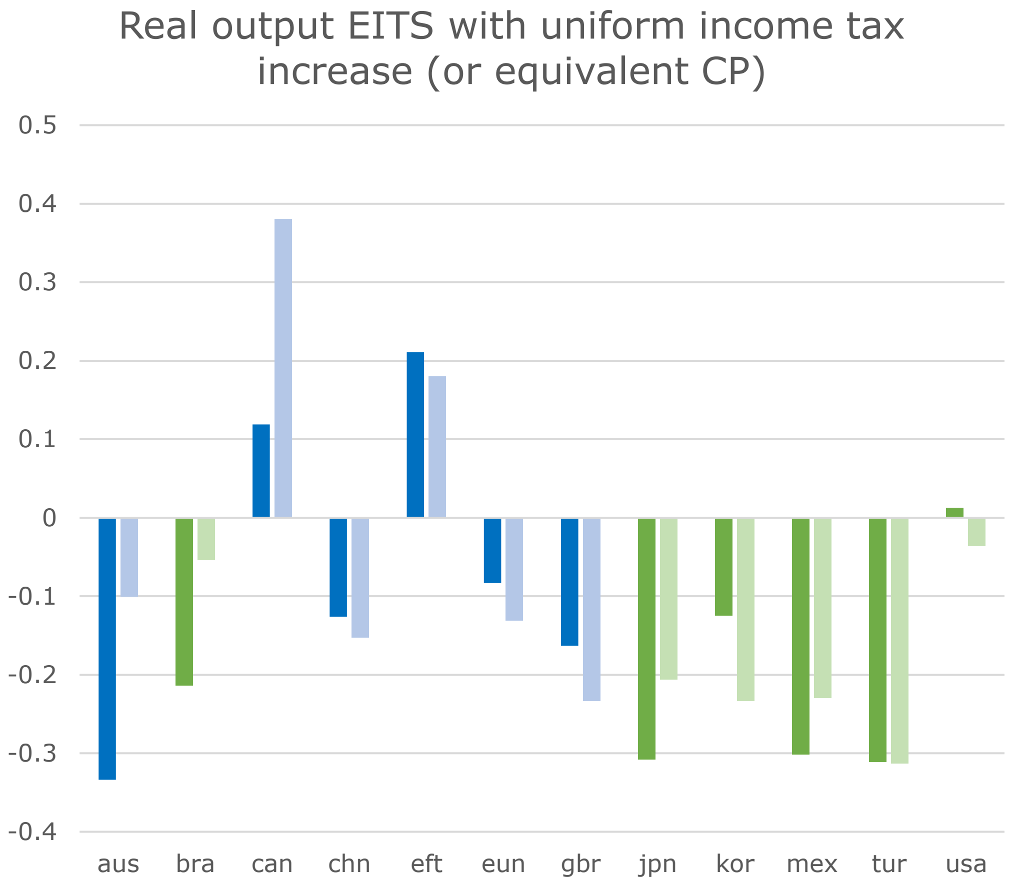


Blue: carbon pricing group; Green: green subsidies group. Dark shaded: Scenario 1 (both groups doing carbon pricing); Light shaded: Scenario 2 (carbon pricing group doing carbon pricing and green subsidies group doing green subsidies).

- Subsidizing regions see electricity output increase more under green subsidies, compared to carbon pricing

Competitiveness/production impacts – downstream

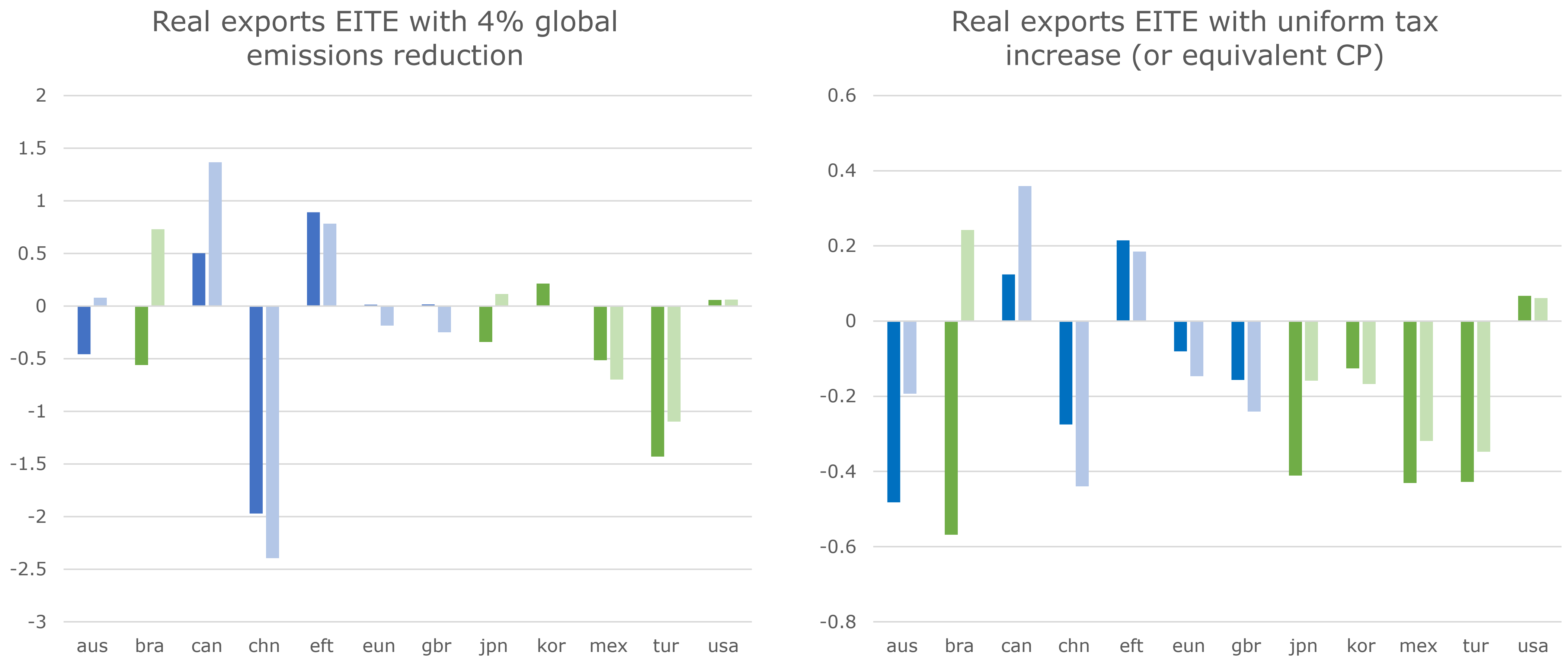




Blue: carbon pricing group; Green: green subsidies group. Dark shaded: Scenario 1 (both groups doing carbon pricing); Light shaded: Scenario 2 (carbon pricing group doing carbon pricing and green subsidies group doing green subsidies).

- Mixed impacts on energy intensive trade exposed (EITE) sector. Subsidies for solar/wind do not always increase output in the energy intensive sector in that region (Korea, Türkiye, USA)

Trade impacts – EITE sector



Blue: carbon pricing group; Green: green subsidies group. Dark shaded: Scenario 1 (both groups doing carbon pricing); Light shaded: Scenario 2 (carbon pricing group doing carbon pricing and green subsidies group doing green subsidies).

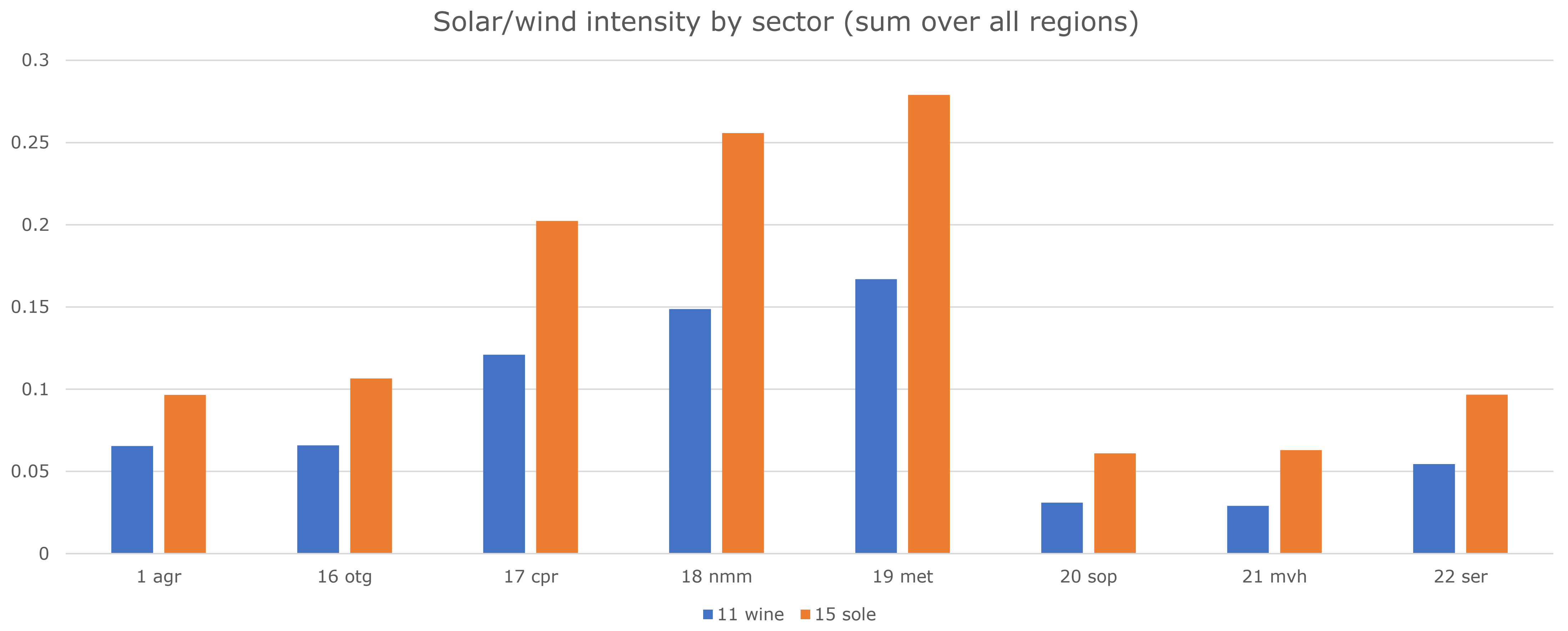
- Mixed impacts on energy intensive trade exposed (EITE) sector. For exports some green subsidy regions (for example Türkiye) lose less.
- Additional increase in some carbon pricing regions are actually bigger (for example Canada)

Trade impacts – other goods

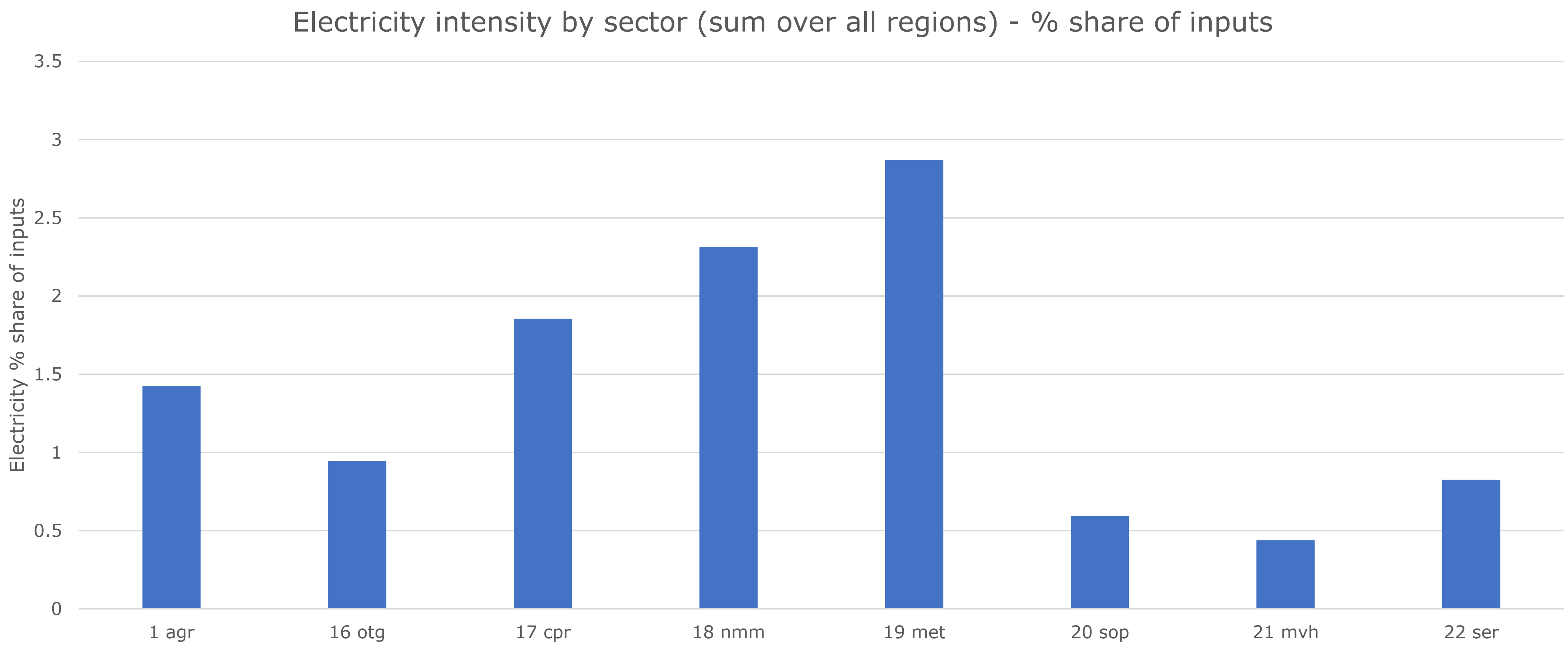
Blue: carbon pricing group; Green: green subsidies group. Dark shaded: Scenario 1 (both groups doing carbon pricing); Light shaded: Scenario 2 (carbon pricing group doing carbon pricing and green subsidies group doing green subsidies).

- In the sector Other Goods, the adverse trade effects for green subsidy regions are larger than in EITE sectors

Solar/wind input shares in gross output (Baseline 2030)



Electricity input shares in gross output (Baseline in 2030)



Summary of Findings

- Green subsidies lead to greater GDP losses in the subsidising regions because of distortions to allocative efficiency and the required tax increases to fund subsidies
  - With carbon pricing more margins of adjustment can be targeted (between different types of fossil fuels for example)
  - Subsidies also suffer from a rebound effect with energy output being promoted, complicating emission reductions
- Green subsidies promote electricity output (from renewable sources i.e. solar and wind) – but this is hardly traded
- Limited beneficial competitiveness impacts of green subsidies in terms of exports in energy intensive sectors. Result of:
  - Renewable electricity is a small share of inputs so little feedthrough
    - This can change over time as EITE sectors like steel start using more electricity inputs and thus renewables
  - Subsidies have larger adverse economic effects

Other results of model with R&D and R&D subsidies

Global Trade Model with R&D sector

- Key Assumptions
  - A proportion of the cost of production is devoted towards R&D by every firm in each sector and region assuming an identical input cost mix
  - Productivity growth is a function of R&D spending
- Imposing a balanced growth path generates an equation for the input share allocated to research
- A research subsidy reduces the cost of the input bundle being used for R&D resulting in a higher share of R&D relative to production which thus promotes productivity growth

Global Scenarios

Targeting global emissions reductions of 27% via:

1. All regions have a uniform yearly rate of 15% of output subsidy to solar and wind.
2. All regions have a uniform rate of 41% of research subsidy to solar and wind.
3. All regions have a uniform rate of 25% of capital subsidy to solar and wind.

These subsidy rates are found to be equivalent in terms of reductions in emissions.

Global subsidy results

	Real GDP			Income tax spent		
	15.5% Output	**41% research**	**25% capital**	**15.5% Output**	**41% research**	**25% capital**
asl	-1.34	0.04	-8.02	165	2	1140
aus	-2.46	-0.92	-1.35	5911	1745	2987
bra	-5.61	-1.46	-6.09	8859	3173	10048
can	-5.90	-1.95	-4.20	18511	6205	13090
chn	-6.37	-4.28	-6.36	52174	40479	51698
eft	-0.99	-1.14	-0.82	1805	2095	1414
eun	-2.71	-1.22	-1.91	83425	54798	57008
gbr	-1.82	-1.11	-1.76	9416	7167	8276
idn	-0.30	0.03	-2.42	163	-29	1356
ind	-8.19	-0.05	-0.45	13543	2377	541
jpn	-4.39	-2.79	-2.00	30379	23865	13707
kor	-4.66	-5.91	-6.74	7987	10974	11953
lac	-3.96	-2.43	-3.18	7735	5621	6449
mex	-4.05	-0.10	-3.72	3620	69	3440
min	-4.71	-0.77	-10.01	8629	1059	20531
oas	-3.30	-0.07	-3.14	5214	150	5264
row	-17.28	1.07	-10.79	9969	946	6267
rus	-18.31	-3.69	-12.86	26029	10009	19090
sea	-6.31	-1.35	-10.05	7481	1830	12864
ssl	-0.26	-0.20	-2.26	31	24	376
sso	-6.40	-0.44	-1.67	5319	750	1240
tur	-5.82	-1.68	-5.77	3550	1388	3630
usa	-5.22	-3.91	-7.64	172360	135120	258148
wld	-5.02	-2.43	-5.12	482276	309816	510517