Fossil fuels subsidy removal and the EU Green Deal policy mix design

Alessandro Antimiani
Valeria Costantini
Elena Paglialunga

DG Trade - Chief Economist Unit
Roma Tre University - Department of Economics
University of Urbino - Department of Economics, Politics, Society

FSR Climate Annual Conference 26-27 November 2020

Outline

- Fossil fuels subsidy removal and the European Green Deal
- The monetary value of subsidies
- The modelling approach
- Simulation design
- Results for the EU
- Conclusions and policy implications

Fossil fuels subsidy removal

- Global fossil-fuel consumption subsidies are recognised as a barrier to reach ambitious low-carbon targets (Chepeliev et al., 2018; Chepeliev and van der Mensbrugghe, 2020)
- Large environmental negative impacts are provoked by subsidies (the coal case in China by Xiang and Kuang, 2020)
- Long-term subsidization trends can be explained by the absence of political will
- Concerns are also related to the risks of regressive impacts on low-income households (Reanos and Sommerfeld, 2018)
- Lack of confidence in the ability of governments to reallocate the resulting budgetary savings (Clements et al., 2013)
- Potential development opportunities from revenue recycling are large (Jakob et al., 2015)

The European Green Deal and carbon neutrality

- Phasing-out fossil fuels is the primary solution to a low-carbon economy
- Fossil fuels subsidy removal is part of the Green Deal 1: *The price of transport must reflect the impact it has on the environment and on health. Fossil-fuel subsidies should end and, in the context of the revision of the Energy Taxation Directive, the Commission will look closely at the current tax exemptions including for aviation and maritime fuels and at how best to close any loopholes*
- Fossil fuels subsidy removal is part of the Green Deal 2: *a greater use of green budgeting tools will help to redirect public investment, consumption and taxation to green priorities and away from harmful subsidies*
- Today, only half of European emissions are covered by a price mechanism, and carbon prices remain too low to drive significant behavioural changes
- Carbon price mechanism should cover the entire economy to bring to a radical shift toward carbon neutrality

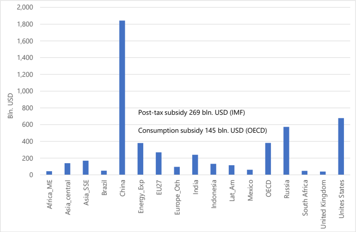
Monetary value of subsidies: methods

Fossil fuel subsidies can be measured in two different ways:

- The first is a narrow measure, named pre-tax subsidies, which simply reflects differences between the amount consumers actually pay for fuel use and the corresponding cost of supplying the fuel including full taxation
- The second is a broader measure, named post-tax subsidies, which reflects differences between actual consumer fuel prices and how much consumers would pay if prices fully internalise supply costs plus the taxes needed to reflect environmental costs

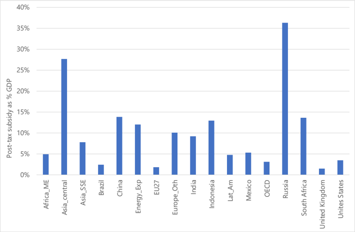
Monetary value of subsidies: quantification

Distribution of post-tax subsidies across regions (Bln. USD in 2019)



Note: own elaborations on IMF and OECD database

Distribution of post-tax subsidies across regions (% of GDP in 2019)



Note: own elaborations on IMF and OECD database

GTAP database

- GTAP 10 (Aguiar et al., 2019): base year 2014, 141 regions and 65 sectors
- GTAP Energy (McDougall and Golub, 2009): base year 2014, provides carbon dioxide (CO2) emissions data distinguished by fuel and by user
- GTAP Power (Chepeliev,2020; Peters, 2016): base year 2014, electricity disaggregation into generation, transmission and distribution, with seven base load technologies and four peak load technologies
- GTAP Non-CO2 emissions (Irfanoglu and van der Mensbrugghe, 2016): base year 2014, emissions for 24 non-CO2 emissions categories associated do consumption and production activities

Substitution in the electricity nest

Nests in production output with GTAP Energy and Power data

```
              TOTAL OUTPUT NEST            qo(j,r)  [ao(j,r)]
                                             /\
                                            /  \  <----- CES
                                           /    \
                                          /      \
                             endowment-energy       non-energy inputs
       Val.-add.-en. nest       /| \                        /\
           CES ----->          / |  \                      /  \  <------ CES
                              /  |   \                    /    \
                             /   |    \                  /      \
                         Land  Labor  K-E subproduct       Domestic      Foreign
                                         /\
                                        /  \
                                       /    \             Capital-energy nest
                                      /      \   <--------- CES (subst. el. ELFKEN)
                                     K       energy subproduct
                                                     /\         Energy nest
                                                    /  \ <--- CES (subst. el. ELFENY)
                                                   /    \
                                                  /      \
                                         electricity  non-electr. energy
                                                 /\              /\
              Electricity energy nest           /  \            /  \
           CES (subst. el. ELFELY)   -----> ely_rw  ely_f      /    \
                                                              /      \
            Non-electricity energy nest                      /        \
            CES (subst. el. ELFNELY)  ------------>non-coal energy   coal
                                                        /\
           Non-coal energy nest     ------------>      /  \
           CES (subst. el. ELFNCOAL)                  /    \
                                         crude oil, gas, petr. products
```

Revenue recycling mechanism and CETs trajectory 1

- Ad valorem carbon tax

$$\tau = \frac{C_{TAX} \frac{CO2}{Y}}{P_F} = \frac{C_{TAX} \frac{\beta \ F}{Y}}{P_F} \tag{1}$$

- Carbon tax revenue

$$CTR = C_{TAX} \ CO2 + s \ FF = C_{TAX} \ \beta \ FF + s \ FF = FF \ (C_{TAX} \ \beta + s) \tag{2}$$

- Innovation fund

$$CET = \gamma \ CTR \tag{3}$$

- Distribution among different CETs

$$CET_{EE} = \delta \ CET \tag{4}$$

$$CET_R ES = (1 - \delta) \ CET \tag{5}$$

Revenue recycling mechanism and CETs trajectory 2

- Energy efficiency as input-augmenting technical change

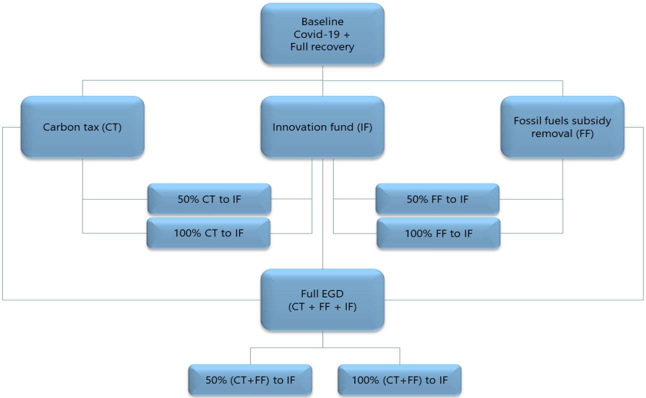
$$tc_{EE} = \varphi \; CET_{EE} \tag{6}$$

- RES as output-augmenting technical change

$$tc_{RES} = \theta \; CET_{RES} \tag{7}$$

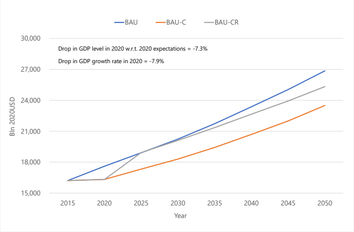
- Calibration for parameter φ
- Calibration for parameter θ

Linkages across different policy instruments

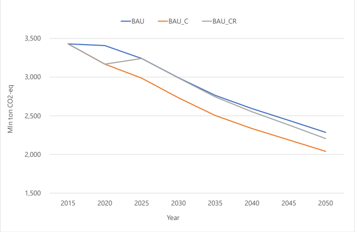


GDP and CO2 emissions for the EU27

Alternative trends in GDP for the EU (Mln. 2020USD)

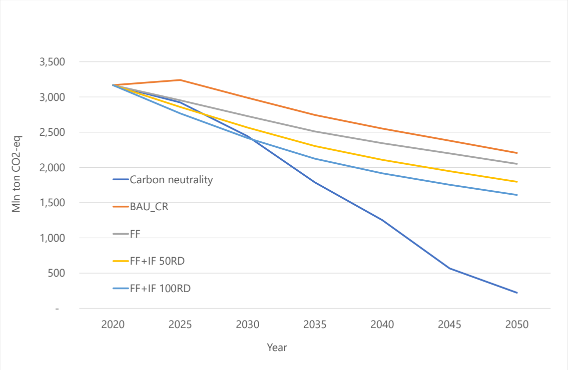


CO2-eq emissions for the EU27 (Mln. ton. of CO2-eq)



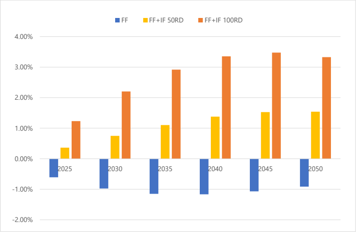
CO2-eq emissions

CO2-eq emissions for the EU27 (Mln. ton. of CO2-eq)

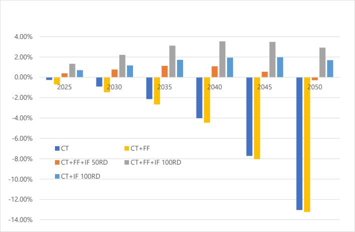


GDP of the EU under different scenarios

GDP for the EU27 (% change w.r.t. BAU)



GDP for the EU27 (% change w.r.t. BAU)



Carbon price

Carbon price for the EU27 (USD per ton CO2)

Scenarios	2025	2030	2035	2040	2045	2050
CT	34	44	131	227	1199	4618
CT+IF 50RD	26	31	88	148	686	2244
CT+IF 100RD	21	24	67	113	506	1584
CT+FF	3	39	127	229	1197	4612
CT+FF+IF 50RD	0	14	74	137	652	2159
CT+FF+IF 100RD	0	0	46	98	472	1505

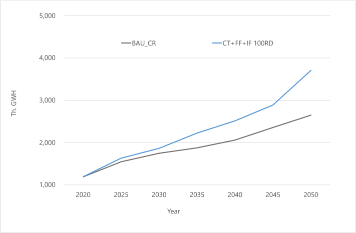
Energy bill

Total cost of energy imports as share of GDP for the EU27

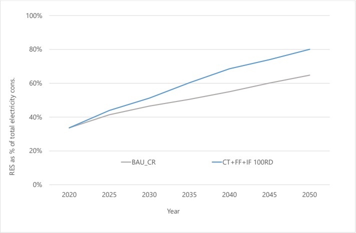
Scenario	2020	2025	2030	2035	2040	2045	2050
BAU_CR	5.27%	4.27%	3.43%	2.74%	2.25%	1.87%	1.56%
CT	5.27%	4.02%	2.98%	1.96%	1.28%	0.66%	0.43%
FF	5.27%	3.82%	3.13%	2.55%	2.12%	1.78%	1.50%
CT+FF	5.27%	3.81%	2.91%	1.95%	1.27%	0.66%	0.43%
FF+IF 100RD	5.27%	3.52%	2.68%	2.06%	1.65%	1.36%	1.13%
CT+FF+IF 100RD	5.27%	3.51%	2.68%	1.77%	1.10%	0.47%	0.21%

RES in electricity production

Electricity production by RES in the EU27 (Th. GWH)

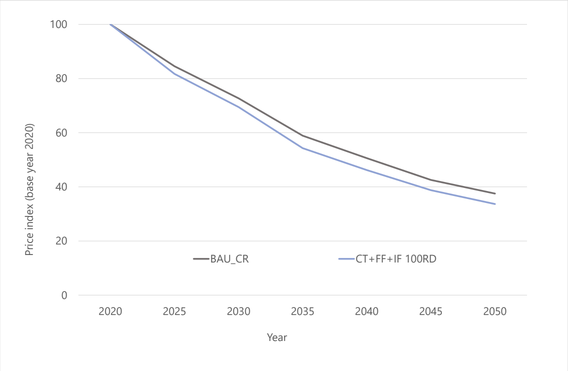


Electricity by RES as % of electricity consumption in the EU27



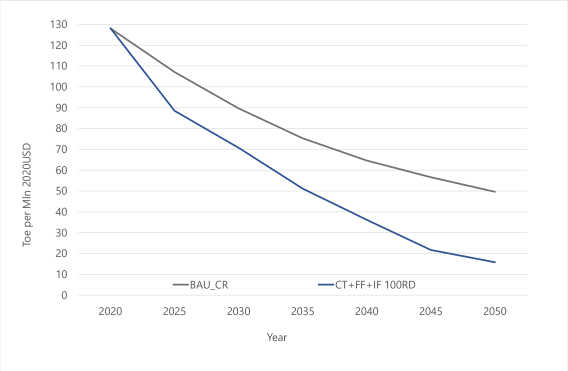
Price of electricity by RES

Price index of electricity produced by RES in the EU27 (base year=2020)



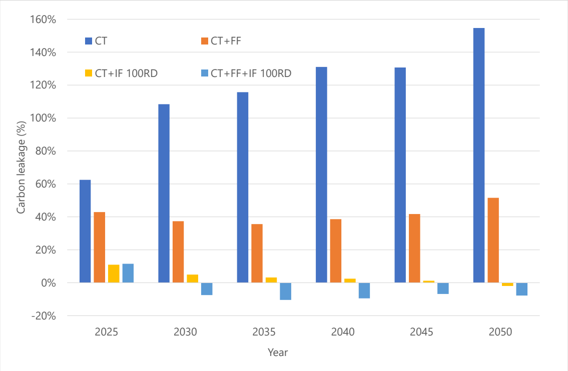
Energy efficiency improvement

Energy intensity in the EU27 (Toe per Mln. 2020USD)



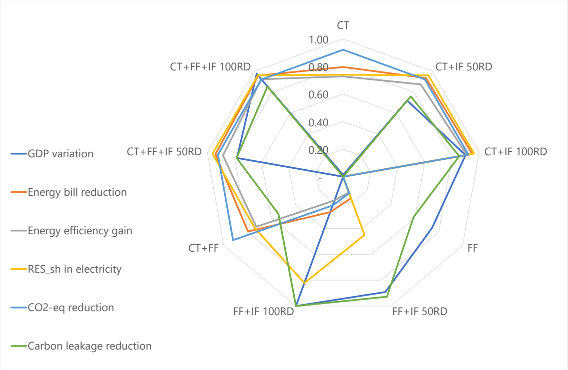
Carbon leakage effect

Carbon leakage rate (%)



Policy mix design

Policy complexity and optimal design (EU27 at 2050)



Optimal policy mix design with multiple instruments

- The European Green Deal must be evaluated with tools that allow for introducing complexity and non-linear interactions
- The multiple instruments addressed in the Green Deal should be analysed both separately and simultaneously
- By simply adding fossil fuels subsidy removal to carbon taxation might bring to further economic losses
- On the opposite collecting revenues to be recycled into innovative activities related to CETs is beneficial for the EU economy and reduces carbon leakage

COVID-19 crisis and the sustainable energy transition

- The COVID-19 pandemic is changing lifestyles faster than expected (smart working, shared mobility, digital skills from the early age, . . .)
- Under the Next Generation EU Fund (investing in a green, digital and resilient society) further resources could be directed to the sustainable energy transition
- Policy coordination is crucial for minimising resource waste and exploiting opportunities of positive spillover effects, with potential effects outside the EU borders

- Aguiar, A., Chepeliev, M., Corong, E., McDougall, R., van der Mensbrugghe, D. (2019). The GTAP Data Base: Version 10. *Journal of Global Economic Analysis*, 4:1-27.
- Chepeliev, M. (2020). GTAP-Power 10 Data Base: A Technical Note (GTAP Research Memorandum No. 31).
- Chepeliev, M., van der Mensbrugghe, D. (2020). Global fossil-fuel subsidy reform and Paris Agreement. *Energy Economics*, 85:104598.
- Chepeliev, M., McDougall, R., van der Mensbrugghe, D. (2018). Including fossil-fuel consumption subsidies in the GTAP data base. *Journal of Global Economic Analysis*, 3:84-121.
- Clements, M.B.J., Coady, D., Fabrizio, M.S., Gupta, M.S., Alleyne, M.T.S.C., Sdralevich, M.C.A. (2013). *Energy subsidy reform: lessons and implications*. International Monetary Fund (IMF).
- Corradini, M., Costantini, V., Markandya, A., Paglialunga, E., Sforna, G., (2018). A dynamic assessment of instrument interaction and timing alternatives in the EU low-carbon policy mix design. *Energy Policy*, 120:73-84.
- Irfanoglu, Z., van der Mensbrugghe, D. (2016). Non-CO2 documentation V9. Purdue University.
- Jakob, M., Chen, C., Fuss, S., Marxen, A., Edenhofer, O. (2015). Development incentives for fossil fuel subsidy reform. *Nature Climate Change*, 5:709–712.
- McDougall, R., Golub, A. (2009). GTAP-E: A Revised Energy-Environmental Version of the GTAP Model. GTAP Research Memorandum No. 15, Purdue University.
- Peters, J. C. (2016). GTAP-E-Power: An Electricity-detailed Economy-wide Model. *Journal of Global Economic Analysis*, 1:156-187.
- Reanos, M.A.T., Sommerfeld, K. (2018). Fuel for inequality: Distributional effects of environmental reforms on private transport. *Resource and Energy Economics*, 51:28-43.
- Xiang, H., Kuang, Y. (2020). Who benefits from China's coal subsidy policies? A computable partial equilibrium analysis. *Resource and Energy Economics*, 59:101124.