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ÖSTERREICHISCHES INSTITUT FÜR WIRTSCHAFTSFORSCHUNG

CATs – Options and Considerations for a Carbon Tax in Austria

Policy Brief

Claudia Kettner-Marx, Mathias Kirchner, Daniela Kletzan-Slamanig, Mark Sommer, Kurt Kratena (WIFO), Stefan E. Weishaar, Irene Burgers (University of Groningen)

Research assistance: Katharina Köberl, Susanne Markytan (WIFO)

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Abstract

The CATs project focused on carbon taxes as a policy instrument for achieving emission reductions particularly in sectors not covered by the EU Emission Trading Scheme (EU ETS). Based on a systematic review of carbon taxes in EU member countries and a qualitative assessment of the implementation barriers and success factors in frontrunner countries a model-based analysis of the effects of various carbon tax scenarios for Austria was performed. Policy recommendations were developed for Austria and the EU. The project results suggest that carefully designed CO2 tax schemes can play an important part in achieving greenhouse gas emission targets for non-ETS sectors in Austria with potentially positive distributive and macroeconomic impacts.

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Options and considerations for a carbon tax in Austria – Policy Brief

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1 Background

Climate change is one of the big challenges humanity is facing. A transition of the global energy system towards deep decarbonisation is required in order to limit climate change. This objective is reflected in the Paris Agreement in which the international community made the commitment to keep global temperature rise well below 2°C above pre-industrial levels. Efforts shall be undertaken in order to limit the temperature increase even further to 1.5°C. However, so far global greenhouse gas emissions are still increasing. A closer look at the situation in Austria demonstrates that after a generally declining trend between 2005 and 2014 (with the exception of the post-crisis year 2010) emissions of greenhouse gases have risen again in the past two years (+4.2%). This is mainly caused by the sectors not covered by the EU Emission Trading Scheme (EU ETS), especially by the transport sector (+5.9% since 2014; +66.7% since 1990) as well as the buildings sector which is largely driven by heating demand due to weather conditions. Thus, greenhouse gas emissions in Austria are now slightly above 1990 levels and no profound reversal of trends is discernible.

For policymakers a broad range of instruments for incentivising GHG emission reductions is available, including performance standards, technology standards as well as market-based approaches like energy or (carbon) emission taxes and emissions trading systems. Economic literature generally argues in favour of market-based instruments since they ensure compliance at the least cost to society by offering flexibility in the choice of abatement measures and their timing. Moreover, taxes and auctioned emission permits raise revenues that in turn can be used to subsidise other abatement measures and R&D activities or to mitigate potentially negative distributional effects. Nevertheless, explicit carbon taxes are still not widely applied and there is still scope for increasing excise taxes for energy (i.e. implicit carbon taxes) to reflect the environmental harmfulness in most EU countries. This also applies for Austria, whose energy tax revenues as percentage of total tax revenues are well below the EU average. In addition, in terms of tax rates for transport fuels Austria only holds the 16th (Diesel) or 17th (gasoline) rank within the EU 28. International organisations like to OECD or the EU have also repeatedly recommended a tax shift in Austria to reduce the burden on labour and increase environmentally related taxes in return.

Additional effort will be required for Austria to achieve the medium to long term climate policy targets. An adequate policy portfolio should contain the implementation of fiscal instruments like carbon taxes, particularly for the non-ETS sectors. Options for a revenue neutral introduction of carbon taxes, related considerations regarding safeguarding against negative distributional and competitiveness impacts as well as legal aspects to be taken into account were comprehensively discussed in the research project CATs.

2 The research project CATs

The CATs project focused on carbon taxes as a policy instrument for achieving emission reduction targets particularly in sectors not covered by the EU ETS. A systematic review of carbon taxes in EU Member States was conducted. This review included the compilation of a comprehensive tax database and a quantitative assessment of energy and carbon taxes on the one hand and a qualitative assessment of their implementation, (potential) barriers and legal and political science aspects related to carbon taxation on the other hand. Based on this appraisal and the identification of best practice examples from front-runner countries in carbon taxation a model-based analysis of the economic, distributional and emission effects of the introduction of different forms of carbon taxes in Austria was performed:

- Scenarios for an Austrian CO_2 tax were developed based on best practice examples derived from the assessment of carbon taxes in EU Member States. This refers to differences in the assumed consumption-based carbon tax rates on the one hand and the design of non-recurrent taxes such as the level and differentiation of registration taxes on the other.
- In addition scenarios were analysed in which tax revenues were recycled via labour cost reductions or lump sum eco-transfers to households. For the recycling of the CO_2 tax a differentiation between household income quintiles was implemented in order to identify and mitigate potentially regressive effects for lower income quintiles.
- The economic assessment of the role of carbon taxes was complemented by a legal and political economy assessment of the implementation issues and barriers of carbon taxes at Member State and at EU level to attain a better understanding of the political feasibility of implementing carbon taxes.

The WIFO-DYNK[AUT] (WIFO Dynamic New Keynesian Model) model was used to assess the carbon tax scenarios developed for Austria (see Kirchner et al. 2018). The model traces the inter-linkages between 62 industries and final users (e.g. private consumption, gross fixed capital formation, public consumption). It further differentiates between five household income groups and models energy consumption explicitly. The model draws on New-Keynesian (i.e. long-run full employment equilibrium and institutional rigidities) as well as neo-classical economic theory (i.e. theory of firm, almost ideal demand system) and can be considered a hybrid form between CGE and static input-output models.[1]

[1] The DYNK model is an input-output model in the sense that it is demand-driven, as all that is demanded is produced. However, static input-output relationships are extended by the incorporation of econometrically estimated behavioural functions for industry & service sectors, the labour market, and private households.

3 Results

3.1 Empirical evidence on energy and carbon taxes in the EU

The minimum tax rates established by the energy taxation directive (Directive 2003/96/EC) are not sufficient in order to establish the price signal required to meet the EU's climate mitigation targets. This has already been noted in the Presidency Conclusions of the European Council of March 2008 with respect to the 2020 targets.

The analysis of energy and carbon taxation in the EU Member States shows that tax rates differ widely between Member States and energy sources[2]. Table 1 gives an overview of the energy tax rates implemented for the different energy sources and application areas in the 28 EU Member States as of January 2017. It shows that while effective excise duties correspond to the minima in some Member States, in others the tax rates are considerably higher. As also provided for in Directive 2003/96/EC, the highest taxes are levied on fuels used as propellant, i.e. on petrol and diesel, as well as on gas. Minimum tax rates for heating fuels amount to 1-11% of the minimum tax rate for petrol and are highest for gasoil (see Kettner and Kletzan-Slamanig 2008).

Converting the (minimum) energy tax rates based on the fuels' carbon content into a CO_2 price signal delivers the implicit carbon tax rates levied in the EU Member States as of January 2017 (Table 2). With respect to propellants, implicit carbon minimum tax rates are 128 €/CO_2 for diesel and 140 €/CO_2 for petrol. For coal used as heating fuel, in contrast, minimum tax rates are 1.6 €/CO_2 for business use and 3.2 €/CO_2 for non-business use respectively.

[2] Carbon taxes have so far only been implemented in about one third of Member States.

Table 1. Energy Tax Rates in EU Member States in €/GJ as of January 2017

	Coal - Heating Business use	Coal - Heating Non-business use	Petrol	Gasoil - Propellant	Gasoil - Heating Business use	Gasoil - Heating Non-business use	Gas - Propellant	Gas - Heating Business use	Gas - Heating Non-business use	Electricity - Business use	Electricity - Non-business use
AT	1.70	1.70	15.20	11.43	3.14	3.14		1.66	1.66	4.17	4.17
BE	0.41	0.41	19.16	14.34	0.50	0.50		0.28	0.00	0.83	0.54
BG	0.31	0.31	11.07	9.19	9.19	9.19	0.43	0.31	0.00	0.28	0.00
CY	0.00	0.31	14.60	12.52	3.47	3.47	2.60	2.60	2.60	1.39	1.39
CZ	0.31	0.31	14.49	11.27	11.27	11.27	0.70	0.31	0.31	0.29	0.29
DE	0.17	0.33	20.19	13.30	1.49	1.92	11.46	8.67	8.76	4.27	5.70
DK	9.62	9.62	20.19	11.67	9.11	9.11	11.55	8.74	8.74	0.15	33.97
EE	0.93	0.93	14.18	12.46	12.46	12.46		0.89	0.89	1.24	1.24
ES	0.15	0.65	13.42	9.21	2.36	2.36	1.15	0.15	0.65	1.42	1.42
FI	7.49	7.49	21.42	14.76	6.36	6.36	5.17	5.17	5.17	1.95	6.26
FR	2.78	2.78	19.84	14.76	3.31	3.31	1.53	1.63	1.63	6.26	6.26
GR	0.30	0.30	21.34	11.40	11.40	11.40	0.00	0.60	0.30	1.39	0.61
HR	0.31	0.31	15.68	14.74	1.57	1.57	0.00	0.15	0.30	0.14	0.27
HU	0.30	0.30	12.12	10.41	10.41	10.41	2.67	0.30	0.30	0.28	0.28
IE	1.89	1.89	17.92	13.32	2.84	2.84	2.60	1.03	1.03	0.14	0.28
IT	0.16	0.32	22.21	17.17	11.22	11.22	0.09	0.34	3.89	2.30	6.31
LT	0.15	0.30	13.24	9.18	0.59	0.59	6.56	0.15	0.30	0.14	0.28
LU	5.00	0.30	14.13	9.36	0.28	0.28	0.00	0.30	1.08	0.14	0.28
LV	0.35	0.35	13.29	9.48	1.09	1.09	2.67	0.46	0.46	0.28	0.28
MT	0.30	0.30	16.75	13.13	6.46	6.46		0.84	0.84	0.42	0.42
NL	0.54	0.54	23.47	13.48	13.48	13.48	4.57	2.55	7.16	11.43	27.99
PL	0.30	0.30	12.40	9.45	6.45	6.45	2.48	0.30	0.30	1.30	1.30
PT	0.59	0.59	18.83	11.18	9.53	9.53	3.13	0.59	0.59	0.28	0.28
RO	0.16	0.32	11.35	9.49	9.49	9.49	2.79	0.18	0.34	0.15	0.30
SE	12.89	12.89	20.57	17.19	8.36	12.02	6.40	5.87	8.89	0.15	8.66
SI	1.86	1.86	16.75	13.10	5.63	5.63	3.45	1.42	1.42	0.85	0.85
SK	0.31	1.00	16.24	10.49	10.49	10.49	2.60	0.37	0.37	0.37	0.00
UK	0.00	0.00	20.23	18.46	3.55	3.55	5.67	0.61	0.61	0.00	0.00
EU MED*	0.15	0.30	10.95	9.18	0.58	0.58	2.60	1.15	0.30	0.14	0.28

* Minimum Excise Duty

Note: Tax rates as displayed in the EU Excise Duty Tables (January 2017); country-specific exemptions not included.

Source: Kettner and Kletzan-Slamanig (2018).

Energy and carbon taxation can make a significant contribution towards achieving emission reductions, particularly in the transport sector where greenhouse gas emissions continue to be on the rise in the EU. Evidence on the economic impacts of energy and carbon taxes furthermore shows that a double divided, i.e. the achievement of a reduction of emissions and positive macro-economic effects, can be achieved. With respect to the distributional impacts of carbon and energy taxes evidence is, however, mixed. While studies generally negate regressive effects of the taxation of propellants, energy and carbon taxes on heating fuels and electricity tend to be found regressive.

Since an EU-wide approach towards energy and carbon taxation seems out of reach Member States should consider carbon taxes at the national level in view of achieving the respective greenhouse gas reduction targets in sectors not covered by the EU ETS.

Table 2. Implicit CO_2 Tax Rates in EU Member States in € / t CO_2 as of January 2017

	Coal - Heating Business use	Coal - Heating Non-business use	Petrol	Gasoil - Propellant	Gasoil - Heating Business use	Gasoil - Heating Non-business use	Gas - Propellant	Gas - Heating Business use	Gas - Heating Non-business use	Electricity - Business use	Electricity - Non-business use
AT	18.09	18.09	194.85	146.56	40.30	40.30		30.74	30.74	99.24	99.24
BE	4.41	4.41	245.61	183.79	6.40	6.40		5.13	0.00	11.69	7.50
BG	3.30	3.30	141.89	117.78	117.78	117.78	7.96	5.74	0.00	2.89	0.00
CY	0.00	3.30	187.23	160.47	44.48	44.48	48.15	48.15	48.15	17.73	17.73
CZ	3.30	3.30	185.74	144.51	144.51	144.51	12.96	5.74	5.74	3.17	3.17
DE	1.81	3.51	258.81	170.47	19.08	24.55	212.22	160.56	162.22	50.36	67.17
DK	102.29	102.29	258.81	149.56	116.80	116.80	213.95	161.83	161.83	2.68	606.14
EE	9.89	9.89	181.75	159.76	159.76	159.76		16.48	16.48		
ES	1.60	6.91	172.10	118.03	30.21	30.21	21.30	2.78	12.04	17.28	17.28
FI	79.68	79.68	274.59	189.25	81.55	81.55	95.74	95.74	95.74	34.85	111.68
FR	29.57	29.57	254.34	189.25	42.40	42.40	28.33	30.19	30.19	93.07	93.07
GR	3.19	3.19	273.61	146.21	146.21	146.21	0.00	11.11	5.56	13.01	5.73
HR	3.26	3.26	201.03	189.00	20.10	20.10	0.00	2.78	5.55	1.81	3.62
HU	3.19	3.19	155.37	133.47	133.47	133.47	49.49	5.62	5.62	3.82	3.82
IE	20.11	20.11	229.72	170.81	36.47	36.47	48.15	19.07	19.07	1.86	3.72
IT	1.70	3.40	284.71	220.17	143.79	143.79	1.67	6.30	71.94	34.54	94.78
LT	1.60	3.19	169.81	117.68	7.54	7.54	121.48	2.78	5.56	4.08	7.93
LU	53.19	3.19	181.10	120.06	3.57	3.57	0.00	5.49	20.00	2.62	5.25
LV	3.72	3.72	170.42	121.60	13.95	13.95	49.44	8.52	8.52	7.44	7.44
MT	3.19	3.19	214.74	168.32	82.76	82.76		15.56	15.56	5.42	5.42
NL	5.74	5.74	300.93	172.76	172.76	172.76	84.63	47.22	132.59	156.43	383.05
PL	3.19	3.19	158.93	121.19	82.73	82.73	45.93	5.56	5.56	13.87	13.87
PT	6.28	6.28	241.37	143.36	122.17	122.17	57.96	10.93	10.93	3.49	3.49
RO	1.70	3.40	145.47	121.63	121.63	121.63	51.67	3.33	6.30	1.94	3.85
SE	137.13	137.13	263.70	220.35	107.15	154.04	118.52	108.70	164.63	4.80	282.00
SI	19.79	19.79	214.69	167.95	72.19	72.19	63.93	26.33	26.33	9.08	9.08
SK	3.30	10.64	208.14	134.51	134.51	134.51	48.15	6.85	6.85	6.20	0.00
UK	0.00	0.00	259.41	236.66	45.50	45.50	105.00	11.37	11.37	0.00	0.00
EU MED*	1.60	3.19	140.32	117.68	7.49	7.49	48.15	21.30	5.56	1.77	3.55

* Minimum Excise Duty

Note: Implicit CO_2 tax rates using UNFCCC emission factors and energy tax rates as displayed in the EU Excise Duty Tables (January 2017); country-specific exemptions not included.

Source: Kettner and Kletzan-Slamanig (2018).

3.2 Carbon taxes at EU level – Introduction issues and barriers

The analysis of EU legislative procedures regarding introduction issues and barriers of a CO_2 tax at EU level indicates that there is legal uncertainty relating to the actual wording and application of the environmental and energy legal basis and if the ordinary legislative procedure employing qualified majority voting could be relied upon (see Weishaar 2018a). If a CO_2 tax would need to be introduced by means of the special legislative procedure, unanimity voting would be required. In practice there has not been an example where a legislative act was based on the unanimity requirement under Articles 192(2)(a) or 194(3) TFEU[3]. It is submitted that the Commission may refrain from taking legislative action under the unanimity requirement if it is apparent from informal pulsing that there is significant Member State opposition. Additional barriers to introducing a CO_2

[3] Treaty on the Functioning of the European Union.

tax at EU level stem from national legal systems that influence the transposition of EU rules and co-determine the position of a Member State in the Council. It is of course not only the legal embedding that is important in this respect but also the national interest of a Member State. Legislative processes in the EU prescribe consultations, and that relevant national actors such as the national parliaments are duly informed and part of the discourse. Stakeholders can seek out different fora at various levels of government to influence the adoption of a CO_2 tax (see Weishaar 2018a).

The European Commission has made several unsuccessful attempts to legislate in the area of climate change regulation and may therefore be reluctant to invest time in a course of action that may not be embraced by the Member States[4]. EU law does, however, provide for a course of action. In specific circumstances a group of Member States may be allowed to act upon a legislative proposal of the European Union and undertake measures that would otherwise fall within the ambit of the competences of the Union. The so-called 'enhanced cooperation' is a procedure where a minimum of nine EU countries are allowed to establish advanced integration or cooperation without the other EU countries being involved[5]. The procedure can help overcome the dead-lock of proposals which are blocked by individual countries (see Weishaar 2018a).

Support for more environmental taxation may also come from an unexpected direction: the Brexit. Britain's exit leaves a considerable budget gap at Union level[6]. New income bases need to be identified. The Commissioner for the EU Budget recently proposed the introduction of a Plastic tax and a change of the EU ETS. Perhaps a new approach on carbon taxation could be considered as well.

3.3 Introducing carbon taxes at Member State level – Issues and barriers

The review of the experience of front-runner countries regarding the introduction of carbon taxes (Denmark, Finland and Sweden) addressed the question which barriers had

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4 In August 2017, the European Commission has adopted an Evaluation and Fitness Check Roadmap on the evaluation of the Energy Taxation Directive, which ought to be completed in 2018. According to the EC; "the evaluation will focus on identifying the possibilities for simplifying the legislative act, for reducing regulatory burdens and on identifying and calculating regulatory benefits and savings from the enforcement of the Directive" (https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2017-4224148_en).

5 It is regulated by Article 20 TEU and Articles 326 to 334 TFEU.

6 In 2014 the High Level Group on Own Resources was established at EU level with the objective to examine how the revenue side of the EU budget can be made more simple, transparent, fair and democratically accountable. The recommendations of the final report included a CO_2 levy, proceeds from the European emission trade system, an electricity tax, a motor fuel levy (or excise duties on fossil fuels in general), and indirect taxation of imported goods produced in third countries with high emissions as viable candidates for EU own resources (http://ec.europa.eu/budget/mff/hlgor/library/reports-communication/hlgor-report_20170104.pdf).

to be overcome before implementing the tax and which were respective supporting factors (Weishaar 2018b).

Similar impediments were at play in all three Member States, relating to revenue recycling in order to mitigate adverse impacts on competitiveness and regressivity. 'Issue linking' to strike a balance between different interests and the broad involvement of all stakeholders has been of paramount importance in all countries. Recycling money back to industry can safeguard companies' competitive positions and hence foster political support or at least reduce resistance. The experiences made in the case study countries show that the introduction of CO_2 taxes was possible by employing a consensus approach. In all countries the political resilience of the CO_2 taxes was ensured by frequent adaptations of either the CO_2 tax or its wider framework, the environmental tax reform (ETR).

The consensus approach underlines the importance of revenue recycling in policy design. The issues of competitiveness and income distribution in this context are tightly related as the inclusion of measures to avoid adverse effects on either are a prerequisite for broad societal support for an ETR. Nevertheless, the concessions made should not go as far as to significantly reduce the environmental effectiveness of the measure.

In the case study countries households received inter alia income tax reductions but were bearing a bigger share of the tax burden while companies were at least in part able to receive tax exemptions or tax refunds. In the examined countries companies also benefited from energy efficiency schemes that were designed to help them reduce production costs. Finland is a special case in this regard as for long it did not have such derogations for industry and the Finnish CO_2 tax did also not benefit from flanking support of an ETR that could offer additional possibilities to support stakeholders. This is one of the reasons why the Finnish CO_2 tax started with relatively low tax rates that were only increased as provisions favouring industry were introduced. It appears that in general industry interests were considered to a larger extent in the design of carbon taxes while impacts on household income distribution were playing a lesser role. This can be explained by pointing towards collective action problems that hinder households to undertake action or the acceptance of the environmental goals as a policy justification. Another lesson that can be learned from the case study countries is that they all introduced the carbon tax or ETR at a point in time that provided a favourable policy environment for such a policy approach. All countries had experienced a significant degree of economic strive and used this impetus for fiscal reforms or to unlock different funding sources.

3.4 Analysis of the Effect of a Carbon Tax in Austria

The macroeconomic assessment of different CO_2 tax scenarios in Austria focused on short-term distributive, macroeconomic, and CO_2 emission impacts (see Kirchner et al. 2018). The scenarios aim at covering a reasonable range of tax rate variants and tax recycling schemes that were derived from the analysis of tax rates in the EU and the review of case study countries. The main focus of the scenarios is on energy-related CO_2 emissions generated in non-ETS sectors, i.e. mostly private households, transport and service sectors.

Table 3: CO_2 tax price scenarios for Austria

Scenario Name	Explicit CO_2 tax (€/tCO_2)	Energy Tax	Implicit CO_2 tax rates for fossil fuels (€/tCO_2)				
			Petrol	**Diesel**	**Oil[1]**	**Gas**	**Coal**
Base	0	Current	195	147	40	31	18
Low	60	Current	255	207	100	91	78
Med	120	Equivalized	315	315	160	178	153
High	315	None	315	315	315	315	315

[1] Refers to heating oil.

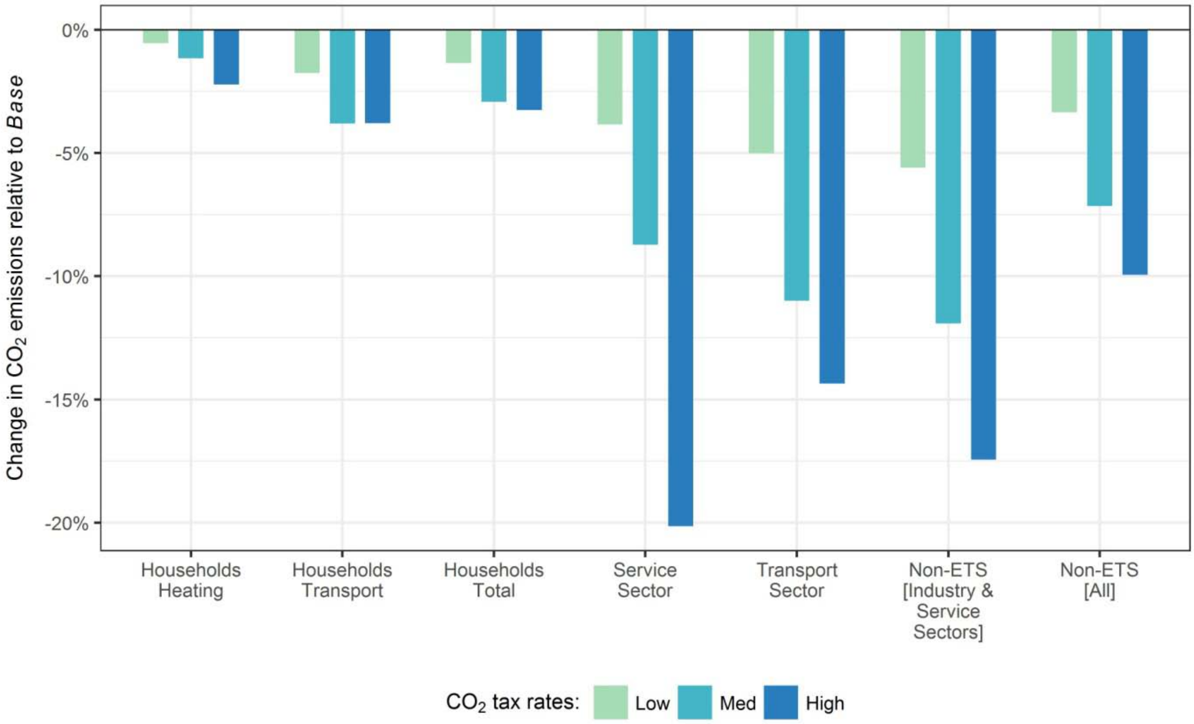
Table 4: CO_2 tax recycling / compensation scenarios for Austria

Scenario Name	**Description**
NoRec	No tax recycling
RecH	*All CO_2 tax revenues are recycled via equal per-capita lump sum payments to all households (H)*
RecH[low]	*All CO_2 tax revenues are recycled via equal per-capita lump sum payments to the three lowest households (H) income groups (QNT1 to QNT3)*
RecQ	*All CO_2 tax revenues are recycled via uniformly reduced employers' social contribution for industry & service sectors (Q) affected*
RecQH	*CO_2 tax revenues from households (H) are recycled as in RecH* *CO_2 tax revenues from industry & service sectors (Q) are recycled as in RecQ*
RecQH[low]	*CO_2 tax revenues from households (H) are recycled as in RecH [low]* *CO_2 tax revenues from industry & service sectors (Q) are recycled as in RecQ*

Three additional scenarios were considered: (1) the CO_2 tax as a floor price for the ETS sectors; (2) an increase in the vehicle registration tax (NoVA) for vehicle purchase; and (3) policy scenarios until 2030.

The range of short-term (i.e. one year) impacts of the simulated CO_2 tax scenarios on energy-related CO_2 emissions in non-ETS sectors is illustrated in Figure 1 for the tax recycling scenario with lump sum transfers and lower labour taxes (*RecQH*). Total non-ETS emissions decrease by 3% (*Low*) to 10% (*High*). Impacts are lowest in the household sector due to the very low (short-term) price elasticities estimated for service energy demand and range from -1% to -3%. This indicates that comfortable room temperature as well as mobility (e.g. commuting by private cars) are basic necessities for households, which will not change considerably in the short term even if prices increase strongly. Non-ETS Industry & service sectors react more sensitively with decreases of up to 14% in the transport sector and 20% in the service sector. The impact for overall non-ETS industry & service sector emissions lies between -6% and -17%.

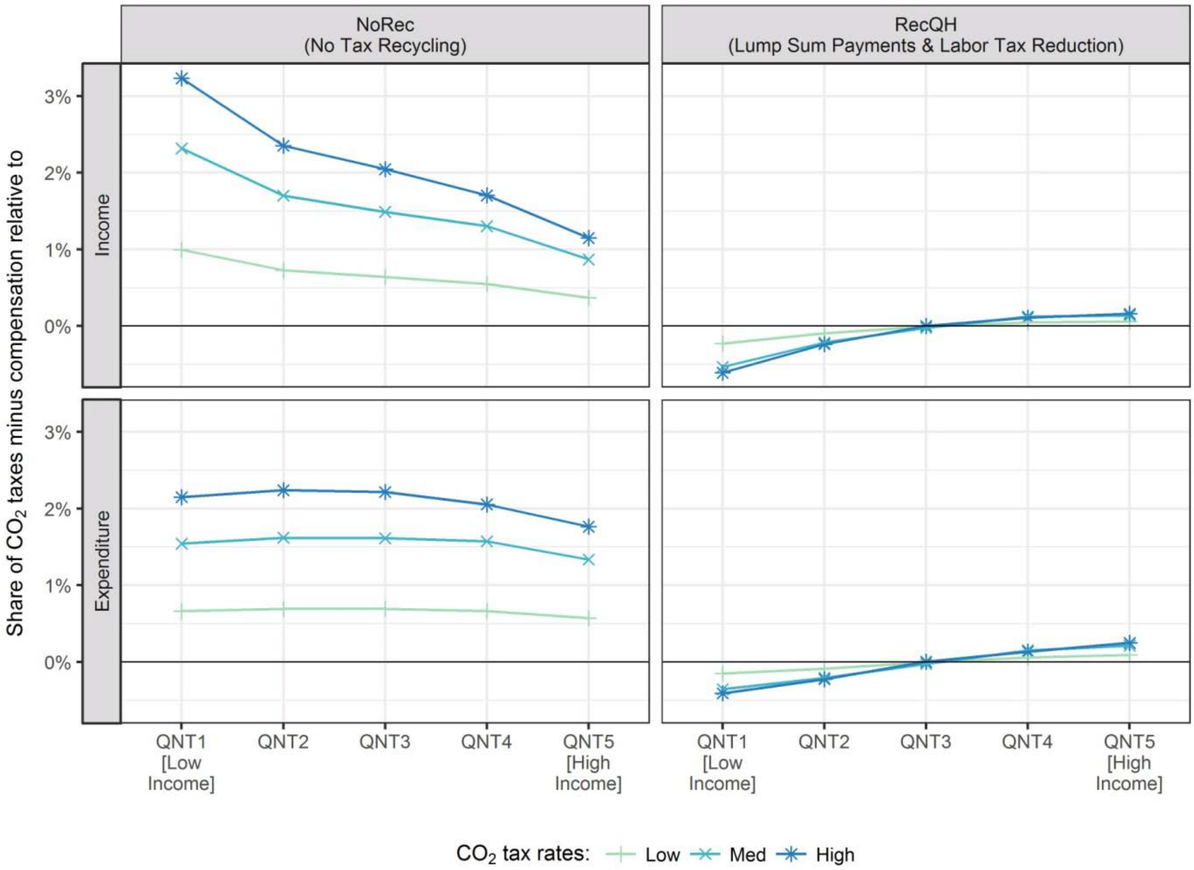
Figure 1: CO_2 emissions impact of the CO_2 tax rates (Tax recycling scenario: RecQH).



Source: Kirchner et al. (2018).

Figure 2 illustrates the "tax burden relative to income" and "tax burden relative to expenditure" for the range of CO_2 tax rates without tax revenue recycling (*NoRec*) and tax compensation for both households and industry & service sectors (*RecQH*). In *NoRec* the first quintile spends between 1.0% (*Low*) to 3.2% (*High*) of their income on CO_2 taxes compared to only 0.4% to 1.1% for the fifth quintile. In absolute terms, annual CO_2 tax payments range from 108 € to 349 € per year and per capita in the first quintile and from 159 € to 489 € per year and per capita in the fifth quintile. The impacts become less regressive if one looks at CO_2 taxes paid relative to total expenditure. This is because (i) differences in expenditure between the household income groups are smaller than differences in income levels, and (ii) different relative price changes for transport and heating and their respective expenditure shares. If compensation measures in the form of lump sum payments are subtracted from CO_2 taxes paid, the CO_2 tax rate scenarios become progressive both relative to income and expenditure and lead to net increases in income for the first and second quintiles.

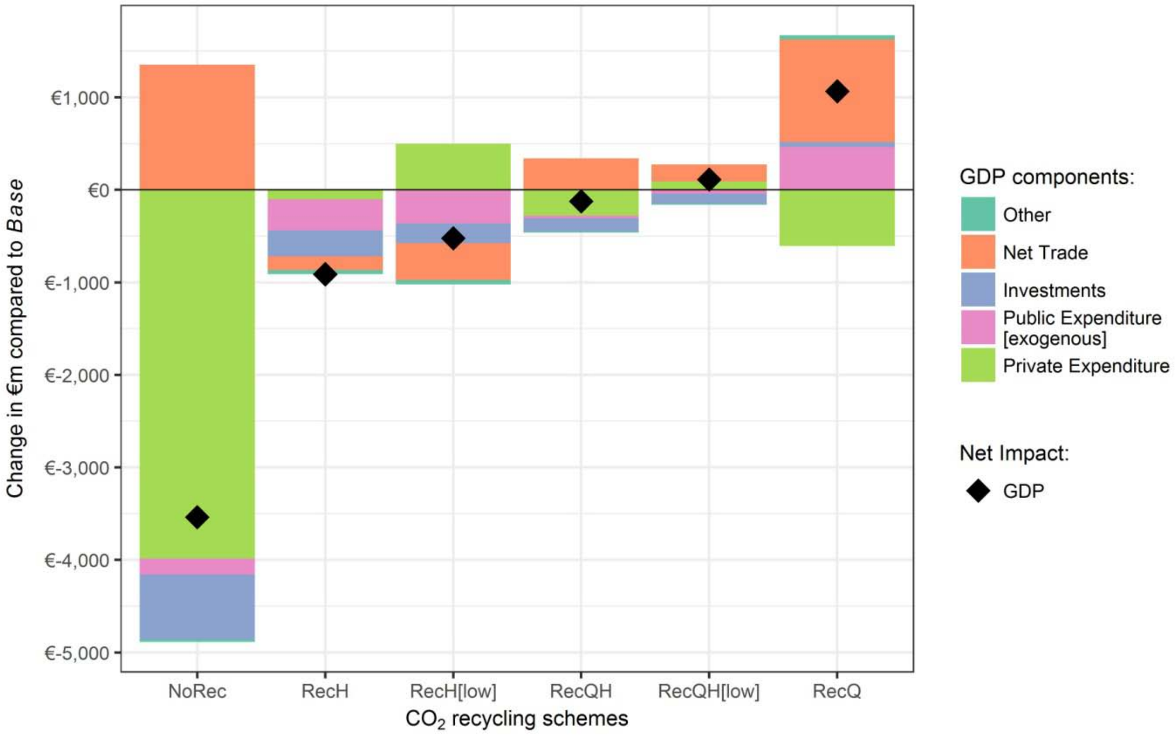
Figure 2: Tax burden impact on households.



Source: Kirchner et al. (2018).

The GDP impact of the CO_2 tax rate *Med* and our tax recycling schemes is illustrated in Figure 3. Without compensation (*NoRec*) real GDP is negatively affected (-3.5b € or -1%). This decrease is primarily driven by significant reductions in private expenditure and lower investment (due to lower production output). Although one might expect that import shares increase with CO_2 taxes, the impact on net trade is actually positive (i.e. imports decrease stronger than exports). This is because commodities affected by the CO_2 tax, such as petrol and diesel, have much higher import shares than the average commodity. In addition, changes in import shares are generally quite low, as domestic output prices do not change considerably given that energy costs play only a minor role for most sectors.

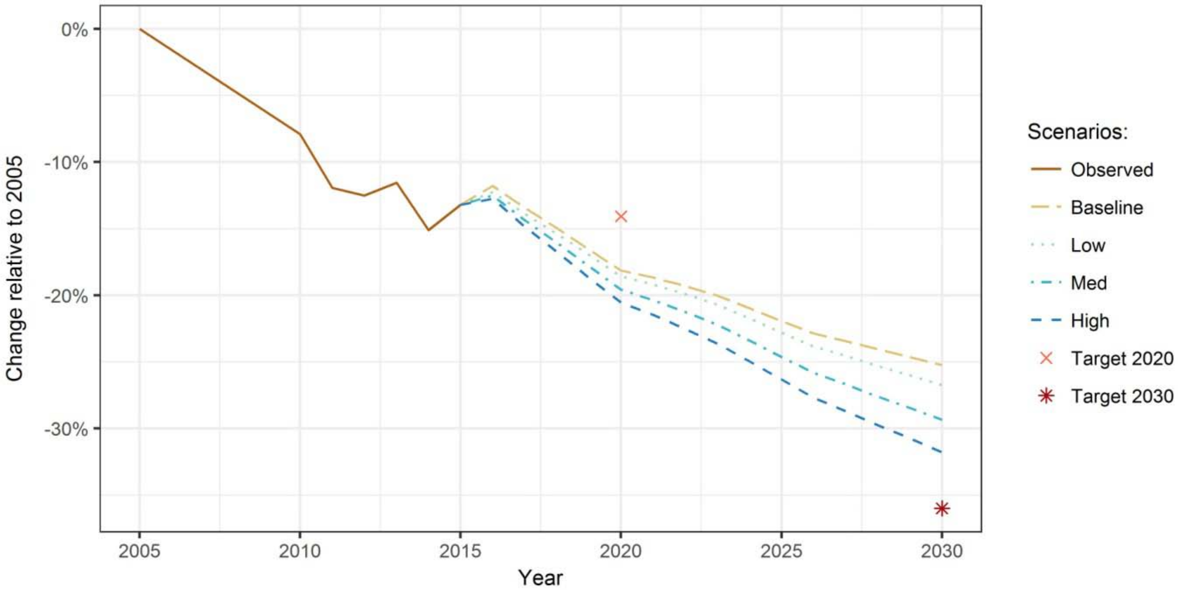
Figure 3: GDP impacts (real values) (CO_2 tax rate: Med).



Source: Kirchner et al. (2018).

Possible trajectories of total non-ETS CO_2 emissions until 2030 are shown in Figure 4. It includes the observed trend of non-ETS GHG emissions between 2005 and 2015 as well as the mandatory 2020 target (UBA, 2017b) and the proposed 2030 target (-36%). Relative changes in CO_2 emissions in DYNK are used to extrapolate possible trajectories from 2015 to 2030. The *Baseline* scenario CO_2 emissions are considerably driven by economic growth, the forward projection of past energy intensity trends in industry & service sectors, and exogenously assumed trends in household energy efficiencies. Although CO_2 emissions increase between 2014 and 2016 due to very low fossil fuel prices, a declining trend in total non-ETS CO_2 emission in the *Baseline* scenario can be observed already in 2017. This declining trend keeps emissions below the 2020 target, but is not enough to reach the proposed target for 2030 in the model. The CO_2 tax scenarios lead to lower emission trends, but also come short of the 2030 target (*High* leads to a reduction of ca. 32%).

Figure 4: Non-ETS CO_2 emission trends: observed (2005-2015) and modelled (2015-2030).



Source: Kirchner et al. (2018).

In addition, the impact of a change in the vehicle registration tax NoVA on vehicle stock efficiency and CO_2 emissions was simulated for the period 2015-2030. Increased revenues from NoVA are assumed to be recycled via equal lump sum payments to all households. Compared to the CO_2 emissions in the CO_2 tax rate scenario *Med* an increase in the NoVA has a more significant impact on diesel and petrol emissions than the CO_2 tax rate. Compared to the *Baseline*, emissions in 2030 are only 2% lower in *Med*, but 8% lower with an additional rise in the NoVA. An increase in the NoVA affects the fuel efficiency of diesel and petrol vehicles by augmenting the share of more fuel-efficient vehicles amongst new cars and subsequently in the total car stock.

4 Summary and concluding remarks

The CATs project analysed the issue of energy and carbon taxation from different points of view, including theoretical (economic and legal) literature, empirical evidence for the EU (quantitative and qualitative) as well as model simulations for a range of taxation scenarios for Austria.

The comparison of theoretical recommendations and actual implementations of energy and carbon taxes reveals various divergences, which exist due to conflicting political objectives (environmental protection, income distribution, competitiveness) and resulting compromises in order to gain acceptance for fiscal measures or environmental tax reforms. It also has to be noted that energy taxes were initially introduced in order to raise revenues. Environmental concerns were included much later on, with a shift to climate change mitigation in the 1990s. Recently, CO_2 emissions are increasingly taken into account in vehicle taxation (registration and ownership taxes). The assessment of energy and vehicle taxation in the EU Member States reveals a broad range of tax rates and a variety of preferential tax treatments.

On EU level, minimum energy tax rates have been defined in Directive 2003/96/EC but attempts to adapt these tax rates to reflect the climate policy ambitions of the EU have failed due to the unanimity requirement in taxation issues. Thus, the EU regulation falls short of being adequate for reaching the long-term emission reduction objectives. Given the requirement of unanimity voting and the existence of diverging national interests of Member States any agreement regarding an introduction of EU-wide carbon taxes seems out of reach. Currently, the EU carries out an evaluation and fitness check of the Energy Tax Directive. It is, however, unclear whether the results of this check will lead to another initiative to adapt minimum energy tax rates to reflect the climate policy ambitions of the EU or how successful such an initiative could be. Support for more environmental taxation may also come from an unexpected direction: the Brexit. Britain's exit leaves a considerable budget gap at Union level. New income bases need to be identified. The Commissioner for the EU Budget recently proposed the introduction of a plastic tax and a change of the EU ETS. The High Level Group on Own Resources also recommended in its final report environmental taxes (including a CO_2 tax) as viable options for generating EU own resources.

Against this background, action to limit greenhouse gas emissions on national level is required, particularly in the sectors not covered by the EU ETS. Fiscal measures such as energy and carbon taxation can contribute towards achieving climate policy targets by pricing the externality.

This is supported by the CATs model simulations for the range of scenarios analysed for Austria. The results for a revenue neutral introduction of carbon taxes generally show a significant effect on emissions, especially in the transport and service sector. Macroeconomic impacts, in contrast, are moderate for all scenarios analysed including the scenario with a floor price for ETS sectors. It has to be noted, however, that the recycling of additional tax revenues is a key aspect in order to mitigate negative impacts on income distribution (regressivity) and competitiveness.

The need for structural changes in the Austrian tax system has been repeatedly emphasised by international organisations (e.g. OECD 2013; EC 2015). The introduction of a CO_2 tax would permit a shift of the tax burden from e.g. labour to environmental externalities. In addition to reducing greenhouse gas emissions this also entail positive employment and economic effects (double dividend). Furthermore, an ambitious climate policy triggers research and innovation and facilitates the structural changes required to achieve a deep decarbonisation.

Evidence from other EU Member States that have introduced comprehensive environmental tax reforms including carbon taxes shows that one prerequisite for the implementation is a broad societal and political consensus and the integration of long term climate policy objectives in all areas of policy making.

Overall, the project results provide many arguments that carefully designed CO_2 tax policies can play an important part in achieving GHG emission targets for non-ETS sectors in Austria with potentially positive distributive and macroeconomic impacts. The case for CO_2 taxes is further amplified if one would account for the positive benefits and co-benefits of mitigating CO_2 emissions.

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