European Commission

SCIENCE FOR POLICY BRIEFS

FAIRNESS POLICY BRIEF SERIES: 1/2022

Options for socially just and effective climate policies – a microsimulation for 27 EU countries[1]

Headlines

- Evaluations of climate policies should not only focus on the emission reductions that these policies achieve. Evaluations should also pay attention to the distribution of related costs and benefits across social groups and the policies' impact on fuel and transport poverty.
- Carbon taxes on home energy and motor fuels are regressive. This is because they put a higher financial burden – relative to income – on poorer households than they do on richer households.
- Redistributing carbon-tax revenue using equal per-capita tax rebates can remedy that regressive impact. This would benefit low-income and disadvantaged households.
- However, if these tax rebates lead to additional consumption with a high carbon footprint, they risk partially cancelling out expected emission reductions.
- Combining carbon taxes with additional public investment in green services (such as renewable energy and public transport) can considerably speed up decarbonisation.
- Providing everyone in society with an equal amount of such green services (e.g. using vouchers) is as redistributive as tax rebates. However, it has the added advantage of reducing fuel and transport poverty.

Background

Fast reduction of emissions to net zero by 2050 is needed to avoid an acceleration of already existing climate-change impacts (IPCC, 2021). Many climate-change policy packages including the European Green Deal (European Commission, 2019) consider carbon and energy taxes as a vital policy instrument for reducing carbon emissions. Carbon taxes are expected to: (i) stimulate the reduction of high-carbon energy; and (ii) encourage the production/consumption of greener energy sources. However, there is a problem with carbon and energy taxes on goods and services that satisfy basic needs. Such taxes generally mean that lower-income households end up spending a greater percentage of their income on these essentials than richer households. This effect is called 'regressive impact'. It shows the unequal distribution of taxes, burdening lower income households more than higher income households. Therefore, it is not surprising that more than half of the EU population opposes such taxes and that opposition is particularly high among low-income groups (Schnepf et al., 2022).

Options for addressing the unfair impact of carbon taxes

Which options exist for addressing carbon taxes' regressive distributional impact on home energy and motor fuels? In the paragraphs below, we compare two possible compensation options: equal per-capita tax rebates and equal per-capita provision of green electricity and public transport. In the first option, the carbon tax revenue is redistributed on an equal per-capita basis to people in the 27 EU countries. The second option is similar to the first one. It redistributes the tax revenue on an equal per-capita basis to everyone in the 27 countries. However, instead of redistributing it as cash, the revenue is used to provide everyone in society with an equal amount of free renewable electricity or public transport, using vouchers. Some studies have examined the distributional impact of equal per-capita tax rebates. However, no study has yet compared the environmental and energy-poverty impact of tax rebates with the impact of providing green services. Our judgement on which option is the most suitable is based on how the policy options compare on:

- emission savings;
- fair distributional impact; and
- minimising fuel and transport poverty.

We apply microsimulation modelling to estimate these outcomes. Microsimulation is useful here because it makes it

[1] This policy brief has been prepared by Milena Büchs, Diana Ivanova and Sylke V. Schnepf. It builds on the article 'Effectiveness, fairness and needs satisfaction: new options for designing climate policies' published in Environmental Research Letters 16 (2021), https://iopscience.iop.org/article/10.1088/1748-9326/ac2cb1/pdf. This brief can be downloaded from https://ec.europa.eu/jrc/en/research/crosscutting-activities/fairness.

© European Union, 2022

JRC128150

Joint Research Centre

possible to evaluate this impact factoring in the distribution of income and household emissions at the household level. The study is based on household expenditure data from the latest EU household budget surveys (2010 and 2015), matched with emission factors from Exiobase for 27 EU countries (the quick guide contains more details on the data and methods used).

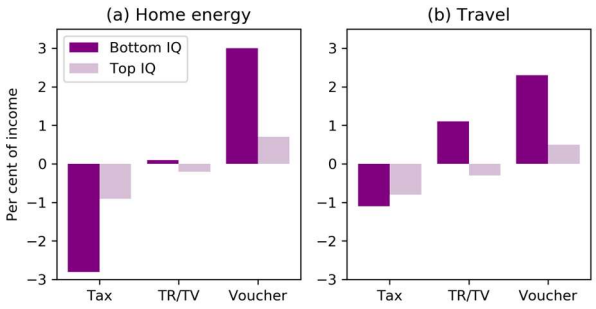
Microsimulation requires that a number of parameters and assumptions be set up front. The carbon tax is set at EUR 80 per tonne. It is adjusted to the price level in each of the 27 EU countries to equalise the carbon price in real terms. This carbon price has been chosen because it reflects the range of values that scientists and the International Monetary Fund recently recommended for effective climate change mitigation. On the green voucher schemes, we assume that renewably generated electricity will replace average grid electricity for the value of the vouchers. We also assume that public transport replaces car travel. The green voucher scheme requires that renewable electricity provision and public transport infrastructure be expanded. However, this investment would cost less than 0.3% of gross domestic product and is therefore a reasonable supposition. Green vouchers could be made tradable, which would increase their flexibility.

Findings

Results across 27 EU countries demonstrate that carbon taxes on home energy are regressive. This means that, relative to income, they put a higher tax burden on poorer households than on richer households. In addition, more vulnerable households (e.g. households with older people; households with people struggling with chronic health issues; households with children; and households headed by women) pay higher relative carbon taxes on home energy than households that are better off (see Büchs et al., 2021). In comparison to taxes on home energy, carbon taxes on motor fuels are on average less regressive across the EU. A progressive impact could only be identified in some countries, e.g. Bulgaria, Croatia, Czechia, Greece, Hungary, Lithuania, Latvia, Poland, and Romania.

However, as Figure 1 shows, the 'tax and rebate' and 'tax and voucher' models have the same progressive impact. Therefore, these models do not lead to poorer households being worse off. The impact is the same because everyone in this study receives the same amount in cash – either by way of the tax rebate or in kind by way of the green vouchers. Providing green vouchers without imposing any tax first (i.e. a 'voucher only' model), leads to an even more progressive distribution.

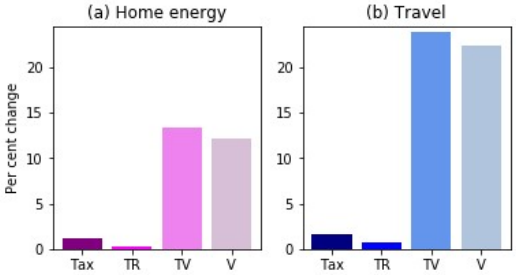
Figure 1: Income loss or gain by households in the top and bottom of the income quintile by carbon reduction policy in 27 EU countries.



Note: income loss is indicated by a negative per cent and income gain by a positive per cent. TR = 'tax and rebate' model, TV = 'tax and voucher' model, Voucher = 'voucher only' model. Bottom IQ= households in the lowest income quintile. Top IQ = households in the highest income quintile. Both Panels (a) and (b) show that the 'voucher only' models are progressive under both the home energy and the travel policies.

However, green voucher schemes lead to greater emission reductions than tax-rebate models because they stimulate additional public investment in green services. Such investment is missing in the tax-rebate model, which reverses part of the emission reductions previously achieved by the carbon taxes. This is because households are likely to spend the money they receive in rebates, causing new carbon emissions.

Figure 2: Decrease of greenhouse gases by carbon reduction policy in 27 EU countries.



Note: for abbreviations, see note to Figure 1. V = voucher only. Positive percentages indicate a decrease in CO_2 equivalent emissions from home energy and motor fuel for all 27 countries.

Figure 2 shows that green voucher schemes reduce greenhouse gases from home energy by 13% (based on renewably generated electricity, amounting to 92 Mt CO_2 equivalent) in all 27 countries combined. This reduction is even bigger if the focus is on travel, with a decrease of emissions from motor fuel of around 24% (amounting to 178 Mt CO_2 equivalent). Hence, the voucher schemes' additional investment in green infrastructure would achieve significantly higher emission reductions than other carbon reduction policies, which lack additional investment in green energy and transport.

Quick guide

This study matches household expenditure data from the 2010 and 2015 EU household budget surveys (HBS) (covering 4 and 23 countries respectively) with emission factors from Exiobase. The total sample covers 275,614 households in 27 EU countries.

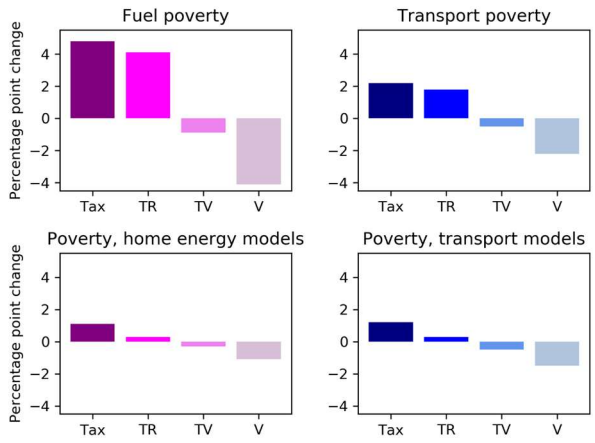
We summarise relevant HBS expenditure variables into two broader categories: home energy and motor fuels. Using data from Exiobase, a database for multiregional input-output analysis, we can estimate the population's annual greenhouse gas emissions (in CO_2 equivalent units) for these HBS expenditure categories. We divide total emissions according to Exiobase by total HBS expenditure per category and country to generate emission factors in kg CO_2 equivalent per euro. These factors are then multiplied by household expenditure and converted to tonnes of CO_2 equivalent per household. This procedure automatically takes varying price levels between countries into account.

In line with expert recommendations (Gies, 2017, Parry et al, 2021), we set the carbon tax at EUR 80 per tonne of CO_2 equivalent and adjust it to the price level in each country to achieve an equal tax rate in real terms. We achieve this adjustment to national price levels by using price level indices for final household consumption. To model the impact of this **carbon tax**, we first use income elasticities per income quintile to estimate the emission reduction due to reductions in real income that households would experience as a result of the tax. We then apply the carbon tax to the reduced emissions. The '**tax and rebate**' model is estimated in a similar way to the carbon tax model. However, the 'tax and rebate' model factors in rebates by re-allocating all tax revenue from the baseline model to adults and children on an equal basis. The '**tax and voucher**' estimations consider the impact of in-kind vouchers instead of cash rebates. We treat the 'tax and voucher' and the 'tax and rebate' models as distributionally equivalent in this study. We do this by setting the same value for rebates and vouchers per household to be able to compare the differences in emission reductions and fuel/transport poverty between both models. We assume that renewable electricity would be fed into the grid, replacing standard grid electricity for the amount of the electricity vouchers. We also assume that households use the public transport vouchers to cover trips that they previously did by car. The '**voucher only**' model distributes green vouchers to households in the same way as the 'tax and voucher' model without imposing any tax first.

A number of limitations need to be highlighted. The microsimulation models take behavioural change into account. However, this is only done based on income elasticities and not on either price elasticities or related substitution effects. Regional fuel price variations within countries are not taken into account. Potential barriers to the uptake of rebate distribution and vouchers have not been fed into the analysis. We also cannot take account of varying expenditure patterns for home energy by household income group (if a poorer and a richer household each spends EUR 5 on home energy, the type of emissions they cause may vary).

For more detail, see Büchs et al (2021).

Figure 3: Percentage point changes in: (i) fuel poverty, (ii) transport poverty; and (iii) poverty by carbon reduction policy. Data covers 27 EU countries.



Note: for abbreviations, see note to Figure 1. V = voucher only. The percentage point changes are compared to a baseline without taxes or compensations, resulting from each of the four models. Positive percentage point changes indicate an increase in overall poverty, fuel poverty or transport poverty; and negative percentage point changes indicate a decrease in overall poverty, fuel poverty, or transport poverty.

A third criterion for evaluating policies to reduce carbon emissions is to focus on fuel and transport policies, using the 'low income, high costs' definition of poverty (Hills, 2012; Mattioli et al., 2017). Figure 3 demonstrates that carbon taxes on home energy and motor fuel intensify fuel and transport poverty. This calls into question whether these policies are fit to generate a fair transition to net zero emissions by 2050.

Results indicate that implementing both carbon taxes and taxes with rebates would increase fuel poverty by about 4 percentage points and transport poverty by about 2 percentage points across the 27 countries. As a result, overall poverty would increase by about 1 percentage point in both models. In contrast, the green voucher schemes would again produce the most favourable outcome. Fuel and transport poverty would decrease by about 4 and 2 percentage points respectively. This would lead to an overall decrease of poverty by about 1 to 2 percentage points.

Conclusion

This evaluation of various policy options for carbon reductions was based on three criteria:

- fair redistribution of costs and benefits;
- emissions-reduction potential; and
- impact on fuel and transport poverty.

Results indicate that providing free green services is the only option that scores favourably on all three evaluation criteria. Providing everyone in society with an equal amount of free green electricity and public transport would increase demand. To meet this increased demand, infrastructure for renewable electricity generation and public transport would need to be expanded. This would speed up decarbonisation compared to current rates.

Equal per-capita tax rebates are redistributive. However, they would increase fuel and transport poverty due to the carbon taxes imposed first. They are also less effective in reducing emissions than providing green services for free.

Carbon taxes are well established policy instruments. However, raising carbon taxes without new compensation mechanisms may not prove popular, as the *gilets jaunes* protests in France suggest.

Providing free green services is a more novel policy proposal which might take longer to develop and implement. However, there are some examples that could be built upon:

- free bus passes for people aged 66 and over in Ireland;
- free public transport for everyone in Luxembourg; or
- cheques for free energy for vulnerable households in France or Belgium.

Policy recommendations

- Carbon or energy taxes on home energy aiming to reduce carbon emissions should be combined with compensation schemes that balance out the regressive distributional impact of those taxes.
- In many EU countries, carbon taxes on transport also have regressive effects but less so than for home energy. In these countries, carbon taxes for transport should also be combined with compensation schemes that balance out their regressive distributional impact.
- Another policy option is to provide households directly with free green electricity and/or free public transport (green voucher schemes) without imposing any tax first. This leads to greater emission reductions, fairer cost distribution and lower poverty compared to carbon-tax policy options.
- To enable these high emission savings, green voucher schemes require new investment. Renewable electricity must replace conventional grid electricity. And easily available, demand-guided public transport must replace car travel.

References

Büchs, M., Ivanova, D., Schnepf, S.V., 'Fairness, effectiveness, and needs satisfaction: new options for designing climate policies', *Environmental Research Letters*, Vol. 16, No 12, 2021.

European Commission, *Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions – The European Green Deal*, COM(2019) 640 final, European Commission, Brussels, 2019.

Gies, E., 'The real cost of energy', *Nature,* Vol. 551, 2017, pp. 145-147.

Hills, J., 'Getting the Measure of Fuel Poverty – Final Report of the Fuel Poverty Review', *CASE report* No 72, Department of Energy and Climate Change / London School of Economics, London, 2012.

IPCC, *The Physical Science Basis: Summary for Policy Makers*, 2021, in: Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S.L., Péan, C., Berger, S., Caud, N., Chen, Y., Goldfarb, L., Gomis, M.I., Huang, M., Leitzell, K., Lonnoy, E., Matthews, J.B.R., Maycock, T.K., Waterfield, T., Yelekçi, O., R., Y., Zhou, B. (Eds.), *Climate Change 2021 – The Physical Science Basis. – Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge.

Mattioli, G., Lucas, K., Marsden, G., 'Transport poverty and fuel poverty in the UK: From analogy to comparison', *Transport Policy*, Vol. 59, 2017, pp. 93-105.

Parry, I., Black, S., Roaf, J., 'Proposal for an International Carbon Price Floor among Large Emitters', *IMF Staff Note* No 2021/001, International Monetary Fund, Washington, D.C., 2021.

Schnepf, S.V., Buchs, M., Bastianelli, E., *Public opposition against fuel taxes in Europe: how important is social disadvantage?* 2022 (forthcoming, manuscript available on request).

Contacts:
sylke.schnepf@ec.europa.eu

The European Commission's science and knowledge service
Joint Research Centre

EU Science Hub: *ec.europa.eu/jrc/en* @EU_ScienceHub Joint Research Centre
EU Science Hub – Joint Research Centre EU Science Hub