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Steering toward net zero—a plea for a consumer-level carbon footprint tax

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Abstract
Past and current policies appear ineffective in limiting global warming to below 2 °C, as the share of fossil energy has stayed well above 80% for the last 30 years, and global greenhouse gas emissions still show a rising trend. A small but fundamental change in perspective could have the potential to enable a democratically supported last-minute turn toward a sustainable economy. We define a set of criteria that climate policy instruments should ideally meet in order to be both effective and sustainable. For fulfilling these criteria, we rationally propose a paradigm shift with respect to carbon taxing. Instead of taxing emissions at the chimney, our proposal is to re-consider a consumer-level tax on the carbon footprint of products and services combined with a rigorous lump sum refund policy. This could potentially eliminate relevant obstacles for unilateral application of effective carbon prices. We also mention potential challenges with the proposed option. It is our aim to bring the possibility of a consumer-level carbon footprint tax to the attention of the scientific community and to trigger multidisciplinary research on this topic.

Keywords Climate change · Carbon tax · Carbon footprint · Consumer · Policy · Carbon dividend · Social sustainability

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1 The missing Rudder

Humanity is sailing toward the cliffs of climate catastrophe (Steffen et al. 2018; IEA 2024). For a long time, we have known what course we should take to reach safe archipelagos (IPCC 1992). Political leaders have reacted to scientists' warnings by setting targets that could be seen as waypoints on the route to safety. However, our ship seems to lack an effective rudder to change its heading to the required extent (IPPC 2022; IEA 2024). Thus, we find ourselves on board a disabled vessel watching the safe islands pass us by in the distance. Calls for action are growing louder.

What would a responsible crew do in such a situation? Would it gain more data about the cliff coast we are heading toward to know more about the crash we expect to happen? Would it better define the target and the waypoints on the safe trajectory? Would it find another safe island as we apparently fail to take the currently identified route to safety (Gasser et al. 2015)? Would it develop the technologies we will need once we have reached safe waters (Meckling and Biber 2021)?

Acknowledging that all these efforts have been and will continue to be valuable and important but putting ourselves in the situation of a ship's crew, we may sense what is necessary: to build the rudder we need to change course.

2 Problem definition

Trying to identify what requirements such a steering tool ideally fulfills, we find that it should be:

a) effective, i.e., have the potential to reduce CO_2 equivalent emissions quickly.
b) regionally applicable without the need for global governance, i.e., activate local actors while avoiding economic damage.
c) legally feasible, e.g., applicable within the existing free trade frameworks.
d) technologically open, i.e., the most cost-efficient mitigation actions should be prioritized.
e) socially sustainable, i.e., the measure should ideally reduce inequality.
f) democratically supported, i.e., it needs to obtain and keep the support of the majority of the electorate.

Carbon tax, i.e., pricing CO_2 emissions, has been identified as a means of triggering climate action (Döbbeling-Hildebrandt et al. 2024; Sterner 2024; van den Bergh and Botzen 2024). Our current understanding of carbon tax seeks to price either fossil fuel consumption or emissions at the chimney. The emitters are power companies, oil companies, the production sector, the transport sector (i.e., operators of cars, trucks, ships, and airplanes), offices and households (heating and cooling). The advantage of rigorous CO_2 pricing is that the most cost-efficient mitigation technologies will succeed on the market. This means that requirements (a) and (d) would be fulfilled. However, two main problems of carbon tax can be identified. First, emissions may be shifted to other regions of the globalized economy where lower or no carbon taxes are charged. To avoid that kind of carbon leakage, border tax adjustments have been proposed (CLC 2019). Second, carbon tax may entail macroeconomic effects. To avoid a decrease in purchasing power, lump sum dividends have been

identified as a means of redistributing carbon taxes to the population (CLC 2019; Fried et al. 2018). This would fulfill requirements (e) and (f), as it could also lead to the necessary support from the electorate in democratic societies.

Although a number of countries have already implemented carbon taxing in different ways, we see no breakthrough effects on greenhouse gas emissions thus far (Tvinnereim and Mehling 2018; Ritchie et al. 2020; Green 2020). The limited practical success of carbon taxes might be attributed to the comparably low tariffs applied. If, however, high tariffs were implemented in current settings, the local economy would lose competitiveness in the globalized market, and the population might finally oppose to that (Benjamin et al. 2022). Legally complex accompanying measures such as border adjustment mechanisms are required if high tariffs for emitters apply, which has not been achieved in practice yet. Even though there is no scientific evidence that producer-based mechanisms cannot be made to finally work in practice, it may be worthwhile for responsible science to investigate alternatives.

3 Paradigm shift

To circumnavigate some of the obstacles and to accelerate the transition to a sustainable economy, we suggest changing our perspective based on an almost trivial correction to the current understanding of carbon tax: the responsible emitters are we ourselves, as individuals and consumers, whereas the abovementioned companies just cover our demand. If we were made to effectively pay for our personal carbon footprint, we would obviously seek to improve our economic situation by reducing this footprint (Carattini et al. 2019). Products and services with a decarbonized supply chain would become more competitive in such a situation, giving rise to the required change.

Producer-side carbon taxes, such as Pigouvian taxes, have long been studied and implemented (Cornes and Sandler 1985), while taxing policies targeting consumers' carbon footprints remain relatively underexplored. The idea of a carbon footprint tax was proposed around 2008 (Stiglitz 2008; Courchene and Allan 2008; Hufbauer et al. 2009) as carbon-added tax and then debated in Canada (McLure 2010; Courchene and Allan 2011). Gemechu et al. (2012) test a tax on products and services based on the carbon footprint in a case study. McAusland and Najjar (2015) introduce the term carbon footprint tax, propose a hybrid design based on product categories in order to reduce the effort for carbon footprint determination and discuss issues such as competitiveness, leakage, feasibility and costs of implementation as well as consistency with trading rules. Sommer and Kratena (2020) compare a carbon tax on fossil fuels to a carbon footprint tax in a modelling study and find a pronounced effect on carbon leakage as expected. However, they also report a reduced effectiveness in emission reduction for the case of the carbon footprint tax. All in all, scientific attention to a tax on carbon footprints has been relatively limited.

4 The vision

What could such a consumer-level carbon footprint tax look like in practice?

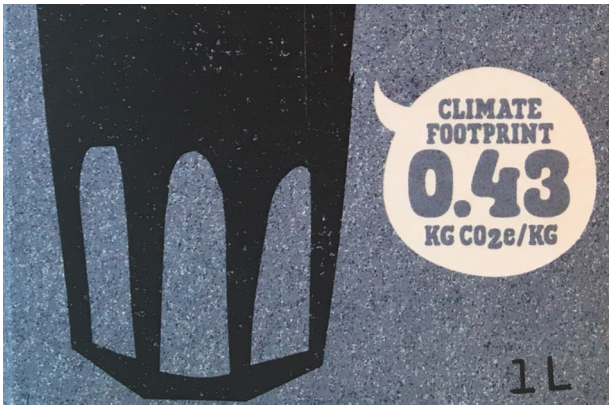

Fig. 1 Product-related carbon footprint information about a vegan milk substitute

The worst-case carbon footprint of a product or product category can be assessed based on methodologies such as standardized life cycle assessment (LCA) or standardized input-output models and be priced. Methods that allow the determination of the footprint are available (Pieper et al. 2020). Some companies voluntarily indicate the carbon footprint on products (Fig. 1).

The consumer will pay the carbon tax at the point of sale. Processing can be carried out together with and using the infrastructure of value added tax (Courchene and Allan 2008; McAusland and Najjar 2015). The carbon tax will then be redistributed as a lump sum dividend to all residents of the region applying the policy (CLC 2019; Fried et al. 2018). This measure is critically important within our proposal. Inherently, without affecting purchasing power, consumers will have an incentive to act in a climate-friendly manner. Thus, the advantage for competitiveness comes mostly from the combination with lump sum refund. Such a refund policy is likely simpler to implement with a consumer-level tax than with producer-based taxes or traded certificates, as the tax is returned, after the important re-distribution, back to those who pay for it. The general concern with respect to producer-based taxes that these would just be handed on to the consumers shows an important difference between producer- and consumer-level tax: while the consumer has to pay in any case, the increased transparency about the carbon footprint and the direct link to the lump sum refund policy on the regional level may improve public acceptance and the steering effect of the policy.

Companies will have the possibility to claim individual carbon footprints for their products that are lower than the official standard for the respective product category. Authorities will check and eventually admit the claim, issuing a certificate that allows the application of the reduced tariff. If a company successfully decarbonizes its procurement chain, its products will be cheaper and gain in competitiveness. A race for creating lower carbon footprint products would ideally commence. In this sense, fuels and electricity purchased by consumers are also products. The policy could also be extended from products to services (Gemechu et al. 2012). Notably, this carbon tax will be paid only by consumers. Business-to-business trade as well as wholesale imports and exports would remain technically unaffected. The effects on industry and trade are expected to come indirectly from the market advantages of decarbonized products.

5 Pros, cons and opportunities

The winning advantages of consumer-level life cycle-based carbon footprint taxing are as follows:

- Even though the carbon tax tariff should be increased carefully and transparently to allow industry to adapt, it can in principle be increased to very high values without the risk that the local economy will lose its competitiveness in the global market. This is key to requirement (a) above: if we are free to define the carbon tariff without the threat of losing purchasing power or competitiveness, we can effectively steer our economy toward net zero. High tariffs will lead to considerable redistribution effects within the region but should not lead to recession.
- Local production will be strengthened (requirement b). Imported goods from economies without climate change mitigation policies will tend to be less competitive because of higher carbon footprints for both production and transportation.
- There will be no need for complex border tax adjustments (requirements b and c), as an assessment of carbon footprints is possible for both imported and domestic goods. The current advantage of moving production sites to places outside the region to avoid emission accounting is inherently eliminated.
- Socially vulnerable individuals would profit as long as they emit less than the average (requirements e and f). Redistribution through lump sum dividends may reduce inequality and lead to more resilient societies (Fried et al. 2018).
- The approach could be tested for a reasonable period in suitable environments such as island states to gain knowledge and confidence. In case of success, other regions and larger regions might want to follow early to keep up with the technological development triggered by the new situation in the participating regions.

The following challenges require consideration:

- The carbon footprint assessment methodology must be standardized and steadily reassessed to guarantee best practices in the application of the policy.
- Consumer price indices should exclude the carbon tax as it is returned to the consumers.
- The policy needs to be defended against claims made by free-trade partners of the implementing region that it would constitute a case of trade restriction. The option to claim footprint corrections for products or commodities should be open for companies regardless of origin.
- The measure needs to be supported by the local population. The transparency and simplicity of the measure are expected to be key here to fulfill the requirements (e) and (f) above (Mildenberger et al. 2022).
- Other policy instruments should ideally be abandoned in favor of the new approach in regions where it is applied. This may require the iteration of multilateral agreements.

There are opportunities that lie beyond the immediate focus of steering toward net zero. In this sense, environmental or social parameters other than the carbon footprint could be additionally considered in the tax formula. This could enable steering in a situation of multiple crises (Sterner et al. 2019). It may be worth exploring whether imposing taxes on both

producers and consumers would lead to greater efficiency, or if a differentiated approach should be adopted for different industries. Future research might also address optimized carbon tax schemes for different sectors. Given all these considerations, it is still astonishing that consumer-level carbon footprint taxing has received only little attention in the research community thus far.

6 Conclusion

In view of the ambition gap (CAT 2024) and the severe threat of climate catastrophe, we think that it is high time for the research community to come together to build a rudder for humanity that is at least potentially effective to steer toward net zero. Proposals will certainly require analysis, discussion, refinement and real-world testing in suitable environments. Further, proposals must be continuously evaluated at global and regional level including issues of public acceptance and communication. But, most likely, only a novel perception of our roles will bring about the tools to effectively and sustainably change course.

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Declarations

Competing interests The authors declare no competing interests.

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