Climate

Enabling a just transition – why taxation has a vital role to play

Tax policy can help the energy transition to be just and sustainable

October 2024

pwc

Despite the ambitious commitments to decarbonisation made by businesses, governments and international institutions, progress towards the Paris targets still appears to be slow: PwC's Net Zero Economy Index for 2023 shows that the world achieved a decarbonisation rate of just 2.5% in 2022. Clearly, a significant intensification of effort is needed if the targets are to be met.

Central to this effort need to be well-framed policies focused on ensuring a just transition. That's because, to succeed, decarbonisation initiatives worldwide have to be sustainable, with genuine societal buy-in. This will be difficult, if not impossible, to achieve if reductions in greenhouse gas emissions have adverse socioeconomic effects, particularly in sectors and regions heavily reliant on fossil fuel energy.

Drawing on empirical evidence and extensive academic research, this report outlines the role of tax policy in shaping this just transition through three key revenue recycling mechanisms: (i) lump-sum transfers; (ii) targeted transfers; and (iii) tax reductions. While each of them involves trade-offs between redistributive goals and economic efficiency, we believe that these mechanisms can play a crucial role in reducing the negative impacts of energy transition and making progress towards net zero as equitable as possible.

It's important to make clear that this is not in any sense the final word on this subject. What constitutes a just transition – and how to achieve it – are evolving areas of study. We also emphasise that spending programs such as the development of sustainable infrastructure, enhancement of public services, and the development of labour and skills frameworks (both domestically[1] and through developed economies supporting developing and emerging economies[2]) are beyond the scope of this report[3].

Additionally, two areas which while noteworthy are not addressed in this report, are **(i) international equity across different countries,** due to the current lack of empirical research in this area, and **(ii) Measures in the US Inflation Reduction Act ("IRA")**, which are focused on low-income and energy communities, promote apprenticeships and prevailing wages, and promote investments in clean energy-using equipment. Again, although these elements are of significant interest, due to their recent implementation, there is not enough research available at this stage.

[1] In Germany, for example, the 2020 Coal Exit Act outlines both the coal phase-out schedule and compensation for power plant operators. Meanwhile, the contemporaneous Structural Aid Act for Coal Regions provides financial aid to facilitate structural change in areas impacted by the phase-out. The European Just Transition Fund supports these types of policies across the EU(27). For example, in 2019, the Spanish government initiated a Just Transition Strategy to mitigate the effects felt in coal-producing areas and from the closure of power stations.

[2] The Just Energy Transition Partnership (JETP), for instance, facilitates funding for countries through a blend of equity investments, grants, and concessional loans. This support comes from the G7 nations, multilateral banks, and private financiers, aiding their shift to sustainable energy. South Africa set a precedent as the inaugural beneficiary of the JETP, securing a finance commitment of US$8.5bn in 2021. Subsequently, Indonesia and Vietnam obtained pledges totalling US$20bn and US$15.5bn, respectively, in late 2022. Most recently, Senegal consented to a package worth €2.5bn.

[3] PwC has extensively addressed these related, non-tax subjects, delving into themes like green technology investment and the promotion of skills for renewable energy sectors (e.g. WBCSD, 2023).

Section 1

Targets and challenges

The 2015 Paris Agreement is a landmark accord within the United Nations Framework Convention on Climate Change. It sets out a global framework to limit global warming to well below 2°C above pre-industrial levels, and is pursuing efforts to limit it to 1.5°C.

In step with the Paris Agreement, developed economies have set ambitious green targets. The European Union aims to reduce greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels, aiming for a climate-neutral continent by 2050. Similarly, the United States has pledged to reduce greenhouse emission by 50-52% from 2005 levels by 2030.

Other G20 economies have also established their own significant targets to combat climate change. In November 2021, India made a commitment to achieve net-zero carbon emissions by 2070. And Brazil committed under the Paris Agreement to cut greenhouse gas emissions by 37% by 2025 and by 50% by 2030. It aims to reach climate neutrality by 2050. Meanwhile, China has made several pledges to reduce its carbon footprint and move towards net zero emissions. Overall, it aims to reach peak carbon dioxide emissions before 2030 and achieve carbon neutrality before 2060.

The challenges of transition

Adherence to these commitments also raises challenges. There are many examples of these, spanning developing, emerging, and advanced economies. In China, for instance, the coal industry's workforce has contracted sharply due to government policies aimed at reducing overcapacity and improving air quality, with employment falling from 5.3 million in 2012 to 2.6 million by mid-2023.

One EU study estimates that from 2020 to 2025, 15,000 jobs could be lost in the European coal sector due to the first wave of coal power-plant shutdowns. The UK, Germany, Poland, the Czech Republic, and Spain would be impacted the most. A further 18,000 positions are at risk of disappearing in the following five years, up to 2030, with Germany, Poland, the UK, Bulgaria, and Romania expected to be the hardest hit.

While the green transition could lead to job losses and reduced earnings in high-emission sectors, the green economy also creates new jobs. However, the skills needed are often distinct from those that workers in fossil fuel industries currently possess. As a result, workers and communities may be left behind if people do not get access to retraining opportunities.

According to the PwC Green Jobs Barometer, green jobs in the UK offer higher financial rewards and job satisfaction, with entry-level positions commanding a 23% pay premium in certain sectors. However, many of these roles can often require longer hours and provide less job security.

The concentration of green jobs in skilled professions calls for higher educational levels, which exacerbate regional inequalities, and potentially marginalise communities with lower average qualification levels and underrepresented ethnic groups. A 2021 study, for example, presents comparable findings for the UK and European economies, noting that green jobs are predominantly filled by older workers and men.

The role of tax policy

A blend of policies, including taxation, is key to achieving a just green transition. As well as aiming to incentivise eco-friendly practices among households, governments and businesses, these policies are designed to shift consumption, investment and more generally spending patterns towards more sustainable options.

Carbon prices, including taxes on greenhouse gas emissions and cap-and-trade systems are key economic tools to modify behaviour. The fundamental principle behind environmental taxation is to ensure polluters account for the societal costs of their pollution, which would otherwise not be internalised and accounted for by the polluter. By increasing the price of polluting activities, environmental taxes reduce demand for those activities (Fullerton et al, 2010).

Ideally, carbon prices would achieve a level of pollution that balances the costs and the benefits derived from the activity that causes it (Adam et al, Tax by Design, 2011). That said, however, it's possible that carbon prices, including taxes, will have undesirable distributive outcomes, imposing disproportionate costs on the less affluent, on particular sectors, and on certain geographical areas.

The risk of regressive outcomes

Essential items such as electricity, heating (and, although the evidence is more mixed, transportation) are basic necessities that consume a considerable share of poorer households' financial resources. Consequently, environmental levies, which are imposed on the use of fossil fuels, transportation and/or energy consumption, tend to be regressive.

For example, using data on UK households, a 2021 study found that carbon taxes represent almost 8% of weekly expenditures for the lowest income decile and around 5% for the richest households. Meanwhile, a 2018 study found that a carbon tax in the US would be moderately regressive (if revenues are used to reduce the deficit).

Overall, the extent of regressivity depends on the criteria for assessing ability to pay, the treatment of taxes on embedded emissions, and the consideration of short- versus long-term impacts.

The impact of carbon pricing on income distribution doesn't just differ vertically among various income levels. It also varies horizontally within the same income brackets because of the diverse energy use that is a function of household size, location, property features, power generation methods, travel habits, and the energy efficiency of appliances.

In fact, as a 2019 study shows, disparities in horizontal equity often surpass those in vertical equity. Another study, published a year later, observed the same phenomenon in rural communities, with their greater reliance on private transport and larger homes, while a 2021 paper (citing earlier research by Reames and Bednar) identified a heavier energy burden in US neighbourhoods with a higher minority population.

In addition, the concept of a clean environment may be perceived as a luxury good – an item for which demand escalates more than proportionally as income increases. In this context, individuals with higher incomes may exhibit a greater willingness to pay for the benefits of environmental conservation, meaning that they enjoy the advantages of environmental policies more than their less affluent counterparts.

The successful enactment of policies hinges on their acceptance by the public, a sentiment that may wane if reforms engender widespread economic dislocation. To navigate this conundrum, policymakers can rely on tax instruments that not only incentivise emission abatement but also incorporate mechanisms for cushioning the economic blow to affected parties. Such policies must be part of any transition (rather than permanent subsidies) designed to balance the environmental and economic impacts of transitioning to a low-carbon economy.

Section 2

Mitigating the transition's socio-economic impacts through taxation

Evidence-based recommendations

The distributional outcomes of environmental tax measures depend, crucially, on how the revenues are used (Kosonen, 2012). Lawrence (2024) and Rosenberg et al (2018) find that while carbon taxation by itself is regressive, it can be made progressive by returning the revenue to households.

Revenue raised by carbon prices and green tariffs can either be incorporated into the general budget or dedicated for specific uses. Governments can enhance their fiscal resources. For example, the US Congressional Budget Office estimates that implementing a carbon tax of US$25 per metric ton may cut the budget deficit by US$571bn to US$865bn over a decade, with variations contingent on the rate of price increase and the potential exclusion of motor fuels. Governments can also adjust the tax system to compensate those affected, reduce distortionary taxes, or fund specific environmental projects and income support programs.

In its 2024 report, the World Bank indicates that the majority of global carbon revenue in 2022 was allocated to green initiatives and national budgets. Over half funded green transport, energy efficiency, and renewable energy projects, with the EU mandating member states to invest at least 50% in climate and energy projects. Around 25% went into general budgets, as seen in France and the UK. Redistribution efforts ensure 10% reaches households and businesses impacted by carbon pricing (both Austria and Canada return funds to citizens; in Canada, 80% of households gain more than they spend on carbon tax).

Mitigating negative impacts through revenue recycling

Based on a large body of empirical evidence, **revenue recycling**, as opposed to allocating the revenues to reducing government debt, is one of the most common recommendations for mitigating the negative impact of climate policies on the most vulnerable parts of society.

A carbon tax can reduces economic activity:
real wages are lower because of higher prices and therefore labour supply decreases as most individuals tend to reduce their work hours when real earnings decrease. In addition, overall tax revenues could also decrease because of a smaller labour income tax base.

This implies that a set of green taxes and broader measures, implemented without a revenue recycling mechanism, increase the fiscal cost of climate policy. In addition, **without a revenue recycling mechanism**, it's likely that **a large share of households** (especially in adversely affected regions and sectors) **will not support the shift towards sustainability**. A mechanism to redistribute the economic costs and gains from the green transition could be key for its political success (Van der Ploeg et al., 2022).

So how should revenues be recycled? **Revenue recycling mechanisms** could include lump-sum transfers, targeted transfers, and reductions in labour or capital taxes. Revenue recycling mechanisms can have different designs across jurisdictions, depending on the sophistication of the tax and benefits systems, redistributive preferences, and local political processes and decision-making (Lawrence, 2024).

The choice of recycling mechanism frequently involves a trade-off between equity and efficiency objectives (Kosonen, 2012). Importantly, revenue recycling to mitigate income disparity may increase consumption of high-carbon goods (Semet, 2023). The best strategy to improve the efficiency of the tax system, and therefore of the economy, is to reduce the most distortionary taxes: capital income taxes (on dividends, capital gains), corporate taxes and taxes on labour income. Unfortunately, recycling methods that are most effective in reducing economic inefficiency may also be the most regressive. Rosenberg et al. (2018) find that using revenue to reduce the corporate income tax would result in higher taxes for low-income families.

It is possible to redistribute the revenues from carbon prices equally among households as lump-sum rebates. However, because these do not reduce other distortionary taxes, an opportunity to make the economy more efficient is missed.

Additionally, because carbon pricing income can vary (as a result of market forces and policy choices) a degree of unpredictability exists. As they design their revenue recycling strategies, policy-makers should be ready to take this into account.

Distributing tax proceeds through lump-sum transfers

Early research on carbon levies often presumed that tax proceeds would be redistributed as a uniform lump sum (Goulder, 1995). In a lump-sum transfer, revenues are returned in equal amounts to every household or individual, regardless of their income or consumption patterns.

The lump-sum transfer is intended to compensate households for the higher prices of goods and services that result from the carbon tax (Douenne, 2020).

Empirical evidence identifies two potential positive effects of lump-sum transfers.

- **Redistribution:** To the extent higher costs are a larger share of the income of low-versus high-income households, a lump sum transfer increases vertical equity (i.e. it makes the tax system more progressive).
- **Economic efficiency:** Giving people fixed amounts of money, without changing prices of goods consumed via tax, may be more efficient for the economy as this method doesn't affect people's consumption mix (although total consumption will be affected). The lump-sum transfers cannot be influenced by any current decision of the individuals and firms. After these transfers are made, the market can set prices that show the true costs of goods, leading to a more balanced and efficient use of resources.

Klenert et al. (2018) argue that recycling all revenues from the carbon tax as a visible and transparent carbon dividend (a lump-sum transfer) generates enough political support to make green tax reform politically acceptable.

Using German households' data, Van der Ploeg et al. (2022) find that recycling carbon tax revenue as lump-sum transfers can alleviate poverty and marginally decrease inequality. That said, such a mechanism adversely affects higher income households due to increased consumer prices, lower real wages and, therefore, fewer hours worked. A lower labour income tax base will lead to income tax hikes to achieve fiscal balance.

Consequently, economic activity diminishes (although less than under targeted transfers). Overall, hours worked decrease by 0.7% and emissions decrease less than when there are no revenue recycling mechanisms (24% versus 25%). In the end, only a minority of German households (30%), primarily the less affluent, benefit from a combination of carbon prices and lump sum distribution, undermining potential political backing for eco-friendly tax reforms.

For the US, Rosenberg et al. (2018) find that lump-sum rebates would offset the carbon tax burden for low-and middle-income taxpayers but leave high-income families with a net tax increase.

Distributing tax revenues through targeted transfers

A targeted transfer is a form of revenue recycling that involves distributing a portion of the carbon tax revenue to specific groups of households based on their characteristics (e.g. income, energy use and/or location).

Studies suggest that transfers targeted to income can soften the regressive impact of the carbon tax across different income groups. In other words, they can soften vertical inequality (Van der Ploeg et al., 2022).

However, there are drawbacks. Transfers purely targeted to income levels may increase horizontal inequality (if considered independently of the benefits derived from lower emissions). This is because households with similar income levels but different consumption patterns, preferences, or exposure to climate risks may receive the same amount of money, regardless of their actual tax burden and vulnerability to carbon prices (Douenne, 2020).

In addition, there is also evidence that transfers linked to carbon emissions can create perverse incentives for households to maintain or increase their carbon consumption, leading to a backfire effect that reduces the environmental benefits of the policy. Transfers may weaken the incentive to reduce carbon emissions, as households may not face the full marginal cost of their consumption choices, and may use the transfer to buy more carbon-intensive goods and services (R. Semet (2023), Van der Ploeg et al. (2022)).

Using French households' data, Douenne (2020) simulates a carbon tax with four alternative revenue-recycling mechanisms that could potentially reduce the negative effects of a carbon tax on horizontal inequality:

- The **lump-sum transfers** mentioned in this paper. This improves vertical redistribution but does not solve horizontal distributive disparities that can be much greater in magnitude than the vertical ones.
- **Transfers by area** provide an additional transfer to rural households that face higher transport and heating costs. This mechanism does not lead to significant improvements mainly because urban versus rural location is not an adequate proxy for energy consumption and the incidence of carbon prices.

- **Transfers by energy** provide an additional transfer to households heating with fuel or gas. These households are more exposed to the carbon tax. This scheme only slightly reduced the horizontal distributive effects and the share of low-income households that lose from carbon prices. In addition, McCord and Costella (2023) note that, unless carefully targeted, the provision of subsidies for greener fuels may result in regressive outcomes. For instance, 40% of the Indian LPG subsidy benefitted the richest 20% of the population.
- **Transfers by area and energy** combine the previous two mechanisms. Like them, this mechanism does not lead to significant improvements.

Overall, horizontal inequities are important but also difficult to address, even via targeted transfers. This is because it's difficult to precisely target households that would benefit most from certain interventions (Paoli and Van der Ploeg (2022), Douenne (2020) and Sallee (2019)).

Understanding the impacts of tax reductions

Taxes, including environmental taxes, prompt unwelcome behavioural changes that reduce individuals' welfare by diminishing both labour supply and investment. The higher the tax rates, the larger the distortions (Fullerton et al., 2010). By lowering the marginal tax rates on labour or capital income, tax cuts can reduce the distortionary costs of the existing tax system. This could increase incentives for work, saving, and investment, and boost economic activity and welfare (Van der Ploeg et al., 2022).

For Spain, the carbon pricing's effect on jobs is unclear and hinges on revenue being used to lower the cost of labour: using carbon tax income to lower labour taxes boosts sectoral employment.

The double-dividend hypothesis of green taxation emerges from the notion that green levies could simultaneously reduce emissions and improve economic efficiency (Goulder, 1995). This is achieved by reallocating the tax burden – away from distortive taxes on labour and capital and towards green taxes. However, carbon pricing and tariffs, like all taxes, introduce their own distortions. A genuine double dividend materialises only if the efficiency cost of these new taxes is outweighed by the reduction in existing ones (Fullerton et al., 2010) and at the same time, environmental benefits (including co-benefits) are accounted for (Bovenberg, 1999; Goulder, 1995; Fried et al., 2019; WEF & PwC, 2021).

Tax reductions can have different effects on the efficiency, equity, and environmental outcomes of a carbon tax policy, depending on how they are designed and implemented. If the revenues are used broadly to reduce labour taxes, the effect may be regressive, as high-income households may benefit more from lower marginal income tax rates.

For the US, Rosenberg et al. (2018) find that utilising carbon-tax proceeds to lower payroll taxation can yield a net gain for upper middle-income earners and marginally elevate the fiscal load on both low- and high-income brackets. Using data for UK households – Paoli and Van der Ploeg (2021) calculate that an across-the-board income tax reduction of 18% has good efficiency properties but less desirable equity properties.

The efficiency gains are evidenced in the fact that the tax cut leads to the smallest drop in hours worked (1.6%) and to the second highest increase in consumption (2.8%), while still delivering a cut in emissions of about 10%. Nonetheless, the Gini index, a measure of income inequality, increases more than under the assumption of no recycling mechanism.

Viewed from a different angle, expanding social security benefits can provide a progressive recycling strategy for carbon pricing revenues, as evidenced by Paoli and van der Ploeg (2021). This approach ensures less inequality with respect to the situation where there is no revenue recycling mechanism. There is, however, an efficiency cost: while hours worked drop by a very similar amount (around 3.2%), emissions drop by only 9.5%, compared to 14% with no revenue recycling.

Observers have also suggested reducing VAT on specific goods that are typically consumed by lower-income households. The aim is to reduce the price of the overall household consumption basket to compensate for higher carbon prices (McCord and Costella, 2023).

However, VAT exemptions and differential rates complicate administrative compliance, often benefit higher-income groups disproportionately, and VAT cuts may not be passed on to consumers, depending on the market conditions (de la Feria and Krever (2013), Keen (2013)). Reducing taxes that are more distortionary than VAT (e.g. income taxes) would achieve greater economic efficiency.

Carbon pricing proceeds also offer an opportunity to reduce taxes that hinder the green transition. Germany provides an example. In 2024, the German Climate and Transformation Fund (KTF)[4] allocated €10.6 bn (partially from carbon pricing) to continue subsidising the renewable electricity surcharge (EEG) reduction, benefiting both industry and households. However, a 2024 study found that these measures, while supportive of renewable energy expansion, fail to address the unequal redistributive impact of carbon pricing. A 2021 study by Edenhofer et al found that lump-sum transfers are more effective in alleviating the financial strain on low-income families than the reduction in the renewable energy surcharge.

[4] In Germany, funds generated through national carbon pricing and the European emissions trading scheme are channelled directly into the Energy and Climate Fund (EKF).

Table 1. Summary of the trade-offs for different revenue recycling mechanisms.

Aspect	Lump-sum transfers	Targeted transfers	Reductions in income taxes
Efficiency			
Effects on carbon emissions	Decrease in emissions marginally lower than without revenue recycling.	May reduce environmental benefits due to perverse incentives for households to maintain/increase carbon consumption.	Decrease in emissions marginally lower than without revenue recycling and lower than with lump-sum transfers.
Labour supply	Overall decrease in hours worked as in a scenario without revenue recycling.	Effects on labour supply not explicitly mentioned, but perverse incentives may affect labour supply indirectly.	Increases incentives for work, boosting labour supply (while without recycling labour supply drops).
Consumption	Increased consumption, more than without revenue recycling but less than with tax cuts.	May lead to increased consumption of carbon-intensive goods due to perverse incentives.	Increased consumption, substantially more than without revenue recycling and with lump-sum transfers.
Inequality			
Horizontal	Does not address horizontal inequality.	Potentially, helpful to reduce horizontal inequality but targeting of households beyond income remains practically difficult.	By definition, income taxes generally imprecisely target households beyond their income.
Vertical	Improves vertical inequality by compensating low-income households for higher prices due to carbon tax.	Can soften the regressive impact of carbon tax by compensating low-income households.	Can be designed to offset or reverse the regressivity of carbon pricing, but broad labour tax reductions may be regressive.

Revenue recycling schemes – real benefits but trade-offs to be made

Tax policy, while only one aspect of just transition strategies, can offer compensatory mechanisms for those most impacted by the green transition.

Our research – based on a variety of national contexts, data and approaches – has identified a consensus on the **criticality of revenue recycling schemes to bolster green transition efforts**.

All revenue recycling schemes present a trade-off between redistributive goals and economic efficiency, with the latter including the effects on labour and capital supply as well as on carbon reduction. Specific plans for these schemes will hinge on achieving an optimum balance between these objectives.

Optimal approaches may entail a mix of direct transfers and cuts in pre-existing distortionary taxes. What is clear is that there are policy choices available that enable the tax system to support a just transition.

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RITM0111252