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Addressing the distributional impacts of carbon pricing policies

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Executive Summary

As countries consider appropriate strategies for meeting their Nationally Determined Contributions (NDCs) under the Paris Agreement, carbon pricing is a key element to cost-effectively achieve the required emission reductions in national economies. Carbon pricing harnesses market forces, effectively engages the private sector in abatement efforts, generates public revenue, and provides significant co-benefits such as cleaner air. Yet ultimately, the introduction of a carbon price depends on its political feasibility. The question as to whether the carbon pricing mechanism proposed effectively addresses key distributional and competitiveness concerns is of utmost importance for the policy to gain and retain the support needed over time. This is all the more relevant in emerging and developing economies, which are increasingly moving toward adopting carbon pricing tools and where historical inequalities and poverty affect a significant share of the population

The present paper lays out key considerations for addressing key distributional impacts of carbon pricing policy. It systematically discusses the main distributional concerns from carbon pricing for different societal groups – households, local communities, workers particularly affected by carbon pricing, and firms – and discusses options to alleviate them, drawing both on real-life examples from jurisdictions currently implementing these policies and additional options proposed in the literature. In general, distributional concerns can often be addressed by altering the design of the pricing mechanism itself, or through complementary policies and measures. Frequently, socially just outcomes depend on the considered use of a portion of the carbon pricing revenues. Finally, while addressing distributional impacts regularly requires trade-offs between the primary objective of carbon pricing – ensuring cost-effective mitigation – and other desired outcomes, maintaining the carbon price signal should always remain a priority.

Households are affected by carbon pricing, whether from ETS or a carbon tax, in two main ways: they may face higher costs for carbon intensive consumer goods and services; and their income from work and investments may decrease due to higher production costs for firms. The question whether carbon pricing disproportionately affects the poor and increases inequality depends on the design of the policy and the domestic context. While carbon pricing is often found to be regressive in industrial countries, it may be progressive in developing countries. Geographic disparities can also be expected, with urban areas often less affected than rural, and regions that depend more heavily on fossil fuels more affected than others.

The main potential to mitigate the regressive effects of carbon prices, or to accentuate progressive effects, lies with using carbon pricing revenue. This can be achieved through direct (lump sum) transfers that return carbon pricing revenue to households, subsidies for consumption of specific goods to compensate for higher carbon prices, or “tax swaps” that recycle carbon pricing revenues to permanently reduce other forms of taxes. Key considerations when choosing among the options include their capacity to preserve the carbon price signal, their potential to improve social equality, and their impact on the overall efficiency of the tax system.

Impacts of carbon pricing also relate to the distribution of the resulting environmental and social co-benefits, for instance in terms of improved public health from reduced emissions of air pollutants. Broad market-based carbon pricing policies, such as ETS and carbon taxes, do not necessarily determine where emissions abatement activities will take place, meaning that particularly impacted communities may not realize proportionate co-benefits.

There are four broad options for creating a fairer and more targeted distribution of carbon pricing co-benefits, by adjusting or complementing the carbon pricing instrument or by using

revenues: quantitative and qualitative limits on the use of offsets; revenue spending to compensate disadvantaged communities; zonal restrictions or sectoral caps, where the carbon pricing instrument is adjusted to target where abatement activities take place; and direct regulation of pollution outside the carbon pricing policy itself. For all of these options except for revenue recycling, their benefits may need to be balanced with the resulting loss in cost-effectiveness of the carbon pricing policy itself.

Carbon pricing can drive structural changes in employment across sectors and workforce groups. Communities dependent on carbon intensive industries for their livelihoods will be the worst affected by unemployment and job relocation. Options for promoting a socially just low-carbon transition for workers and their communities include the use of carbon pricing revenues to drive employment diversification and growth, and outside of the sphere of climate policy, labour market development and transitional welfare support. When considering these options, it will be important to identify impacted groups at an early stage and design appropriate support in an inclusive manner. Moreover, wherever possible, revenue spending should focus on fostering green jobs and technologies to enable a low-carbon transition.

Last but not least, policy makers need to assess and address potential *impacts on firms* from carbon pricing as it in some cases, this may represent a disproportionate or unfair burden. There are three cases in which carbon pricing can unfairly impact firms: excessive administrative burdens on smaller firms, stranded assets, and competitive disadvantages for energy intensive and trade exposed sectors.

Carbon pricing design, including the use of revenues, can address these impacts through: setting thresholds for participation in the carbon pricing system; free allocation in an ETS and exemptions, reduced obligations or output-based tax rebates in the case of a carbon tax. These measures need to be well justified, decided in a transparent manner and clearly communicated both to firms and the public. Importantly, not all these options preserve the CO_2 price incentives. Where the price incentive is not preserved, provisions should be designed and communicated either as one-off or transitional forms of support. Moreover, in many cases reducing the burden on firms will be associated with a higher burden on households, thus potentially undermining the public support for the policy in the longer term.

1 Introduction

1.1 Proliferation and benefits of carbon pricing, and the need for attention to distributional impacts

As countries consider appropriate strategies for meeting their Nationally Determined Contributions (NDCs) under the Paris Agreement, **carbon pricing is a key element to cost-effectively achieve the required emission reductions in national economies**. Explicit carbon pricing mechanisms, most prominently emissions trading systems (ETS) and carbon taxes, are now being implemented in more than 42 countries and 25 sub-national jurisdictions.[1] A carbon price makes covered entities pay for every ton of greenhouse gases emitted, thereby shifting production and consumption patterns towards more climate-friendly choices.

While the early phase of adoption of carbon pricing instruments has taken place primarily in developed economies, **emerging economies and developing countries are increasingly moving to integrate carbon pricing into their domestic climate policy toolbox**. In Latin America, Mexico, Chile and most recently Colombia and Argentina are pioneering the use of carbon taxes, as is South Africa. In Asia, China declared the launch of its national ETS, the world's biggest carbon market, at the end of 2017.

There are clear benefits to market-based climate action in both developed and emerging economies. **Carbon pricing harnesses market forces and effectively engages the private sector in abatement efforts, generates public revenue, and provides significant co-benefits** such as cleaner air. Yet ultimately, the introduction of a carbon price depends on its political feasibility. The question as to whether the carbon pricing mechanism proposed effectively addresses key distributional and competitiveness concerns is of utmost importance for the policy to gain and retain over time the support needed. This is all the more relevant in emerging and developing economies, where historical inequalities and poverty affect a significant share of the population. Carbon policies should be aligned with efforts to reduce inequality, ensuring that emissions reductions go hand in hand with sustainable economic and social development.

1.2 Goal of this paper

This paper lays out **key considerations for addressing key distributional impacts of carbon pricing policy**[2]. It discusses how carbon pricing can negatively impact different groups in society and provides examples how these are addressed and mediated in jurisdictions currently implementing these policies, also drawing on additional options proposed in the literature.

[1] World Bank "Carbon Pricing Watch 2017" available at https://openknowledge.worldbank.org/bitstream/handle/10986/26565/9781464811296.pdf?sequence=4&isAllowed=y

[2] To date, in climate policy, the issue of justice and equity primarily garnered attention in the context of the international climate regime. This dimension is not discussed in the present paper, with a view to keeping the analysis focused on the distributional impacts of domestic implementation of climate policies, in this case, carbon pricing.

Carbon pricing generally targets the carbon content of fossil fuels where they are used as inputs for electricity generation, heating and transport. Some industrial processes may also be covered, such as cement production. In limited cases, carbon pricing is also applied in the land use sectors such as forestry or agriculture. The most common forms of carbon pricing are ETSs targeting the power and industrial sectors, and broad-based carbon taxes that cover the general use of solid or liquid fossil fuels. One of the main advantages of domestic carbon pricing policy, characteristic of both ETS and carbon taxes, is the cost-effective abatement that it can drive. This effect depends on the instrument delivering a price signal across the economy that encourages both producers and consumers to change their investment decisions. **In addressing the distributive impacts of the policy, a central consideration is maintaining a clear price signal**, so as to ensure that the carbon price is able to fulfil its intended role in the climate policy mix. Distributive impacts can therefore be addressed not only by adjusting the policy design, but also through the targeted use of revenues and supporting complementary policies.

Paying attention to social justice aspects of carbon pricing also allows framing achievement of climate targets within the broader context of sustainable development goals. Domestic carbon pricing policies, if appropriately designed, have the potential to accelerate, rather than hinder, poverty reduction efforts by fostering socially inclusive green economic growth. Last but not least, the goal is to design the transition to a low-carbon society in such a way that not only the resulting burden, but also the benefits of the change are distributed in an equitable manner.

In this sense, it is important to acknowledge that **carbon pricing policy creates both costs and benefits**, which are distributed across economic and social actors. **While the burden of the policy needs to be equitably shared, so does the value that is created**. Not only are the outcomes of climate policy valuable, whether they are climate change mitigation or local pollution benefits. There is value created when the government regulates a carbon price, inherent in the price of allowances or the value of the tax. In economist terms, this is termed carbon pricing 'rent', and there are competing interests – public and private, and also between sectors – in capturing this value. One clear split is between private and public actors. If a carbon price generates revenue, value is transferred to public agents, who then can decide to redistribute this value in the public interest. Granting tax exemptions or giving free allocation in an ETS, on the other hand, allows this value to remain with certain private actors. This represents foregone public revenue that can no longer be spent, for example, on household compensation or on low-carbon technology development. There are also competing private interests, between different firms and sectors, who will look for an advantage over their competitors, as well as between local communities that will look to gain the most benefit from the policy outcomes. Policy options that deal with the distributive effects of a carbon price influence who will gain this value or bear the costs. It is therefore important to identify the competing interests as well as the opportunity costs, or next best use, of the value created by the policy.

1.3 Outline

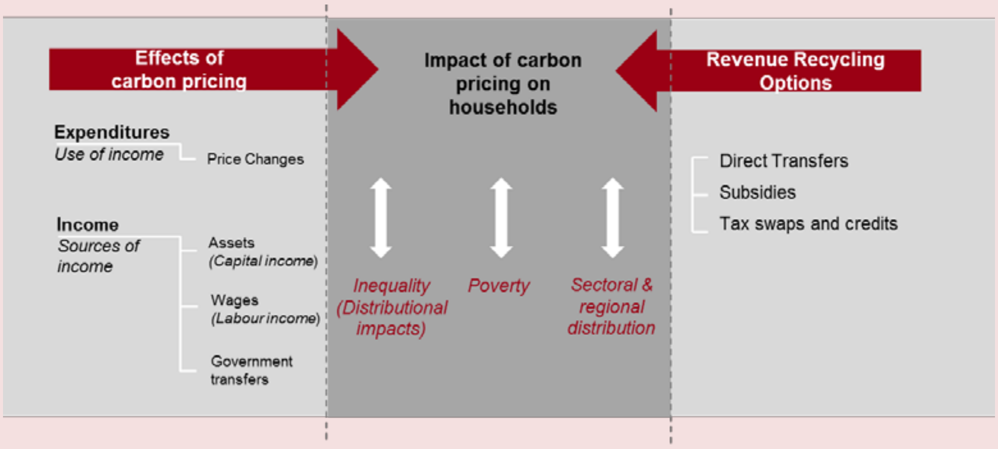
The paper proceeds in six parts, structured in terms of the impact of carbon pricing on certain groups and the respective options available to address the impacts. The next section, Chapter 2, focuses on households impacted by carbon pricing through relative changes in prices and incomes. Chapter 3 discusses how the co-benefits of carbon pricing can be distributed across local communities, with particular regard to environmental justice. Chapter 4 discusses how to enable a 'just transition' for particularly impacted communities of workers, for instance in the coal sector. Chapter 5 looks at the distributional impacts on firms, particularly focusing on competitiveness concerns, stranded assets and administrative costs for small and medium enterprises. Chapter 6 draws the different strands together and concludes.

2 Distributing the costs of carbon pricing across households

Summary

- Households are affected by carbon pricing, whether from ETS or carbon tax, in two main ways: a) Households may face higher costs for carbon intensive consumer goods and services; and b) Household income from work and investments may decrease due to higher production costs for firms.
- Low-income households are disproportionately affected by a regressive carbon price, raising inequality. Depending on its design, carbon pricing is often found to be regressive in industrial countries, but may be progressive in developing countries.
- Households at or near the poverty line have very limited options to adjust to carbon price impacts. Geographic disparities can also be expected, with urban areas often less affected than rural, and regions that depend more heavily on fossil fuels more affected than others.
- Using the revenue from carbon pricing is the best way to address the effects of the policy. This can be achieved through:
    - o Direct Transfers
    - o Subsidies
    - o Tax reform: tax swaps and credits
- Key considerations in applying these options are:
    - o Supporting low-income households
    - o Preserving the carbon price incentive
    - o Increasing availability of low-carbon substitutes
    - o Reducing distortionary taxes

Figure 1: Carbon pricing impacts on households and revenue recycling options



Carbon pricing, whether via ETS or carbon tax, is considered to be cost-effective across the economy – it can achieve abatement at a lower overall cost compared with other instruments. However, over the short to medium term, introducing a carbon price still imposes cost, which is distributed across different economic actors through changes in the costs of production and consumption.

Generally, it is large firms that face the legal obligations of measuring and reporting their emissions and meeting their compliance obligation, either by paying the proportionate amount of carbon taxes or surrendering ETS allowances. Their costs are then incorporated into their products and passed down the production chain until they reach the end consumer. Where prices cannot be passed on, it is the firms that face the costs. Eventually the carbon price impacts households, whether it is as a) end consumers of electricity, fuel and products; b) workers that earn wages and salaries, or c) investors, shareholders and asset owners.

2.1 Carbon pricing affects household incomes and expenditures

Households are likely to be affected by a carbon pricing policy in two main ways (see Figure 1 above). **Firstly, through increased *expenditures***: as energy prices rise with carbon pricing, so too does the proportion of households' income that is spent on energy. In addition to increasing the price of fossil fuels, such as coal, heating oil and diesel, carbon pricing can also affect the price of carbon-intensive goods and services such as electricity and industrial products (Kaufmann and Krause 2016). On the other hand, higher prices also incentivize households to move away from carbon-intensive consumption. Importantly, this depends on households having good options to react to the carbon price by switching to low-carbon alternatives. For some products and services, there are limited options, and some basic needs must also be met. **Secondly, carbon prices can affect household *incomes*,** by altering the income received from wages (labour income), from assets (capital income)[3], and from government transfers (social security, benefits) (Kaufmann and Krause 2016). Carbon prices can affect wages (labour income) of workers employed by companies that produce carbon intensive goods and services, as well as the returns on investments in these companies. Income effects are less clear and more difficult to measure than expenditure effects, as they depend on how businesses react to the carbon price. Generally, the more costs can be passed to consumers, the less the carbon price will affect income and the more it will affect household expenditures.

Carbon taxes and emissions trading can have similar effects on households. However, its final distributive effects will largely depend on the design and use of revenues. The next section identifies and discusses the impacts that both carbon pricing policies can have on households with regard to income distribution, poverty, and sectoral and regional distribution.

2.1.1 Distributional impacts of carbon pricing across households

Carbon pricing can have distributional effects across households.[4] A carbon pricing policy is considered regressive when it affects low-income households proportionally harder than high-income households. In general, the higher the carbon intensity of household´s consumption the larger the impact on expenditures (Kaufmann and Krause 2016; Metcalf et al.

[3] Note that asset income can take many forms, including capital, but also multiple types of natural resources (Williams et al. 2014).

[4] The question how costs are distributed across income groups or regions is known among economists as the economic incidence of a tax (Grainger and Kolstad 2010; Williams et al. 2014). While a regressive policy places a larger burden, as a percentage of wealth, on low-income households, a progressive one places a larger percentage burden on high income households (Grainger and Kolstad 2010).

2011). In line with this, high-income households tend to have greater consumption of carbon intensive goods and services, and therefore pay a higher absolute CO_2 price. However, carbon pricing can hit low-income households disproportionally when they spend a higher percentage of their income in energy or carbon intensive goods.

The distributional effects of carbon pricing on household expenditures are well documented. Whereas, based on the available literature, carbon pricing is found to be regressive in most industrialized countries (Burtraw et al. 2009), **in developing and emerging economies carbon pricing is in most cases shown to be progressive** (Brenner et al. 2007; Datta, 2010; Dorband 2016). This is because low-income households in developing countries typically spend only modest amounts on fossil fuels and carbon intensive goods, there is less car ownership, and on average less use of fossil fuels for heating due to warmer climates (PMR and World Bank Group 2017; Krechowicz 2011).

2.1.2 Carbon pricing impacts on poverty

Related to the issue of income distribution, carbon pricing can also impact the poorest members of society, potentially exacerbating poverty levels. Poverty-stricken households are different to low-income households, as they face special challenges relating to their vulnerability and low capacity to adjust their expenditures or incomes. Even small changes in the price of basic needs, such as shelter, energy, food and transport, can therefore have a big impact. .

As the most direct effect of a carbon price is on energy costs, an important concept is ‘energy poverty’ (also referred to as fuel poverty). This encompasses not only energy access (see section 4.2.2), but also “affordability-challenges”, whereby the main factors include low-income levels, high energy prices, and low efficiency of the household’s energy use (Ürge-Vorsatz and Herrero 2012). In developing countries, energy poverty might be related to both access and affordability, whereas in developed countries it is mostly associated with affordability. In addition, in developing countries, energy-poor households may often rely on biomass energy, which typically is not covered by any carbon pricing policy and has its own environmental challenges.

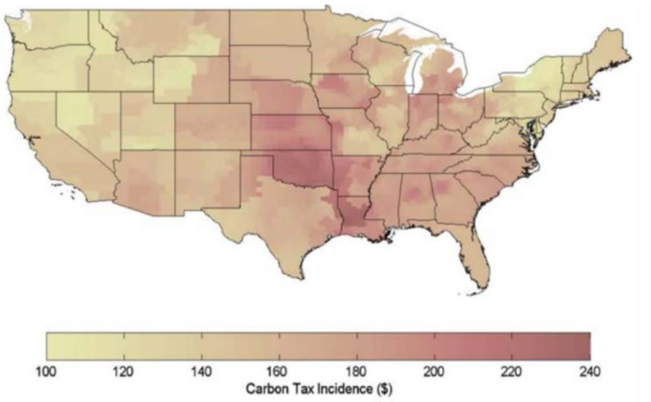
There are many domestic and international efforts that have poverty eradication as the main objective. In designing carbon pricing measures, especially when using revenues to support poor households, policymakers should look for synergies and avoid conflicts with existing policies and measures. The SDG targets for ‘Affordable and Clean Energy’ provide an approach for carbon pricing to be nested in a broader sustainable development framework

2.1.3 Regional impacts of carbon pricing

Just as carbon pricing can generate distributional impacts across income groups, it can also disproportionally affect households in certain regions, also called the spatial incidence of carbon pricing (Pizer et al. 2010; Kaufman and Krause 2016).

Disparities can result from pre-existing consumption and production patterns across regions, between urban and rural areas, or within specific communities. One driver for regional differences in carbon pricing impacts is the electricity generation mix of a region. Regions generating a large share of fossil fuelled electricity bear a higher burden from rising carbon prices than regions with high penetration of clean energy sources (Morris and Munnings, 2013).

Figure 2: Carbon pricing incidence across states in the United States



Source: Pizer et al., (2010)

At the same time, communities in rural areas may be more affected than in urban areas because their spending on energy (for fuel and transport) represents a higher proportion of total income, though this is likely different across industrialized and developing countries (PMR and World Bank Group 2017). Finally, communities whose jobs and wages are dependent on a particular carbon-intensive industry may be especially affected by carbon pricing (see Chapter 4).

Addressing regional impact is part of a socially just carbon pricing policy. Compensation can take many forms, but several authors argue that use of carbon pricing revenues is likely to be sufficient to address regional disparities (Kaufman and Krause 2016).

2.2 Options to address carbon pricing impacts on households

The main potential to mitigate the regressive effects of carbon prices, or to accentuate progressive effects, lies with using carbon pricing revenue.[5] This is often called revenue recycling, especially in reference to 'revenue neutral' carbon pricing, which is a policy approach that reinvests all revenues back into the economy. There are three main options for addressing impacts through the use of carbon pricing revenue: a) **direct transfers**, b) **subsidies**, and c) **tax swaps and credits.**

There are several considerations for policy makers when applying these options:

1. Supporting low-income households: Options can effectively redistribute the cost of the policy to lower the burden on low-income households
2. Preserving the carbon pricing incentives: The primary aim of carbon pricing should be to provide a price incentive across the economy to switch to low carbon alternatives. Options should not interfere with this incentive.
3. Increasing availability of low-carbon substitutes: The price incentive will work best if there are options to change consumption patterns and behaviour.
4. Improving the efficiency of the tax system: using revenues to lower other forms of taxes that distort the economy can have overall public benefits.

[5] Compensating the poorest households is both feasible and would require only a small share of the carbon pricing revenues. For example, in a study of the U.S., Morris and Mathur (2014) found that a $15 carbon tax would comprise 3.5% of the income of the poorest 10% of households, but that about 11% of the carbon pricing revenues would be enough to offset the burden on the poorest 20%.

2.2.1 Direct (lump-sum) transfers

A straightforward approach to compensate rising prices that result from a carbon price is a direct transfer that returns carbon pricing revenue to households on a per capita basis (Burtraw et al. 2009). This form of direct support is also called lump-sum transfer, “cap-and-dividend”, “tax-and-dividend” or “sky trust”. It compensates households, while preserving the carbon price signal. The simplest way of designing it is to transfer the same “carbon dividend” to all households. This is highly progressive because poorer households receive more relative to their change in income and/or expenditures due to the carbon price (Williams et al. 2014; Burtraw et al. 2009)

This option has been used by several jurisdictions. For example, California has legislated its commitment to support low-income households and vulnerable communities as part of its cap and trade program. Under AB 32, revenues from the cap and trade program go into a Greenhouse Gas Reduction Fund (GGRF). The state has employed a combination of strategies to protect low-income households, and, at the same time, preserve the price signal. One of these policies is a **climate credit or dividend**, through which a share of the auction revenues is directly returned to households[6] twice a year on their electricity bills. In 2015, these credits were approximately $25-$30 twice a year[7] depending on the amount of allowances sold by that utility and the number of clients (Gattaciecca et al. 2016). The climate credit is not related to the electricity use, which means that it does not interfere with the carbon price signal. Indeed, low-income households in California are likely to receive more in credits than what they pay on higher electricity costs associated with the cap and trade program. The net financial impact on the electricity bills of low-income household was positive: their electricity bills were on average $15 in 2016, while they received $65 in climate credits (Gattaciecca et al. 2016).

Switzerland uses a dividend approach whereby a portion of the revenue is redistributed equally to all residents. This is done through the national health insurance system. The amount granted to each household is settled against their health insurance premium (CPLC 2016).

2.2.2 Subsidies and other transfers

A second option is to subsidize households’ consumption of specific goods to compensate for higher carbon prices. Options include: food subsidies, energy efficiency support, or public transportation. Depending on how these subsidies are designed, they can contribute to a progressive result of the overall carbon pricing scheme. For the case of Mexico, Gonzalez (cf. Gonzalez 2012) finds progressive effects when revenue from a tax on CO2 is recycled as a food subsidy, compared to regressive effects when it is recycled as a manufacturing tax cut.

Alternatively, carbon pricing revenues can be used to subsidize energy efficiency programs. This is done for instance in California to reduce the electricity, natural gas, and gasoline consumption of Californians, thereby reducing household energy consumption. Similarly, France uses EU ETS revenues to fund the National Agency for Housing that supports energy efficiency investments (CPLC 2016). Finally, policy makers could use carbon pricing revenues

[6] Households and small businesses that receive the climate credit are customers of an investor-owned utility company.

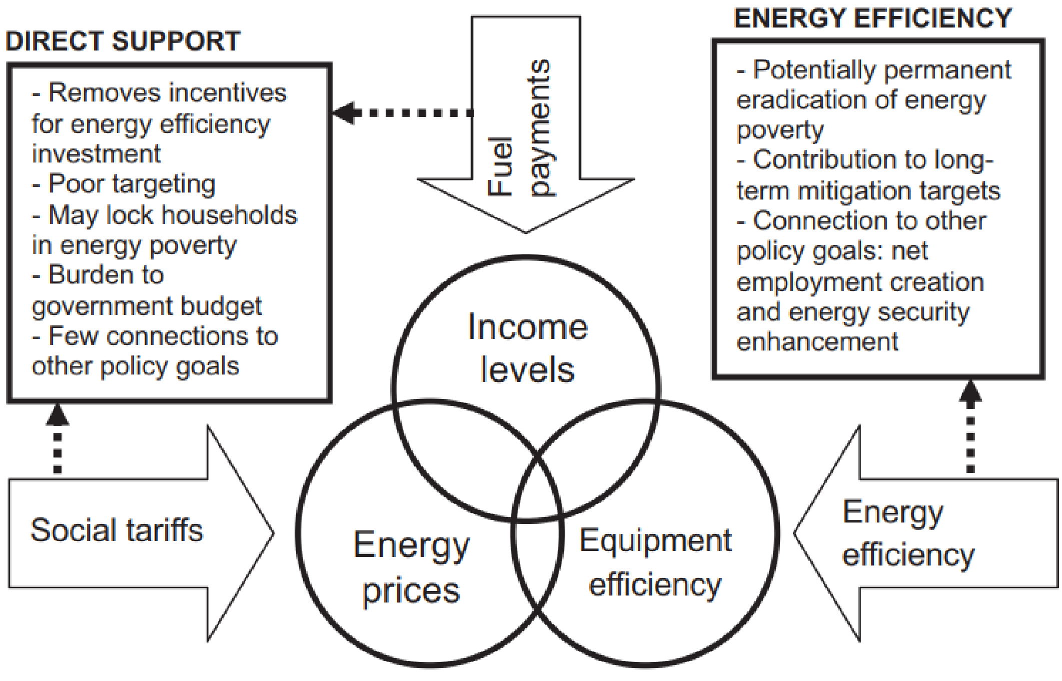
[7] The credit amounts vary according to each utility, but all customers of the same utility receive the same amount. The variation of the climate credit between utilities is explained by the amount of allowances sold and the number of customers of the utility.

to increase welfare payments that are already progressive. This has the advantage of leveraging upon existing institutional structures.

The effects of subsidy policies will depend upon the specific design and item subsidized in each jurisdiction. For example, a subsidy on public transportation that increases availability (e.g. increasing subway routes) effectively creates a low-carbon option for households and preserves the carbon price signal. However, subsidies could also be designed in a way that interferes with the price signal. One example is a subsidy that directly returns carbon pricing revenue on the electricity bills. In this case, consumers will perceive that electricity is less expensive, changing the CO_2 price signal, and potentially leading to more consumption and emissions (Burtraw et al. 2012).

Subsidies for energy efficiency are also considered to be an effective option to address energy poverty over the long term. In an assessment of three approaches to alleviating energy poverty (direct transfers to support household incomes, fuel subsidies to reduce energy prices, and subsidizing energy efficiency measures), Ürge-Vorsatz and Herrero (cf. Ürge-Vorsatz and Herrero 2012) argue that policies supporting energy efficiency can best address both climate change mitigation and energy poverty. Although fuel subsidies may reduce energy poverty, they incentivise increased fuel consumption and emissions. Similarly, policies that support income levels can reduce poverty in the short term, but may remove incentives for energy efficiency in the long term, thereby locking households into energy poverty.

Figure 3: Energy (fuel) poverty and its contributing factors



Source: Ürge-Vorsatz and Herrero (2012)

2.2.3 Using revenues to reduce other taxes (tax reform): tax swaps and credits

One approach for compensation is a “tax swap” that recycles carbon pricing revenues to permanently reduce other forms of taxes. Using revenue to reduce pre-existing distortionary taxes, such as capital and labour taxes, can improve the efficiency of the tax system. In other words, a tax on a “bad”, in this case CO2 emissions, replaces a tax on a “good”, in this case capital and labour. This option can partially ease competitiveness concerns, particularly when the increase in carbon taxes is swapped by an equivalent reduction in other taxes.

However, several authors have warned against the use of this option, since it can increase the natural regressivity of carbon pricing (Williams et al. 2014). The initial benefit of a carbon-for-capital tax swap goes to owners of capital, which are typically high-income households. A carbon-for-labour tax swap would be a more progressive option than a carbon-for-capital tax swap, but even then, a full compensation for low-income households is not guaranteed.

Finally, a tax swap has the benefit that it preserves the carbon price signal. However, this option does not improve the opportunities for substitution of carbon intensive goods and service for cleaner alternatives (see Table 1 below).

A more targeted option to compensate low-income households is to introduce a **tax credit**. A tax credit reduces the amount of tax that a person or firm owes to the government. Unlike tax swaps, a tax credit can be targeted to low-income households through eligibility criteria and can be either personal or per household. British Columbia uses a climate action tax credit payable four times per year that compensates low-income households for the impacts of the carbon tax. In the case of British Columbia, the size of the credit depends on the family size and the adjusted net income of the family (British Columbia 2017). Depending on its design, carbon tax credits have the potential to be progressive. For example, Callan et al. (cf. Callan et al. 2008) find in a study of Ireland that tax credits would be progressive, while tax swaps would be regressive.

Both tax swaps and credit approaches have been used in practice. For example, in addition to the climate tax credit referred to above, British Columbia implemented personal and corporate income tax cuts alongside its carbon tax, with a view to making it revenue neutral. Early studies of British Columbia’s policy show that the carbon tax was in itself regressive. However, the recycling of revenues through the tax swap and low-income tax credit led to a progressive result overall (Beck et al. 2015). In its first year of implementation 2008-2009, the tax regime was projected to provide a net gain for the poorest 40% of households (Lee and Sanger 2008).

2.2.4 Summary of options for compensating households

The way carbon pricing revenues are recycled will largely determine the social outcomes of the carbon pricing policy, but will also affect how the policy is perceived, and whether or not the CO_2 price signal is preserved. In this section, we summarize the main considerations for policymakers in choosing among options for compensating households, namely: 1) their capacity to preserve the carbon price signal, 2) to preserve or improve social equality, 3) to address competitiveness concerns, 4) to increase the availability of low-carbon options, 4) to reduce other distortionary taxes.

As shown in Table 1 below, in comparison to tax swaps, a direct lump sum compensation would be progressive, though less efficient for the tax system (Williams et al. 2014). The distributional outcome when using subsidies will depend on the specific design and item subsidized, but will not affect the efficiency of the tax system.

The choice of support will also have implications for the consistency of the price signal and the availability of cleaner options. For example, the three options presented can preserve the carbon price signal. However, special attention should be paid to the interaction of ETS and certain forms of subsidies.

Efforts to transparently communicate the support measures are critical to increase support for carbon pricing policies. Some forms of compensation are more visible, such as dividends stated on the electricity bills sent to households. However, other measures are not directly branded as compensation, such as subsidies for energy efficiency. Transparently communicating the carbon pricing revenues and uses is good practice that helps consolidate the longevity of the policy.

Table 1: Carbon pricing impacts on households and design options for revenue recycling

	Households		
	Direct (lump sum) transfers	**Subsidies**	**Tax Reform: credits and swaps**
Supports low-income households	Yes	Partially	Potentially
Preserves the carbon price incentives	Yes	Partially	Yes
Increases availability of low-carbon substitutes	No (may have lock-in effects)	Potentially	No
Reduces distortionary taxes	No	No	Yes

3 Health co-benefits and environmental justice

Summary

Carbon pricing not only benefits the climate, it can also produce positive local environmental and social outcomes, known as co-benefits, for instance in terms of improved public health from reduced emissions of air pollutants.

Broad market-based carbon pricing policies, such as ETS and carbon taxes, do not necessarily determine where emissions abatement activities will take place, meaning that particularly impacted communities may not realize proportionate co-benefits.

There are four broad options for creating a fairer and more targeted distribution of carbon pricing co-benefits, by adjusting or complementing the carbon pricing instrument or by using revenues:

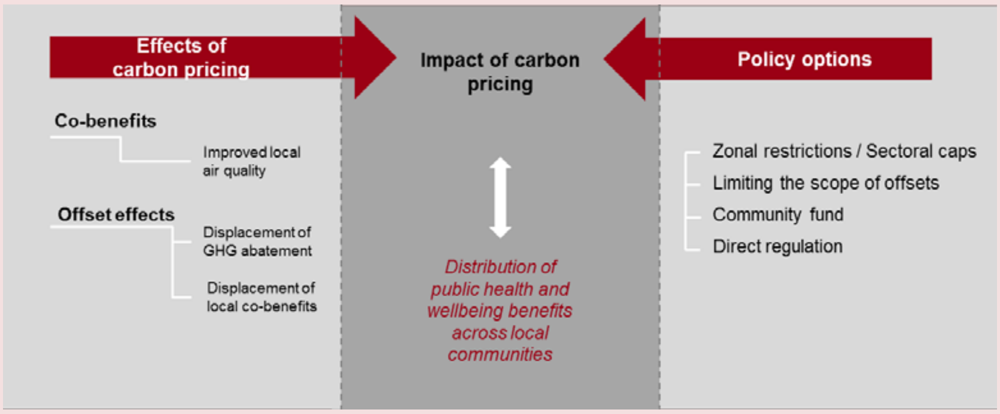
- Zonal restrictions or a sectoral cap approach – adjust the carbon pricing instrument to target where abatement activities take place.
- Targeting the scope of offsets – determines how much abatement activity inside ETS covered sectors can be offset as well as what kind of co-benefits are generated by offsets and where.
- Community fund revenue recycling – compensates disadvantaged communities.
- Direct regulation of pollution – addresses local issues outside of the carbon pricing policy via separate regulations.

Key considerations in applying these options are:

- Ensuring the carbon pricing mechanism improves rather than exacerbates local environmental impacts
- Maintaining the cost-effectiveness of the carbon pricing mechanism

Under any option, monitoring and evaluation should be done to assess potential effects of the carbon pricing mechanism on local environmental and social outcomes.

Figure 4: Co-benefits distribution and carbon pricing



3.1 Ensuring a fair distribution of carbon pricing co-benefits

Carbon pricing is first and foremost a climate change mitigation policy – the primary objective is to reduce emissions of GHGs to the atmosphere, and thereby reduce the impacts of global climate change. The benefits of climate change mitigation are distributed globally, and are not directly related to local abatement activities. However, as carbon pricing also works to change local economic activities, it creates other effects at the local or regional level, with a range of often positive outcomes for local communities. The positive side effects, or 'co-benefits', of carbon pricing policy are often used to promote the overall benefits of the policy. However, as many of the co-benefits accrue locally, their distribution raises issues of equity, especially as policy design helps determine which local communities will realize the benefits.

3.1.1 Carbon pricing improves health by reducing local air pollution

A range of carbon pricing co-benefits have been identified in the literature, and several studies have attempted to quantify these in economic terms. Co-benefits include improved public health from a reduction in local air pollution, increased energy security, and positive outcomes for land-use and biodiversity from the forest and agriculture sectors (Eden et al. 2016). The health co-benefits of carbon pricing have received the most attention. As well as generating greenhouse gasses, fossil fuel combustion and industrial activities generate co-pollutants that are released directly to the local environment, affecting air and water quality. The main co-pollutants assessed in the co-benefit literature are airborne pollutants, including sulphur dioxide (SO2), nitrogen oxides (NOx), carbon monoxide (CO), particulate matter (PM), atmospheric ozone, and heavy metals such as mercury.

Studies using macro-economic modelling have estimated the overall health co-benefits of carbon pricing to be substantial, and to compensate many or all of the direct economic costs of climate policy (Nemet et al. 2010; Parry et al. 2014; Thompson et al. 2014) Among the existing carbon pricing programs, RGGI explicitly calculates and publishes the health co-benefits of the policy. Across the RGGI states, the cap-and-trade program has contributed to a significant decline in SO2, NOx, and mercury emissions. Between 2009 (the start of the RGGI program) and 2015, reduced local air pollution has led to an estimated USD 10.4 billion in health savings from avoided illness, hospital visits, lost work days, and premature deaths (Stutt and Shattuck 2016).

Studies indicate that developing countries would have more to gain from climate policy health co-benefits, in particular India, China and other East-Asian countries (Nemet et al. 2010). However, despite overall projected gains, conditions could also worsen in the short term for some households in areas of South-Asia and Africa where climate policies could drive greater use of biomass among poor households for cooking and heating (West et al. 2013; Rao et al. 2016)

3.1.2 Environmental justice and health co-benefits

As health effects from co-pollutants depend on their local concentrations, communities living nearest to the sources are generally assumed to have the most to gain from local climate action. It is well documented that neighbourhoods close to sources of airborne pollution, such as factories, power plants and busy roads, are often home to low-income communities, racial and ethnic minorities and other disadvantaged and vulnerable groups. As a result of socio-economic patterns, as well as regulations for zoning and pollution control, these groups already bear a disproportionate burden of air pollution. Patterns of environmental disadvantage have been identified in the U.S. and around the world. For example, a study of pollution patterns across the U.S. found that racial minorities, low-income families and elderly people were more likely to be exposed to higher levels of pollution due to where they live

(Clark et al. 2014). A worldwide literature review found similar patterns across North America, Asia and Africa, but found mixed results across Europe (Hajat et al. 2015).

3.1.3 The distribution of polluting activities under carbon pricing

Despite the potentially large health co-benefits of carbon pricing, relatively little attention has been given to their equitable distribution. Most studies tend to aggregate the value of co-benefits across the whole economy, without examining how they are distributed across local communities and households. While the issue has been identified in the academic and legal literature, there are so far few empirical studies.[8] [9] Most of the literature focuses on the U.S., in particular California, where environmental justice advocates have been vocal about their concerns regarding the California Cap-and-Trade Program. California therefore provides the best current example for the discussion of environmental justice in carbon pricing policy and may provide lessons that are transferable to other parts of the world.

For communities heavily impacted by local pollution from, for example, power stations, refineries and major highways, the flexibility of carbon pricing policy does not necessarily work to their advantage. For them, the value of co-benefits outweighs the primary benefits of climate change mitigation. The ability of polluting firms to avoid reducing emissions by trading allowances or paying a carbon fee may be perceived as unfair, as does the free allocation of permits or tax exemptions (see Chapter 4). Furthermore, a 'worst-case-scenario' would not only see the unfair distribution of co-benefits, but a worsening of conditions for the most disadvantaged and vulnerable. Environmental justice groups have argued that carbon pricing, via market forces, may potentially drive a geographic redistribution of economic activity so that polluting activities aggregate in 'hotspots', particularly in areas where environmental regulations are lax and political opposition is low. Academics have reasoned, however, that there is no intrinsic tendency for carbon pricing to increase pollution in a specific area of disadvantaged communities. Market forces will rather drive abatement where the marginal costs are lowest, and there is no reason to believe that older or dirtier facilities will be favoured over newer or more efficient ones, or that the location of these facilities will affect abatement decisions (Farber 2012). Evidence from other trading schemes, for example, the Acid Rain Program for SO_2 emissions across the U.S., shows that hotspots have not materialized (Ringquist 2011).

[8] One preliminary study of Europe has examined the distributional effects of the EU ETS on co-pollutants with regard to some socio-economic indicators (Wagner and De Preux 2016). The study shows that the EU ETS has overall reduced emissions of some airborne co-pollutants, while waterborne pollutants seem to have slightly increased. Reductions in some airborne pollutants are shown to correlate with population density, income and age (elderly populations).

[9] A second preliminary study, from the California Environmental Protection Agency (CalEPA), has established a highly detailed methodology for assessing the environmental justice outcomes of climate policies under the Global Warming Solutions Act of 2006 (AB 32), including the California Cap-and-Trade program (OEHHA 2017). The aim of the study is to track and evaluate the benefits and impacts of the program on disadvantaged communities, and will be updated at least every three years. While data does not yet allow the authors to determine the effect of the policy on particular communities, they find that many of the co-pollutants emitted by covered facilities are correlated with areas of disadvantage, in particular around a few large facilities.

3.2 Options for preserving co-benefits in carbon pricing policy

We here outline and discuss policy options for enhancing the equitable distribution of the local health co-benefits of carbon pricing. The two main forms of carbon pricing policy, carbon taxes and ETSs, operate in a similar fashion with regard to the distribution of co-benefits, so the policy options are in theory similar in each case.[10]

In general, a first and critical step in accounting for the distribution of health co-benefits of carbon pricing is monitoring and evaluation. The task of monitoring and evaluating health impacts on disadvantaged communities has, in the case of California, been incorporated into the program as part of the adaptive management approach of the California Air Resource Board (CARB 2011; OEHHA 2017).

3.2.1 Limiting the scope of offsets

Most operating ETSs (as well as carbon taxes in Mexico and in future South Africa) include an offset component, which allows covered entities to surrender eligible offset certificates generated from emission reduction activities outside the scope of the program for compliance. Offsets allow covered entities to access potentially cheaper abatement options, reducing compliance costs and increasing the cost effectiveness of the program. While offsets also have great potential to create co-benefits,[11] these normally accrue to communities far away from the polluting entities use them for compliance. According to one study, around three quarters of offsets used in the California Cap-and-Trade Program up to 2014 were sourced from out of state (Cushing et al. 2016).

Therefore, limiting the quantity of offsets that may be used under the carbon pricing mechanism is the most straightforward way to ensure that covered entities undertake more abatement activities. Limits increase the cost of generating offsets, but give more control over where, how and by whom emissions reductions are made. Most carbon pricing systems using offsets limit the quantity, type, or geographic range of offset projects allowed. Restricting the geographic range or type of offset projects, for example by accepting only domestically produced offsets or forestry projects, provides some assurance that the projects will benefit communities within a particular region or sector.

However, such restrictions cannot determine which sectors or firms will reduce emissions or which specific communities will benefit. Furthermore, limiting the scope of offsets will make it costlier to achieve GHG emissions targets.

3.2.2 Community fund revenue recycling

Alternatively, carbon pricing revenue may be directed to a fund to benefit communities that face a disproportionate burden of co-pollutants. Funds could be used directly to mitigate the effect of co-pollutants through air-quality improvements or other measures that may reduce the vulnerability of disadvantaged communities, or indirectly in projects that otherwise benefit these communities, for example by providing health, job training or other services that can

[10] Environmental justice advocates have argued that carbon pricing should be replaced entirely with alternative policies to provide a fairer local outcome. However, rejecting carbon pricing in favor of alternative policies would likely reduce abatement activity and increase costs, so that although the outcome may be a more equitable distribution, disadvantaged communities would still be worse off overall (Schatzki and Stavins 2009).

[11] Offset programs often encompass social and environmental benefits beyond carbon emissions. Prominent examples include the Clean Development Mechanism of the UNFCCC and the Gold Standard voluntary carbon offsets, which were explicitly designed to promote sustainable development outcomes that benefit local communities directly.

compensate for their environmental burden. Funds may come from the auctioning of allowances or from carbon tax revenues, also potentially with an additional ‘environmental surcharge’.

Under California’s cap-and-trade program, 25% of the proceeds must go to projects that provide a benefit to disadvantaged communities, and at least 10% of the funds go to projects located within those communities. The investment minimums were set in 2016 with Assembly Bill (AB) 1550, which requires that at least 25% of proceeds go to projects both within and to the benefits of disadvantaged communities, and an additional 10% are to go to low-income households and communities.[12]

The CalEPA is obliged to identify disadvantaged communities, and has developed an integrated method for the task. In October 2014, CalEPA released a list of designated disadvantaged communities, based on the California Communities Environmental Health Screening Tool 2.0 (CalEnviroScreen 2.0).[13] The methodology was updated based on new data and public consultation, with the CalEnviroScreen 3.0 released in April 2017. The tool integrates a range of data sources including census data to identify areas disproportionately burdened by and vulnerable to multiple sources of pollution. It incorporates 20 different indicators into four components and two broad groups (see Figure 4). The methodology arguably represents current best practice, and could be adapted to different settings, depending on data availability.

Figure 5: CalEnviroScreen 3.0 Indicator and Component Scoring

Pollution Burden			Population Characteristics			
Exposures	Ozone Concentrations PM2.5 Concentrations Diesel PM Emissions Drinking Water Quality Pesticide Use Toxic Releases from Facilities Traffic Density	×	*Sensitive Populations*	Cardiovascular Disease Low Birth-Weight Births Asthma Emergency Department Visits	=	CalEnviroScreen Score
Environmental Effects	Cleanup Sites Groundwater Threats Hazardous Waste Impaired Water Bodies Solid Waste Sites and Facilities		*Socioeconomic Factors*	Educational Attainment Linguistic Isolation Poverty Unemployment Housing Burdened Low Income Households		

Source: CalEPA (2017).

The Californian legislation requires that projects funded from cap-and-trade proceeds contribute to climate change mitigation. Therefore, they cannot directly target co-pollutant emissions at the source. The community fund projects in California therefore mainly provide compensation for the pollution burden of affected communities. A survey of the current and planned projects shows that they can, however, contribute to reducing the pollution burden indirectly, for example, by funding energy efficiency and renewable energy, zero-emission vehicles, public transport and urban green spaces in disadvantaged communities.[14]

[12] CalEPA - http://calepa.ca.gov/EnvJustice/GHGInvest/
[13] CalEPA - https://oehha.ca.gov/calenviroscreen
[14] http://www.caclimateinvestments.ca.gov/about-cci

3.2.3 Zonal restrictions / sectoral caps

This approach, which incorporates elements of command and control policy into the carbon pricing mechanism, obliges installations within a given area, or across a particular sector to undertake a portion of their abatement obligations ‘in house’. In practice not used so far, it requires the identification of high-impact facilities, groups of facilities or sectors. These would then be obliged to undertake additional abatement activities through restrictions on carbon trade, individual emissions quotas or other obligations.

The approach could be implemented at different scales, from individual facilities, to high-impacts zones or even sectors (Boyce and Pastor 2013). A sectoral cap approach for instance would impose a more stringent cap on facilities in specific sectors compared to the overall cap. Under a carbon tax, they would be restricted in their ability to pay the carbon fee for a given quantity of emissions, also obliging them to undertake some ‘in house’ abatement. This would combine a carbon tax approach with an emissions standard.

Improved local environmental outcomes are however still uncertain under this approach. Firstly, co-pollutant emissions necessarily vary between firms and across sectors. Secondly, as firms base abatement decisions on GHG emissions, there is no incentive for them to consider co-pollutants and therefore to find an efficient solution for both. Thirdly, the impact of any reductions in co-pollutants on local communities would still be uncertain due to variations in where and when abatement takes place (Schatzki and Stavins 2009).

Moreover, such restrictions would likely have negative effects on the operation of the carbon pricing mechanism. By increasing the cost of achieving a given level of GHG reductions they would reduce its cost effectiveness and introduce an extra administrative burden. They may also introduce competitiveness issues between firms or sectors, and might raise the prices of energy and energy intensive goods for households in areas that they are supposed to help.

3.2.4 Direct regulation of air pollution

Alternatively, co-pollutants would not be addressed within the carbon pricing policy itself, but through a separate policy framework focusing on the direct regulation of the relevant pollutants. This approach acknowledges the primary aim of carbon pricing is to reduce GHG emissions, and that co-benefits are secondary. It also holds that addressing air pollution directly is more efficient, particularly when dedicated regulatory frameworks are already in place (Schatzki and Stavins 2009). The measure should include a monitoring component that ascertains that it delivers on its intended purposes.

For several years, the Environmental Justice Community of California has campaigned for the reform of the California Cap-and-Trade Program to address local air pollutants. In 2017, Californian law-makers passed the ETS reform Assembly Bill AB 398, which extends the California Cap-and-Trade Program to 2030 alongside AB 617, which aims to reduce exposure to air pollution in the most impacted communities. As accompanying legislation, AB 617 is designed to address local pollution directly without interfering with the functioning of the Cap-and-Trade Program.

Chile provides another relevant example on how air pollution regulation can be implemented alongside a carbon tax. While fixed emissions sources (turbines or boilers) with a thermal input equal or higher than 50 MW are obliged to pay a tax of 5 USD per tCO_2, the same sources must also pay a tax on local pollutants (SO_2 and NOx). The Chilean tax on local pollutants is very close to a Pigouvian tax because the tax rate per ton is defined in relation to the estimated social cost of pollution. The underlying formula considers the concentration of environmental health effects and health damages in USD as well as the population size in the zone to be taxed. Facilities in a zone with high population would thus be subject to a higher tax rate than those in a zone with low population density (Pizarro, Pinto & Ainzúa, 2017)

3.2.5 Summary of options for preserving co-benefits in carbon pricing

Table 1 below shows a summary of options enhancing the equitable distribution of local co-benefits of carbon pricing. Most options would, directly or indirectly, support low-income households. In principle, these options will also preserve the carbon pricing incentives to reduce emissions. However, most of them would increase the overall costs of achieving the same target. Importantly, community revenue recycling stands out as an option that would not reduce the cost-effectiveness of the policy, while addressing a more equitable distribution of co-benefits and supporting low income households.

Table 2: Carbon pricing options for preserving co-benefits

	Local communities – environmental justice and co-benefits			
	Limiting the scope of offsets	**Community fund revenue recycling**	**Zonal restrictions / Sectoral Cap**	**Direct regulation of air pollution**
Supports low-income households	Partially	Yes	Yes, indirectly through air quality effects	Yes
Preserves the carbon price incentives	Yes, but reduces cost effectiveness	Yes	Yes, but reduces cost-effectiveness	Yes

4 Carbon pricing, employment and a just transition

Summary

Carbon pricing can drive structural changes in employment across sectors and workforce groups. Communities dependent on carbon intensive industries for their livelihoods will be the worst affected by unemployment and job relocation.

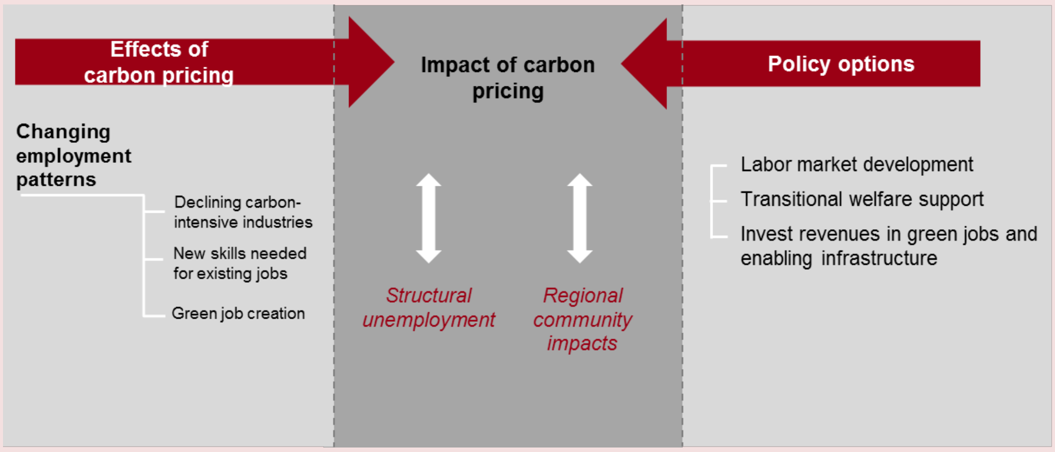
Options for promoting a socially just low-carbon transition for workers and their communities include:

- Labour market development and transitional welfare support
- The investment of carbon pricing revenues to drive employment diversification and growth

Considerations when applying these policy options include:

- Ensuring impacted groups and communities are identified, targeted and appropriately supported
- Supporting the development and availability of low-carbon substitutes – carbon pricing revenues should ideally foster green jobs and technologies that enable a low-carbon transition.

Figure 6: Carbon pricing effects and impacts on employment



4.1 The effects of carbon pricing on fossil-intensive communities

Carbon pricing will likely have uneven impacts on employment across sectors and workforce groups. It can change the net quantity of jobs across the economy, cause job reallocation as workers move from declining to growing firms and sectors, and transform existing jobs to meet new requirements. These processes will impact countries and regions differently depending on their economic profile and development level. However, low-skilled workers and those that live in areas with a single dominant industry, such as many coal mining communities, are expected to find such job transitions most difficult (ILO and OECD 2012).[15]

A socially just outcome of carbon pricing therefore depends on the use of revenues and supporting policies to balance adverse effects. A key objective for particularly affected communities should be to ensure a 'just transition' to ease the adverse impact of these policies and ensure broad participation in the opportunities that arise.[16]

In this section, we discuss potential impacts of carbon pricing on workers, as well as options for public investment of carbon pricing revenues to support impacted groups and create new employment opportunities, with a view to help attain the sustainable development goals (SDGs) of 'affordable and clean energy' and 'decent work and economic growth'.[17]

4.1.1 Identifying impacted groups

Major employment losses as a consequence of carbon pricing policies are likely to be concentrated in a few key industries and sectors. As emission-intensive power generation, transport and industrial sectors reduce their demand for fossil fuels, this will have knock-on effects on industries such as mining, refining and fuel transportation. However, while many jobs in these sectors will be transformed, only some sectors are likely to face overall job losses (ILO and OECD 2012).

Manufacturing jobs will likely change and adapt to new low-carbon products and processes, and workers will have the opportunity to up-skill or shift to different firms with similar skill requirements. Carbon intensive industries, such as steel and cement production, are also expected to maintain jobs while transitioning to lower-carbon technologies and processes. The fossil-energy generation sector is expected to face job losses as renewable energy and nuclear are favoured. However, this sector has some prospects to maintain jobs in the short- to medium term while reducing emissions, for example, as new high-efficiency technologies such as Combined Heat and Power are implemented. The fossil fuel extraction and refinery sectors are likely to face the largest overall job losses, as they face decreasing demand without options to increase efficiency. In particular, the coal mining sector can be expected to face net job losses as a result of a carbon price.

[15] On the plus side, many studies from around the world show that climate policy is able to generate net gains in employment (ILO 2012)[15]. On aggregate, job losses in fossil-intensive industries are expected to be more than offset by job gains in sectors such as renewable energy and energy efficiency. The effect of stringent carbon pricing on 'job-churn' is also projected to be much less than current drivers, such as globalization or economic crises (Château et al. 2011). The quality of employment can also improve with ambitious climate policy improve, as jobs in low-carbon sectors are on average higher-skilled, less dangerous, and have better working conditions than those of traditional fossil-intensive sectors (UNFCCC 2016).

[16] The concept of a 'just transition' has been developed by the trade union movement to protect workers' rights, jobs and livelihoods when economies are shifting to sustainable production. The International Labour Organisation (ILO) has produced the 'Guidelines for a Just Transition'(ILO 2015) that anchors the concept in the principles of sustainable development. The concept has also been included in text of the Paris Agreement and the UNFCCC has initiated work examining the implications of climate change policies for a just transition.

[17] United Nations Development Programme: Sustainable Development Goals. http://www.undp.org/content/undp/en/home/sustainable-development-goals.html

The impacts of job losses in these industries are also expected to be concentrated in particular groups, regions and communities. Despite their relatively low share of employment[18], the most carbon-intensive industries employ disproportionately high shares of low-skilled and older workers. Both of these workforce groups are known to face above average difficulty in finding new jobs, as they have fewer transferable skills and less potential to acquire new skills (ILO and OECD 2012). Furthermore, fossil-intensive industries are often highly localized, being the dominant industry in a remote area with few other employment options. To take the example of coal mining, while coal workers may have many transferable skills,[19] they are the least able to take advantage of new job opportunities because of factors such as skill level and age, as well as the major relocation that it would entail. Even if they were to move to where they can find new jobs, their communities would still suffer the indirect effects of their income loss and departure. In sum, remoteness, lack of diversification and limited potential to innovate are all regional factors that reduce labour mobility, making it harder for unemployed workers to reintegrate (UNFCCC 2016).

4.1.2 Maximising green growth and employment opportunities

While a carbon price will negatively impact employment in some carbon–intensive sectors, it can also promote jobs in other sectors. However, while the carbon price acts as a basic incentive to invest in a low-carbon alternatives and energy efficiency, there are limits to what a modest carbon price can drive. Therefore, jurisdictions typically support carbon pricing instruments with public spending that aims, for example, to promote renewable energy expansion, encourage energy efficiency measures and build low-carbon infrastructure.

Carbon pricing revenues are often directed towards these public funding instruments, especially when they help to achieve climate targets by supporting the transition to a low-carbon economy or help to adapt to the impacts of climate change. The potential to generate green jobs from the investment of revenues can further increase the public acceptability of the policy, for example, as in the RGGI states in the period after the financial crisis.

The public investment of revenues can promote green growth and employment in several ways. Firstly, there is the direct creation of jobs, for example, as projects require staff, new installations require construction workers, and ongoing maintenance requires technicians. Secondly, investment in R&D can promote new technologies and processes, and spark private investment. Thirdly, the provision of green infrastructure, such as public transport or energy grids can create an enabling environment for economic diversification and employment growth. Labour market policies complement all of these effects, maximizing the growth of new markets and building the necessary skills and knowledge for workers to take advantage of them.

[18] Studies indicate that across developed countries, GHG emissions are concentrated in a small number of industries that also have a relatively small share of total employment. The share of employment across these industries is generally higher in countries with lower GDP. Developing and emerging countries are likely to have a higher, but not dominant proportion of jobs in these sectors (ILO and OECD 2012)

[19] A recent study in the U.S. matched the skills of workers in various positions across the coal mining sector with nearest equivalent positions in the solar P.V. sector, and found a high potential for retraining at relatively low cost. However, the study did not take into account labor mobility barriers, such as the need to relocate, and the impact that would have on the community (Louie and Pearce 2016)

4.2 Options for promoting a just transition through carbon pricing

Altering the carbon pricing mechanism, through changes in scope or price level, does not offer many options for alleviating employment effects in key industries. While there is the option of offering exemptions to some sectors or industries, this would certainly compromise the emissions reduction potential of the mechanism.

The greatest potential for a carbon price to support a just transition is through the targeted use of revenues to drive green economic growth and employment for highly-impacted communities. To date, no jurisdiction has explicitly earmarked carbon pricing revenues for the transition of a specific group of workers. However, allocating carbon price revenues for this purpose would be technically and politically feasible. Beyond the immediate scope of carbon pricing, an active labour market and welfare policy is required. We examine each in turn.

4.2.1 Investing revenues to promote green growth and jobs

Complementing just transition policies (see below), carbon pricing revenues can be invested in programs that promote new job opportunities and drive green growth. Investments should specifically target disadvantaged or low-income groups or communities, or those that are particularly impacted by job losses due to the carbon price.

The design of investment programs will determine which groups, areas and communities will benefit from the publicly-funded projects. Projects may have social justice objectives if they target disadvantaged groups or if they aim to support broader sustainable development goals. However, there is the risk that public investments in low-carbon technology and infrastructure may accentuate existing patterns of inequality. For example, subsidizing new energy efficient technologies, whilst achieving climate goals through the provision of low-carbon substitutes, may primarily benefit only those households that can afford them. Also, due to local lobby power, investments in public infrastructure may tend to be concentrated in wealthier communities. Furthermore, if the carbon price impacts on household incomes are already regressive, investments that benefit businesses over wage earners, or relatively wealthy over poor, may accentuate this effect (see Chapter 2). On the other hand, investments that favour low-income communities may make the policy less regressive. Investment can also be targeted at regional economic development, either broadly at areas suitable for green growth, or specifically at disadvantaged regions. The example of coal communities is one instance where the impact of the carbon price on job losses can be moderated by targeted investment of the carbon pricing revenue, for example, in economic diversification, renewable energy and energy efficiency (see Box 1).

Several major ETS generate revenues from auctioning allowances, which are then reinvested in a wide range of projects and programs. European Union members, California, Québec and the RGGI states all explicitly use revenues to promote green growth and jobs among other objectives. Three typical areas of investment have been shown to create jobs – energy efficiency, renewable energy and low-carbon infrastructure. The RGGI program can provide an example, as job creation resulting from revenue investment has been measured in 'job hours' created (Stutt and Shattuck 2016).

However, while investments in these jurisdictions have been shown to create overall employment opportunities, most jurisdictions do not specify where the investments should take place, or which communities should benefit. California is the only jurisdiction that has determined through legislature that the investment of revenues should have social and environmental justice outcomes (see also Chapter 3)

We here provide a few examples of socially just revenue spending for the three main kinds of investment – energy efficiency, renewable energy and infrastructure

Low-carbon infrastructure – investment in public infrastructure, such as transportation, electricity and communications networks, can have both immediate and long-term effects on local employment patterns. For example, public transport networks can increase workers' mobility and foster economic diversification. They can particularly help disadvantaged communities if they link them to broader networks and reduce the costs and environmental impacts of private transport

Subsidies for energy efficiency measures - Households and businesses may be granted full or partial subsidies to invest in energy-efficient equipment. To maximize the social benefits, the policy would, for example, target housing insulation programs within disadvantaged communities. This would not only create local employment opportunities, but would also both lower energy bills and improve living conditions for households (see also Chapter 2).

Financing for renewable energy generation - Low-interest loans may be provided for installing small scale solar or wind power generators. This may reduce energy bills and create local job opportunities. Large-scale RE projects may potentially target regions in need of new employment opportunities, such as remote coal mining areas.

It should, however, be noted that revenues are a limited public resource and should ideally be used for the maximum public benefit. Targeting particular regions or communities reduces the scope of viable investment options. Decisions therefore need to balance broad public benefits with the costs of supporting particular groups. While ensuring a just transition is a valid public good, the support provided should be viable and proportional. It may, for instance, be uneconomical to build renewable energy plants in some regions, even if the local communities are in particular need of the job opportunities.

One option that has been discussed especially for the case of developing countries is to use carbon pricing revenues to support green growth and poverty reduction by investing directly in basic infrastructure. This approach would be one way to place climate policies within a larger sustainable development framework, which considers climate targets in combination with other development goals (Jakob et al. 2016). For example, poor access to electricity contributes to energy poverty (see Section 2.1.2. – Carbon pricing impacts on poverty) and is major barrier to economic growth in some regions. Improving energy access has therefore been identified as a key sustainable development goal.[20] Carbon pricing revenues could be earmarked to fund energy infrastructure, such as grids and power plants, with the goal of extending electricity access. Although it has not yet been put into practice, the approach potentially represents a socially just carbon pricing policy for developing countries. It would also potentially improve climate change mitigation outcomes if it was combined with renewable energy and energy efficiency policies, as well as local health benefits from reduced indoor pollution.

[20] UNDP Sustainable Development Goals 'SDG 7: Affordable and clean energy' http://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-7-affordable-and-clean-energy.html

4.2.2 Labour market and transitional support

Ensuring a 'just transition' for workers that are affected by job losses and transformations as a result of the carbon price would have three main components: an active labour market and skills policy, transitional support and social welfare, and an inclusive and participatory approach to policy design and implementation.

Labour market and skills policy

Governments can take an active role in helping both workers and employers make the transition, including the following elements:

Training – providing workers with opportunities to meet the emerging job-skill requirements of a low-carbon economy. This includes vocational training for workers in new industries, as well as mid-career workers that need retraining or up-skilling. Employers can be funded to provide workplace training or it can be organized through local and regional institutions.

Marketing – efforts to bring emerging low-carbon technologies and firms to the market and to expand their market share so as to maximize growth in new job opportunities.

Diversification – labour market investments aimed at diversifying local and regional economies heavily dependent on declining industries. This can provide options for low-mobility workers to retrain for new jobs within their own communities.

Information – labour market information and analysis can help better understand and anticipate changing labour demand and job-skill requirements. This also involves providing information services that enable workers, training providers, employers and customers to find their match.

Transitional support and social welfare

Job losses will likely not happen in the same place or at the same time as new jobs are created, and for low-mobility, low-skilled and older workers, finding alternative work may be especially challenging. A priority for ensuring a just transition, therefore, is to make sure that displaced workers receive the help they need while reintegrating into the labour market (UNFCCC 2016). Specifically, this means social safeguards related to health care, pensions, and adequate social welfare payments for the structurally unemployed.

While developed countries may be able to depend on existing social welfare systems for this purpose, for developing countries, basic 'social protection floors', originally conceived for overcoming economic crises and poverty, may help enable a just transition for affected workers (ILO 2014).

Ensuring rights and promoting inclusion

During the transition, it is important to guarantee workers' rights in line with international labour standards. Extensive social dialogue, including tripartisan exchanges (between government, employers' and workers' organisations) can foster 'decent work' opportunities through negotiations, dispute resolution and information exchange. There is also the opportunity to promote social inclusion by targeting work programs, training and development opportunities to disadvantaged groups and communities (UNFCCC 2016).

4.2.3 Summary of options

The options for promoting a just transition for workers and their communities are complementary. The first option focuses mostly on job creation and green growth, whereas the second, labour market development, focuses mostly on the workforce groups.

Public investment has also the potential to increase the availability of low-carbon substitutes. However, the public investment option should be carefully designed, avoiding crowding-out private investment and ensuring additionality. Importantly, public investment requires a balancing act between targeting particular regions or communities affected by carbon pricing and generating public benefits. In many jurisdictions, directing investment toward the achievement of other development goals may be a priority and targeted support might be limited.

Table 3: Options for promoting a just transition through carbon pricing

	Public investments for green growth and jobs	Labour market development and welfare
Supports low-income households	Depends on target group	Yes
Preserves the carbon price incentives	Yes	Yes
Increases availability of low-carbon substitutes	Yes	No

5 Socially just carbon pricing in relation to firms

Summary

Carbon pricing increases costs for firms and may reduce their profitability. In some cases, this represents a disproportionate or unfair burden.

There are three cases in which carbon pricing can unfairly impact firms:

- A disproportionate administrative burden for small enterprises
- Unexpected loss of value for carbon intensive assets
- Loss of competitiveness of emissions intensive trade exposed firms

Carbon pricing design, including the use of revenues, can address these impacts through:

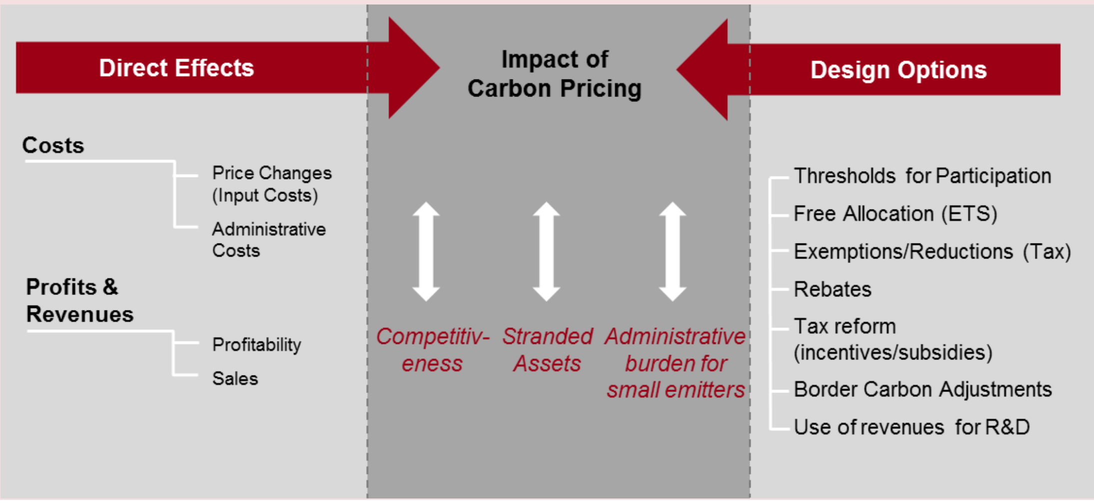
- Setting thresholds for participation
- Granting allowances for free under an ETS
- Providing carbon tax exemptions or reducing the tax obligation
- Providing tax rebates based on a firm's output
- Tax reform
- Border carbon adjustments
- Use of revenues for R&D

However, key considerations in applying these options are:

- Preserving the carbon price incentive for firms
- Increasing availability of low-carbon substitutes to enable technological options for firms to reduce emissions

Furthermore, providing exemptions, rebates or free allocation needs to be well justified, decided in a transparent manner and clearly communicated both to firms and the public.

Figure 7: Potential carbon pricing impacts on firms and design options for compensation



Carbon pricing affects firms in several ways. First, by raising the prices of inputs of production, in particular, the cost of energy, carbon pricing increases the costs of firms in carbon intensive industries. Secondly, it creates administrative costs associated with compliance, for example, measuring and reporting emissions annually. Where firms are not able to raise their prices and pass costs on to consumers, carbon pricing may affect their profits. Alternatively, where costs can be passed on to consumers, demand side responses may reduce sales, as consumers switch to cleaner alternatives or reduce their consumption of those goods. The next subsections explore the potential impacts of carbon pricing on firms as well as the design options available for addressing them (see Figure 5).

5.1 Carbon pricing impacts on firms

Policymakers need to assess and address three potential impacts on firms from carbon pricing: disproportionate administrative burden on smaller firms; stranded assets, and competitive disadvantages for energy intensive and trade exposed sectors.

5.1.1 Administrative costs and small and medium enterprises

Firms covered by carbon pricing regulations incur administrative costs associated with fulfilling their legal obligations. Typical administrative costs include performing activities related to monitoring, reporting and verification (MRV), gathering information and submitting application forms. For example, under the EU ETS, MRV obligations make up the bulk of such costs.[21] Small and medium enterprises (SMEs) tend to face a relatively higher burden than large firms, as they face similar fixed costs but cannot utilize economies of scale in administration[22].

The burden, however, depends on the choice of the policy. In many cases, a carbon tax would place a lower burden on firms compared to an ETS because some tasks would not be required (Goulder and Schein 2013). For example, when carbon taxes are applied to the fuel sales in proportion to their carbon content firms incur fewer administrative costs as they are not required to implement MRV activities.

5.1.2 Stranded Assets

Some firms, industries and sectors argue that they should be compensated for the unfair impact of a carbon price on the value of their assets. When a carbon price is first introduced, existing assets that in the past generated profits can face a permanent and unforeseen fall in value as their emissions are hard to reduce and their operating costs rise. These assets may lose value, or even become uneconomical to operate, and be retired earlier than expected as stranded assets.

A carbon price will most obviously impact fossil fuel assets, such as coal mines and coal-fired boilers (PMR and ICAP, 2016). According to a IEA study (IEA 2010), some 300 GW (or around one-third) of new coal and gas CCGT power plants built worldwide between 2010

[21] Studies of transaction costs for firms under the EU ETS estimate that MRV costs make up around 70% of transaction costs (Heindl 2015; Heindl 2012).

[22] Heindl (2015) shows that across the EU ETS, from 2010-2012, the average transaction costs per ton of CO2e emitted were much higher for small emitters, and declined sharply as emissions increase above a certain threshold. This can be explained by the fixed costs associated with MRV, which can be better absorbed by large emitters due to economies of scale. The study finds that for small emitters (less than 25,000 tCO2/year) average MRV transaction costs amount to EUR 0.47 tCO2.For large emitters (more than 1,000,000 tCO2/year), average costs drop to EUR 0.05 per tCO2.

and 2035 will become uneconomic due to carbon pricing policy and will be closed down before the end of their technical lifetime.

While it is reasonable to expect that some fossil intensive assets will drop in value under a carbon price, others may be unexpectedly or unfairly impacted, particularly over the short term as the carbon price is introduced. As the carbon price will rapidly affect costs across the economy, a range of asset holders may be justified in receiving compensation for loss of value. This typically includes firms that have made recent investments in energy-intensive assets under the assumption that they will not incur a carbon price. Compensation therefore often focusses on the implementation and transition to a carbon price, enabling firms to recoup some of their investment and allowing time to adjust.

In general, well-founded and transparent compensation can help build support for carbon pricing among impacted sectors, while unjustified compensation can negatively affect public perception of the policy. Furthermore, compensating emissions intensive industry can prolong the use of these assets, effectively being a capacity subsidy that slows down the intended low-carbon transition. For example, in the electricity sector, compensating coal-fired power generation has been shown to postpone the retirement of old and inefficient power plants.

5.1.3 Competitiveness concerns

The impact of carbon pricing on a carbon-intensive firm's competitiveness is not, in itself, unfair. This is because a carbon price is "meant to account for the costs of damages caused by GHG emissions" and a contraction of carbon intensive production is inevitable under a carbon price (CPLC 2016). A carbon price that is fair covers all competing firms, and encourages them to react accordingly, for example, by substituting fuels, investing in efficiency or developing low carbon products. In many regards, it can be better for a firm to be covered by a carbon pricing mechanism than not. The carbon price gives an economic incentive for investment in innovation and resource efficiency, which can strengthen a firm's competitiveness compared to others using business-as-usual production methods. Looking ahead, firms that invest more now may also enjoy an early mover advantage (PMR and World Bank Group 2017)

However, energy intensive and trade exposed firms (EITEs) may be unfairly impacted. These firms face rises in costs due to their carbon intensity, and are not able to pass on the costs to their customers because they are in price-based competition with firms that do not face an equivalent carbon price. A carbon price therefore puts them at an unfair disadvantage, resulting in reduced profit or loss of market share. Furthermore, rather than reducing emissions, this can result in 'leakage', which negates the mitigation effect of the carbon price by causing the displacement of carbon-intensive activities to countries or regions with weaker regulations (Arlinghaus 2015). The risks of competitive disadvantage and leakage are of major concern to industry groups and policymakers. Although there is little or no evidence that leakage has occurred as a result of existing carbon pricing policies (Arlinghaus 2015; PMR 2015) as industry groups are key carbon pricing stakeholders, addressing leakage concerns is often crucial for the successful implementation of the policy.

5.2 Policy options for firms

We discuss options for firms in terms of aspects of critical importance for policy makers: their ability to compensate or account for disproportionate impacts on firms, their ability to preserve the carbon price signal, the extent to which they support the poorest households, reduce regressivity, and increase options for substitution of carbon intensive goods.

5.2.1 Options to address the disproportionate burden of administrative costs for small emitters

The design of the carbon pricing mechanism can reduce the number of small firms with administrative tasks, and the remaining firms can be granted an exception depending on their size. The point of obligation determines which firms along the production chain are obliged to directly account for their emissions. Covering fossil fuels where they enter the economy (upstream) reduces the number of small entities that are covered, since upstream entities are typically larger and can pass the costs through to smaller firms and consumers downstream. This consideration went into the design of the Australian carbon pricing scheme (Jotzo and O'Gorman 2014) which was repealed in July 2014. Similarly, New Zealand implemented the NZ ETS with an upstream point of obligation in order to reduce the overall administrative burden. California and Québec follow an upstream approach for liquid fuels, which reduces the number of covered entities in the transport sector (PMR and ICAP 2016).

Where downstream coverage is preferred, setting participation threshold is the common approach to address the issue of small emitters. A threshold sets a given level of emissions, below which entities may be excluded from the regulation, or may face less stringent obligations. The threshold approach must balance the benefits of broad coverage with the relatively larger burden on small emitters. Small emitters typically contribute only small fraction of the total emissions of a country (see Figure 6 for European countries). In most European countries 70 percent of all installations contribute less than 10 percent of the total emissions (Betz et al. 2010).

In terms of threshold values, in the EU ETS, small emitters emitting less than 25,000 tonnes of CO2e per year are excluded from the scheme.[23] The same threshold also applies in several other ETSs (PMR and ICAP 2016). However, being exempt from the carbon pricing regulation does not mean firms have no obligations. To maintain a fair and even treatment, small emitters are often still obliged to report their emissions and may be subject to other regulations.

5.2.2 Options to address firms' potential impacts under an ETS

Competitiveness concerns and stranded assets issues can both be addressed by similar measures. Before deciding on an option, policymakers need to identify which firms are facing competitiveness risks and which are justified to receive compensation.

In the case of carbon leakage, eligibility is usually determined with objective criteria for carbon intensity and trade exposure. A firm's entitlement to compensation for stranded assets, on the other hand, is often decided on a case-by-case basis.

Free allocation

In an ETS, cost-free allocation of allowances is often used as an option to protect firms from leakage or to provide compensation, whereby instead of purchasing all of their allowances at auctions or on the carbon market, firms are granted a number for free. [24] Free allocation may be used to grant some compensation for stranded assets, reduce leakage concerns or ease the transition to an ETS. When well-targeted, free allocation has the advantage that the carbon price signal is preserved. This is because allowances obtained free of charge still have

[23] The European Commission passed Article 27 of Directive 2003/87/EC recognizing that small emitters faced disproportionately higher transaction costs. Entities below the threshold may decide to opt-in if it is in their interests to take part

[24] Different methods of free allocation may also effect the impacts of free allocated allowances, for further discussion see PMR and ICAP (2016)

‘‘opportunity costs’ - the allowances have value and can be traded, so a firm still stands to gain from reducing their emissions and selling extra allowances.

Free allocation may be granted to compensate for stranded assets, in recognition that at the time investments were made, GHG emissions were regarded as harmless (Brohé et al. 2010). Importantly, compensation for stranded assets should be clearly framed as transitional. For example, when New Zealand introduced a carbon price in 2008, some sectors were granted one-off compensation: owners of forestry land were compensated for the impact of the carbon price on land values, while owners of fisheries quotas (permits to harvest a quantity of fish) were compensated for the rise in operating costs related to fuel consumption. Compensation for stranded assets can also be conceived as a transitional shift that allows firms to adjust to the carbon price. In any case, it needs to be reduced overtime and should not be linked to any updating provisions; otherwise it creates perverse incentives for firms to increase their emissions in order to obtain more allowances. Furthermore, phasing out free allocation is needed to support a gradual shift to low carbon substitutes.

An important distinction should be made between free allocation to protect against leakage, and free allocation to compensate loss of value. If a firm is able to pass carbon costs on to consumers, then it is not at risk of losing competitiveness. When firms are able to pass on costs, free allocation results in windfall profits, whereby producers mark-up prices in line with the carbon price, while also selling the allowances that they obtained for free (Woerdman et al. 2009). For example, energy-intensive companies earned over €24 billion in windfall profits from the EU ETS during 2008-2014 (De Bruyn et al. 2016). Windfall profits are undesirable on several accounts and threaten to undermine public confidence in the fairness of the system: governments forego public revenue they would have received if allowances had been auctioned instead of distributed for free, consumers pay more than necessary for some goods, and those firms who cannot pass on their costs are put at a disadvantage. In recognition of this, ETS jurisdictions aim at targeting free allocation to those who are really at risk of leakage and are gradually increasing the share of auctioned allowances.

Even with a gradual reduction in free allowances, the relocation of firms to other countries is discouraged. As firms are initially compensated they react to the carbon price by making low-carbon investments. The lock-in effect then encourages them to remain, even when an immediate relocation would have been economically profitable (Schmidt and Heitzig 2014).

5.2.3 Options to address firms’ potential impacts under a carbon tax

Tax exemptions and reductions

Different measures have been implemented to address competitiveness concerns and compensate for stranded assets in carbon tax systems. A straightforward strategy is to implement tax exemptions or tax reductions in order to ease the carbon tax burden on firms. The advantage of exemptions is that they are relatively easy to implement. However, they risk violating the ‘polluter pays principle’ as they allow polluting firms to avoid paying the carbon price. Harrison (cf. Harrison 2010) points to two possible undesirable impacts. Firstly, every tax exemption is a forgone opportunity for emission reductions; secondly, exemptions can create an incentive to shift to carbon-intensive fuels or goods that are not taxed.

When targeting leakage concerns, the main difference between free allocation under an ETS and exemptions or reductions in a tax system is that the price signal is preserved with free allocation.

Output-based tax rebates

An output-based rebate is an option to protect the competitiveness of EITE firms that preserves the carbon price signal. Firms are granted a tax rebate based on their level of output (i.e. units of goods produced), not their level of emissions. The advantage is that the entity can compete in foreign markets against products manufactured in a non-carbon tax country. Yet since the size of the rebate does not depend on the emissions intensity of the entity, this policy option still gives incentives to lower emissions (Gray and Metcalf 2017). The main drawbacks of this approach are uncertain and potentially high costs to the public, high data requirements and reduced incentives for shifting to low-carbon products (PMR and World Bank Group 2017).

Sweden introduced an output-based rebate as part of its tax on NOx emissions. All NOx tax revenue is returned to emitters in proportion to their production of useful energy[25]. Entities with high emissions relative to their energy output are net payers, whereas entities with low emissions relative to energy output are net recipients (Swedish Environmental Protection Agency 2006).

Böhringer et al. (cf. Böhringer et al. 2017) found that an output-based rebate under a carbon tax can be highly effective against carbon leakage, making it a suitable measure for mitigating competitiveness concerns at the firm level.

5.2.4 Options to address firms' potential impacts common to both carbon taxes and ETS

Tax reform: tax incentives and tax swaps

Another option to compensate firms for a loss of value is to use tax incentives, which can support firms impacted by the carbon price to make low-carbon investments. Policymakers can consider options such as production or investment tax credits. For example, tax credits can help lower the cost gap between renewables and fossil fuels and to provide certainty when investing in certain technologies (Cohen et al. 2015). The United States has implemented an investment tax credit that provides a 30 percent tax credit for solar energy systems for residential and commercial buildings since 2006. Since its implementation, annual solar installation has grown by over 1,600 percent (ibid). Depending on the specific design, this option can be more or less targeted to the sectors that bear the carbon prices.

As mentioned in Chapter 2, if the carbon pricing revenue is used to reduce other pre-existing distortionary taxes, such as capital and labour taxes, the efficiency of the tax system is improved. However, as a carbon-for-capital tax swap could result in compensation for capital owners, it could be highly regressive.

R&D support

Government support for research and development might help alleviate the issue of stranded assets by enabling firms to apply new low-carbon technologies with existing assets. In addition, government investment in development and demonstration of breakthrough technologies shows commitment towards the low-carbon transition (Acworth et al. 2017). Indeed, the EU ETS has been accompanied with carbon capture demonstration projects in an effort to address stranded assets in the coal industry (ibid).

Border carbon adjustments

When it comes to international competitiveness, input costs play a key role. Border carbon adjustments close the cost gap between locally produced goods that face higher input prices

[25] Useful energy produced is a definition used to reasonably measure and compare output from heterogeneous activities: paper mills, power plants, and other (Sterner and Höglund, 2000)

due to the carbon price and internationally produced goods outside a carbon pricing jurisdiction. Under this approach, a tariff would be applied to carbon intensive goods as they are imported, or, alternatively, the carbon price of exported goods would be rebated (Kortum and Weisbach 2016). So far, this measure has been theoretically discussed but not implemented, in part because they may not be compatible with the international rules of the World Trade Organization (WTO).[26]

5.2.5 Summary of options for compensating firms

The options presented in this section address competitiveness concerns, provide compensation for stranded assets, or provide mechanisms to reduce the burden on small firms. However, not all these options preserve the CO_2 price incentives. Where the price incentive is not preserved, they should be presented and communicated either as one-off or transitional forms of support.

In addition, reducing the burden on firms can be associated with a higher burden on households (World Bank and Ecofys 2014). For example, compensating firms with free allocation implies less leeway for using revenues to compensate low-income households that are disproportionately burdened by carbon pricing (see Section 1 on households). According to Carbon Market Watch (cf. Carbon Market Watch 2016), governments have forgone at least 135 billion euros by granting more than 11 billion free emissions permits over the period 2008-2014. Over time, free allocation may undermine public confidence in the system, particularly if it is perceived to be unjustified.

Importantly, because of their nature, tax reform and CO2 tax exemptions typically accompany carbon tax implementation, while free allocation goes alongside with emissions trading. Rebates and R&D investment stand out as measures that can preserve the carbon price signal. Combined they could both increase the availability of substitutes and address competitiveness concerns.

[26] Hillmann (2013) points out ways how adjustments could be in line with international trade agreements depending on the design of the taxes, for a detailed discussions see Hillmann (2013).

Table 4: Carbon pricing impacts on firms and design options available for revenue recycling

	Firms				
	Tax reform	Free allocation	Tax exemptions	Output-based tax rebates	R&D investment
Preserves the carbon price incentives	Yes	Partially	No	Yes	Yes
Increases availability of low-carbon substitutes	Depends	No	No	No	Yes
Reduces distortionary taxes	Yes	No	No	No	No
Addresses competitiveness concerns	Partially	Yes	Yes	Yes	Partially
Compensates devaluation of assets	Depends	Yes	No	No	Partially

6 Conclusion

When the distributional impacts of carbon pricing are adequately addressed, this holds the potential to create a broader support base for the policy. This in turn is key to its longevity, including at times of political change. By contrast, taking a narrow view on carbon pricing may obscure the potential of the instrument to contribute to a low-carbon transition that also supports other sustainable development objectives.

The present paper discussed the social impacts of implementing carbon pricing policies on different groups of actors – low-income households and disadvantaged communities, impacted communities of workers, and firms – and, drawing on international experience to date, mapped options how these can be addressed. A framework with key considerations for policymakers was also presented. Table 5 below summarizes the main impacts and related policy options, and highlights core challenges and trade-offs in this regard.

Putting emphasis on the social justice dimension of carbon pricing policies is particularly warranted for early phases of implementation, where a 'soft start' of the policy can help gain acceptance and avoid a public backlash that results in lasting reputational damage. For a carbon tax, this may for instance involve a starting with a lower tax rate or a broader range of exemptions. For an ETS, this could be reflected in a first phase with a more lenient cap, higher levels of free allocation and a gradual extension of the scope of the ETS. In general, well-founded and transparent compensation can help build support for carbon pricing among impacted sectors, while unjustified compensation can negatively affect public perception of the policy.

Decision-makers should, therefore work to ensure that initial policy settings do not result in a lock-in that prevents the carbon pricing measures from becoming more comprehensive and stringent overtime. Revenue use is a core means to alleviate adverse effects on affected communities. Yet, whereas the revenue-raising property of a carbon tax is basically guaranteed (unless it is designed revenue-neutral and other taxes are reduced accordingly), for an ETS, public income depends on a share of emissions allowances being auctioned rather than allocated for free. It may therefore be advisable to start early with a small share of auctioning of allowances, and increase that portion over time.

As the analysis in the previous chapters demonstrates, addressing the distributive impacts of carbon pricing regularly requires trade-offs between their primary objective – ensuring cost-effective mitigation – and other desired outcomes. This is illustrated by the discussions on tax reform and firm-level considerations in previous chapters, as well as the quest for an equitable distribution of the co-benefits of carbon pricing policies. In general, concerns can sometimes be addressed by altering the design of the pricing mechanism itself, or through complementary policies and measures. More often, socially just outcomes depend on the considered use of a portion of the carbon pricing revenues. Which option may be preferable will depend on the individual case and its larger political context. Given the broader rationale for the policy, however, maintaining an adequate carbon price signal should always remain a priority.

Overall, the saliency of addressing distributive concerns in carbon pricing policies is also a function of the broader level of economic development and the socio-economic profile of a country. To date, most experience with these mechanisms stems from industrialized countries with relatively low levels of inequality and absolute poverty, as well as robust social welfare systems. Implementing a carbon price in emerging and developing countries will likely require even more political attention being dedicated to these issues, perhaps also involving some policy innovation and going beyond what has been pioneered as best practices in existing carbon pricing systems. Also, the relevance of these considerations highlights the importance of effective stakeholder involvement, beyond the groups that are traditionally effective at making their voice heard in domestic policy discussions.

Finally, it is clear that social justice concerns and impacted groups will change and evolve over time as climate and carbon policies become more stringent and as societies are making progress toward decarbonizing their economies. On the one hand, households, communities and firms will gradually adapt to the changes brought about by the carbon price, and low-carbon substitutes will increasingly become available, depending also on technological developments. Other issues require a more long-term view, especially as they seek to support disadvantaged communities to achieve sustainable development goals alongside a low-carbon transition. Robust policy evaluation and policy reviews that also map possible distributional impacts are therefore essential to long-term robust carbon pricing policy.

Table 5: Summary of carbon price impacts, social justice implications, and policy options

Impacted groups	Effect of carbon price	Implications for inequality/fairness	Policy options	Challenges and trade-offs
Households	Household expenditure effects • Price changes Household income effects • Assets • Wages • Government transfers	Increased price of goods and services • Inequality (distributional impacts) • Poverty • Sectoral and regional distribution	• Direct transfers • Subsidies • Tax swaps and credits	Preserving the price signal Might reduce leeway for increasing availability of low carbon substitutes and compensating firms
Local communities	Co-benefits • Local pollution effects Offset effects • Displacement of GHG abatement • Displacement of local co-benefits	Unequal distribution of public health benefits Disadvantaged communities close to pollution sources	• Zonal restrictions/sectoral caps • Limiting the scope of offsets • Community fund • Direct regulation	Reduced cost-effectiveness of carbon pricing mechanism
	Structural changes in employment from a low-carbon transition • Declining carbon intensive industries • New skills needed for existing and new jobs • Green job creation	Broader impacts on communities impacted by structural change • Structural unemployment • Regional community impacts	• Labour market development • Transitional support • Investing revenues in green jobs and enabling infrastructure	Ensuring equal access to job opportunities Optimizing investments for both specific impacted communities and broader public benefits.
Firms	Costs • Price changes • Administrative costs Profits and revenues • Profitability • Sales	Impact: • Competitiveness • Stranded assets • Administrative burden for small emitters	• Thresholds for participation • Free allocation (ETS) • Tax exemptions or deductions (Tax) • Rebates • Tax reform (incentives/subsidies) • Border tax adjustments • Use of revenues for R&D	Maintaining the price signal Windfall profits Preventing lock-in of high carbon assets

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