Chapter 1. Introduction

This chapter provides the context and motivation for the analysis of effective carbon rates. Effective carbon rates are the total price that applies to carbon dioxide emissions from energy use as a result of market-based instruments (specific energy taxes, carbon taxes and carbon emission permit prices). The chapter also provides an overview of the main results for 42 OECD and G20 countries, which together account for about 80% of global carbon emissions from energy use.

Clean air, pure water and moderate temperatures provide numerous benefits to individuals, companies and countries. Where these are available, people tend to be healthier, happier and more productive, and threats to biodiversity are more limited. Climate change poses a threat to these environmental and natural resources.

Global temperatures have risen by one degree Celsius above pre-industrial levels and are expected to rise further if greenhouse gas emission patterns remain as they are. In the absence of decisive policy shifts, the planet risks overheating, with average temperatures increasing by five or more degrees Celsius compared to now. Adaptation to such increases would most likely be extremely costly.

Given the upward pressure from global GDP on the demand for energy services, cutting emissions from energy use is a *conditio sine qua non* for containing the risks of climate change, and this ultimately requires shifting energy use to carbon-neutral fuels, i.e., decarbonisation. In addition, phasing out fossil fuels reduces air pollution by reducing emissions of particulate matter and other local pollutants. This also reduces water pollution as there will be less acid rain.

Failing to act increases the risk of disaster. Delaying action risks driving up the costs of shifting to carbon-neutral fuels. As power plants, boilers and other energy assets tend to be long lived, continuing to invest in carbon-intensive asset risks incurring financial losses when carbon budgets become ever tighter in the future. Decarbonisation, starting now, therefore is imperative.

By pricing carbon emissions countries can effectively steer their economies along a carbon-neutral growth path. Carbon pricing stimulates the search for energy efficiency and ultimately encourages emitters to shift away from polluting fuels and use clean fuels instead. This mitigates carbon emissions and stimulates clean investment. Increased demand for clean fuels and assets boosts innovation and opens up new markets, allowing economies to flourish and prosper. Instead of facing increasingly scarce fossil resources, countries can tap into the abundance of renewable power.

Carbon pricing is also cost effective, i.e. it maximises the emission reductions per Euro of abatement effort. Cost effectiveness is an important ingredient of full decarbonisation, as heavily relying on abatement options that are more expensive than necessary can negatively affect economic performance and reduce social support for clean investments. Carbon pricing can also raise revenue, and this adds flexibility to fiscal policy. More carbon pricing revenue allows reducing other taxes, increasing public spending, or cutting debt.

Box 1.1. Why carbon pricing works

Carbon prices maximise emission reductions from each Euro invested in abatement

Pricing greenhouse gas emissions is an essential climate mitigation policy. Pricing emissions, through taxes or tradable emission permits, encourages emitters to seek cost effective abatement options. The introduction or strengthening of carbon prices also signals strong policy commitment, creating certainty for investors that it pays to invest in carbon-neutral technologies.

Carbon prices are effective for reducing emissions because they increase the price of carbon-based energy, so decreasing demand for it (Arlinghaus (2015[1]); Martin et al. (2016[2])). Pricing carbon encourages substitution towards less carbon-intensive forms of energy and lowers demand for energy overall.

Taking generation of electricity as an example, producers can switch from coal to natural gas, or to zero-carbon energy sources, such as solar and wind power. In addition, where market structure and regulation allow, electricity producers will pass on the increase in production costs resulting from carbon prices to consumers of electricity, in the form of higher electricity prices, and this encourages price sensitive consumers to decrease consumption. For example, firms and households may become more vigilant about turning off appliances when they are not in use or may use them less, and they can choose more efficient appliances at the time of replacement.

Carbon prices are a cost effective policy tool and that this makes them particularly attractive compared to other policy options. The cost effectiveness of carbon pricing is due to three reasons:

- First, emitters have an incentive to cut emissions as long as this is cheaper than paying the price, and this equalises marginal abatement costs across emitters, ensuring economy-wide cost effectiveness.
- Second, carbon prices decentralise abatement decisions, thus overcoming the asymmetry of information between the government and polluters: regulators do not need to stipulate which emissions should be reduced using which technologies.
- Third, they provide an ongoing incentive to cut emissions, thus stimulating innovation.

Sources: OECD (2016, pp. 27-35[3]) and OECD (2017, pp. 189-199[4])

This report measures progress with carbon pricing across 42 OECD and G20 economies, using the *effective carbon rate* (ECR) as a measure of carbon prices. The ECR is the total price that applies to carbon dioxide emissions from energy use as a result of market-based instruments (specific energy taxes, carbon taxes and carbon emission permit prices). The report uses the terms “carbon price” and “effective carbon rate” interchangeably. In each of the 42 countries, the ECRs are measured separately for six economic sectors: road transport, off-road transport, agriculture and fisheries, residential and commercial energy use, industry, and electricity generation.

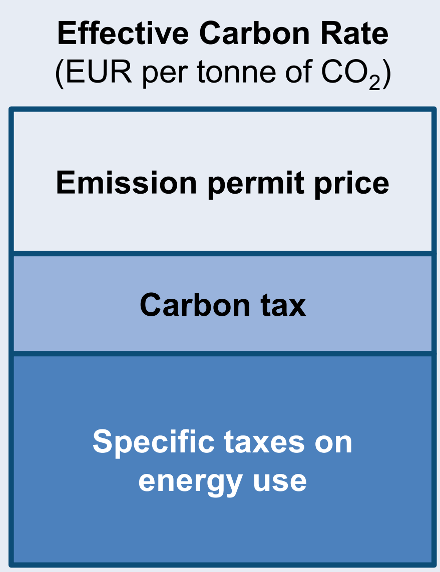
Box 1.2. The effective carbon rate (ECR)

Effective carbon rates are the total price that applies to CO_2 emissions from energy use as a result of market-based policy instruments. They are the sum of taxes and tradable emission permit prices, and have three components (Figure 1.1):

- carbon taxes, which typically set a tax rate on energy based on its carbon content,
- specific taxes on energy use (primarily excise taxes), which are typically set per physical unit or unit of energy, but which can be translated into effective tax rates based on the carbon content of each form of energy, and
- the price of tradable emission permits, regardless of the permit allocation method, representing the opportunity cost of emitting an extra unit of CO_2.

The effective carbon rate measures how policies change the *relative* price of CO_2 emissions from energy use.

Figure 1.1. Components of effective carbon rates



Source: OECD (2016[3]).

The report discusses the change of ECRs by comparing pricing patterns in 2012, 2015 and estimates for 2018. It discusses the distribution of the rates, and considers the "carbon pricing gap", a summary measure of the difference between actual and benchmark rates. Two benchmark values are used, EUR 30 and EUR 60 per tonne of CO_2. The first, EUR 30, is a low-end estimate of the damage that carbon emissions currently cause. Pricing emissions above EUR 30 does not guarantee that polluters pay for the full damage they cause, or that prices are sufficiently high to decarbonise economies. A price below EUR 30 does mean, however, that emitters are not directly confronted with the cost of emissions to society and that incentives for cost effective abatement are too weak.

The second benchmark, EUR 60 per tonne of CO_2, is a midpoint estimate of carbon costs in 2020, as well as a forward-looking low-end estimate of carbon costs in 2030. Rising benchmark values over time for carbon costs reflect that the marginal damage caused by one tonne of CO_2 increases with the accumulation of CO_2 in the atmosphere. Integrated assessment models show carbon prices that increase significantly in real terms over time. On the basis of such models, The High Level Commission on Carbon Pricing (2017[5]) finds that carbon prices should amount to *at least* USD 40 - 80 per tonne of CO_2 by 2020 and USD 50 - 100 per tonne of CO_2 by 2030, to be able to reach the goals of the Paris Agreement.[1] These are conservative estimates in the sense that many models suggest higher price targets, and that models commonly assume that carbon prices are introduced in a context where policies are well aligned with climate objectives.

The carbon pricing gap measures the extent to which current prices fall short of a benchmark value, as a percentage. The results show that the carbon pricing gap is large, but that it falls over time. Using EUR 30 per tonne of CO_2 as the benchmark, it drops from 83% in 2012 to 79.5% in 2015, and to 76.5% in 2018. This amounts to a decline of about one percentage point per year.

While the direction of change of the carbon pricing gap is encouraging in that it indicates better use of market-based instruments to reduce CO_2 emissions, the current rate of change is too slow compared to the ambition of the Paris Agreement. This report takes the view that carbon pricing is instrumental to a cost-effective transition to a carbon-neutral economy, and that delaying decarbonisation or relying only on other policies will drive up costs, which ultimately can erode public support for ambitious climate policy. Progress with carbon pricing therefore needs to accelerate.

A close look at the drivers of the observed narrowing of the carbon pricing gap suggests that the momentum for carbon pricing in the global economy is in fact strengthening. The more countries pursue robust carbon pricing policies the stronger becomes the incentive for other countries to follow suit, creating a self-reinforcing feedback loop. The perception of carbon pricing is shifting from its role as an instrument for marginal emissions abatement, to be used sparingly and only in as far as short-term competitiveness and equity considerations allow, to its function as the keystone of the policies needed to drive a low-carbon transition.

The Paris Agreement leaves no doubt as to the objective of climate policy, namely to decarbonise economies in the course of the second half of the century. In this context, carbon pricing is pro-competitive as it prepares companies for strong performance in a low-carbon economy. Furthermore, carbon pricing engenders co-benefits, for example through reduced air pollution from energy use, and these benefits are of prime domestic importance in many countries. In addition, there is rising awareness that increased use of carbon pricing increases the flexibility of the fiscal policy toolkit, allowing modification of tax and spending policies in line with country-specific priorities.

The emergence of positive feedback loops ultimately is not a matter of policy principles or perceptions, but of policy practice. In this context, it is encouraging to note that, to a considerable degree, the narrowing of the carbon pricing gap is the consequence of broader coverage of emissions by a pricing system in relatively large and emission-intensive countries. The anticipated introduction of a country-wide emissions trading system in China and of the backstop carbon pricing policy in Canada are estimated to result in a ten percentage point increase in coverage of global CO_2 emissions by a carbon price, from 43% to 53% between 2015 and 2018. Policy action in Mexico and at the subnational level in the United States also contributed significantly to the narrowing of the carbon pricing gap. These developments contribute to a stronger worldwide carbon pricing momentum because they weaken concerns over short-run competitiveness threats and because they illustrate that growth-oriented economic policy and effective climate policy can go hand in hand.

Emissions trading systems contribute strongly to broadening coverage of emissions by a price. However, prices in these systems have not increased strongly over time, and they remain very low. This highlights the need for gradual tightening of emission caps, in line with the decarbonisation trajectories required by the Paris Agreement.

Among the recent and expected developments that bolster support for carbon pricing are the reforms of the European Union's Emissions Trading System. Future efforts to tighten the cap could drive up prices to EUR 30 or more, and this would reduce the global carbon pricing gap by three percentage points. If China follows through on its intention to extend coverage of the country-wide emissions trading system to industry, and if prices would evolve to levels above EUR 30 per tonne CO_2 (Rathi, Akshat and Huang, 2018[6]), the global carbon pricing gap would decline from 76.5% to 63%.

Persistently low price levels in emissions trading systems imply little change over time to the very high share of carbon price signals that comes from taxes, in particular taxes on energy use (and not carbon taxes). Well over 90% of the effective carbon rate in transport, agriculture and fisheries, and household and commercial use comes from taxes. In industry, the share is about two thirds. In the electricity sector, emissions trading systems dominate as taxes represent just 19% of the total price.

Higher carbon prices will lead to higher carbon pricing revenues in the short to medium term. Judicious and transparent deployment of these revenues is as important to the economic effectiveness of and public support for carbon pricing. Climate policy becomes increasingly intertwined with mainstream economic policy, and through its revenue impacts, with fiscal policy.

The effective carbon rate analysis considers all emissions trading systems and taxes on energy use in each of the 42 countries covered. However, it does not take into account support measures for fossil fuel use that may affect the carbon price, except for tax incentives delivered through energy taxes.

The OECD's database of budgetary support and tax expenditures, discussed in the *OECD Companion to the Inventory of Support Measures for Fossil Fuels 2018* (OECD, 2018[7]) identifies and documents about 1000 individual policies that support the production or consumption of fossil fuels in OECD and selected partner economies. The inventory includes direct budgetary transfers and tax expenditures that provide a benefit for fossil fuel production or consumption when compared to alternatives. Many of these tax expenditures are included in the *Taxing Energy Use* database (OECD, 2018[8]) and therefore are reflected in the tax rates used for the calculation of effective carbon rates.

Value-added taxes (VAT) affect end-user prices of energy products in many jurisdictions in addition to the three components of ECRs. VAT is usually not specific to energy products: as long as the same rate applies, the relative prices of energy products remain unchanged. In this case, VAT should not be taken into account, as effective carbon rates measure policies that change relative prices. Differential VAT rates, however, do change the relative prices of energy products and VAT then becomes a *de facto* specific tax measure. OECD (2015[9]) provides an overview of the differential VAT rates that apply in the analysed countries. Seventeen countries apply reduced or zero VAT rates on selected energy products. This counteracts the intention to increase the relative end-user prices of energy products, and can mitigate or even offset the effective carbon rate, depending on the relative magnitude of the amount of price differentiation introduced by the differential VAT rate and the effective carbon rate.

The caveats about support measures and the potential impact of VAT notwithstanding, the ECRs capture an important component – and in most of the 42 countries analysed, by far the dominant component – of policy-driven carbon pricing.

In line with previous editions of *Taxing Energy Use* (OECD (2013[10]), OECD (2015[9]) and OECD (2018[8])) as well as of *Effective Carbon Rates* (OECD, 2016[3]) this publication reports results including emissions from the *combustion* of biomass. Annex 3.A discusses the implications of the *combustion approach* and considers recent evidence on *lifecycle* emissions of biofuels. It also discusses why emission bases from *Taxing Energy Use* and *Effective Carbon Rates* are not directly comparable with UNFCCC inventories. In addition, the annex provides tables with results excluding emissions from the combustion of biomass. Readers can use these tables to draw inferences on how results change given specific information about the lifecycle emissions from biofuels.

The remainder of this report will look at the current state of carbon pricing (Chapter 2) as well as compare carbon pricing developments between 2012 and 2015 (Chapter 3).

Notes

[1] This report assumes parity of the United States Dollar and the Euro in the long term.

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