Chapter 5

Effective carbon rates: Summary and conclusions

This chapter summarises the results of the analysis of effective carbon rates and draws some conclusions on the distribution of carbon prices across the economy and by sector, and on the composition of effective carbon rates.

Pricing carbon with market-based instruments is one of the most effective and lowest-cost means of inducing carbon abatement. While pricing alone is not sufficient to deliver the degree of abatement required for a low carbon transition, it is an essential part of the solution.

Two market-based mechanisms can be used to price carbon: taxes and emissions trading systems. Taxes can be further divided into those with a stated explicit purpose to induce CO_2 abatement (carbon taxes) and specific taxes on energy use, that also give rise to an effective tax rate on CO_2 emissions from energy use, even if levied for a mix of reasons. Whichever mechanism is used, pricing should cover emissions as broadly and uniformly as possible in order to ensure cost-effective abatement.

There are at least two approaches to valuing the climate cost of carbon emissions. The value can reflect the estimated marginal cost of climate change per unit of abatement, or it can be set as a function of the desired level of abatement. The marginal cost of climate change is very uncertain, with EUR 30 per tonne representing lower-end estimates in this report. There is considerable debate about appropriate levels of carbon pricing, a debate partially related to inter-country distributional concerns. The low-end estimate used here is not a recommendation on what prices to implement, but instead is merely a marker to gauge the current state of carbon pricing policies.

This report is the first combined and comprehensive analysis of the use of three carbon pricing instruments: specific taxes on energy use, carbon taxes, and emissions trading systems – together called the "effective carbon rate". It considers their levels and application across 41 OECD and G20 countries which together account for 80% of global CO_2 emissions from energy use. It finds that policy-induced prices of CO_2 emissions from energy use are often very low, even when the impact of all three pricing mechanisms is taken into account. Sixty percent of the emissions in these countries are not priced at all, either under emissions trading systems, carbon taxes, or specific taxes on energy use. Across the group of countries, only 10% of emissions are priced at or above EUR 30 per tonne of CO_2, and most of these emissions are from road transport energy use. Very low rates of carbon prices are found outside road transport, where 85% of total emissions originate. Within the non-road sectors, 70% of emissions face no carbon price at all, and only 4% face a price of more than EUR 30 per tonne of CO_2.

The low prices across the group of countries as a whole are in part due to the low prices or limited coverage by pricing mechanisms in several of the largest economies. Their weight in total emissions strongly influences the results. For example, the top five countries in terms of the quantity of emissions (China, the United States, India, Russia and Japan) together account for 70% of the emissions from all countries included in the analysis, but have comparatively low average ECRs on an economy-wide basis, with all of these countries but Japan featuring among the seven lowest economy-wide ECRs observed.

The high ECRs in road transport, relative to ECRs in other sectors, are observed both for the 41 countries as a whole, and also within every individual country. Within the road sector, almost all emissions are taxed at these comparatively high rates, including notably the emissions from gasoline and diesel use, which together comprise over 95% of all road emissions. However, in the road sector, it is very unusual for either carbon taxes or emissions trading systems to play a key role in pricing (notable exceptions include the carbon taxes in Finland, Norway, Sweden and British Columbia, and the emissions trading systems in California, Quebec and New Zealand). Consequently the price signal in the road sector is almost entirely derived from excise taxes.

As noted, however, road transport typically represents a small proportion of emissions, at 15% in total and varying between 6% in China to 38% in Slovenia (Iceland and Luxembourg are here excluded as outliers, in Iceland's case because of the extremely high share of renewable energy in electricity generation, which means that transport forms a disproportionately high share of emissions, and in the case of Luxembourg, because of the high volume of fuel sales for transit traffic). In all countries except Iceland and Luxembourg, non-road emissions represent more, and often significantly more, than 60% of total emissions; and 85% of total emissions across the 41 countries as a whole. It is in the non-road sector where much of the variation in pricing arises.

The non-road sectors of energy use include residential and commercial use, industry, electricity generation, offroad transport, and agriculture and fisheries. Of these sectors, the three biggest sources of emissions are industry, electricity generation and the residential and commercial sector (at 33.3%, 33.2% and 15.0%, of total CO_2 emissions from energy use, respectively). The other two sectors, agriculture and fisheries, and offroad transport account for only 1.2% and 2.2% of emissions respectively. Within countries, the relative weights of the sectors differ, but in every country, the former three sectors are considerably larger than the latter two.

The impact of the different pricing mechanisms varies considerably among these sectors and across the countries considered. In general, emissions in non-road sectors are subject to much lower tax rates than road transport, and in several cases, taxes are almost non-existent in these sectors. However, emissions trading systems apply most strongly outside road transport. Their coverage is largest in the industrial and electricity generation sectors. Emissions from residential and commercial energy use are more typically covered by taxes. Emissions trading systems do not affect prices or coverage substantially in this sector. Carbon taxes contribute very weakly to coverage and price levels in the non-road sectors across the 41 countries, almost entirely overlapping with taxes or ETS when they do apply. Within countries, they are most influential in Switzerland, Iceland, Ireland, Denmark, Finland, Norway, Slovenia and Sweden.

In the industrial sector, there is a degree of overlap in coverage between taxes and emissions trading systems, meaning that they act together to increase the carbon price beyond the level of either instrument alone – trading systems cover 13% of emissions, taxes apply to 17% of emissions, and total coverage is 26%. However, it is rare that taxes or emissions trading systems, whether applying separately or together, increase ECRs on industrial emissions beyond EUR 30 per tonne of CO_2. The overall impact on average ECRs in industry is highest from taxes when assessed across the 41 countries, but when isolating countries using an ETS, the two instruments are often more equal in price signals.

In the electricity sector, emissions trading systems and consumption taxes overlap almost entirely where trading systems exist. Consumption taxes on electricity fail to distinguish between the carbon-intensity of fuels used to generate electricity, but they do raise the price of emission-intensive electricity all the same.

The summary of results up to now defines emissions of energy as those from the combustion of energy, including combustion of biomass. Alternatively, biomass emissions can be excluded, for example if they are considered as carbon neutral on lifecycle emissions. Such alternative treatment does not affect the results across the 41 countries to any appreciable degree, but results for countries with large shares of biomass combustion are affected more strongly, particularly if those countries price non-biomass emissions highly. Biomass in road transport is relatively unimportant, but where it is used, ECRs are relatively high, reflecting relatively high rates on transport emissions in general. Emissions

from non-road biomass combustion are usually exempt from or zero-rated in pricing mechanisms. Consequently, omitting these emissions from the ECR calculations increases coverage and average rates.

Summing up, the main features of the current landscape of carbon pricing instruments are as follows:

- Taxes are higher and more uniform in road transport, and lower and more variable in other sectors. They fairly consistently apply at highest rates to oil products. In electricity, taxes primarily relate to consumption. These patterns are observed in most countries.
- In countries where they exist, emissions trading systems typically have the highest coverage in the electricity and industrial sectors. Differences across countries in terms of implementation, coverage, rates and allowance allocation mechanisms are large. However, in all cases, allowance prices are uniform across the sources covered (in contrast to taxes) and outside road transport are more similar in magnitude to taxes.
- Carbon tax coverage is low in most of the countries where carbon taxes apply. Carbon taxes almost always apply in countries that also implement an emissions trading system.
- The combined impact of low taxes and the low and still limited deployment of emissions trading systems outside road transport leads to the conclusion that most emissions are not priced at all or to a low degree.

While this report did not aim to investigate how these main features have come about, some observations were made. For example, more emissions are priced in countries with higher per capita GDP and with a lower carbon-intensity of GDP. Causation can run in two directions, with high rates having induced more abatement or low carbon dependence allowing higher ECRs. Also, countries that import a large share of their energy use are more likely to price CO_2 emissions from energy use, possibly related to energy security or trade balance concerns.

The principal contribution of this report is to present the distribution of ECRs on energy use. These distributions describe what share of emissions is subject to at least (or at most) a given level of carbon price. In addition, these shares are attributed to sectors, and the composition of the ECRs is presented. A summary measure of the distribution is introduced, namely the "carbon pricing gap".

The carbon pricing gap measures the extent by which carbon pricing falls short of the EUR 30 benchmark, as a percentage of total emissions. For current ECRs, the carbon pricing gap is 80.1%, meaning that less than 20% of emissions are priced at EUR 30 per tonne of CO_2 or more. If prices and coverage in all countries were to increase to at least the levels currently observed at the median for each sector, the carbon pricing gap would decline to 53.1%, suggesting that significant progress can be made by increasing rates where they are currently low, or implementing them where no carbon price applies currently. Such an approach would also lead to more uniform carbon prices, and this would result in more cost-effective abatement. Cost-effectiveness is always a criterion worth considering, and it becomes more important as abatement targets become more stringent.