Credible, effective and publicly acceptable policies to decarbonise the European Union

Final report

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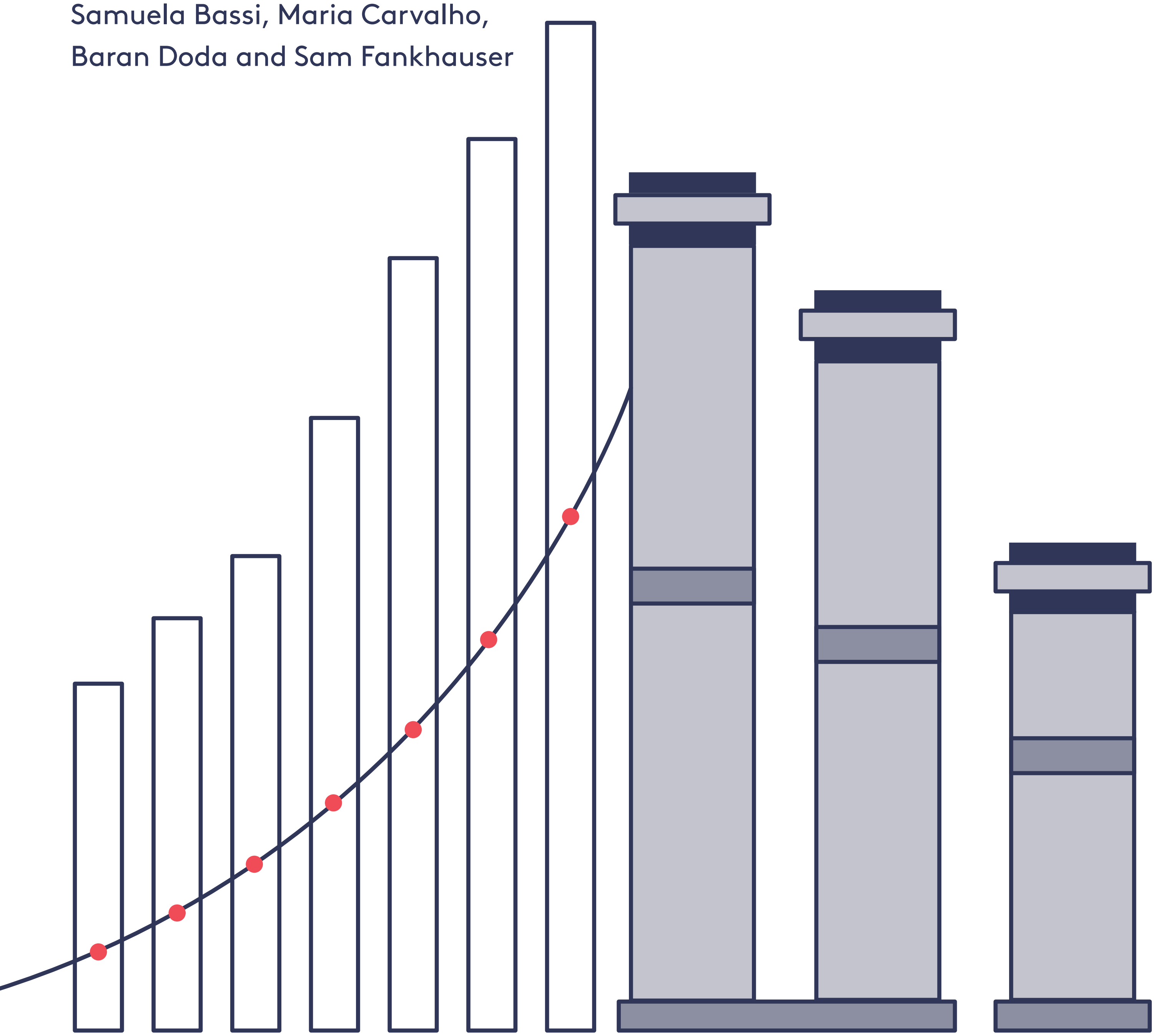

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About the authors and acknowledgements

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Executive summary

Further decarbonisation of the power sector is crucial for the European Union to meet its climate targets

The European Union was at the forefront of the international negotiations that led to the Paris Agreement. It has also set a number of mandatory internal climate targets for 2020 and 2030, which commit its member states to significantly reduce their greenhouse gas emissions, increase the share of renewable energy sources and improve their overall energy efficiency.

The ability to meet these targets depends crucially on the successful decarbonisation of electric power, as this, together with heat production, is the largest carbon emitter in the EU, accounting for more than a third of its emissions. Access to low-carbon electricity is also central to decarbonisation strategies for other sectors. Furthermore, the use of electricity is expected to increase sharply, for instance as the share of electric vehicles grows; therefore, 'clean' sources are vital.

Decarbonisation of the power sector is entering a new phase, which requires new policies

Over the past decade climate-related policies, coupled with stronger political will, have contributed to the rapid technological development and significant levels of uptake of low-carbon electricity generation in the EU.

Decarbonisation in the power sector to date has relied largely on the fluctuating carbon price signal from the EU emissions trading scheme (EU ETS) and on national financial support for 'nascent' renewable electricity sources, such as solar and wind technologies. As a result, these sources are becoming increasingly competitive with fossil fuels, as well as with long-standing low-carbon sources, such as nuclear and hydropower. These policies, however, have also led to some market distortions, which have eroded the competitiveness of incumbent low-carbon resources not targeted by subsidies.

The decarbonisation of the EU power sector is transitioning into a new phase, characterised by: the availability of more market-competitive renewable sources, which are less in need of infant industry-type support; a growing stock of incumbent low-carbon technologies, which now also include wind and solar technologies, some of which are reaching the end of their life and need replacing; and much tighter emissions constraints, to which the EU committed in the Paris Agreement and in its 2030 climate and energy framework.

The challenge now is to move to power systems that are eventually fully decarbonised

Full decarbonisation necessitates increasing the share of low-carbon sources that can compete with fossil fuel-based power, especially if carbon emitters face an appropriate carbon price. It also requires maintaining and upgrading the existing power generating stock, which consists of an increasing share of 'incumbent' low-carbon generation, currently accounting for nearly half of the EU's power generation. The emergence of this growing fleet of mature low-carbon generators creates an opportunity, and a need, to review the current balance between technology support policies (such as deployment subsidies) and carbon pricing.

As the decarbonisation of the power sector progresses, the focus will shift increasingly to reducing emissions from other sectors. In many there is an urgent need to improve and strengthen policy intervention, particularly by placing a price on carbon. Outside the EU ETS, this can be set through carbon taxes. The experience in the power sector offers lessons for how policy gaps may be closed using carbon pricing tools, notably carbon taxes, by making them more publicly acceptable.

Main findings on policy credibility, distributional impacts and acceptability

This report aims to show how the EU and its member states could feasibly and credibly achieve their medium- and long-term climate change targets, accounting for the opportunities and challenges of this new decarbonisation phase. The report explores three aspects of EU climate policy:

1. Distributional impacts among power producers

Through a theoretical model, we identify the most effective policy interventions in a power sector that can increasingly draw on mature (rather than nascent) low-carbon technologies and we explore how these policies vary in the way costs and benefits are distributed. We assess the welfare implications of a carbon price (in the European Union, this is applied to the power sector through the EU ETS), a coal tax, a tax on electricity consumption, and a technology-specific subsidy alternatively financed by the revenues from general taxation, taxes on electricity consumption or the proceeds from carbon pricing.

Taking into account the impact on power generators, governments' fiscal position and consumer welfare, out of these instruments, carbon pricing achieves emission reduction targets at the lowest cost and with the fewest distributional side effects. This is because it directly targets each input that generates carbon emissions, whereas other policies do so with additional distortions, or indirectly. Unlike most technology subsidies, carbon pricing maintains a level playing field between low-carbon sources of power, and unlike an electricity tax it does not curtail beneficial energy consumption.

2. Credibility of commitments to decarbonise the power sector

We then look at existing policies and institutional arrangements to assess how credibly the EU and its member states could embrace the policy reforms needed to achieve their decarbonisation commitments. In other words, we assess how 'credible' their commitments are — with credibility meaning the likelihood that policymakers will keep their implementation promises. We assess credibility along a common set of indicators, which include: having a suitable set of policies and legislation, a robust track record of policy consistency (by refraining from sudden policy reversal) and of meeting targets, sound and transparent decision-making processes (including for enforcing and monitoring policy), capable policymaking bodies, and a supportive socioeconomic environment, in terms of public opinion and the private sector.

Among the eight individual member states we assessed, credibility varies and there are weaknesses in all. Denmark, Germany and the UK are the top performers, while Poland and the Czech Republic appear to be those where the credibility of commitments need to be strengthened the most. Italy, France and Spain fall in the middle. The EU as a whole performs best in terms of having public bodies dedicated to climate change action, supported by consultative mechanisms, and in terms of having practically no history of climate policy reversal. It performs less well in terms of having a private sector supportive of climate change action, a climate-aware public, and on its policy and legislation.

3. Acceptability of carbon taxes for sectors outside the EU ETS

Our third area of focus is the need for stronger policies in sectors that lie outside the EU ETS. While the EU ETS is useful in creating a carbon price for large industrial emitters (such as the power sector), domestic carbon taxes, complemented by targeted regulation, can be relatively simple and effective tools for reducing emissions from sectors such as transport, waste, and, to a lesser extent, buildings and agriculture (where other policy instruments also have a role to play). Building on growing evidence on the acceptability of environmental taxation, we provide recommendations on how member states could introduce or strengthen domestic carbon taxes to curb emissions outside the EU ETS.

Introducing or strengthening carbon taxes is challenging, as it is often opposed by industry and the general public. The failed revision of the EU Energy Taxation Directive is a case in point. A growing body of evidence from surveys and field experiments shows that public opposition to carbon taxes stems from concerns that the personal costs of a tax would be too high, that carbon taxes may be regressive and that they may be less effective than subsidies. Individuals also tend to be suspicious of governments' 'true' motives, and may assume that carbon taxes are introduced only to raise revenues rather than reduce emissions. Yet we show that carbon taxes can be made publicly acceptable if they are communicated well and designed to address the most widely held concerns.

Policy recommendations

This assessment of the distributional impacts, credibility and acceptability of climate change policy points towards three key messages:

1. Distributional impacts

The existing imbalance between carbon pricing (embedded in the EU ETS) and subsidies for the decarbonisation of electricity is costly, and does not create a level playing field between current and future power generation assets. Our theoretical analysis concludes that:

- Carbon pricing is the most cost-effective policy instrument for reducing emissions. It treats incumbent and new low-carbon generators neutrally. Measures to raise the EU ETS price should feature more prominently in the EU policy mix, now that many low-carbon technologies have matured (thanks in part to past subsidies).
- Technology-specific subsidies to mature low-carbon technologies should not be the instrument of choice to reduce emissions because they are unnecessarily costly to society and have adverse impacts on the profitability of those who do not receive the subsidy.
- Carbon pricing works better if accompanied by complementary policies that target additional market failures, such as innovation and network externalities, and capital market imperfections. Flanking measures may also be needed to compensate those, such as low-income households and energy-intensive industries, who would be disproportionately hit by a higher carbon price.
- Technology-specific subsidies for the next generation of low-carbon technologies should be financed by the proceeds from carbon pricing, rather than through electricity taxes or general taxation. This is more cost-effective and leads to a more equitable distribution of policy costs and benefits among the incumbent and new generators.

2. Credibility

Successful decarbonisation of the power sector requires trust in a credible policy and institutional framework. Credibility has many dimensions, some of which take time to influence. However, fast improvements are possible in several areas:

- Strengthening legislative frameworks, both at EU and member state level, to include a clear long-term vision, statutory interim targets, and a commitment to key policy reforms, such as a stronger carbon price (through strengthening the EU ETS), the removal of fossil fuel subsidies and support for low-carbon innovation.
- Strengthening joined-up thinking on climate change and energy in public bodies and enabling independent scrutiny of their work through the parliamentary process, public debate and dedicated expert committees.
- Avoiding sudden policy reversals that destabilise investor confidence, through commitment devices and clearly articulated, transparent processes for the review of policies.

3. Acceptability

The EU's climate targets cannot be met through power sector decarbonisation alone. Introducing carbon pricing instruments through domestic carbon taxes is an effective way to incentivise emissions reductions outside the EU ETS and make all polluters pay. There are design options to make carbon taxes more acceptable to the public:

- Phasing in carbon taxes over time allows people to become familiar with the tax and can overcome initial resistance.
- Earmarking tax revenues to finance mitigation projects enhances acceptability by signalling a public commitment to reducing emissions.
- Alternatively, and preferably, tax proceeds may be used to address the regressive effects of carbon taxes or to achieve revenue neutrality.
- For all design options, information-sharing and clear communication are essential, both before and after the introduction of carbon taxes, in order to foster acceptance.

1. Introduction: the power sector and decarbonisation in the European Union

The European Union was at the forefront of the international negotiations that led to the Paris Agreement. It also set a number of mandatory internal climate targets for 2020 and 2030 that commit its member states to significantly reduce their greenhouse gas emissions, increase the share of renewable energy sources and improve their overall energy efficiency (European Commission, 2014a).

The production of electricity and heat is the largest contributor to greenhouse gas emissions in the EU, accounting for about 37 per cent of EU emissions in 2014 (International Energy Agency [IEA], 2016a). The use of electricity is also expected to increase, for instance as the share of electric vehicles grows (IEA, 2016b). Decarbonisation of the power sector must therefore be central to EU climate policy. The costs of reducing carbon intensity in the power sector are generally lower than doing so in other sectors (Committee on Climate Change, 2010).

The power sector has already witnessed a large transformation in the past decade, thanks to a number of policies that have addressed different market failures: carbon pricing to mitigate greenhouse gases externalities,[1] subsidies to support the uptake of nascent low-carbon technologies, and other market and regulatory tools, many of them aimed at energy efficiency improvements.

As a result, the EU is now moving into an important new phase of decarbonisation. Its power generation fleet has changed, with a growing portfolio of relatively mature low-carbon technologies (such as wind and solar power) in the process of reaching cost-parity with fossil fuels and long-standing low-carbon sources (such as nuclear and hydro power). Although fossil fuels still represent a significant share of the EU generation, as they are insufficiently challenged by relatively low carbon prices, low-carbon sources now provide nearly half of the electricity generated in the EU[2] (European Commission, 2017). Some of these are reaching the end of their life and will need replacing.

It is now a crucial time for policymakers to devise the next policy steps, in order to achieve ambitious decarbonisation targets while accounting for the changing features of the power generation fleet. New, cost-competitive renewable sources are being added to a growing pool of incumbent low-carbon generation, while fossil fuels will have to be phased out gradually, yet more radically. However, the EU's climate targets cannot be met through power sector decarbonisation alone, and reducing emissions outside the power sector is becoming increasingly important.

Focus of the report

This report investigates the extent to which current policies and institutional arrangements are fit for purpose for this new decarbonisation phase in the EU. The report explores three aspects of EU climate policy in particular, before highlighting key conclusions:

- **Chapter 2 explores the issue of the 'distributional impacts' associated with policies for reducing emissions in the power sector.** We explore how different policies vary in the way their costs and benefits are distributed among the government, consumers and electricity producers, focusing particularly on the supply-side of the power market.

1 A carbon price imposes a cost on a unit of greenhouse gas emissions. This can be done directly, by assigning a tax on each unit (commonly measured as a tonne of carbon dioxide equivalent, or indirectly, through a cap-and-trade scheme, such as the EU ETS. The carbon price for the power sector is covered under the EU ETS.

2 Solar, wind and hydro power combined account for about 20 per cent of total EU electricity generation; nuclear provides an additional 27 per cent of total generation (European Commission, 2017).

- **Chapter 3 discusses the credibility of member states' efforts to decarbonise electricity.** We investigate whether or not the current institutional arrangements are sufficient to enable member states to translate their commitments to decarbonise electricity into action or, in other words, how credible their low-carbon commitments are. We identify countries' strengths and weaknesses and suggest areas for improvement.
- **Chapter 4 focuses on the issue of public acceptability of carbon taxes on sectors outside the EU ETS.** We identify challenges, policy design options and communication strategies that could help make such taxes more acceptable.

Finding out more – background papers

This report is a summary of three research papers, carried out as part of the Statkraft Policy Research Programme by the Grantham Research Institute. They are:

- *The credibility of the European Union's efforts to decarbonise the power sector* (Bassi, Averchenkova and Carvalho, 2017)
- *Energy policy and the power sector in the long run* (Doda and Fankhauser, 2017)
- *How to make carbon taxes more acceptable* (Carattini, Carvalho and Fankhauser, 2017)

All are available to download from our website at **www.lse.ac.uk/GranthamInstitute/publications/**

2. The effectiveness of decarbonisation policies

Climate and energy policies vary in the way their costs and benefits are distributed among the government, consumers and electricity producers using different generation technologies. To date, the debate about distributional consequences has focused almost exclusively on the impact of carbon policies on energy consumers. However, there are also important differences on the producer side: that is, in the way policy affects different power generation technologies. One aspect that has been particularly neglected is the differing effect of carbon policies on new and incumbent low-carbon producers.

Using a theoretical model and simulation analysis, this chapter focuses on these 'distributional impacts', in particular on the supply-side of the power market.

Background: expansion and development of renewables

The past decade has seen a significant development in renewable electricity technologies. In 2015 they represented almost 30 per cent of the EU's power generation (European Commission, 2017). Some renewable sources, including hydropower, have been used for decades and their technology is well established, while others have seen a rapid growth in deployment in recent years. For instance, between 2005 and 2015 the share of electricity from wind rose from 2 to 9 per cent, and from solar power from nearly zero to almost 3.5 per cent of total EU generation.

The large expansion of renewable electricity from these sources has been stimulated by a range of energy and climate change policies aiming to decarbonise the power sector. Such policies have come to determine the allocation of electricity generation sources in the EU and globally. As a result, renewable resources, including wind and solar power, have matured and are becoming increasingly competitive against more established low-carbon technologies as well as fossil fuels.

At the same time, the first generation of wind and solar installations are reaching the end of their preferential tariff period, joining nuclear and hydropower in a growing fleet of incumbent clean electricity producers. Other power plants in the existing fleet are reaching the end of their life and will need replacing. It is crucial that future policies are consistent with the reality of this new generation mix, and enable countries to achieve the 2030 and 2050 targets at the least cost to society.

Assessing the distributional impacts of climate change policies

We developed a stylised theoretical model and simulated it to assess the implications of alternative policy packages.[3] In our model simulations we focused on six generation technologies, which together account for most of the power generation in the EU, grouped under the following three categories:

1. Wind, hydro and solar power. There are two distinguishing features of technologies in this group. First, they do not generate carbon emissions. Second, they produce power in sites whose productivity declines as more are developed, implying that less capacity is installed in sites with lower productivity. The decline in productivity can be due to geographic constraints (for example, limited sites suitable for dams) or technological constraints (for example, rapidly rising system-level costs when the share of intermittent renewables in total generation increases).

2. Coal and gas power. The productivity of these technologies is not site-specific, but they require fossil fuels, and therefore emit carbon as a by-product of generation. While firms operating these technologies can adjust the scale of production, they are restricted from developing new sites due to political-economy constraints (for example, local opposition motivated by NIMBYism).[4]

3. Nuclear power. This power source differs from wind, hydro and solar because it does not feature site-specific productivity. Despite being subject to political-economy constraints similar to coal and gas generation, nuclear is distinct from them because it does not generate carbon emissions.

Using the model, we assess the welfare implications of alternative policy packages:

1. A carbon price. In the underlying theoretical model, there is no difference between an emissions allowance price that emerges in an emissions trading system (such as the EU ETS) and an explicit carbon tax (such as the carbon price floor in the UK). Consequently, this report refers to both instruments as a 'carbon price'. In the European context, our findings apply to the EU ETS carbon price, since this is the main instrument regulating power sector emissions in member states (with the exception of the UK, as noted above, where the power sector is subject to both the EU ETS carbon price and the UK domestic carbon price floor).

2. A coal tax, which raises the effective energy input price for coal power plants only and discourages coal use.

3. An electricity tax, that is, a tax on the amount of electricity consumed, raising the relative price of electricity, no matter how it is generated (thus it is 'technology-neutral').

4. A technology-specific subsidy, that is, a subsidy provided by the government to incentivise greater generation by a select low-carbon technology. These subsidies can raise the price a generator receives (for example, green certificate schemes) or reduce the generators' input costs (for example, capital allowances and subsidised loans). Below we focus on subsidies that reduce input costs, and distinguish between three alternative ways of financing them using revenues collected through:

a) general taxation
b) an electricity tax
c) carbon pricing

3 The model is a partial equilibrium model of the power sector and abstracts from energy efficiency and technological improvements that can arise in response to policy intervention. For a full description see Doda and Fankhauser (2017).

4 The model assumes that political-economy constraints are binding for coal, gas and nuclear but slack (although not absent) for wind, hydro and solar power. This is discussed in detail in Doda and Fankhauser (2017).

In the model simulations, the stringency of each policy package is set to achieve the same reduction in emissions. For illustrative purposes, we discuss the results when the subsidies (in policy packages 4a, b and c) are applied to wind power. Results regarding other technologies are discussed in Doda and Fankhauser (2017).

The analysis provides a comparison of the changes in electricity prices, generation level and mix, and government expenditures associated with one of the policy packages above (which are additional to existing policies), relative to a benchmark case with no new policy. The simulation results are used to assess the implied change in welfare following the implementation of a policy package. Changes in welfare are measured by the sum of three distinct components, namely the difference between the amount each consumer is willing and able to pay for electricity and the actual market price (so-called 'consumer surplus'), each generator's current and future stream of profits, and the government's net revenues.

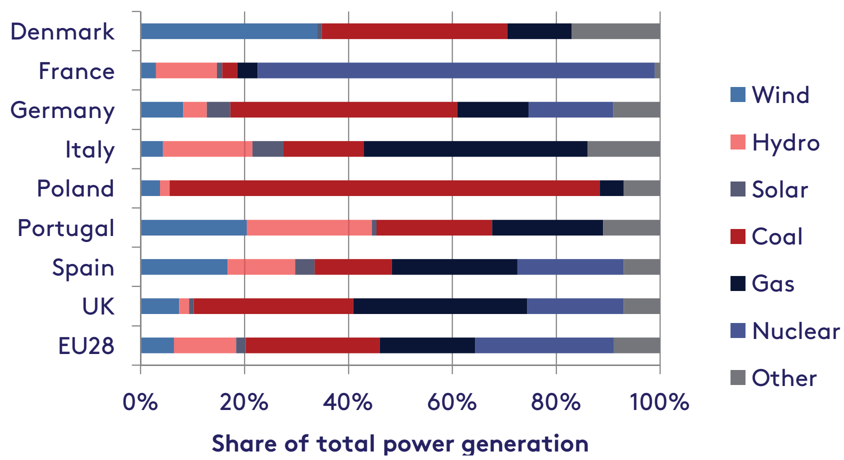
It is important to emphasise that the only policy objective here is to reduce emissions. There are other pertinent issues that energy and climate change policies can help address, but which fall beyond the scope of this analysis. These include innovation and network externalities related to low-carbon technologies, market power and security of supply in the electricity sector, capital market imperfections affecting climate finance, and barriers preventing the uptake of energy efficiency measures (Fankhauser and Stern, 2017).

Model results

The model results discussed below are based on data from Spain. This EU member state was chosen because its power mix includes all the six generation technologies mentioned above, and no single technology is dominant (i.e. accounts for more than 25 per cent of generation). Moreover, the technologies excluded from the model (such as biomass, geothermal and tidal) account for only a small share of power supply (about 7 per cent), therefore their exclusion is not likely to affect the results significantly. Spain also has ample potential to expand its generation from hydro sources. Finally, its generation mix is the most similar to the EU average.

The results we discuss below remain qualitatively valid, albeit quantitatively different, when the model is applied to the seven other member states that are also covered in this analysis, namely Denmark, France, Germany, Italy, Poland, Portugal and the UK. These countries feature substantially

Figure 2.1. Power generation mix, average 2010–2015, eight selected EU member states



Source: Authors' calculations based on European Commission (2017) different power generation mixes implied by their distinct economic, institutional, political and geographic contexts. As Figure 2.1 shows, France and Poland are characterised by a generation mix skewed towards a single technology: nuclear power in France (which provides almost 80 per cent of the total electricity generated) and coal in Poland (almost 90 per cent of generation). Nuclear generation is absent from the mix in Denmark, Italy, Poland and Portugal. Germany and the UK are different from the other countries analysed as they have used up a large share of their hydroelectric potential, which was quite small to start with. (The results for Poland and France are discussed in Doda and Fankhauser, 2017), while those for the other countries are available from the authors upon request.)

The impact of alternative policies on equilibrium prices and quantities in the electricity market is relatively small because it is possible to shift generation towards those technologies that become more competitive following the introduction of the policy. The only exception is an electricity tax. In this case a decline in emissions can only be achieved by constraining demand significantly, and this implies a reduction in total generation and aggregate profits.

Crucially, the policies also differ in the way they affect the generation mix and the market value of individual generators. A carbon price and a coal tax increase the amount of electricity generated by those that are not directly affected by these instruments, and raise their market value. While a coal tax reduces the value of only coal generators, a carbon price implies both coal and gas generators are negatively affected. All carbon-free generators experience an increase in their market values.

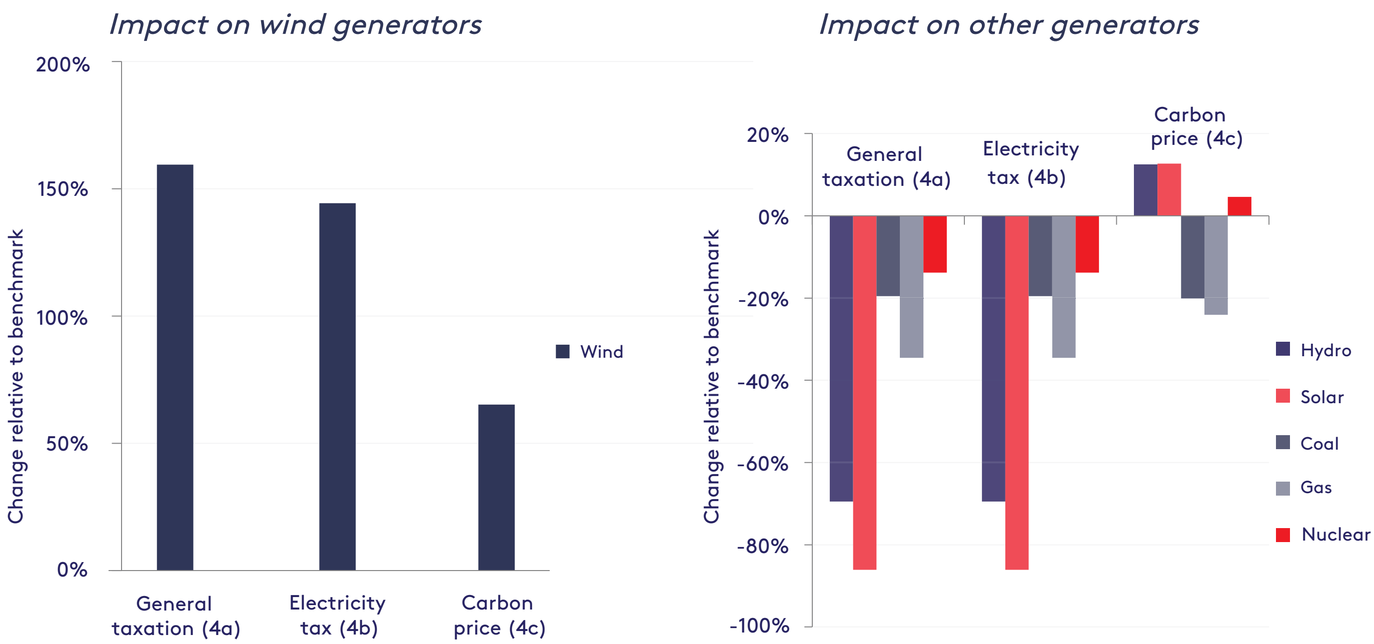
The electricity tax instead affects the overall size of the market, shrinking the amount generated by all power producers and their market value. The market values of wind, hydro and solar power generators are the most impacted. This is in part because the less productive sites, which were profitable in the absence of the electricity tax, are abandoned when the policy is introduced. The impact on the values of coal and gas generators, by contrast, is more modest relative to renewable producers. In the case of Spain, for instance, there is a decline in the level of coal generation, but, as the generation from other technologies declines too, the share of power generated by coal plants over total electricity supply increases slightly.

Technology-specific subsidies financed by general taxation (policy package 4a) shift the generation mix towards the subsidy recipient and raise its market value at the expense of all other technologies. Their distributional impacts on electricity generators, however, are different when the subsidies are financed by an electricity tax (4b) or using the proceeds from implementing a carbon price (4c). Using subsidies to the wind firm as an example, Figure 2.2 below shows the change in market value by generator. The figure singles out the wind firm in the left panel which, as the subsidy recipient, is impacted much more compared with firms using other technologies.

When financed by general taxation, the subsidy increases the market value of the wind firm by more than 150 per cent, but also implies sizable reductions in the market values of all other generators, including low-carbon ones. If the subsidies are paid for by an electricity tax instead, the change in the wind generators' market value is more modest, while the implications for the values of non-wind generators are identical to the case where the subsidies are financed by general taxation. It is also possible to finance the subsidy with revenues generated by a carbon price. Doing so further limits the increase in the value of the wind generators and raises the value of other low-carbon generators relative to both an electricity tax and the benchmark case.

All things considered, the welfare in the economy (consisting of consumer surplus, power generators' profits and the government's net revenues) declines in response to each of these policy interventions compared with the benchmark case.

Figure 2.2. Technology-specific subsidy to wind: impact on firms' market value

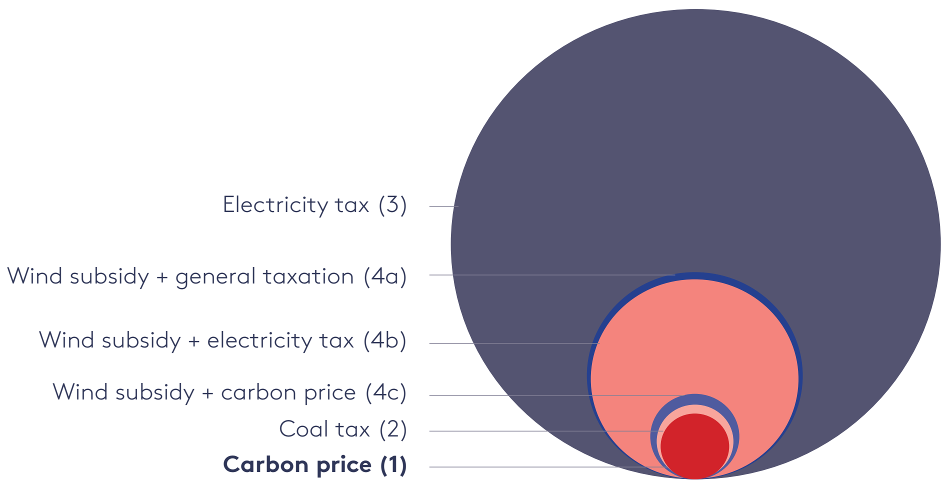


Source: Authors

It is important to be explicit about what is excluded from this welfare measure. First, any local and global benefits due to the reductions in emissions are absent from the model. Consequently, the model can help find the policies that achieve a given reduction in emissions (here, a hypothetical 25 per cent) at the lowest cost to society, but cannot provide any guidance on the choice of the target itself. Second, the model overestimates the costs of policy intervention. This is because it was not possible to take into account the beneficial effects that policy is also likely to induce, such as technological advances and efficiency improvements, which can offset all or some of the policy costs.

With these caveats in mind, among the instruments considered, a carbon price achieves the emission reduction target at the lowest cost to society. This is shown in Figure 2.3, where the welfare cost of alternative policy packages is depicted by the areas of the six circles.

Figure 2.3. Welfare cost of selected policy packages reducing emission by 25 per cent relative to a carbon price



Source: Authors

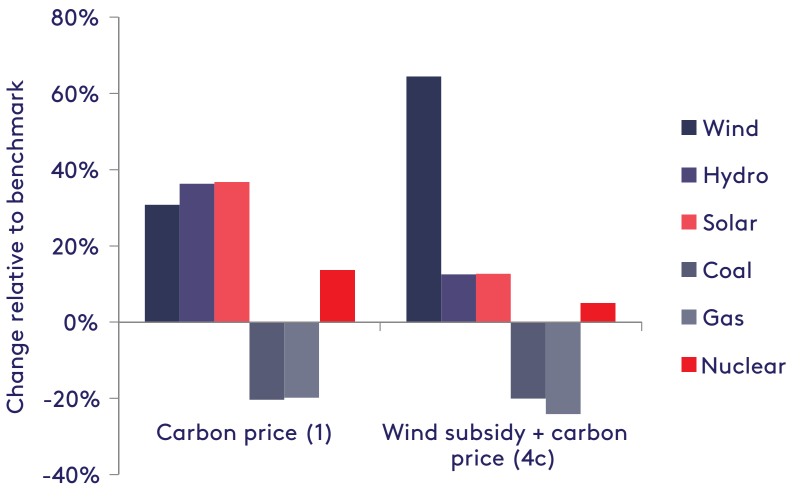
The carbon price is cost-effective because it directly targets each input that generates carbon emissions, whereas other policies do so with additional distortions, or indirectly. For example, a coal tax in effect ignores (in fact, increases) emissions from gas generation and hence places a needlessly high burden on coal generators. A subsidy to wind generation financed by general taxation revenues reduces emissions indirectly by improving the competitiveness of wind relative not only to coal and gas, but also to other low-carbon technologies (namely hydro, solar and nuclear). An electricity tax also implements the emissions reduction indirectly, by shrinking the market as a whole. In so doing it hurts both consumers and generators so much that even the sizable revenues it generates for the government are not worthwhile from society's perspective by a wide margin.

A technology-specific subsidy imposes the smallest cost on society when financed by the proceeds of a carbon price, i.e. policy package 4c. At the other extreme is policy package 4a, which pays for the subsidy using revenues from general taxation, and implies a welfare cost about six times that of 4c. This large difference is due to the fact that 4c operates on two channels that reinforce each other. The first channel is the subsidy, which provides a competitive edge to a particular low-carbon technology (here, wind). At the same time, the second channel, the carbon price, reduces emissions from coal and gas generators disproportionately by raising their input costs.

When subsidy expenditures are alternatively financed by an electricity tax, as in policy package 4b, the second channel no longer operates. Emissions still decline, due to the reduced demand for the output of coal and gas generators induced by the tax. However, the tax also reduces the demand for the output of those low-carbon technologies that are not subsidised (here: hydro, solar and nuclear firms). Consequently, the higher price faced by the consumer implies a larger reduction in consumer surplus, making the overall welfare cost somewhat smaller than that of policy package 4a.

Finally we note that, in addition to being the most cost-effective policy, a carbon price alone, i.e. policy package 1, also leads to a more equitable distribution of the costs and benefits of policy intervention among the generators. This is illustrated in Figure 2.4, showing the supply-side distributional impacts of a carbon price and a technology-specific wind subsidy financed by the proceeds of a carbon price, i.e. policy package 4c. Not surprisingly, the latter package implies disproportionately large gains for the subsidy recipient which the former can moderate by treating all low-carbon technologies neutrally.

Figure 2.4. Carbon price with and without a technology-specific subsidy to wind: impact on firms' market value



Source: Authors

Policy recommendations

The modelling exercise above leads to a number of insights for policymakers as the power sector moves into a new phase of cost-competitive renewables.

a) A carbon price is the most cost-effective instrument to reduce carbon emissions from the power sector. It should be more prominent in the future policy mix.

This finding is unambiguous and well-known. By targeting the carbon emitters directly, a carbon price introduces relatively small distortions in the market in delivering the targeted emissions reductions. An important new result emerging from our analysis is that a carbon price treats all mature low-carbon generators neutrally and does not reduce their market value. In the future, therefore, measures that raise the EU ETS price should feature more prominently in the EU policy mix.

b) Technology-specific subsidies to mature low-carbon technologies should not be the instrument of choice to achieve further emissions reductions.

Technology-specific subsidies reduce emissions indirectly by providing a competitive advantage to the subsidy recipient, enabling it to increase its share in the generation mix at the expense of coal and gas generators. However, incumbent low-carbon generators that do not receive the subsidy also lose market share and their profitability is adversely impacted.

c) Carbon pricing works better if accompanied by complementary policies that remove additional market failures.

Although carbon pricing emerges in this study as the most desirable policy from a welfare point of view, it does not mean that there is no scope for other policies. Examples of other relevant market failures include those affecting capital markets, low-carbon innovation and energy conservation (Bowen and Fankhauser, 2017). Notably, subsidies and other support policies will still be needed for those low-carbon technologies that are not yet cost-competitive. These include, for instance, next generation renewables (e.g. tidal and wave technologies) and carbon capture technologies. Flanking measures may also be needed to compensate those, such as low-income households and energy-intensive industries, who would be hit disproportionately by the carbon price.

d) Technology-specific subsidies for the next generation of low-carbon technologies should be financed by the proceeds from carbon pricing, rather than revenues from electricity taxes or general taxation. Carbon pricing is the least costly way of paying for technology-specific subsidies and it leads to a more appropriate distribution of the costs and benefits of policy intervention among generators.

Using revenues from carbon pricing to pay for technology subsidies allows the government to achieve emissions reductions through two channels that reinforce each other. First, the subsidy improves the competitiveness of the low-carbon technology receiving the subsidy, enabling it to expand and capture market share. Second, the coal and gas generators shrink as their costs increase disproportionately due to the carbon price. Financing via electricity or general taxation cannot rely on the latter channel because all non-subsidised generators, including low-carbon ones, are disadvantaged and must shrink their production.

3. The credibility of decarbonisation commitments

Credibility is vital for building trust among investors and the international community, and for helping to increase the ambition of political commitments over time. An important question is therefore to what extent the EU as a whole, and its member states individually, will be able to translate their climate change commitments into action, specifically in terms of decarbonising the power sector. This chapter aims to address this question, by providing a first assessment of the credibility of EU member states' efforts to achieve their 2030 objectives.

This assessment does not intend to be a ranking of credibility of the given countries; indeed, a quantified assessment of a concept like credibility would be impossible and potentially misleading to make. The aim here is to provide a simplified framework to identify key trends, areas of strength and weakness, and opportunities for improvement of countries' political credibility with respect to their commitments to decarbonise the power sector.

Background: why investigate the credibility of a country's commitments?

Assessing the credibility of a country's decarbonisation efforts can offer important policy insights:

- First, a better understanding enables member states' policymakers to act upon those determinants that can improve the likelihood that member states will deliver on their commitments.
- Second, it offers some additional guidance to investors in new or existing low-carbon power generation. Although technologies are maturing, many low-carbon generators still rely on government intervention to correct basic market failures, exposing them to policy risk that some investors may be reluctant to take on (Fankhauser and Bowen, 2017). Policy credibility is therefore essential for reassuring investors that governments will stand by their promises.
- Third, it can support the European Commission in identifying strengths and weaknesses in the climate strategies of member states, for instance in the context of the Integrated National Energy and Climate Plans, which members are required to submit to the Commission by 2018. These will set out their national contributions to the 2030 energy and climate targets and present objectives, policies and measures to attain them. The methodology developed here could be applied to these plans to assess how the commitments therein can be made more credible.

It is important to note that the assessment of credibility is different from analyses of effectiveness (that is, the extent to which a policy achieves its stated objectives) and of ambition (for example, whether or not policies are sufficient to meet the 2°C Paris Agreement target). However, all three are closely related, in a complex and multifaceted way. For example, the lower the ambition of a commitment, the higher the probability that the policies to implement it will be effective. And as governments are able to fulfil low-ambition promises easily, the credibility of those commitments would appear to be high. Credibility, effectiveness and ambition therefore need to be viewed together in order to understand the bigger picture of how countries are tackling climate change. As a large body of literature has focused on ambition and policy efficiency, this analysis aims to complement those assessments by focusing on credibility.

How to measure credibility

The approach taken by this report builds on the work by Averchenkova and Bassi (2016), which developed a framework for the assessment of the political credibility of the pledges submitted by the G20 countries for the Paris Agreement, focusing on the likelihood of those governments adhering to their commitments. This framework has been refined to account for the specific governance framework of the EU and its member states, a narrower policy focus (the decarbonisation of the power sector), and a larger set of comparable data available for these countries compared with the G20.

While emissions from the power sectors are regulated at EU level through the EU ETS, member states have a crucial role to play in ensuring that their institutional set-up (including complementary domestic policies, the functioning of government bodies, and stakeholders' engagement) supports long-term credibility of their decarbonisation commitment and attracts investment. A full description of the approach used for this assessment can be found in Bassi et al. (2017).

Credibility, in this assessment, means 'the degree of likelihood that policymakers will keep their promises to implement their announced pledges or policies' (as defined in Averchenkova and Bassi, 2016). Specifically, it is the likelihood that member states will decarbonise their power sector consistently with the EU medium- and long-term climate change objectives.

Assessing credibility is challenging because it is driven by multiple factors that often interact and mutually reinforce one another. Drawing on various theoretical and empirical studies, it was possible to outline the main features that appear to increase the likelihood of a country's announced commitment being implemented. These are:

1. **Legislation and policy:** a coherent and comprehensive legislative and policy basis
2. **Public bodies:** dedicated public bodies supported by consultative mechanisms
3. **Policy reversal:** no history of policy abolition
4. **Past performance:** a track record of delivering on past climate change commitments
5. **Decision-making process:** a transparent, inclusive and effective decision-making process with sufficient political constraints to limit policy reversal
6. **Private bodies:** private bodies supportive of climate change action
7. **Public opinion:** climate-aware public opinion supportive of climate change action

While these determinants were chosen in light of a particular focus on the power sector, the assessment also largely applies to climate change mitigation commitments in general. The first two determinants – legislation and policy, and public bodies – are within the direct and immediate control of policymakers. Improvement on these determinants would have an immediate effect on the level of credibility of a country's commitment.

Policymakers can also act directly on the determinants for policy reversal, past performance and decision-making process, although the effects may only be perceived in the longer run because it would take time for a government to improve its history of meeting targets and maintaining policy coherence. Decision-making processes, which include acting with transparency and building buy-in from stakeholders, arguably also require institutional changes, which may take time to consolidate.

The last two determinants – private bodies and public opinion – are related to the socioeconomic context of a country, and are outside the control of policymakers. However, improvement of the determinants that are under government control can, in the long run, also have a positive effect on the response of society, by improving the level of support for climate action by stakeholders.

In light of this set of determinants, a simplified set of qualitative and quantitative information and indicators were selected in order to measure the credibility of member states' efforts to decarbonise their power sectors. These are listed in Table 3.1. Most of these indicators refer to a specific point in time (the year the latest data was available for, as indicated in the table). The analysis therefore provides a snapshot of countries' credibility at the present time, rather than a dynamic picture. Conducting similar assessments in the future could help to develop a more nuanced view of how credibility changes over time. A full description of the indicators and how they have been assessed can be found in Bassi et al. (2017).

Table 3.1. Determinants and indicators for analysing the credibility of climate commitments				
	Determinants	Indicators	Data for scoring	Year
1	**Legislation and policy:** Coherent and comprehensive legislative and policy basis	High-level vision	- Climate change mitigation framework legislation - Economy-wide greenhouse gas targets: time horizon - Renewable targets for the power sector: time horizon	2017 2017 2017
		Low-carbon policies relevant to the power sector	- Carbon price level - Size of fossil fuel subsidies (€/GDP) - Size of low-carbon electricity subsidies and variance - Weighted average cost of capital (WACC) of renewable investment	2016 2006–2014 2008–2012 2016
2	**Public bodies:** Dedicated public bodies supported by a consultative mechanisms	Public bodies	- Dedicated climate change bodies joined up with energy bodies - Consultative bodies	2017 2017
3	**Past policy reversal:** No history of policy abolition	Abolition of climate change legislation	- Unexpected reversal of climate change-related legislation for power sector inconsistent with decarbonisation objectives	2000–2017
4	**Past performance:** Track record of delivering on past climate change commitments	Achievement of EU targets and milestones	- Performance towards emissions abatement in EU emissions trading system - Performance towards interconnection - Performance towards emissions abatement in EU emissions trading system	2017 2017 2017
5	**Decision-making process:** Transparent, inclusive and effective decision-making process with sufficient political constraints to limit policy reversal	Mechanism for building buy-in from stakeholders	- Voice and accountability index	2015
		Stable, consistent and not easily reversible law and policymaking process	- Political constraints index - Government effectiveness - Political stability and absence of violence/ terrorism - Government stability	2016 2015 2015 2015
		Transparent, consistent and effective administrative and enforcement mechanisms	- Bureaucracy quality - Corruption Perceptions index - Rule of law - Regulatory quality	2015 2015 2015 2015
6	**Private bodies:** Supportive private bodies	Private bodies	- Jobs in carbon-intensive sectors - Jobs in low-carbon sectors - Litigation cases	2013 2015 2017
7	**Public opinion:** Climate-aware public opinion	Public opinion	- Perception of climate change (importance and seriousness) - Support to climate action (renewables and energy efficiency targets) - Political support (green party seats in European Parliament)	2015 2015 2017

These indicators, or combinations of them, were assessed on a scale from zero to four, rating their support to the credibility of climate pledges, as follows: 'not supportive' (0.00–0.49), 'slightly supportive' (0.50–1.49), 'moderately supportive' (1.50–2.49), 'largely supportive' (2.50–3.49), and 'fully supportive' (3.50–4.00) to the credibility of climate commitments. The overall score for each determinant was obtained as a simple average of the score of their underlying indicators. Given the lack of empirical studies on the relative importance of the determinants of credibility, we simply assumed that every indicator is equally important or, in other words, that they have the same weight. For the same reason, the study does not create an aggregated quantitative indicator of credibility. Rather, the primary focus of this analysis is to identify, rather than weigh up, the individual factors affecting credibility, and to draw insights from individual determinants.

Finally, it should be noted that the determinants of credibility and the indicators chosen to describe them are mostly qualitative in nature and are strongly influenced by the complex features of the country they are applied to. The information collected under each indicator is intentionally simple and easy to replicate. The resultant scoring system is a relatively crude approximation of the strength of each determinant of credibility in each country, and some nuances are necessarily lacking. For instance, cross-border issues (such as the unintended effects of domestic policies on other member states) and dynamic factors (such as the timing of elections) could not be taken into account. While the approach is far from perfect, this first assessment aims to stimulate discussion on how credibility can be improved across the EU.

Credibility of power sector decarbonisation efforts in the EU

The framework was used to assess the credibility of efforts to decarbonise the power sector in selected member states. The country results are meant to illustrate how the methodology works in practice. They also provide a first broad-brush assessment of how strongly climate change efforts are supported by the political, institutional and socioeconomic features already in place in the analysed countries. In light of this, it is possible to identify areas in which countries can improve the factors that influence the credibility of their climate commitments.

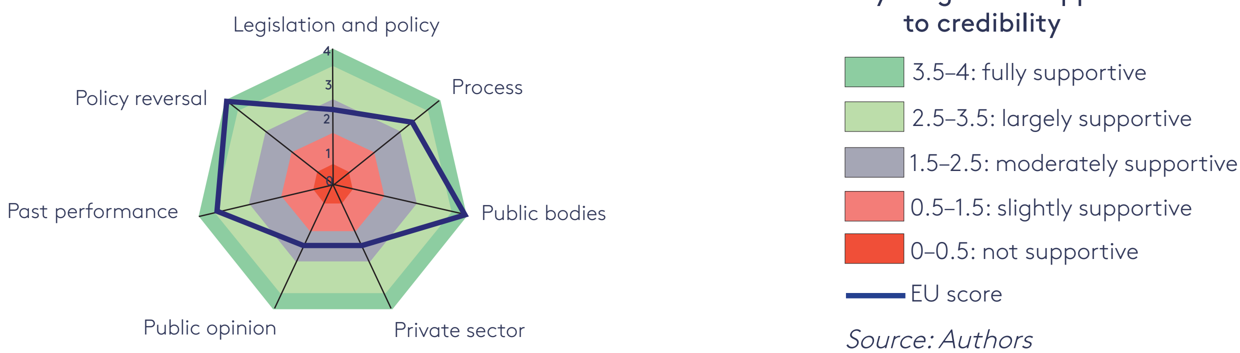
The analysis focuses on eight selected member states: the Czech Republic, Denmark, France, Germany, Italy, Poland, Spain and the United Kingdom. This sample was chosen to ensure sufficient geographical diversity among northern and southern countries, as well as among old and new member states. It also accounts for different levels of carbon intensity of economies. While the framework is applied only to a subset of member states, it is designed to be applicable to any other member state and, in principle, to other countries outside the EU.

The assessment of credibility was also carried out on the EU as a whole – see Figure 3.1. Some of the data collected for the EU is based on an average of the 28 member states' scores (for example, on public opinion or on decision-making processes, as these are based on existing indicators developed at the country level only), while some reflect specific characteristics of the EU, such as institutions and policies.

Results for the EU as a whole

The EU as a whole performs best on the public bodies and policy reversal dimensions, which appear to be strongly supportive to credibility. This reflects the quality of its institutions, which display joined-up thinking through a shared commissioner for the directorate in charge of climate change and the directorate for energy policy. The need for strong consensus in the legislative process and the balance of veto power of the member states also means that EU legislation affecting the decarbonisation of the power sector is rarely fully reversed. However, in some cases EU policies and procedures can lead to some policy inconsistencies in the member states. For example, the EU's state aid regulations, which are meant to regulate government interventions that could distort competition, have induced some

Figure 3.1. Scores for the whole European Union



Source: Authors

unintended policy reversals at member-state level. The credibility framework could only capture these revisions at that level rather than at EU level. However, the introduction in 2014 of revised guidelines on state aid for environmental protection and energy (European Commission, 2014b) arguably has improved clarity and reduced the risk of sudden U-turns on national climate policy.

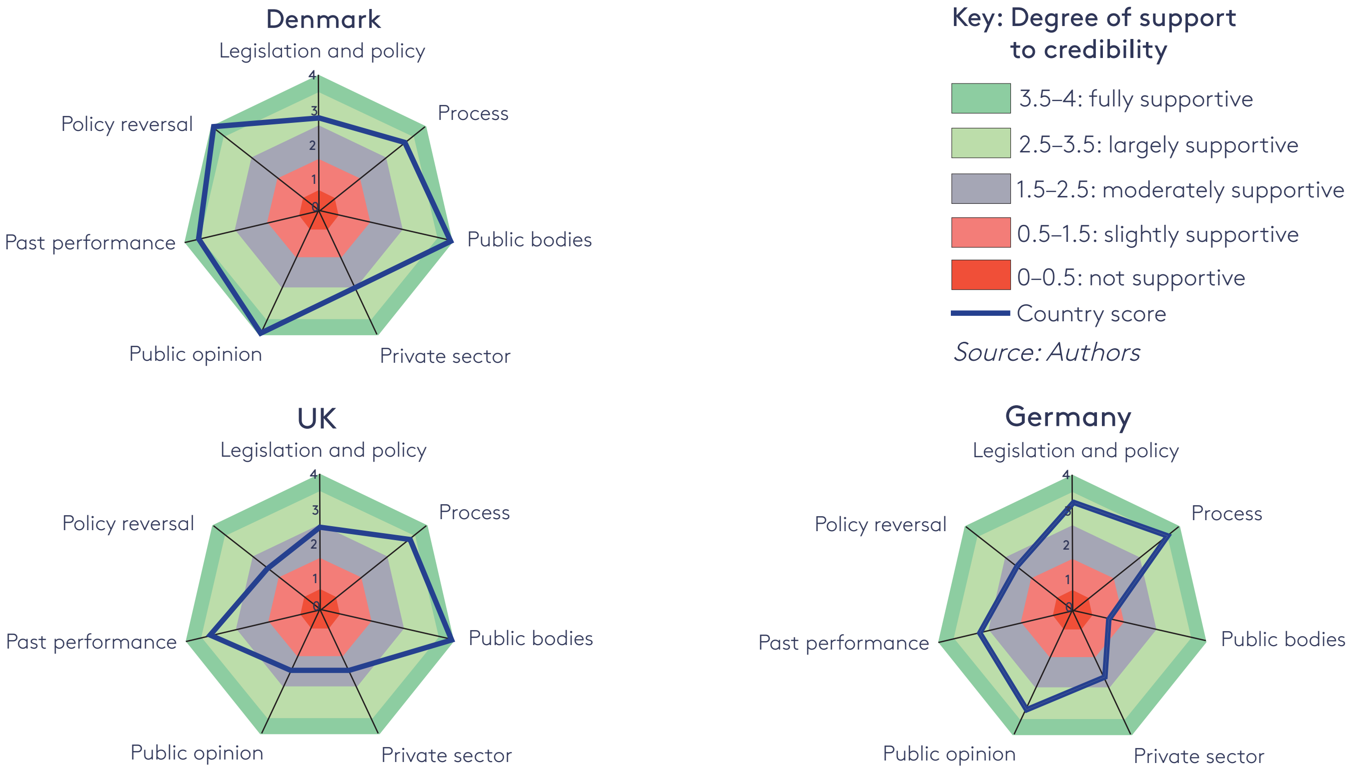
EU policy and legislation are only moderately supportive to credibility, largely due to the currently low carbon price embedded in the EU ETS and the lack of specific targets for the power sector (although the latter are left to the discretion of member states).

The EU performs less well on the private sector, public opinion and past performance dimensions, which reflects the average scores in the 28 member states.

Results for the individual member states

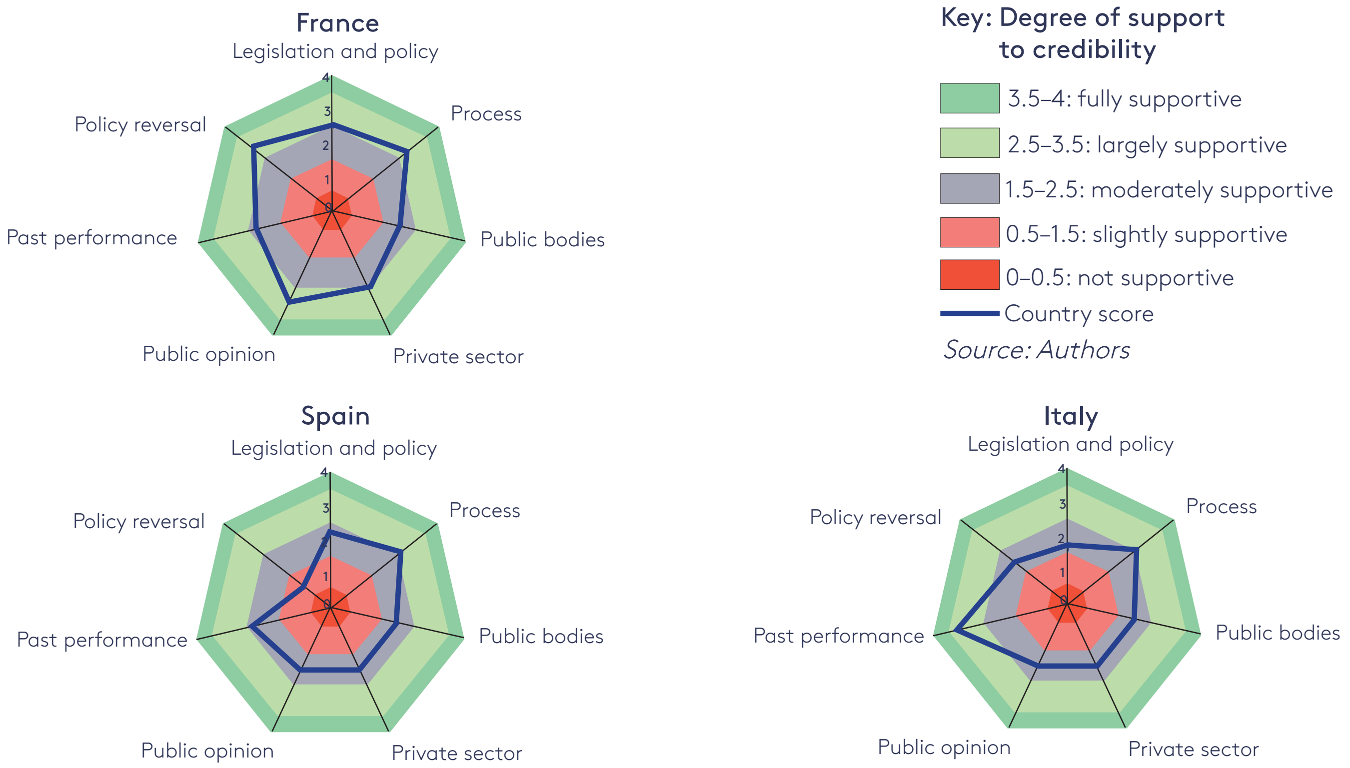
Credibility varies across member states. All the countries analysed display some individual weaknesses in their institutional framework that will need to be addressed in order to improve their credibility in the

Figure 3.2. Overview of country scores: **Top performers**



Source: Authors

Medium performers



Bottom performers

eyes of both investors and peers. Denmark, Germany and the UK are the top performers, while Poland and the Czech Republic appear to be those where credibility is least supported. Italy, France and Spain fall in the middle – see Figure 3.2 above.

Legislation and policy is largely supportive to credibility in the Czech Republic, Denmark, France, Germany and the UK, and moderately supportive in Italy and Spain. Only in Poland are existing policy and legislation slightly supportive of credibility.

All countries have a framework mitigation policy, except for Poland. In some countries this is complemented by climate change targets that go beyond the EU requirements. The UK, France and Germany, for instance, have legally binding greenhouse gas targets for 2050 as well as detailed intermediate targets. Germany, Denmark, the Czech Republic and France also have targets for the uptake of renewable sources in the power sector beyond 2020.

Furthermore, all member states share a common carbon pricing, embedded in the EU ETS. This, however, is relatively low, standing at around €4.50 in 2016 (World Bank et al., 2016). For the purpose of this study, we consider an additional domestic carbon pricing as having a positive effect on credibility. This is because an additional carbon price applied to electricity signals a willingness to go beyond EU policies, although it does not lead to additional emissions reductions at EU level (the emission cap in the EU ETS is fixed). If carbon pricing is applied to other sectors, it would ensure a more uniform and coherent carbon pricing across the economy, also signalling credibility. And Denmark, France and the UK have additional domestic carbon pricing above €20 per tonne of carbon dioxide, although only the UK's applies to the electricity sector (acting as the lower bound to the EU ETS carbon price). Germany, Italy, Poland, Spain and the UK also have relatively low fossil fuel subsidies, below the EU average (0.14 per cent of GDP).

All of the member states we investigated have introduced subsidies to support renewables uptake. Generally, subsidies in the past have helped to stimulate innovation and investment, therefore higher subsidies are associated with higher levels of credibility. As discussed in chapter 2, however, as technologies become more mature, subsidies become less desirable, therefore there is an expectation that countries would (and should) gradually decrease their level. What matters in terms of credibility is that these changes are introduced in a predictable and transparent manner, rather than as an unexpected, sudden drop in support, which can destabilise investment. The study therefore also takes into account the level of variability of subsidies over the period 2008–2012 (for which comparable data is available), assuming that high variability in the subsidy rates over time hampers credibility. Poland and Italy, for instance, display a relatively low level of subsidies (as a percentage of GDP) as well as high variance. Poland also has the highest weighted average cost of capital (WACC) among the countries analysed (based on Ecofys, 2016), a measure of the risk faced by investors.

In terms of public bodies fully supportive to credibility, Denmark and the UK provide particularly good examples. They display joined-up thinking in climate and energy policy as these are dealt with by the same government department – the Ministry for Climate, Energy and Building in Denmark and the Department for Business, Energy and Industrial Strategy in the UK. In addition, their progress towards meeting their climate change objectives is monitored by independent bodies – the Climate Council in Denmark and the Committee on Climate Change in the UK. Public institutions could be improved in particular in Poland and Germany, by joining up climate and energy polices in a single department, and ensuring government action is scrutinised by independent bodies.

Frequent, sudden policy reversals lowering the ambition of decarbonisation efforts are a challenge to the credibility of decarbonising efforts in several of the countries analysed. The Czech Republic and Spain have experienced the largest number of policy reversals, affecting several low-carbon technologies. To a lesser extent, policy reversals were also enacted in France, Germany, Italy and the UK.

Policy changes are not necessarily detrimental, and do not hamper credibility if planned well in advance and in a transparent manner. Germany is an example of a country that has made both good and bad policy revisions. For instance, it was able to incorporate policy design mechanisms to discover actual technology prices, announced in advance that it would review feed-in tariff rates annually, and limited capacity additions in order not to overburden budgets. A contrasting example is the unexpected revision of Germany's proposal to extend the operating lifetime of its nuclear power fleet, which followed the 2011 nuclear accident in Fukushima, Japan. This unforseen, sudden change led to the premature end of the licences of eight nuclear generation plants.

Importantly, the 'policy reversal' determinant needs to be considered in conjunction with the determinant for 'policy and legislation', to understand if the lack of reversal is in itself a sign of climate policy coherence, or rather if it is due to the fact that policies are too few and weak to stir any opposition or change. Denmark and Poland are cases in point. Denmark scores high on policy and legislation credibility, and displays no reversal. Poland, on the other hand, has made no significant policy reversal, but its score on policy and legislation is low.

Countries' performance towards existing targets is at least moderately supportive to credibility in all the countries analysed. Some countries have been struggling with some of the domestic targets considered here. Notably, France and Spain are likely to miss their 2020 renewables targets for the power sector, stated in their National Renewable Energy Action Plans (NREAPs). Poland and Spain are those that are the furthest away from meeting the 2020 electricity interconnection target (to be able to transport at least 10 per cent of electricity from domestic power plants across borders to neighbouring countries). While interconnection is in some cases outside the control of an individual country, it is an indication of how ready their infrastructure is to higher shares of intermittent renewable electricity, and this in turn affects the feasibility and credibility of their decarbonisation objectives. Poland is also the only country among those analysed whose emissions in the EU ETS are above its allowance for the third trading period (2013–2020). While buying allowances is allowed and, indeed, an intrinsic feature of the EU ETS, it implies limited domestic investment in low-carbon generation. This may increase the risk that carbon-intensive generation capacity becomes stranded if carbon prices increase. In our assessment this is considered detrimental to credibility.

Decision-making processes largely supportive of credibility are apparent in all the countries analysed, thanks to well established and functioning institutions, although with slight differences. In particular, the mechanisms for building buy-in from stakeholders appeared to be largely supportive to credibility in all countries but Poland, where it is only moderately supportive. The indicators for stable policymaking processes appear largely supportive to credibility in the Czech Republic, Denmark, Germany, Poland and the UK, and moderately supportive in France, Italy and Spain. Finally, the score for administrative and enforcement mechanisms was generally higher, being fully supportive to credibility in Denmark, Germany and the UK, and largely supportive in all the other countries.

The composition of the private sector is largely supportive of credibility in Denmark and France, with a relatively small number of jobs in carbon-intensive sectors (especially in France), a relatively large number of low-carbon jobs (especially in Denmark) and a history of almost no litigation cases hampering climate policy.

The carbon-intensive sector is a relatively important source of jobs in the Czech Republic, Germany, Italy and Poland (i.e. above the 70 per cent EU percentile), and this could embolden the lobby power of these groups in those countries. Notably, in Poland the private sector has challenged climate legislation in several court cases.

The scores for public opinion display significant differences across the countries analysed. Overall, public opinion appears to be fully supportive to credibility in Denmark, largely supportive in Germany and France, and moderately supportive in Italy, Spain and the UK. Climate change awareness among the public in Poland and the Czech Republic is among the lowest in the EU, and this could undermine policymakers' appetite for bolder low-carbon policies in those countries.

Policy recommendations

From this assessment of credibility, a number of lessons can be highlighted for the eight countries analysed by our research, and they are generally valid, too, for EU member states that share similar characteristics.

a) Clear policy and firm legislation are key areas in which policymakers can make immediate gains in terms of credibility.

Notably, credibility is enhanced by having a coherent high-level vision and long-term planning, which can give investors a clear direction of travel. Under the proposed Regulation on Governance (European Commission, 2016), the forthcoming Integrated National Energy and Climate Plans (NECPs) up to 2030 are offering an important opportunity for member states to develop a more integrated approach to their energy and climate policies. Among the countries analysed, Poland appears to score the lowest on this aspect. Its credibility would be improved by introducing a climate change strategy in framework legislation (Poland is the only country among the eight analysed that does not have one), and setting clear short- and long-term targets for the power sector.

Policymakers can also enhance credibility by introducing or strengthening appropriate low-carbon policy. This would include raising the price of carbon (through the EU ETS for what concerns the power sector, and by raising domestic carbon pricing in other sectors to ensure that emissions are priced consistently across the economy), removing fossil fuel subsidies and making low-carbon subsidies more predictable, for instance by designing and communicating how subsidies could be adjusted to changing circumstances. Poland and Italy's low-carbon policies would particularly benefit from policy reform in these areas.

b) Policymakers can further strengthen credibility by improving joined-up thinking and scrutiny of decision-making bodies.

Dealing with climate change and energy within the same government department could stimulate a higher level of joined up-thinking on decarbonising the power sector. In addition, setting inter-parliamentary or, ideally, independent bodies that monitor government action on decarbonisation would further reinforce credibility. Here again, the preparation of the integrated NECPs should be used as an opportunity to foster closer cooperation among government departments. Denmark and the UK already represent a good example of public bodies fully supportive to credibility. Poland and Germany, on the other hand, are those that would benefit the most, among the countries analysed, from improved coordination and independent oversight.

c) Commitment devices may be required, to ensure policy consistency over time.

Frequent policy reversal is an important credibility issue in several member states, especially the Czech Republic and Spain, and, to some extent, France, Germany, Italy and the UK. Making changes to policies is not necessarily detrimental, as policies do need to be updated to reflect changing dynamics, such as changes in technology and energy prices, along with changing economic circumstances, but clear adjustment mechanisms should be planned for and announced in advance. These countries, however, have made unexpected retrospective changes to the terms of existing policies, or have temporarily or permanently abolished them before their end dates. These kinds of policy reversal are especially detrimental when they affect the basis on which investors found their business case. The establishment of the 10-year NECPs should encourage more consistency in medium- to long-term decision-making, provided that the possibility of sudden policy U-turns in the period covered remains limited.

d) Dialogue and consultations, together with tailored policy design, should be pursued to generate policy buy-in from the private sector and the general public.

This is important as credibility hinges on the support and buy-in of stakeholders. Their support for climate action is crucial in particular in those countries where climate change policy needs greater reform. Denmark, for instance, has a supportive stakeholders' base and scores well across all determinants. In Poland, on the other hand, public opinion and the private sector are not supportive of climate change action, and this appears to be associated with an overall poor performance across most of the determinants of credibility. Some countries, like the Czech Republic, have been able to introduce policies supporting credibility despite low support from public opinion. This suggests that policy reforms can be enacted even in the absence of widespread approval for climate action, although this can be more challenging. Establishing or reinforcing a constructive dialogue and consultation with citizens and stakeholders could help governments in these countries to overcome opposition and build trust in climate change action. Policy can also be designed in a way that can win over opposition or distrust from the general public. This is discussed in chapter 4, in the context of carbon taxes.

4. The public acceptability of carbon taxes

The EU's climate targets cannot be met through power sector decarbonisation alone. Success in reducing emissions outside the power sector is an essential complement to electricity decarbonisation. There is a need for stronger policies, and in particular a stronger carbon price, in those sectors. As previously noted, carbon pricing is determined by the EU ETS for the power sector and other large emitters regulated under the scheme. Other sectors, however, are not subject to the EU ETS carbon price signal, therefore other measures are needed at domestic level. Carbon taxes hold particular promise. Complemented by targeted regulation, taxes could be a relatively simple and effective way of reducing emissions in transport, waste and, to a lesser extent, buildings and agriculture (Goulder and Parry, 2008), whereas other policy instruments such as regulation have a stronger role to play.

Introducing or strengthening a carbon tax is challenging, as it is often opposed by industry and the general public. However, there is a growing body of evidence from surveys and field experiments to suggest that carefully designed and communicated carbon taxes can be made publicly acceptable, and in this chapter we explore practical design options for achieving this goal.

Background: pricing carbon in the EU

By putting a price on carbon, emitters are confronted with the environmental costs of their actions and forced to manage their carbon output. The EU has chosen carbon trading as its preferred way to price carbon when dealing with the large, sophisticated emitters in the power sector and heavy industry, the sectors covered by the EU ETS. However, about 58 per cent of total EU emissions originate outside the EU ETS, in sectors such as transport, buildings, waste management and agriculture. These are the sectors to which policy attention must increasingly turn. Once the Effort Sharing Regulation is finalised, member states will be committed to binding greenhouse gas emission reduction targets to 2030, covering the sectors outside the EU ETS. Yet recent analysis by the European Environment Agency (EEA, 2016) points out that it will be these non-ETS sectors that are most in danger of falling short of meeting their reduction targets – resulting in the EU also missing its overall 2030 emissions reduction target.

Carbon taxes are relatively simple instruments to impose on individual emitters – including smaller ones that are less likely to engage in carbon trading – and straightforward to administer through existing fiscal arrangements. Carbon taxes can be particularly attractive to government at a time of fiscal retrenchment, as they entail charging for 'bad' activities (emitting greenhouse gases) rather than 'good' ones (such as employment) (Bowen and Fankhauser, 2017). However, proposals for carbon taxes are often difficult to pass. Only 12 EU member states have so far introduced an explicit carbon tax, and in many cases the tax rates are frozen at low levels. For example, Poland introduced its carbon tax in 1990 but it has stayed below €1 per tonne of carbon dioxide; Latvia did so in 1995 but the tax remains less than €4; and Estonia in 2000, the tax today remaining at €2 (World Bank et al., 2016).

The failed revision of the EU Energy Taxation Directive also illustrates the difficulty in passing carbon taxes. Proposals for an EU-wide energy and carbon tax were discussed as early as 1992, but the topic was so divisive that unanimous support, required for taxation matters, was not reached by the European Parliament. Agreement did not occur until 2003 – and then only on a diminished version of those early proposals (Speck, 2008). The resulting Energy Taxation Directive (Council of the European Union, 2013) is now deemed outdated (European Commission, 2011a), but a revised version (European Commission, 2011b) failed to gain the backing of the European Parliament and the Council, and to date it is still under revision and negotiation.

Understanding attitudes towards carbon taxes

The reasons for aversion to carbon taxation go beyond a general aversion to new taxes. By unpacking the attitudes of individuals towards carbon taxes it is possible to spell out the key challenges and co-benefits of introducing carbon taxes for member states, and to identify policy design options and communication devices that could make carbon taxes more acceptable to the general public. Our extensive background literature review, carried out by Carattini, Carvalho and Fankhauser (2017), shows that empirical studies based on surveys and field experiments are beginning to shed light on people's wary attitudes towards carbon taxes. Information can also be gleaned from the response of voters to carbon tax proposals put to referendums in countries including Switzerland. We outline the key messages from this literature review below.

Reasons for opposing carbon taxes

The first reason for potential opposition is a perception among individuals that the personal costs of the tax would be too high. Particularly ex-ante – before a measure is introduced – individuals tend to overestimate the cost of an environmental tax and underestimate its benefits (Schuitema et al., 2010). Evidence also suggests that individuals prefer subsidies because they are perceived as less coercive (Steg et al. ,2006). Furthermore, people can visibly see the increased costs of final goods as a result of a carbon tax, but are less aware of the fiscal costs of subsidies to themselves. It should be noted that the pass-through costs of renewable subsidies to the final electricity bill has become a politically salient issue in countries such as Germany and the UK (Helm, 2017; Wehrmann, 2017).

The second reason concerns the objections many individuals have to the regressive nature of carbon taxes. They perceive, rightly, that, without counterbalancing measures, carbon taxes may have a disproportionate negative impact on low-income households (Baranzini et al., 2017). People are also concerned about the wider economic impact of a tax (Carattini, Baranzini et al., 2017).

The third reason is that individuals do not see carbon taxes as an effective way to discourage high-carbon behaviour. They consider low-carbon subsidies to be a more powerful way to reduce greenhouse gas emissions (Steg et al. ,2006). In technical language, they believe the demand response to price changes (the price elasticity of demand for carbon-intensive goods) is close to zero (Kallbekken and Aasen, 2010).

Finally, individuals are often suspicious of government motives. They assume – as a direct consequence of the point above – that the purpose of introducing a carbon tax is not to reduce greenhouse gases, but to increase government revenues (Klok et al., 2006). At its core, this is an issue of trust in government (see also Clinch et al., 2006). Trust issues sometimes concern the specific environmental tax proposal under consideration, but they may also be broader, related to people's general view of tax policy or even to trust in government itself (Hammar and Jagers, 2006).

Besides studies on the general attitude of people towards carbon taxes, there is growing evidence about people's attitudes towards particular tax designs (see Appendices in Carattini, Carvalho et al., 2017, for details). These studies find that:

- **People do not like high environmental taxes.** The public acceptability of an environmental tax depends heavily on policy stringency and in particular the proposed tax rate and implied costs to consumers (Thalmann, 2004; Carattini, Baranzini et al., 2017). Perhaps this is not surprising. However, it is worth remembering that the main purpose of environmental taxes is to discourage harmful behaviour and make the polluter pay (as formalised by Pigou, 1920). The aversion to environmental taxes, as opposed to general taxes, suggests that people's attitudes are influenced more by the direct personal cost of the measure than by an appreciation of the environmental objective (Kallbekken et al., 2011).

- **Public acceptance of a carbon tax is higher if the use of proceeds is clearly specified.** The literature has explored three revenue-recycling strategies in particular: the 'earmarking' of revenues to support emission reduction projects, the redistribution of revenues to achieve a fairer (less fiscally regressive) outcome, and the reduction of other taxes to achieve a revenue-neutral outcome (where there would be no increase or decrease incurred to a government's budget) (Sælen and Kallbekken, 2011; Baranzini and Carattini, 2017; Carattini, Baranzini et al., 2017). Out of these options, individuals appear most interested in earmarking, followed by redistribution and revenue neutrality (Clinch et al., 2006).
- **The interest in earmarking by individuals reflects two of the concerns discussed above: a lack of trust in government, and doubt about the effectiveness of carbon taxes.** Earmarking tax revenues for additional emissions reduction reassures individuals that the tax will be effective and the environmental objective will be met (Baranzini and Carattini, 2017).
- **Public attitudes are not necessarily persistent.** People's aversion to high tax levels tends to abate once the policy is implemented, as individuals become more familiar with the measure and are better able to gauge its costs and benefits (Schuitema et al., 2010). Similarly, information about the environmental effectiveness of different carbon tax designs can reduce individuals' doubt about the effectiveness of carbon taxes and the demand for environmental earmarking (Carattini, Baranzini et al., 2017).

Individuals' perceptions are not necessarily right. There is evidence to show that carbon pricing (either in the form of taxes or through carbon trading) does in fact reduce emissions and has so far had a minimal impact on the wider economy (Dechezleprêtre and Sato, 2017). On the other hand, individuals are right to suspect that governments would probably welcome the extra revenues. Indeed, the benign fiscal implications of a carbon tax are often highlighted as one of its merits (Bowen and Fankhauser, 2017). It is also the case that carbon taxes are often regressive. However, the accuracy of these views is less important than the fact that they are widely held.

Policy recommendations

The growing empirical understanding of public attitudes enables policymakers to design carbon taxes in a way that is more acceptable to individuals. We offer four pragmatic ways in which carbon taxes can be made more acceptable to the public. Our first three recommended options focus on design, while our last recommendation focuses on information and communication, cross-cutting the other three options. While fairly prescriptive, these are high-level recommendations that policymakers will have to adjust to their own political economy context.

The options diverge from the 'first-best' tax designs advocated by economists and therefore require a trade-off between the theoretically desirable and the practically feasible. Some of the options may be implemented in conjunction; others are mutually exclusive. Choosing the alternative designs may therefore impose a penalty in terms of the efficient functioning of the tax instrument. Policymakers may need to obtain estimates from economists on the size of the efficiency penalty implied by deviations from the 'ideal' design. This information can guide policymakers in deciding how to design a carbon tax, based on precisely quantified trade-offs.

Option 1: Phase in carbon taxes over time

By phasing in carbon taxes gradually it is possible to overcome people's initial dislike of high environmental taxes. Phasing takes advantage of the fact that this aversion tends to abate once people have experienced the policy. A slow ramp-up, or even a trial period, provides individuals with the opportunity to gauge the costs and benefits of the tax. Taxes can then be raised progressively until they reach the level required to meet the environmental objective.

If this process is not successful, there is a risk that carbon tax levels may be frozen at a level that is not sufficient to achieve their intended objectives. For example, the UK carbon price floor was introduced, to provide a stronger carbon price signal for power generators under the EU emissions trading system. It was introduced in 2013 at £16 (€ 18.05) per tonne of CO_2, and was steadily increased, reaching £18.08 (€ 20.40) in 2015. Since then, the tax has remained constant at that level, despite an original commitment to further increase it to £30 (€ 33.85) by 2020.

One way to prevent tax rates from remaining too low is to have a predefined commitment device that communicates to the public how the carbon tax would be adjusted over time. Possible commitment devices include making the tax rate schedule part of the legislation (as was done, for example, in British Columbia, Canada), or adjusting tax rates to meet a predetermined emissions cap (such as in Switzerland).

Option 2: Earmark carbon tax revenues to finance additional climate change mitigation

Individuals have a preference for earmarking tax revenues and using the proceeds for additional reductions to greenhouse gas emissions. They are particularly keen on support for low-carbon research and development, along with subsidies to promote deployment. Paying for renewable subsidies through household electricity bills became a politically salient issue in the 2017 elections in Germany and the UK. The German Renewable Energy Federation has advocated for replacing the existing power tax with a national carbon tax for electricity, thereby providing an alternative financing solution to expanding renewable capacity as part of Germany's low-carbon energy transition (Wehrmann, 2017).

Earmarking – or, in fiscal jargon, hypothecation – also responds to the widely-held perception that, on their own, carbon taxes are not effective. This view reflects the fact that people tend to overestimate the costs of switching from high-carbon to low-carbon options, and look for additional government support to help them reduce emissions. However, the demand for environmental earmarking may decrease over time as people observe the impact of the tax and update their beliefs. Governments can again support this process by providing effective information about emissions trends, the distributional effects of the tax and any ancillary benefits. Revenues may then be freed up gradually to address other sources of individuals' aversion.

Tapering the degree of earmarking can also allay concerns about fiscal management. The French carbon tax introduced in 2014 has worked in this way, for example, with the amount of revenues dedicated to green transition plans reducing from 100 per cent upon introduction to 38 per cent by 2016, the rest of the revenue going to general funds (Carl and Fedor, 2016; World Bank et al., 2016).

The earmarking of tax revenues, however, is controversial among fiscal experts because it complicates fiscal management. Earmarking commits governments to spending specific amounts of money on reducing emissions, even if there may be a poor match between actual spending needs and the revenues raised (Goulder and Parry, 2008).

Option 3: Redistribute taxes to achieve fairness and revenue neutrality

Carbon taxes can be made more acceptable by using the revenues in ways that address societal concerns about the tax's potentially regressive effects. In surveys, individuals generally state preferences for earmarking over revenue redistribution, but they support the use of tax revenues to ease the impact of the tax on low-income households. The scope for redistributing (or recycling) tax revenues could increase over time, as higher tax rates are phased in (as in option 1) and the demand for earmarking decreases (option 2).

Revenue-neutral carbon taxes can be designed to be progressive through lump-sum transfers (fixed compensation) and social cushioning measures to reduce costs for low-income households (see, for example, Bowen, 2015). Annual reports can make transparent how revenues have been redistributed and which recipients have been reached.

Some people will be suspicious of a government's long-term commitment to revenue redistribution. To allay those fears, governments can use commitment devices, such as explicit plans on how revenues are to be redistributed (for example, as done each year by the Ministry of Finance in British Columbia, which is then approved by the Legislative Assembly). Redistribution can be made visible by showing how other taxes have been reduced in pay slips or tax statements, or by issuing explicit rebate cheques to households and firms.

Cross-cutting recommendation: Use information-sharing and communication devices to enable acceptance of carbon tax, before and after its introduction

A common feature of all the options is the need for extensive information-sharing and careful communication. As soon as policymakers start considering the design of a carbon tax, they should simulate its effects on a wide range of social and economic outcomes, and use the information from these simulations to navigate the process of public consultations, and to pre-emptively address voter concerns about the carbon tax. Both Carratini et al. (2017) and Klenert et al. (2017) argue that a good communication strategy that increases the visibility of the progressiveness of lump-sum dividends through providing this kind of information can convince voters that dividends can be superior to other redistribution mechanisms and overcome fundamental issues of distributional fairness, political trust, and policy stability.

Therefore, this disclosure should occur before voters are called to ballot, and before lawmakers consider a bill. It is particularly important for governments (or a trusted and independent institution) to provide modelled results that show the effectiveness of the tax (including potential local co-benefits), along with personal and distributional costs (including to the economy and firms exposed to foreign competition). Highlighting the realisation of local co-benefits that appeal to local constituents, such as reducing local air pollution and associated health benefits, is as important a motivating factor for supporting carbon taxes as the original intention of reducing greenhouse gases. This has been observed in studies carried out in Switzerland by Baranzini and Carattini (2016), and in the United States by Petrovic at al. (2014).

This information should include:

- **The greenhouse gas reductions achieved at the chosen rate, and estimated further reductions from raising carbon tax rates over time, plus the local co-benefits** achieved at the chosen rate and over time, such as reduced congestion, air pollution and health costs, and improved atmospheric visibility, health and quality of life.
- **Expected variation in cost for the goods most likely to be affected by the tax and the impact on average household income and the economy as a whole**, including potential competitiveness effects and job losses. This information should include measures undertaken to minimise these impacts, including if revenues are recycled back to households/firms, and the level of the rebate.
- **Impacts on low-income households** (highlighting any social cushioning measures that are used).

Providing this information through different, trusted channels and devices may ensure that the public debate about the effects of a carbon tax is based on the best available evidence. Presenting and communicating these results is especially important to counter some of the claims that opponents of the tax may put forward. The 'industrial flight' argument (i.e. that if emission controls are too severe, industry will relocate to avoid the costs) may concern some parts of the general public (Spash and Lo, 2012). If voters are able to correctly evaluate the competitiveness risks to which firms are exposed, they are more likely to support reasonable carbon tax rates and vote against unjustified exemptions.

Furthermore, once a carbon tax has been passed, the government should regularly measure and report its effects, along with information on how revenues have been used and the intended recipients reached. Disclosing this kind of information increases the visibility of the effects of the carbon tax, and ensures the transparency and accountability of how revenues are recycled. Societal learning is an essential part of this strategy, as increased trust and credibility of carbon taxes can help governments to make the case of phasing the tax from a 'second-best' to the 'first-best' design. This may also prevent the risk of policy reversals that may occur with a change in government or a shift in the political orientation of the legislative body. As discussed in chapter 3, preventing policy reversal will also increase the overall credibility of a country's climate change strategy.

5. Conclusions

This report has assessed the distributional impacts, credibility and policy acceptability of the European Union's carbon policies in the power sector and beyond. It has explored how the EU policy landscape should evolve to ensure that its medium- to long-term climate change objectives are achieved cost-effectively, credibly and feasibly.

New policies need to be tailored to a changing power sector, where the stock of incumbent, cost-competitive low-carbon generation is expanding rapidly. Carbon pricing, embedded in the EU emissions trading system (EU ETS), is the most cost-effective instrument to stimulate the uptake of cost-competitive low-carbon sources in a context where arguments in favour of financial support for 'nascent' technology are much less relevant in the current electricity mix.

Of course, the technology frontier is shifting constantly and the case for supporting low-carbon innovation remains compelling. Nor have other market failures, such as those affecting capital markets and energy conservation, been completely removed. The need for a diverse policy mix therefore remains, but in the power sector the balance is shifting away from technology subsidies and towards higher carbon prices. Outside the EU ETS there is an equally strong case for an effective carbon price to complement other policies, perhaps through a carefully designed carbon tax.

Policy reforms of this kind call for solid institutional frameworks, both at the European Union and member state level, to ensure members' commitments to decarbonise the power sector are credible. The credibility of low-carbon commitments across the EU is uneven. Our suggestions for how credibility gaps may be closed include through strong framework legislation with a clear long-term vision, statutory targets, policy commitments and independent scrutiny.

The policy recommendations highlighted in this report offer guidance to the EU's member states on how to improve their policies and institutions to achieve the challenging decarbonisation targets for 2030 and beyond. The recommendations also support the European Commission in identifying the strengths and weaknesses in the decarbonisation strategies of member states. Such analysis could complement, for instance, the assessment of the Integrated National Energy and Climate Plans, due in 2018. These plans are meant to set out the direction of national energy and climate objectives and policies in a way that is coherent with the EU's 2030 targets. An assessment of distributional impacts, credibility and acceptability would help to determine the likelihood of the member states being able to put these plans into action, and feasible policy improvements to achieve their ambition.

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As the European Union enters a new phase of decarbonisation, now is a crucial time for policymakers to devise the next policy steps for achieving ambitious decarbonisation targets for the power sector and beyond. This report investigates the extent to which its current policies and institutional arrangements are fit for purpose.

The report explores and makes recommendations on three aspects of EU climate policy:

1. How different policies for reducing power sector emissions vary in the way their costs and benefits are distributed among the government, consumers and electricity producers, focusing particularly on the supply-side of the power market.
2. The credibility of member states' efforts to decarbonise electricity: whether or not the current institutional arrangements are sufficient to enable member states to translate their commitments to decarbonise electricity into action.
3. The public acceptability of carbon taxes applied to sectors that lie outside the EU emissions trading system, identifying challenges and policy design options that could make such taxes more acceptable.

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