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A whole-economy carbon price for Europe and how to get there

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Executive summary

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The European Union's plan for climate neutrality by 2050 reopens the question of the role carbon pricing can and should play. Carbon pricing should not – and ultimately cannot – only be an enforcement tool or backstop that ensures targets are met, while the heavy-lifting of decarbonisation comes from directed technological change policies. Instead, a technology-neutral carbon price must become the main element, providing signals for decarbonised operations, investment and innovation in all sectors. is would guarantee cost-e ective emission cuts, provide a clear path to net-zero and is a requirement for international cooperation and a global carbon pricing regime. Carbon pricing must therefore be at the core of EU climate policy.

However, introducing a uniform, credible and durable carbon price across all sectors right away is politically and institutionally challenging. Moreover, policies to address other market failures will continue to a ect signi cantly the impact of carbon pricing. e role of carbon pricing should therefore be strengthened gradually, taking these considerations in2e27of cogthew-2 (and heating sector to prepare the sectors for integration into the EU emissions trading system, and to manage distributional implications. A carbon price balancer would manage price di erences between the two systems in the short term. Second, a carbon price stabiliser (a price oor and price ceiling) should be implemented for both systems to manage price expectations and ensure price convergence between the two systems in the long run. ird, complementary policies (carbon price ampli ers) should be strengthened or put in place to trigger investment and innovation, helping policymakers to commit credibly to enforcing the cap and addressing other market failures. is approach would ensure convergence on a uniform, credible and durable carbon price for the whole economy.

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1 Carbon pricing's current role: an emissions-reduction backstop

For the European Union to reach climate targets of a 55 percent greenhouse gas emissions cut by 2030 compared to 1990, and climate neutrality by 2050, it will need to carry out a fundamental regulatory overhaul. Among the initial steps will be plans to increase the cost of greenhouse gas emissions in di erent sectors by revising the EU emissions trading system (ETS)[1] and possibly extending it to the transport and heating sectors[2], revising the energy taxation directive[3] and taxing the carbon content of imports[4]. ese plans must deal with complex and interlinked technical, legal, political and economic issues.

For consistency in the EU's approach, a paradigmatic question must rst be answered: what role should carbon pricing play in the new policy mix? Arguably, carbon pricing as currently implemented through the EU ETS functions as an enforcement mechanism[5]. Emission cuts and innovation are meant to come mainly from policies and measures to induce directed technological change – such as standards and subsidies. Technology policies are thus the core policies, and carbon pricing complements them. e ETS by means of its cap serves to ensure that climate targets are achieved: its primary objective is to address the compliance problem in case technology policies cannot deliver su cient emission reductions and a gap arises.

A major side e ect is that carbon prices are (arti cially) kept at a moderate level as additional policies reduce the demand for emission allowances. For achieving the EU's 2020 target of a 20 percent emissions cut, the enforcement function was not put to the test because structural shifts[6] and complementary polices[7] caused emissions to fall while carbon prices were still low (at least up to the reform in 2018). Much of the emission reductions observed within sectors covered by the ETS in the past decade were driven by technology policies. In particular the policy-driven increase in wind and solar deployment between 2009 and 2019 replaced about 350 terawatt hours (TWh) of electricity generation[8], while EU eco-design standards might have saved up to 480 TWh[9]. Based on the emissions intensity of the EU fuel mix in 2009, generating these 830 TWh would have caused 300 million tonnes of carbon dioxide emissions. ese emissions, avoided thanks to technology policies, correspond to almost 80 percent of the reduction in emissions covered by the ETS in this period.

e much tougher targets for 2030 and 2050 raise doubts about whether this approach to reducing emissions can continue to be e ective in the coming decade:

1 S www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/ le-revision-of-the-eu-emission-trading-system-(ets).

2 S https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12656-Updating-Member-State-emissions-reduction-targets--E ort-Sharing-Regulation-in-line-with-the-2030-climate-target-plan.

3 S www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/ le-revision-of-the-energy-taxation-directive.

4 S www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/ le-carbon-border-adjustment-mechanism.

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1. First, while technology policies have performed well in the past in terms of developing clean technologies and bringing them to the market, they are not tailored to e cient investment and operation of these technologies large scale, as needed now. ese policies are also of limited e ectiveness in phasing out carbon-intensive technologies head on. In particular, standards are very susceptible to rebound e ects: if, for example, the cost per kilometre falls, the distance travelled typically increases. Bans would be the only option to stop usage of dirty technologies completely, but are complex to administer and also have substantial political cost.
2. Second, if new emissions-cutting technologies, for instance in the industry sector, are more complex or cannot yet be known, regulation leaves too little room for exibility and innovation. Regulators picking winners and losers risk making more mistakes and increasing policy costs considerably.
3. ird, the fact that carbon pricing makes policy costs much more transparent is essential to have an open debate about the true costs of ambitious climate targets. Otherwise, there is a considerable risk of future push back when original cost expectations turn out to be too low.

Furthermore, carbon pricing is starting to actively drive decarbonisation already, and its bite will only be felt more. With the decreasing e ectiveness of technology policies combined with more stringent targets, carbon prices are bound to rise considerably[10], implying that the carbon price will move beyond just playing a disciplining or backstop role. is has already been seen in a small way. Since the 2018 ETS reform[11], allowance prices have risen to levels that have induced noticeable fuel switching (coal to gas) in the electricity market and related emission reductions. In other words, carbon pricing is now playing a measurable role in actively phasing out coal (Bushnell *e al*, 2021; Abrell *e al*, 2020). Carbon pricing is therefore pushing more and more into the foreground. In this context a new approach is needed to guide the adjustment to this situation of the policy mix.

2 Carbon pricing's future role at the core of climate policy

Making carbon pricing the real core of climate policy ultimately requires a uniform, credible and durable carbon price – the economic rst-best approach (Nordhaus, 2011). To get there, carbon pricing rst must apply to a broader range of carbon emission sources (in particular including transport and heating). All additional climate policies then need to be designed with reference to the carbon price, and carbon prices need to be managed through stabilising mechanisms. Putting carbon pricing at the core of climate policy in this way would bring the following bene ts:

1. Increased e ciency in the face of much higher policy costs: with harder-to-reach mitigation goals, costs can be expected to increase considerably. It will become increasingly important for economic growth and intergenerational equity reasons to achieve emissions reductions e ciently.
2. A clear path to net zero: A credible emissions cap makes the costs and challenges of

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11 S https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L0410&from=EN.

climate targets transparent, and thereby reduces risk (and hence capital costs) for investors.

3. Fostering an international move towards a global carbon price regime: if the EU wants to lead in establishing a global carbon price regime, it must set an example and put carbon pricing at the centre of its climate policy.

However, several preconditions necessary to attain this first-best solution are not yet met.

From the point of view of offering efficient incentives for mitigation, the EU ETS should only be extended to other sectors if they have first been made 'allowance-market ready'. As the European Commission's outline climate plan for 2030[12] emphasises, lessons from the ETS suggest that the development of new allowance markets requires setting up functioning monitoring, reporting and verification systems. Insights from Germany's new ETS (Box 1) corroborate this. The buildings and transport sectors, therefore, should be subject initially to a separate ETS, with integration into the EU ETS after a transitional period[13].

Moreover, from a political point of view, extending the ETS to other sectors would have considerable distributional and competitiveness implications. Because emissions cuts in the buildings and transport sector are relatively costly, extending the ETS would imply a considerable increase in the carbon price. For electricity and industry, this could lead to concerns about competitiveness and job displacement, for example from accelerated coal phase outs. Meanwhile, a high carbon price for the buildings and transport sectors, which would primarily fall directly on households, implies equity-related social concerns within and between EU countries. Experience from Germany's new ETS (Box 1) points to the political and regulatory challenges related to ensuring fairness.

All these concerns could in principle be managed through complementary measures including financial transfers to poorer households and mechanisms to ensure industrial competitiveness, but efficiency is only ensured in a system that is optimally designed. Alternatively, differential pricing may be optimal (Abrell *et al*, 2018). Here again, a transitional period with two separate emissions trading systems would allow for more time to develop carefully the complementary measures, using two dedicated revenue streams – from the auctioning of

Box 1: Lessons from the new German emissions trading system

In 2021, Germany's new emissions trading scheme (Brennsto emissionshandel, BEH) for fuel combustion not regulated under the EU ETS went into operation. It started with a xed price of €25/tonne of CO2, which will rise to €55/tonne by 2025. From 2026, allowances will be auctioned within a price corridor (€55-€65). Whether the price corridor will be sustained beyond 2026 will be decided in 2024 after an evaluation of the rst phase of the system, and also depends on policy development at EU level. e strategy of the current government is to integrate the BEH into a new system to be implemented at EU level.

A rst major lesson from the BEH concerns the institutional set-up of an upstream system, and relatedly, the lead time for achieving 'market readiness.' e BEH was implemented as an upstream system to make use of existing energy taxation monitoring, veri cation and reporting infrastructure and rules. However, two important amendments were necessary (Edenhofer *e_al*, 2019): (1) Fuels currently exempted from taxation, such as waste, must be included. is in general requires national law. Moreover, having both upstream and downstream systems (such as the current EU ETS) in place leads to double taxation when plants covered by the ETS use fuels that are already taxed under the BEH. Accordingly, rules and related legislation needs to be developed to clearly separate the two systems. (2) Exemptions from the BEH for selected industries, justi ed by potential carbon leakage needed to be dealt with. German legislators came up with provisional solutions for both issues to get the system up and running within a year. But the fast-track process led to considerable drawbacks in regulatory quality, in particular related to the scope of monitoring rules (risk of loopholes) and industry exemptions. Because carbon pricing operates at the margin, such drawbacks can impair its e ciency. Accordingly, the regulation underpinning a new upstream system at the EU level should be carefully crafted in good time, notably including transparent and evidence-based deliberation about potential industry exemptions. It could take 3-4 years (Matthes, 2019) to achieve market readiness in this sense.

A second major lesson from the BEH concerns the role of distributional impacts for agreeing on the price level. e nancial impact on low-income households and commuters in particular was one of the key aspects in the policy debate preceding the adoption of the 2019 German climate policy pv l2 (aens)-3.Esertion eactole oasvvpact--A sevisg r226ateman cvisa5p-2 (g)3 (u

3 A policy mix that gradually puts carbon pricing at the centre

Taking into account the considerations we have outlined, a sequencing approach should be pursued that strengthens the role of carbon pricing over time[15]. Figure 1 gives an overview of how the problems we have outlined match the solutions we propose. The first set of solutions gives rise to new challenges, for which we propose a second set of solutions.

Figure 1: Problems to tackle and their solutions

Source: Bruegel/PIK.

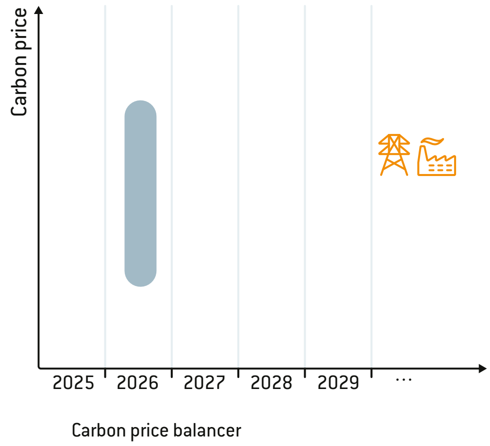
The solutions shown in Figure 1 correspond to three design elements for the overall carbon pricing system: the carbon price balancer, stabiliser and amplifier (Figure 2).

3.1 Carbon price balancer

The main reason for implementing a separate ETS for buildings and transport would be to allow for a transitional period to make an upstream system allowance-market ready, and to have two initially separate revenue streams that can be used to address the very different policy issues in the two systems (industry: competitiveness; households: distributional, see Box 1). At the same time, carbon prices in the two systems are likely to diverge because of different marginal abatement costs – signalling economic inefficiency[16]. Moreover, price divergence can create new distributional concerns related to the different financial burdens from carbon pricing in the different sectors. Therefore, a mechanism is needed to link the two systems and contains price differences, in order to manage the political and economic trade-offs. We call this the carbon price balancer.

The straightforward instrumental mechanism to implement the balancer is the linking of the two systems. Linking needs to be introduced gradually so convergence takes place over time. Two design aspects are important in this: (1) how and when is the carbon price balancer triggered, and (2) how are initial restrictions on linking implemented and determined? On the first aspect, a maximum price differential should be established, with the balancer triggered when this threshold is exceeded. On the second aspect, there are several options to restrict linking (Quemin and de Perthius, 2019), but a quantitative restriction of the volume of tradable allowances (quota) seems to be the easiest to manage. How the level of the quota is set is crucial, since the effect of any given quota on prices in both systems is uncertain. For these price di erential-responsive supply schedule (Burtraw *e_al*, 2020). is guarantees an automatic adjustment process – the higher the price di erence, the higher the quota.

Figure 2: Carbon pricing system design



Source: Bruegel/PIK.

3.2 Carbon price stabiliser (price floor and price ceiling)

While the role of the carbon price balancer is to prevent high price di erences between the a supply function for less/additional allowance allocation at very low/high prices, as in place

3.3.1 Amplification through subsidies

For subsidies, a direct link to carbon pricing requires that the subsidy level needs to decrease with an increasing carbon price: the additional payments necessary to make low-carbon alternatives competitive with high-carbon products decrease as the carbon price rises. When the carbon price is su ciently high, the required subsidy drops to zero[21]. Given uncertainty about future carbon prices, a subsidy that depends on the carbon price also transfers the price risk from investors to governments[22]. is policy design thus also creates an incentive for governments to increase the future carbon price in order to reduce payments.

Further, the formulation in terms of emissions reductions requires that the unit payment for subsidies depends on the expected abatement. is allows the cheapest abatement option to be chosen within a category that is quali ed to receive the subsidy. is would be a major change compared to the current practice since it is common practice that subsidy payments depend on other measures such as square meters, megawatt hours or units. While this is often easier in terms of implementation, it does not guarantee long-term instrument convergence.

Finally, competition can be ensured through competitive auctions, which guarantee that the cheapest abatement options will be subsidised. ey should in general be technology neutral, unless other externalities are present, implying that substantial cost reductions through technological learning or network e ects can be expected for a certain technology.

Current proposals in this area include, for example, carbon contracts for di erence (Richstein, 2017). Firms can o er(Rems can oi(t)1 (e-4 (y.)](o)14 (v)3 (ernmen),3 pr)-7come (ice als)-4 (o tr)1 should be developed into a tradeable programme. Likewise, existing efficiency standards in the building sector should be reformulated in terms of emission intensity, and developed into a tradable programme similar to, for example, France's white certificate system[24].

Where carbon price amplifiers already exist and carbon pricing doesn't, notably in the case of emission standards in the transport sector, it is important to point out that an additional carbon price is an essential complement. That is, it addresses mitigation channels not covered by standards[25]: It incentivises demand reduction (for example in terms of kilometres travelled), thus reducing the rebound effect[26], and creates incentives for phasing out older unregulated vehicles (Lin and Linn, 2019). This only underlines the general case for putting carbon pricing at the centre of the emissions-reduction effort: to achieve ambitious climate goals, a standards-only approach without carbon pricing is insufficient. However, standards can play an important bridging role, which becomes less important as the carbon price rises.

4 Summary

Putting carbon pricing at the centre of the EU climate policy architecture would provide major benefits. It would increase efficiency in the face of much higher policy costs, provide a clear path to net zero, and foster an international move towards a global carbon price regime. Obtaining these benefits requires a uniform, credible and durable carbon price – the economic first-best solution. However, several preconditions required to attain this solution are not yet met, which is why we propose a sequenced approach to ensure convergence of the policy mix on the first-best in the long run.

The starting point should be a separate emissions trading system for the EU buildings and transport sectors, but with a carbon price balancer that links the system with the existing ETS to ensure that large price differentials between the schemes do not arise. In addition, a carbon

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