What is the impact of carbon pricing on inflation in Austria?

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Refereed by: Friderike Kuik, European Central Bank

Tackling the climate crisis is one of the biggest challenges of our times with major repercussions for the macroeconomy. This study focuses on the impact of setting a price for carbon on consumer price inflation. Carbon pricing is a cost-effective means to reduce greenhouse gas emissions and incentivize sustainable behavior by increasing the prices of fossil fuels. To assess the related inflationary risk, we elaborate on two complementary (explicit) pricing approaches – carbon taxation and emissions trading – in the EU and in Austria. After teething problems, the emissions trading system launched by the EU in 2005 turned into an effective tool of decarbonization, with roughly 30% of EU-wide emissions cut by 2020 as emission allowance prices were raised over time. In Austria, rising allowance prices did not have a significant impact on inflation given the high share of renewable sources in power generation. With regard to the carbon tax that Austria will apply in the course of 2022 to sectors not covered by emissions trading, we estimate HICP inflation to go up by 0.1 to 0.2 percentage points annually until 2025, excluding indirect and second-round effects. Looking forward, trends in climate change and low-carbon transition may further impact inflation, its volatility and its distributional consequence and pose a challenge for monetary and other policies alike. This, however, should not detract from necessary climate protection in view of the consequences of unmitigated climate change on inflation and human activity at large.

JEL classification: E31, H23, Q54
Keywords: climate change, carbon pricing, inflation, monetary policy

It stands to reason that climate change and climate mitigation policies should have an impact on prices and inflation. After all, rising average temperature levels imply an increased frequency and intensity of extreme weather events creating adverse economic and social effects (Dafermos et al., 2021). Plus, by creating incentives for the necessary changes in the behavior of companies and consumers, the political drive for renewable energy sources alters not just relative prices. Climate policies may also raise the overall price level given nominal rigidities in goods and factor markets, the low price elasticity of energy demand and the potential unanchoring of inflation expectations if agents misinterpret past (relative) price changes. While economies of scale of green technologies can also have a disinflationary effect, one should expect net effects to be inflationary for some time, until a higher share of energy demand is covered by large scale and low-cost renewables in a more efficient way.

Indeed, mechanical analysis of the inflationary effects of carbon pricing, abstracting from behavior adjustment to changes in relative prices, suggests strong upward inflationary pressure in the short run (see e.g. Nöh et al., 2020). For the medium run, however, empirical studies show very small or even negative effects of carbon pricing on the overall price level (see e.g. Moessner, 2022, and Konradt and Weder di Mauro, 2021).

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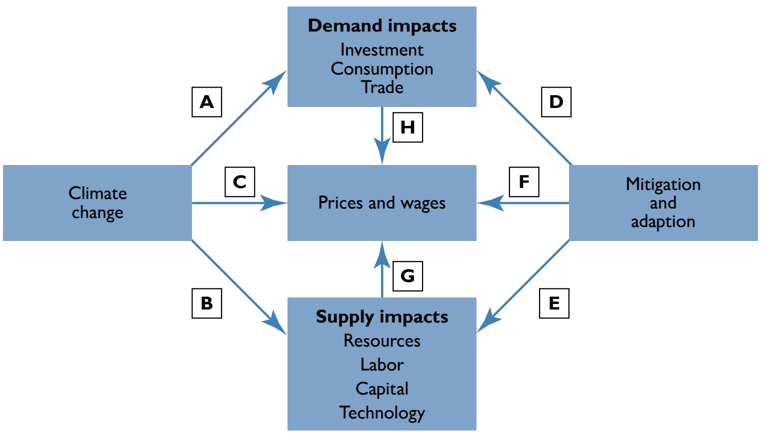
Unlike some other countries, we have not observed significant inflationary effects from the rise in carbon allowance prices in the EU emissions trading system (ETS) in Austria (see below; Pacce et al., 2021). This can be ascribed to the fact that renewable sources account for more than 80% of Austria's electricity mix. Against this backdrop, we analyze the effect planned carbon taxation is likely to have on consumer price inflation in Austria.[2] Regarding the direct impact alone, we project this policy to increase headline inflation between 0.1 and 0.2 percentage points annually from 2022 to 2025, reflecting staged implementation. This may be accompanied by indirect and second-round effects, depending on the pass-through of production costs to consumer prices and successively higher wage claims. Otherwise, the inflationary effect could gradually decrease with progressing decarbonization.

Given political uncertainty, it remains unclear whether prices will continue to be driven up in the medium to long run by ambitious climate policies and/or increasing climate damage. Yet, a predictable low carbon transition path with corresponding (shadow) prices will give economic agents the planning security needed and central banks better conditions to fulfill their mandate. The latter implies that the ECB's monetary policy should react to climate-related energy price increases only if they pose a risk to price stability in the medium term. Ensuring affordable energy costs for vulnerable households is, after all, a matter of fiscal policy.

The remainder of this paper is structured as follows: Section 1 discusses the theoretical literature on the impact of climate change and climate action on inflation. In sections 2 and 3, we elaborate on (fiscal) policies setting a price on carbon emissions, specifically carbon emissions trading and carbon taxation, with a special focus on Austria. Section 4 presents model calculations of the impact of carbon pricing on consumer bills and the affectedness of households in Austria. Section 5 concludes.

Figure 1

Broad linkages between climate change, climate policy and inflation



Source: Andersson et al. (2020).

1 How do climate change and climate policy affect inflation?

The impact of climate change on inflation can be analyzed along different dichotomies: (i) the effects of climate change itself vs. the effects of the mitigation policies to curb climate change; (ii) the direct effects on energy and food prices vs. possible indirect effects on other prices by climate-induced changes in economic activity and productivity; (iii) the effects on the supply side (through productivity, migration) vs. the demand side (through income) of the economy. In any case, most empirical studies on the inflationary effects of climate change are only partial in that

[2] *Our analysis is based on data up to the end of 2021. We use the term "carbon taxation," whereas the Austrian authorities adopted the wording "carbon pricing" because the new tax will metamorphose into an emission trading system as of 2026 (Bundesministerium für Digitalisierung und Wirtschaftsstandort, 2022).*

they assess the effects of one or some aspects but not the overall impact of climate change on inflation.

In this section, we adopt the first perspective, discussing the effects of a rise in the global temperature on the inflation process in the long run (on a qualitative level) before turning to the more specific mitigation effects. Figure 1 gives an overview of the channels through which climate change and climate mitigation policies can affect prices and inflation.

1.1 Effects of climate change on inflation

The currently projected increase in the global temperature would imply an increased frequency and intensity of extreme weather events and natural disasters like floods, storms, wildfires and droughts which will have direct and indirect effects on inflation (see e.g. box 9 in Koester et al., 2021). Resulting disruptions in agricultural production can affect food prices directly while reduced labor productivity due to heat stress, in particular in the Global South, will affect prices rather indirectly. Through possible damages to the infrastructure and production capacities, more frequent extreme weather events may disrupt global supply chains, thus affecting worldwide production and putting upward pressures on prices (negative supply shock; B in figure 1) – see McKibbin et al. (2017). These disruptions may be temporary and local in case of single events but could also have more persistent and global economic consequences in case of correlated or compound events. For example, McKibbin et al. (2017) argue that rising sea levels could lead to abrupt repricing of real estate prices in exposed areas around the world.[3] These effects will be more pronounced the stronger the rise in the average temperature. At the same time, uncertainty about the pace and extent of global warming and the ability of governments to counteract is going to add to macroeconomic uncertainty, which is likely to increase the volatility of macroeconomic variables, including inflation (Andersson et al., 2020).

The most direct and immediate impact of rising mean temperatures is expected for food and agricultural commodity prices (G in figure 1). Faccia et al. (2021) find that during hot summers in the Northern hemisphere global food prices increase by an average of about 0.4 percentage points, which is more than the standard deviation of the quarterly food price series. In the first instance, this constitutes a change in relative prices but depending on the extent of the event and given the low price elasticity of food consumption, headline inflation can be affected as well. More generally, empirical evidence (summarized in Parker, 2018) suggests that impacts of natural disasters triggered by global warming on prices are heterogeneous, depending on the type and extent of the extreme event and the subindex considered. For instance, prices for insurances against natural disasters could increase.

The expected income losses for consumers and firms resulting from lower economic activity due to more intense and frequent natural disasters and extreme weather events will have dampening effects on demand and exert downward pressures on prices (negative demand shock; A in figure 1) – see Andersson et al. (2020). However, the global demand and supply effects of climate change on inflation are difficult to assess as rising temperatures affect different countries and world regions

[3] *For properties potentially affected by floods and rising sea levels, housing prices – according to Parker (2018) – are expected to decline, whereas in safe areas they could even increase.*

differently and as adaptation strategies might dampen or even overturn the effects locally. Specifically, production in countries most exposed to global warming in the Global South might shift to less affected countries in the North, and costly adaptation strategies to the rising temperature level such as infrastructure investments, government support for technological transition or income compensation schemes may also benefit richer countries in the North (see IMF, 2017; IPCC, 2021). Thus, climate change will also have global distributional effects as emerging countries will feel the physical and economic consequences – among them also the price effects – of climate change much more than advanced economies (see IPCC, 2021 and 2022; Faccia et al. 2021; Stern, 2006, chapters 4 and 5).

Concerning the long-run consequences of global warming on real activity, Kikstra et al. (2021) estimate that by the end of the century, global GDP could be up to 51% lower than without warming depending on the persistence of damages. Previous studies such as OECD (2015), based on less sophisticated integrated assessment models, came to more moderate results (up to 10% lower GDP by 2100). IPCC (2022) ascribes the large span of global estimates to nonlinearities and different methodologies. The wide range of possible outcomes reflects uncertainties regarding the size, type and timing of the impacts of climate change and potential nonlinearities stemming from difficulties in assessing sectoral and regional adjustments to climate change.[4] A significant share of these macroeconomic impacts results from the adverse effects of climate change on labor and crop productivity and the capital stock due to heat stress and physical damage. This loss in output and capital stocks will weigh on the net wealth of households and firms, in turn affecting their investment and consumption decisions. While the supply effects described above will exert upward pressures on prices, the demand effects are expected to affect prices and inflation negatively, the difference being that the former occurs in a more erratic and temporary form while the latter materializes rather as a long-run trend.

1.2 Effects of mitigation policies on inflation

The second dimension of the impact of climate change on inflation we want to discuss are the effects of fiscal and other government measures to mitigate climate change (F in figure 1). These effects will be concentrated in the energy and energy-intensive sectors such as (emission-intensive) manufacturing and the automotive and transport industries. Depending on the ambition of climate protection, these effects tend to materialize sooner than the macroeconomic effects described above. Clearly, they depend on the exact design of the policy measures (regulations, cap and trade policies or taxation) but also on the use of the ensuing revenues. If revenues are used to offset the income loss by cutting other indirect taxes, the overall effect could be mitigated, whereas the use of revenues for cutting direct taxes or for subsidies fostering energy efficiency in heating or transport could even increase the effect on inflation in the short run by raising the disposable income of consumers.

A cost-efficient and technologically neutral way of incentivizing decarbonization of the economy is putting a price on carbon to counteract the market failure

[4] *As mentioned before, sectors and regions around the world will be affected differently by climate change. While most sectors and regions will be affected negatively by increasing temperatures, productivity and agriculture at higher latitudes (e.g. in Northern Canada, Russia and Scandinavia) may even benefit initially. This could lead to relocations of production and population that might benefit some countries at the expense of others (IPCC, 2021).*

that prices do not cover the social costs of carbon emissions. Carbon pricing may be implemented through taxes or an emissions trading system.[5] Carbon taxes may be levied directly on the carbon content of fossil fuels, or indirectly via environmental taxes (for a further discussion see section 3). This will affect energy and transport prices directly and, indirectly, the prices of other energy-intensive products, such as steel or cement. An EU-wide emissions trading system (EU ETS) was launched in 2005 as a key element of incentivizing decarbonization in Europe (EU and EEA-EFTA states). While up to 2021, low and variable carbon prices under this regime have not impacted inflation substantially, the drastic price hike in 2021 had considerable inflationary effects in some EU member states (see section 2).

Besides carbon pricing, governments can support the reduction of emissions and the transition to a carbon-neutral economy via command-and-control regulation (e.g. by setting emissions standards[6]), subsidies to increase energy efficiency (e.g. for installing new heating systems and insulating houses) and direct investment in green infrastructure (such as energy and transport systems). Theoretically, these industrial policy measures can be translated into shadow prices of carbon emissions. Yet, these prices and their inflationary impact are ambiguous and therefore difficult to quantify.

Looking ahead, headline inflation has been estimated to increase due to the implementation of ambitious mitigation policies in Europe (including emissions trading, carbon taxation and other measures) by 1 percentage point up to 2030, decreasing over time (NGFS, 2021). However, this inflationary impact of implicit and explicit carbon (shadow) pricing may turn negative close to 2050 when carbon neutrality will be reached due to falling prices of renewable energy and increased energy efficiency, which would in turn reduce the weight of energy in the consumption basket of households (see Andersson et al., 2020).

As discussed above, there are several policies to fight CO_2 emissions having direct and indirect price effects, respectively. In the next chapters we want to discuss two schemes that have a direct impact on prices, namely the ETS system and explicit and implicit CO_2 prices and taxes.

2 EU-wide climate mitigation with a direct price effect: emissions trading

The European Union's key tool for reducing greenhouse gas emissions is the emissions trading system (EU ETS) launched in 2005. It regulates emissions created in the energy, manufacturing and construction, and aviation sectors, across the EU and in Iceland, Norway, Liechtenstein and the UK. The installations[7] covered by emissions trading are responsible for almost half of the EU's human-induced carbon emissions and around 40% of the EU's total greenhouse gas emissions.[8] Between

[5] *Carbon taxes put a price on emissions and let the market determine the amount of emission reduction. Trading schemes define the scope of emission cuts and allow the market to determine the price. While working in opposite directions, the two methods are principally interchangeable.*

[6] *An example for such a change in regulations are stricter emission limits for cars and vans adopted by the European Commission in 2019, aiming at a reduction of CO_2 emissions by more than 30% from 2030 on.*

[7] *According to Article 3(e) of the EU ETS Directive, an installation is a stationary technical unit where one or more activities under the scope of the European Union Emissions Trading Scheme (EU ETS) and any other directly associated activities which have a technical connection with the activities carried out on that site and which could have an effect on emissions and pollution.*

[8] *EU Emissions Trading System (EU ETS) (europa.eu).*

2005 and 2020, verified emissions from installations covered by EU ETS fell by more than 30%, exceeding the 20% reduction target set for 2020.[9]

2.1 How does emissions trading work?

Emissions by energy-intensive industries and energy providers (excluding heating and transport) are covered by EU ETS allowances.[10] The total amount of allowances, which are tradable among the participants ("cap and trade"), are set for each trading period at increasingly lower levels. National caps were replaced by an EU-wide cap in the third trading phase (2013-2020). Currently, roughly 57% of allowances are allocated through auctions. The rest is allocated for free, taking into consideration benchmark values and the risk of carbon leakage.[11] The allocation of free allowances has been reduced over time, while the types of greenhouse gases and sectors covered have been widened. In respect of emissions made during a given year, allowances have to be handed in until April 30 of the following year.[12] One allowance permits the emission of one CO_2-equivalent ton.[13] For each ton of CO_2 emissions not covered by an allowance, participants must pay a penalty of EUR 100. This framework is to ensure cost-efficient investment in carbon-reducing measures and efficient emission reductions in accordance with national climate goals. Allowances that have been neither used nor traded can be carried forward.

For the fourth trading period starting in 2021, the cap for 2021 (excluding aviation) was fixed at 1.57 billion allowances, with an initial annual reduction factor of 2.2%. To reach the more ambitious emissions reduction target of the European Green Deal (–61% by 2030 compared to 2005), the European Commission proposed a one-off reduction of the emissions cap by 117 million allowances as well as an increased annual reduction factor of 4.2%.[14]

[9] *Note that this time period includes the initial COVID-19 pandemic period, which was associated with a considerable reduction in emissions and therefore partly explains the overachievement in 2020. In 2021, verified emissions in the sectors covered by EU ETS decreased further on average over all countries, but in some countries (e.g. Austria) we also see a rebound. Across all economic sectors, European emissions rebounded strongly but not completely (IEA, 2022). For detailed information on progress made, see the EU Emissions Trading System (ETS) data viewer (EEA, 2021) or European Parliament (2020).*

[10] *The legal framework is the EU ETS Directive (Directive 2003/87/EC).*

[11] *Sectors facing competition from industries outside the EU without comparable climate policies receive more free allowances (risk of carbon leakage). The free allocation is calculated using greenhouse gas emission benchmarks for each product. This product benchmark is based on the average emissions of the best-performing 10% of the installations covered. Installations that do not reach the benchmarks receive fewer allowances than needed.*

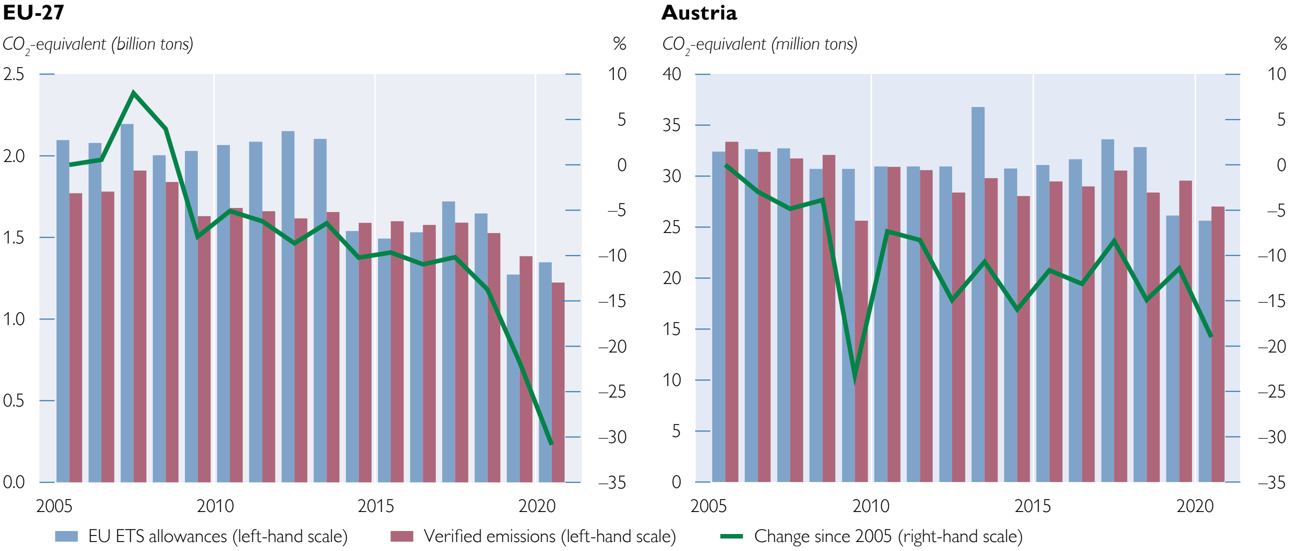
[12] *Apart from the allowances, firms can also use emission reduction units from Joint Implementation or Clean Development Mechanism projects.*

[13] *One allowance permits the emission of one ton of CO_2 or the equivalent of any other relevant greenhouse gas, such as methane, nitrous oxide or perfluorinated carbon. For instance, the emission of one ton of methane is equivalent to the emission of around 25 tons of CO_2.*

[14] *European Green Deal: Increasing the ambition of EU emissions trading (europa.eu).*

Chart 1

Emissions allowances and verified emissions excluding aviation (2005–2020)



Source: European Environment Agency.

Note: EU ETS = EU emissions trading system.

2.2 Emissions trading in Austria

Verified emissions in Austria account for roughly 2% of total verified emissions in the EU plus the UK.[15] Chart 1 shows allowances and verified emissions for the first three trading phases as well as the reduction in verified emissions compared to 2005 in percent for all stationary installations (i.e., excluding aviation). In Austria, verified emissions in 2020 were approximately 19% lower than in 2005. Austria was one of the few member states which by 2019 had not significantly decreased greenhouse gas emissions compared to 1990 and was about to miss the reduction target for 2020. Ultimately, it met the target only because emissions dropped substantially amid the COVID-19 pandemic in 2020.[16]

2.3 Evolution of emission allowance prices

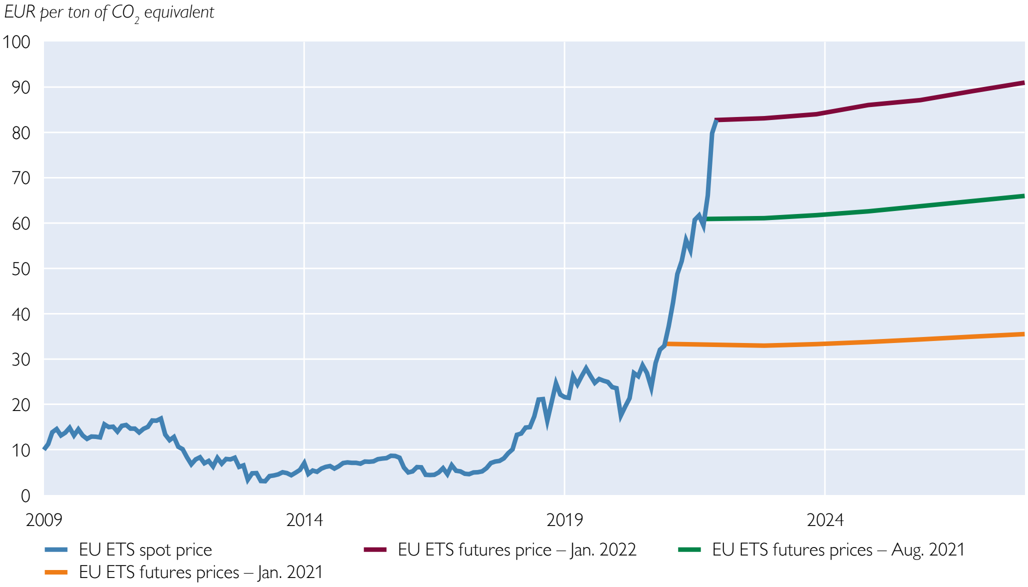
The price of carbon – similar to that of energy prices – is comparatively volatile and depends on factors such as temperature, economic activity, the amount of renewable energy and investments in green technologies. In phase 1 of the EU's emissions trading system, the number of allowances issued (which were allocated for free) exceeded emissions, causing the price to fall to zero. During the second trading phase, the financial crisis of 2008/2009 caused an unexpectedly large reduction in emissions, which led to a surplus of allowances and kept carbon prices low. Nevertheless, Ahamada and Kirat (2012) find that compared to the pilot phase, the impact of the carbon constraint on German and French electricity wholesale prices increased considerably in phase 2. Following the implementation

[15] *EU Emissions Trading System (ETS) data viewer — European Environment Agency (europa.eu).*

[16] *Rechnungshof Österreich (2021). Data for final greenhouse gas emissions for 2021 has been released after publication of the report in May 2022.*

Chart 2

Emissions allowances: spot prices (2009–2021) and futures prices (2022–2027)



Source: Macrobond.

of a market stability reserve mechanism in 2019 to address the surplus of allowances,[17] EU ETS allowance prices increased from around EUR 8 per CO_2-equivalent ton at the beginning of 2018 to EUR 83 in January 2022 (see chart 2). The growing importance of climate policies and the ambitious reduction objectives of the European Green Deal may have contributed to this price increase. As allowances can be banked to cover future needs, there is a tight link between spot and futures prices, which results in EU ETS futures prices being comparatively flat (see chart 2).

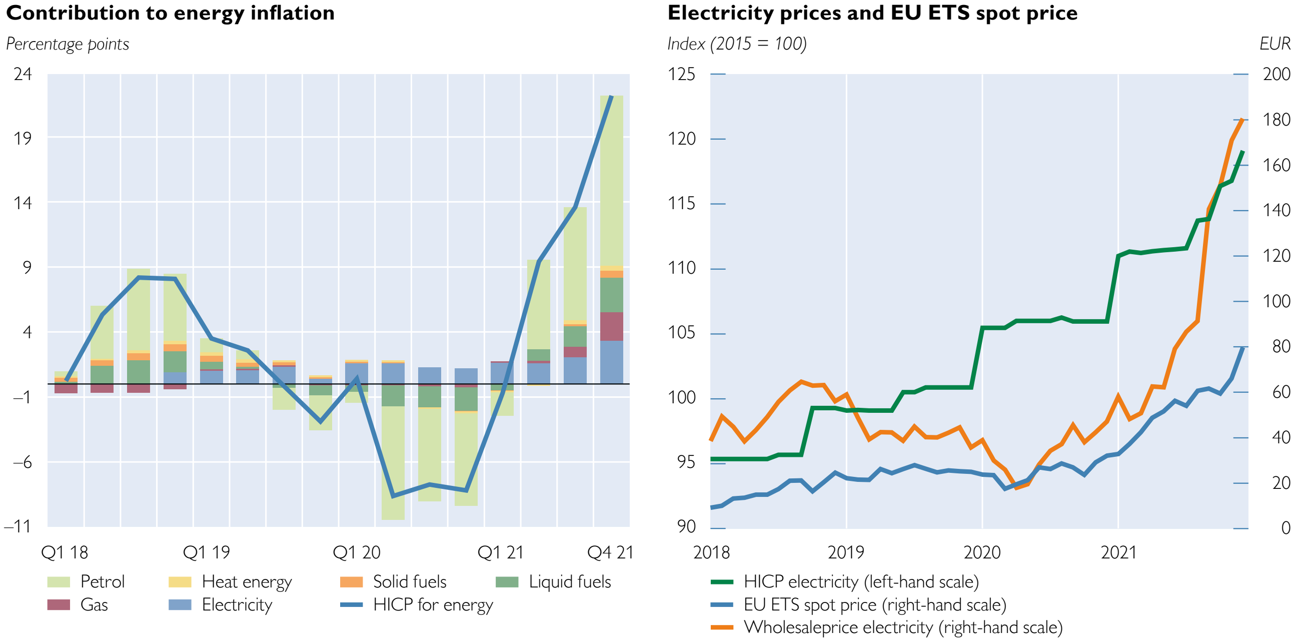
2.4 Impact of emissions trading on inflation in Austria

The ECB (2021a) argues that in the euro area up to summer 2021, EU ETS allowance prices most likely only affected the energy component of the HICP and here particularly electricity prices. This is owed to the limited coverage of emissions trading (which covers aviation but no other forms of transport, excludes housing and agriculture, etc.) and free allocations. In the course of 2021, energy prices increased markedly not only due to soaring oil prices, but also because of a surge in European gas and electricity prices. Gas and electricity inflation developments varied considerably across Europe due to differences in the pass-through of wholesale prices. While for fuels the pass-through from wholesale to consumer prices is (almost) complete, the pass-through of electricity prices is determined by the electricity mix as well as the price-setting mechanism.

[17] *Market Stability Reserve (europa.eu).*

Chart 3

Energy price developments in Austria (2018–2021)



Source: Eurostat.

Wholesale electricity prices are mainly driven by changes in gas prices, given that a larger demand for electricity results in increased (marginal) gas demand for gas-fired power plants.[18] The sharp increase in EU ETS allowance prices played a secondary role in the rise of wholesale electricity prices. European wholesale electricity prices roughly tripled from January to December 2021 (see chart 3). In Austria, electricity consumer prices have typically gone up at the beginning of the year. Most recently, in 2021, we had mid-year rises too, yet still falling short of the sharp surge in wholesale electricity prices or EU ETS allowance prices witnessed in other EU countries (as e.g. Spain or the Netherlands). Apart from a lower share of contracts with flexible tariffs, the share of low-carbon electricity generation is comparatively high in Austria with more than 80% of renewable electricity and hydropower in 2020. In the euro area, however, roughly 38% of electricity came from renewable sources, 36% from fossil fuels and 26% from nuclear power plants in 2020, with large differences across countries.[19] In countries with a high share of renewable or nuclear energy, the impact of changes in wholesale prices or EU ETS allowance prices on consumer prices is more limited. Pacce et al. (2021) estimate that the rise in EU ETS allowance prices was responsible for approximately 20% of the increase in wholesale electricity prices in Spain in the first half of 2021. This increase, in turn, contributed around one-third to the rise in Spain's HICP inflation during the same time period. However, in Spain almost half of the EU ETS emissions stem from fossil fuel electricity generation, which is considerably more than in Austria. While the direct inflationary impact of higher EU ETS allowance

[18] *See ACER (2022) for details on the price setting mechanism for wholesale electricity prices.*

[19] *International Energy Agency and Eurostat data for 2020.*

prices on energy inflation in Austria so far seems limited, potential (future) effects on other components cannot be ruled out.[20] Higher energy prices not only affect energy inflation but, indirectly, also other HICP components and producer prices, and might hence be passed on to consumer prices of other HICP components with some delay.

3 National climate mitigation with a direct price effect: carbon taxation

To reduce emissions from sectors not covered by emissions trading such as transport (excluding aviation), housing, agriculture and waste management, EU member states set national emission reduction targets (Effort Sharing Decision). In 2020, the Austrian government adopted the goal of achieving carbon neutrality by 2040, ten years ahead of the EU.[21] Taxation is an efficient instrument at hand to achieve the necessary decarbonization as it sets a price on environmentally harmful activities. The most recent tax reform based on ecological and social principles, which was passed in December 2021, includes an explicit price for carbon emissions in sectors currently not covered by EU-wide emissions trading (see sections 3.3 and 4).

3.1 Implicit taxes on carbon emissions

Environmental taxes have been at the core of the EU's environmental policy since the early 1990s, when the Mineral Oils Directive (Directive 92/82/EEC) set minimum tax rates on mineral oils for transport and heating and natural gas used for heating. The 2003 Energy Taxation Directive (ETD) introduced minimum tax rates for all energy products and all uses, thus widening the scope to coal, gas and electricity.[22] Above these minimum rates, member states have been free to set their national rates as they consider appropriate. Thus, the ETD framework provides cost-effective incentives for consumers/producers to adjust their behavior toward increased sustainability. Yet, the framework does not target carbon emissions directly and is also guided by competitiveness and social considerations. This is why we have lower ETD minimum tax rates for gasoil (diesel and heating oils) than for petrol, despite gasoil emitting more CO_2. Unsurprisingly, actual tax rates for motor diesel are lower than for petrol in almost all member states except for Belgium and Slovenia.

Energy taxes (covered by the ETD) are the largest part of environmental taxes, which additionally cover transport taxes (directly linked to use/ownership of motor vehicles such as registration taxes) as well as the taxation of pollution and resources (see chart 4). Despite the widespread interest in environmental taxes, they only amounted to 5.4% of EU tax revenues (2.2% of GDP) in 2020, of which energy taxes accounted for around three quarters. While Austria's energy tax revenues are below EU average at 1.2 % of GDP (EU average: 1.7% of GDP), its transport tax revenues are among the highest in the EU (see chart 4). This is due to the fact that Austria levies a vehicle registration tax that is CO_2-dependent and an annual vehicle insurance tax, which are both recorded as transport taxes.

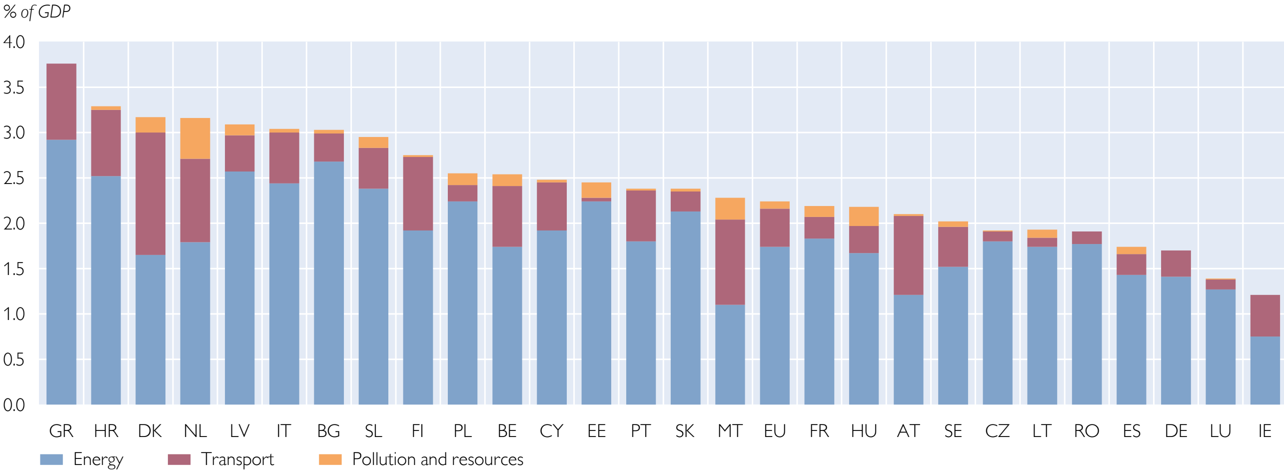
[20] *In Austria, roughly 40% of verified emissions during the third trading period came from the production of pig iron or steel, followed by the combustion of fuels with around 25%, the production of cement clinker (9%) and aviation (less than 5%).*

[21] *See IEA (2020). Austria's emission targets outside the EU ETS: –16% in 2020 and –36% by 2030 compared to 2005 levels.*

[22] *Energy Tax Directive 2003/96/EC.*

Chart 4

Environmental taxes (2020)



Source: Eurostat.

A more granular view of energy taxes in the EU shows that comparatively high tax revenues are not necessarily the result of high tax rates but might indicate high energy intensity (energy consumption/GDP).[23] In particular, countries that joined the EU more recently have a high energy intensity while showing low implicit tax rates on energy, which measure the tax revenue raised per unit of energy consumed (see e.g. Avgousti et al., 2022).[24] Indeed, Bulgaria, Hungary, Poland and Romania apply tax rates for motor fuels that are not significantly above the minimum tax rates. In contrast, the Netherlands and Italy levy tax rates twice as high as the minimum tax rates for unleaded petrol (EUR 359 per 1,000 liters), and Italy, Belgium and France levy diesel tax rates for cars which are almost twice as high as their minimum of EUR 330 per 1,000 liters.[25] Austria's tax rates for motor fuels are in the middle range (maximum diesel rate of EUR 425 per 1,000 liters, minimum tax rate for petrol of EUR 482 per 1,000 liters) and in the lower third for heating fuels – also reflected by the sixth-lowest implicit tax rate on energy – despite having one of the highest purchasing powers in the EU. At the same time, Austria's energy intensity is already among the lowest in the EU.

3.2 Explicit taxes on carbon emissions

Given that carbon emissions are a direct driver of climate change, the literature has advocated carbon taxes as an effective incentive-based fiscal policy measure to mitigate climate change. Unlike energy taxes, for which minimum rates apply across the EU with room for upward flexibility only, carbon taxes are entirely subject to national jurisdiction. Moreover, carbon taxes apply per unit of carbon emission, while minimum energy tax rates are based on the volume of energy products consumed – neither reflecting the energy content nor the carbon emissions of the energy products.

[23] *The EEA (2021) defines energy intensity as "the ratio between gross inland energy consumption (GIEC) and gross domestic product (GDP), calculated for a calendar year."*

[24] *A low implicit tax rate not only mirrors low rates on harmful energy sources, but might also result from an environmentally friendly energy mix relying on sources which are usually taxed at lower rates (e.g. hydroelectric power).*

[25] *Information based on European Commission (2021a).*

Table 1

Overview of carbon tax regimes

Carbon tax rate (per ton of CO_2 equivalent, April 2021)		Share of jurisdiction's greenhouse gas emissions covered	Year of implementation
	EUR	%	
Denmark	23.78	35	1992
Estonia	2.00	6	2000
Finland	62.00	36	1990
France	45.00	35	2014
Germany	25.00	40	2021
Ireland	33.50	49	2010
Latvia	12.00	3	2004
Luxembourg	20.00	65	2021
Netherlands	30.00	12	2021
Poland	0.07	4	1990
Portugal	24.00	29	2015
Slovenia	17.30	50	1996
Spain	15.00	3	2014
Sweden	116.33	40	1991
United Kingdom	21.23	23	2013

Source: World Bank (data updated in April 2021), OeNB.

EU member states have started to levy national prices on carbon on sectors and products not covered by EU emissions trading but largely already covered by the ETD, primarily on mineral oils and gas. Currently, Sweden, Finland, France, Germany, Ireland, Denmark, Portugal, Latvia, Estonia, Poland and Spain levy some kind of carbon tax. The rates range from 7 cent in Poland to about EUR 116 per ton of CO_2 in Sweden (see table 1). Like price levels, the types of greenhouse gas emissions covered differ widely: while some member states, such as Luxembourg, aim for broad coverage to complement EU ETS, others like Spain limit carbon taxes to very specific products such as fluorinated gases.

3.3 Carbon pricing in Austria

Austria planned to levy a carbon tax from mid-2022 on fossil fuels and gas, in particular on motor and heating fuels, liquified petroleum gas as well as natural gas and coal, which are the very products already covered by the ETD but not covered by EU ETS.[26] Technically, Austria's carbon tax was set up on the basis of a national ETS system with staggered fixed prices until 2025.[27] Until 2025, the price will go up to EUR 55/ton CO_2, from a starting rate of EUR 30/ton CO_2.[28] From 2026 onward, the system will operate with market prices, unless the EU-wide ETS system is extended to cover these products. This system basically replicates the German carbon pricing system introduced in 2021 with a starting price of EUR 25/ton CO_2 (see table 2). Like the German system, it covers about 40% of domestic greenhouse gas emissions. By 2025, the Austrian and German systems will be

[26] *While the carbon tax covers all sectors and uses of fossil fuels (heating and motor fuels), certain energy-intensive industries are entitled to a discount if the CO_2 costs exceed a certain threshold. In June 2022, the rollout of carbon pricing was postponed from July to October 2022 in view of the surge in inflation driven by energy prices (Bundesministerium für Digitalisierung und Wirtschaftsstandort, 2022).*

[27] *Unused permits can be returned to the authorities for the purchase price which is fixed by the authorities according to table 2.*

[28] *Federal Law Gazette. Part I No. 10/2022.*

aligned, and as other countries also intend to raise carbon prices stepwise, Austria's carbon price will be well in line with those of other member states.[29]

To compensate for the volatility of energy prices, carbon pricing in Austria is aligned with energy price fluctuations under a price stability mechanism: An increase in energy prices of more than 12.5% in the first three quarters of the current year halves the carbon price increase in the next year (i.e., the price increase would be EUR 2.5 instead of EUR 5). Vice versa, a fall in energy prices by more than 12.5% would lead to a carbon price increase of EUR 7.5 per ton in the following year.

Table 2

Price per ton of CO_2 equivalent

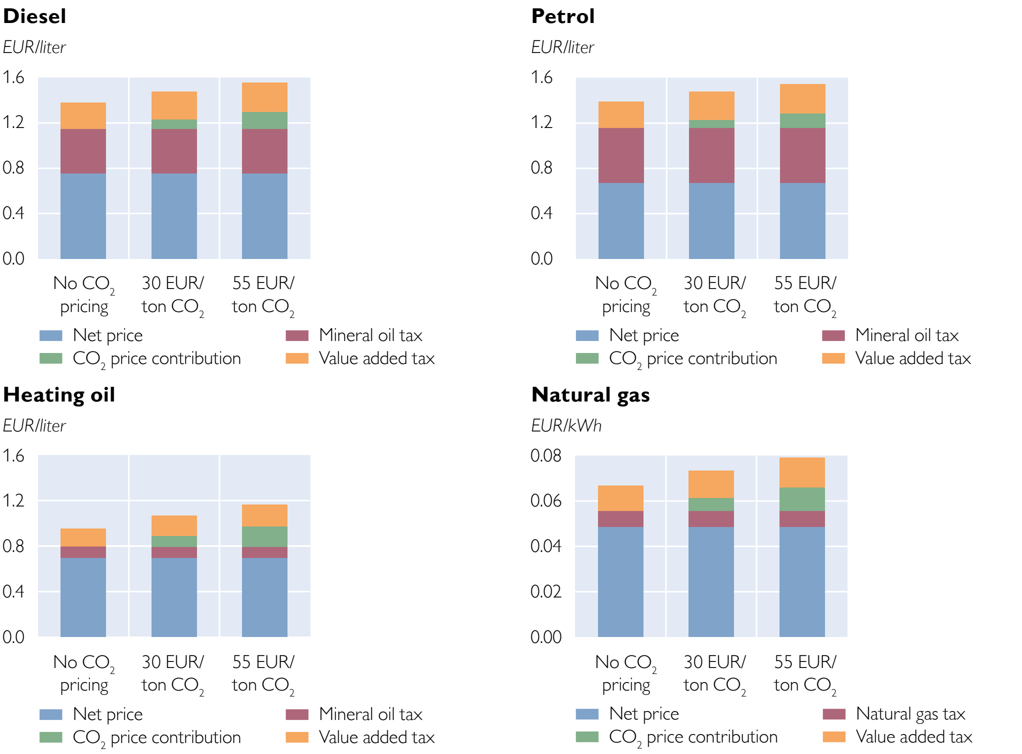
Year	Austria	Germany
	EUR	*EUR*
2021		25
2022	30	30
2023	35	35
2024	45	45
2025	55	55
2026	Trading system	Trading system: 55–65

Source: Germany: Federal Ministry for the Environment, Austria: Eco-social tax reform act 2022, part 1.

The carbon tax is aligned with emission content. In other words, as different energy sources release different amounts of CO_2 during combustion, the resulting carbon price per volume or energy unit differs for each energy source (as displayed in chart 5 for diesel, petrol, heating oil and natural gas).[30]

Chart 5

Price decomposition of different energy sources (December 2021)



Source: OeNB.

[29] *The current energy price hike induced some member states to temporarily cut carbon taxes, energy taxes or the VAT on energy products.*

[30] *In the Austrian case, the emission intensities are 2.38 kg/liter for petrol, 2.67 kg/liter for diesel, 3.24 kg/liter for liquid fuel and 2.04 kg/m3 for gas.*

As described above and indicated in chart 5, energy sources are already subject to a considerable amount of taxation under the ETD and VAT regime. While explicit carbon pricing only accounts for a minor part of the mineral oil price paid by consumers, energy taxes – which can be considered implicit carbon taxes – and the VAT– which is also levied on the taxes – account for about half of the consumer price of petrol and diesel. Until 2025, the carbon pricing system would drive up energy prices by up to EUR 0.18 (carbon price and VAT) per liter, indicating a price increase of 19% at constant energy taxes and net prices.

4 Impact of Austria's carbon pricing system on inflation and distribution

Macroeconomic and inflation impacts of a carbon price are not constant over time. The price elasticity of transport energy and heating demand is very low in the short run, which leads to a high pass-through of taxes to consumer prices in these sectors. Over time, however, consumer behavior may adjust to the change in prices. Therefore, long-run impacts on inflation might be lower compared to what we observe initially. In the following, we quantitatively estimate the short-run impacts on prices in Austria and provide a gauge for medium- to long-term effects with an overview of recent empirical estimates for euro area countries.

4.1 Inflation impact of the Austrian carbon pricing system

Technically, the price on carbon is a mark-up on the prices for transport fuels and heating energy, levied at the producer stage. Consumers have the option of switching to alternative products or services or simply consuming less in many instances. However, passenger transport or heating are somewhat different in this respect. In the case of transport, producers are likely to pass on their mark-up costs to consumers in the short run as the latter are unlikely to substitute quickly. In the case of housing energy, substitution is much easier rather in the medium to long run than in the short run but probably not complete. A case in point for the full pass-through to consumer prices is the mineral oil tax increase made in Austria in 2011 (by 5 cent for diesel and 4 cent for petrol). One month after the tax increase, fuel prices (net of VAT) were raised by about the same amount.

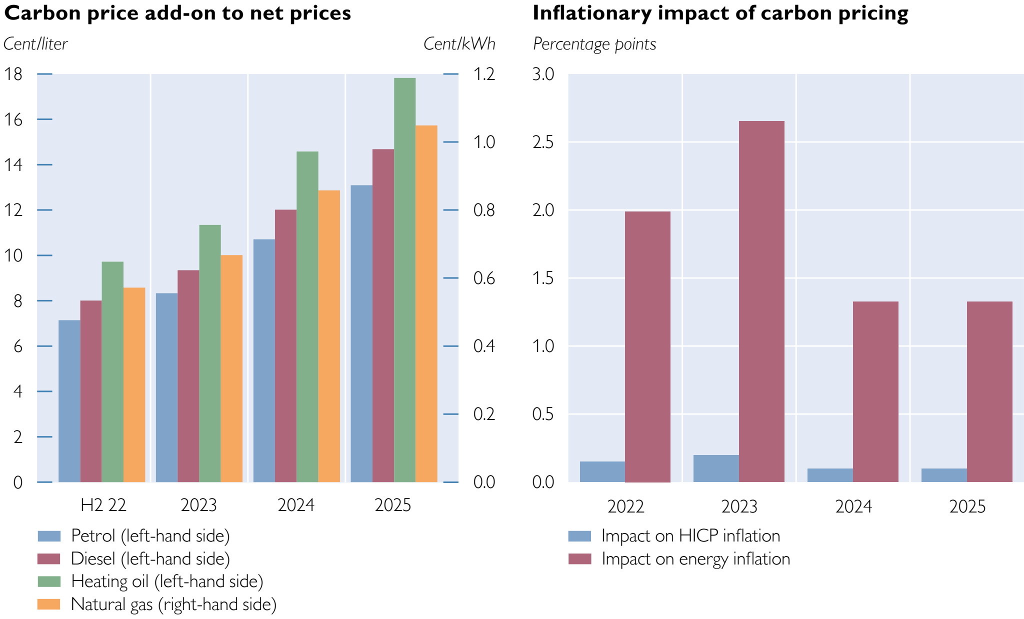
Assuming full and immediate transmission, carbon pricing starting in mid-2022 would raise energy price inflation directly by about 2 percentage points and HICP inflation by about 0.15 percentage points in 2022 (see chart 6, right-hand panel). In 2023, the effect of carbon pricing will be 2.7 percentage points on energy price inflation and 0.2 percentage points on HICP inflation, given the originally planned mid-year start date in 2022 and the mark-up applicable from 2023 (EUR 5 per ton of CO_2).[31] In 2024 and 2025, the inflationary effect of the carbon price will still be 0.1 percentage point for overall HICP inflation and 1.3 percentage points for energy inflation. It should be noted that these impacts are based on the assumption that the price stability mechanism built into Austria's carbon pricing system will not kick in (see section 3.3 above).[32]

[31] *Since the introduction of carbon pricing in Austria was postponed from July to October 2022, the inflationary impact is somewhat lower in 2022 and slightly higher in 2023 than specified in our calculation above.*

[32] *Currently (July 2022), it is likely that the price stability mechanism will apply in 2023. The price impacts are minor as this implies an increase of just EUR 2.5/ton CO_2 instead of EUR 5/ton CO_2 emission.*

Chart 6

Impact of carbon pricing (2022–2025)



Source: OeNB.

With regard to the carbon pricing system that Germany started to phase in in 2021, the Bundesbank estimates the direct and indirect impacts of carbon taxation on inflation to reach up to 0.3 percentage points in the short run (2021 and 2022).[33] Following full rollout, Nöh et al. (2020) estimate the direct and indirect effects on German consumer price inflation to range from 0.2 to 1.0 percentage points in the period from 2021 to 2026.

However, what happens beyond the short run? In case of substantial carbon taxation, there might also be negative indirect effects on consumer spending and competitiveness. As consumer prices rise, real income and hence consumption opportunities could decrease, and wage claims might go up. Furthermore, production costs could also rise via wage increases and transport costs, potentially hitting the competitiveness of the domestic economy. At the same time, incentives for firms to invest in carbon-neutral production capital could stimulate aggregate demand. While no estimates for the long-term inflationary impact are available for Austria, some recent empirical estimates suggest that no inflationary effects might follow in the medium to long run. McKibbin et al. (2021) estimate the impact of a EUR 40 carbon tax (with 30% emission coverage) to increase headline inflation by 0.26 percentage points contemporaneously and by about 1.0 percentage point in the second and third year. Beyond this horizon, the impact is still positive, yet statistically insignificant. For core inflation, the authors find that carbon taxation has a negative, yet not always significant impact over the whole horizon investigated (up to six years ahead). The authors take this as an indication that relative prices change (energy inflation goes up while nonenergy inflation goes down). Konradt and Weder di Mauro (2021) arrive at similar overall results. They empirically show

[33] *The Bundesbank simulations refer to a preliminary pricing scheme which was augmented in the final release.*

that in the medium to long run, carbon taxes in Europe were not inflationary but only changed relative prices.

4.2 Distributional impact of the Austrian carbon pricing system

The reported impacts on headline inflation are a measure for the "average consumer" but vary across households depending on their spending pattern. Low-income households will spend a higher share of their income on housing energy than high-income households. In Austria, households in the lowest expenditure quintile spend 7.5% of their budget on household energy while those in the highest expenditure quintile spend 2.7% on household energy.[34] Hence, the burden of carbon taxation is also comparatively larger for poorer households than for richer households. It is estimated that about 210,000 Austrian households (5.4% of the population) are "energy poor," i.e. not able to keep their home adequately warm (see Statistics Austria, 2021). As Känzig (2022) argues, the negative economic consequences of direct inflationary effects are hence amplified via reduced income for households in the lower income deciles. These distributional consequences could be mitigated by means-tested transfers to vulnerable groups or by reducing the income tax burden (or social security charges) for low-income households.

In the case of transport fuel, the absolute cost burden is higher for richer households as the expenditure share of transport fuels increases with income. According to Budgetdienst (2019) estimates, the absolute burden arising from the carbon price for transport fuels roughly doubles from the lowest quintile to the highest income quartile. As a share of income, however, the tax burden is again higher for low-income households. Carbon tax impacts differ also across regions. Households living in urban areas are likely to be less negatively affected than those in rural areas. City inhabitants spend less on transport and heating fuels (Budgetdienst, 2019). Moreover, they can switch to public transport while inhabitants in less urbanized regions are often compelled to use private transport to commute to work or satisfy basic needs. The "climate bonus" implemented in 2022 was initially designed to smooth such regional differences.

5 Concluding remarks

Fulfilling its obligations from the Paris Agreement, the EU has set ambitious targets to contain climate change, reduce human-made CO_2 emissions and eventually achieve carbon neutrality by 2050. To reach this target, both EU and national administrations have introduced a wide range of climate protection measures. These measures as well as climate change itself might have a nonnegligible impact on energy prices and headline inflation. In general, this impact is difficult to quantify, which is why we restrict our analysis to assessing the direct inflationary effects of two approaches to imposing a price on greenhouse gas emissions, namely emissions trading and carbon taxation.

We estimate the direct impact on consumer price inflation of the forthcoming Austrian carbon tax to range between 0.1 and 0.2 percentage points annually from 2022 to 2025. This direct impact, however, could be exacerbated by possible indirect effects due to the pass-through of higher production costs and possibly higher wage claims. In the medium to long run, the energy mix as well as energy efficiency

[34] *According to the Consumer Expenditure Survey 2014/2015.*

will change during the green transition as a consequence of changes in relative prices for different energy sources. Firms will find it increasingly important to invest in and develop green technologies to obtain an advantage over competitors pressed to pass on production costs driven up by rising carbon prices or competitors operating at lower profit margins. During the transition phase, prices for fossil fuels as well as EU allowance prices are expected to rise in any policy scenario.[35] Moreover, prices are likely to remain highly volatile until renewable energies can largely meet energy demand, and fossil fuels are substituted substantially.

With record inflation rates today, isolating the individual causes is a challenge. The release of pent-up demand during the recovery from the pandemic, associated supply bottlenecks and not least the war in Ukraine are currently more significant inflation drivers than ambitious climate policy measures. All these causes affect energy price inflation in particular. To compensate for the inflation hike to some degree, a number of EU member countries have considered and recently gone ahead with lowering taxes for motor and heating fuels, including the suspension of carbon pricing. This strategy is counterproductive, however, because it removes the incentive to consume less energy and could eventually thwart the price effect if applied everywhere. If policymakers want to protect low-income households from the effects of energy price inflation, direct (means-tested) transfers might be better suited.

Prices play a key role to ensure that in the medium to long term consumer behavior changes and households switch to public transport, e-mobility or more energy-efficient housing. Changes in consumption patterns and demand will result in changes of the weights of the different energy components in the HICP basket and impact inflation. Carbon pricing (and other climate change policy measures) ideally change relative prices without overall inflationary consequences. Apart from unrealistically perfect market conditions, the ideal case relies on two additional aspects. First, the carbon tax revenues need to be redistributed to households and firms in an appropriate way. Second, monetary policy might need to indirectly support the climate change policies by preventing long-term inflation expectations from moving upward and second-round effects from unfolding. To do so, central banks should not counteract the relative price changes and clearly communicate their strategy to the public. However, if carbon pricing were to drive up inflation over the medium term, a monetary policy response to meet the price stability target would be warranted (Schnabel, 2022).

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[35] *The Network for Greening the Financial System (NGFS) considers three scenarios: The "current policy scenario" with no additional climate policies, the "net zero 2050 scenario" with a substantial reduction in the use of gas and oil, and a disorderly transition scenario.*

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