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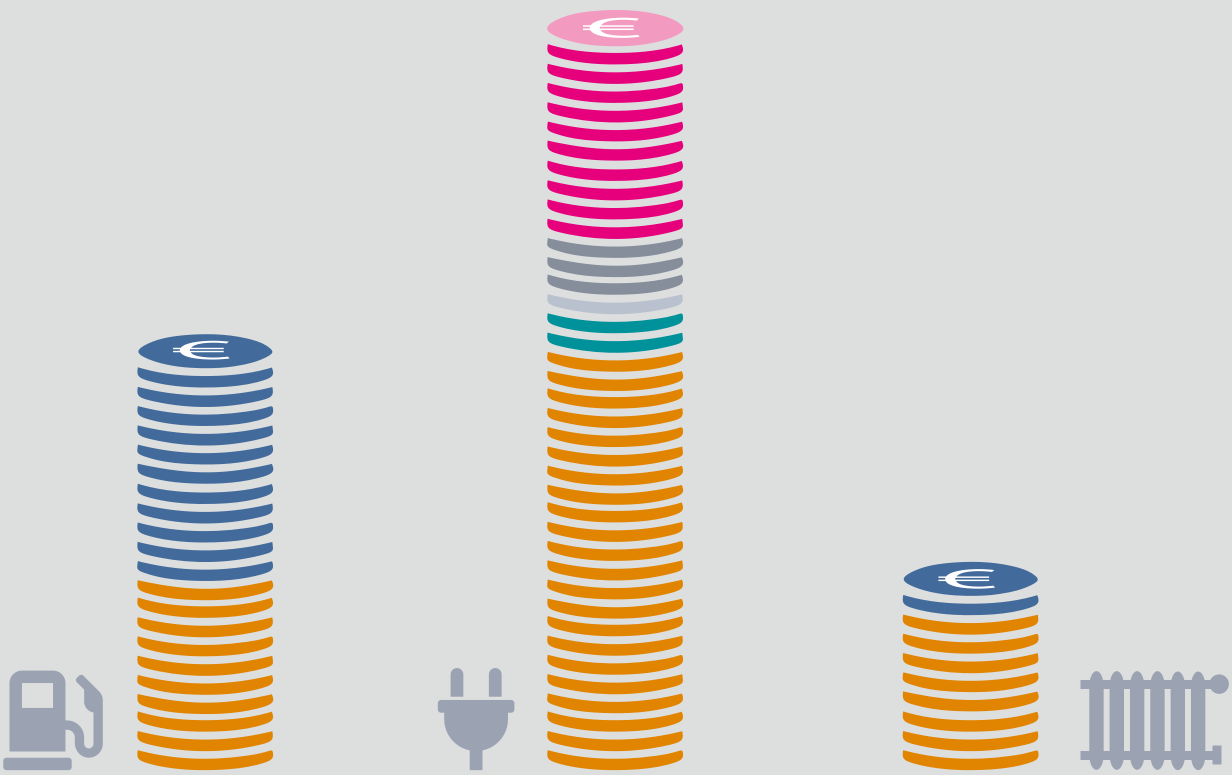
Position paper

Pricing Carbon, Reforming Energy Prices

Pathways to a Cross-sectoral Market Design



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Pricing Carbon, Reforming Energy Prices

Pathways to a Cross-sectoral Market Design

Preface

Germany's Climate Action Plan 2030 has set the country's climate policy in motion: following tough negotiations and sharp criticism from scientists, multiple organisations and civil society, the plan was amended and finally adopted in December 2019. The course has thus been set for Germany's climate policy.

The carbon price set for the heating and transport sectors is the cornerstone of the action plan. Scientists, including many ESYS members, had long argued that this measure was a vital and key instrument for successful climate protection. But the adopted price path is below their hopes and expectations. Ultimately, the question arises as to whether the agreed decisions will be enough to make a sufficiently large contribution to climate protection.

An ESYS working group has now discussed market-based approaches to promoting sector coupling for electricity, heating and transport. This position paper sets out policy options as to how Germany can efficiently achieve the objectives agreed at European level and drive climate protection forward internationally. The decisions made by the Federal government in the Climate Action Plan have been included in the considerations.

One outcome is that a sufficiently high carbon price would be a more efficient key instrument than a profusion of isolated measures. The Federal government's Climate Action Plan is a step in the right direction but is still too timid. Sample calculations made by the experts demonstrate the government revenue which could arise from carbon pricing and how it might be put to efficient use to enhance climate protection.

Essentially, the experts argue that Germany should advocate action to relieve the tax burden on households and industry, eliminate competitive distortion between different energy carriers and, as quickly as possible, establish a carbon price which applies to all sectors and, in the long term, as far as possible also worldwide. Such pricing must be accompanied by root and branch reform of the system of taxes, duties, fees and surcharges.

We would like to express our sincere thanks for the scientists' and reviewers' dedicated work.

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Contents

Abbreviations and units

BMF	Federal Ministry of Finance
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BMWi	Federal Ministry for Economic Affairs and Energy
BKartA	Federal Cartel Office
BNetzA	Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway
BDEW	German Association of Energy and Water Industries
DEhSt	German Emissions Trading Authority
EEG	German Renewable Energy Sources Act
EU ETS	European Union Emissions Trading System
GPS	Global Positioning System
CO2	Carbon dioxide
KWKG	German Combined Heat and Power Act
€ bn	Billion euro
PV systems	Photovoltaic systems
GHG emissions	Greenhouse gas emissions
TSO	Transmission system operator

ct/kWh	euro cent per kilowatt-hour
€/t	euro per tonne
%	per cent

Glossary

Allocative market failure	Allocative market failure describes a situation in which goods are not distributed (allocated) in an economically efficient manner. Causes may for instance be the market power of individual companies (monopolies or oligopolies), environmental impact which has not otherwise been taken into account on the market, such as emissions of toxic gases or fine particulates, or inadequate awareness on the part of market participants.
Benchmarking	A method for allocating emission rights in which the allocated volume of certificates is based on the most efficient plants for producing the same product.
Carbon leakage	Carbon leakage describes the effect of climate policy measures in one country causing companies to relocate their manufacturing activities and thus also their carbon dioxide emissions to countries with less stringent climate protection requirements. As a result, one country's climate protection efforts can bring about a global increase in emissions.
External effects	Effects on outsiders which are not taken into account in the price. One typical example of negative external effects is the harm caused by greenhouse gases and other kinds of environmental impact. Government can impose taxes and duties to ensure that external effects are factored into prices and in this way prevent allocative market failure – in the case of greenhouse gases by carbon pricing.
Effort sharing regulation	The effort sharing regulation establishes binding emission reduction targets by 2030 for all EU Member States for those sectors of the economy which are not covered by the European Emissions Trading System. Member States can decide which measures are used to achieve the reduction targets.
Resource allocation	Distribution of goods or resources. Supply and demand determine prices on a market and thus the distribution of goods.

Summary

How should the **market be designed** to enable efficient climate protection in Germany and drive sector coupling forward? A comprehensive carbon pricing scheme and a reform of taxes, duties and surcharges are key components. This position paper categorises the decisions from the Climate Action Plan 2030 and sets out options for how revenue from carbon pricing can be put to use to achieve a **double dividend**[1] for climate protection. The following points are crucial:

1. A **uniform and comprehensive carbon price in Europe** is the cornerstone of an efficient and effective market design. One obvious approach is to **extend** the European Emissions Trading System (**EU ETS**) if possible to all sectors **by 2030**.

2. Germany should persuade other Member States to join it in its national **carbon pricing scheme in the transport and heating sectors**, which the Federal government decided in the Climate Action Plan 2030. Together, they will be able to form a **strategic carbon alliance** which would ideally lead to an expansion of the EU ETS.

3. The revenue from carbon pricing can be used **to reform the system of taxes, duties and surcharges** with the objective of relieving the tax burden on excessively severely taxed energy carriers. In this way, a **double dividend** can be achieved and sector coupling fostered. Replacing the EEG surcharge and reducing electricity tax is of particular assistance.

4. Emissions in the **transport sector** are today at the same level as in 1990. A better market design could make a decisive contribution to solving these climate policy challenges in the transport sector in a targeted and efficient way. The Federal government should initiate a process to develop suitable solutions.

1 In this position paper, the term "double dividend" indicates that a higher and more comprehensive carbon pricing scheme enhances climate protection (first dividend) and the resultant revenue relieves the tax burden on citizens at another point. Relieving the tax burden in this way yields the second dividend by reducing existing inefficiencies in taxes, duties and surcharges.

Sector coupling requires undistorted competition between different energy carriers

The Federal government's **Climate Action Plan 2030** has added new impetus to the country's climate and energy policy. By extending carbon pricing, policy makers are acceding to a long-standing recommendation by leading climate researchers and economists. However, the approach is still in many respects fragmentary and it is disputed whether the decided measures will be enough to achieve the 2030 climate objectives. This position paper investigates how Germany can efficiently achieve agreed European objectives and drive climate protection forward internationally. The results are set against the decisions of the Climate Action Plan and used as the basis for formulating policy options for the next steps.

A central question is how the climate-damaging emissions from the heating and transport sectors can be significantly reduced. Low-emission and renewable energy carriers will have to replace fossil fuels. A range of technical options is available: renewably generated electricity from wind and PV systems can be used in electric cars, heat pumps and industrial applications. Biomass, being a material, easily stored energy carrier, can also be put to greater use in the transport sector and industrial processes. And hydrogen, the use of which is under discussion in various fields, may in future also help to reduce emissions. Energy carriers which at present are primarily used for individual applications should thus in future be available for flexible use across different sectors. Such "**sector coupling**" is a central plank of a low-emission energy supply.

If **sector coupling** is to increase, the energy carriers must be in undistorted competition. This means that all energy carriers are traded under identical terms and equal account is taken of the environmental harm arising from extracting and using them. This is not the case in the present system essentially for two reasons:

- **Firstly,** price setting does not include environmental harm sufficiently, in particular due to emissions of climate-damaging greenhouse gases. This should be achieved by means of a **cross-sectoral carbon price appropriate to the environmental harm**.

- **Secondly,** taxes, duties and surcharges on energy carriers are not optimally designed: while, among others, the electricity tax, EEG surcharge and KWKG surcharge are levied on electricity, only very little energy tax is imposed on heating oil, for example. Energy taxation on diesel and petrol, on the other hand, is comparatively high. At the same time, the KWKG surcharge, EEG surcharge and electricity tax do not differentiate how the electricity was generated and so apply equally to renewable and fossil-generated electricity. **Existing duties, surcharges and taxes must be reformed** in order to drive sector coupling forward efficiently. Only once the unequal levels of taxation have been eliminated will carbon pricing become fully effective.

Carbon price as the basis for efficient and effective climate policy

Two fundamental decisions must be taken in relation to the introduction of a carbon price: which emissions should be recorded? How should the price be determined?

- Fundamentally, **the more emissions are recorded, the more efficient can pricing be**. This firstly means that as many sectors as possible should be covered. Secondly, as many countries as possible should participate, so reducing the risk of companies relocating their manufacturing operations to countries with lower carbon prices ("carbon leakage"). A global pricing scheme should be the long-term objective.

- There are two different approaches to setting prices: charging a direct **carbon price** or using an **emissions trading system.** A direct carbon price, for example by carbon-based taxation[2], facilitates planning for market actors but on the other hand does not necessarily achieve a possible volume target. In contrast, the situation is reversed in **emissions trading,** where the entire volume of emissions is fixed and the price is established accordingly, making it uncertain in advance. In practice, due to the different advantages and drawbacks, a **hybrid system** is often proposed: emissions trading with a price floor or a price corridor. The effect of a carbon pricing scheme is, however, similar in the two systems. What is crucial is for a carbon pricing system to introduce prices which are high and commensurate with the climate damage so that the Federal government's objectives can be achieved.

This gives rise to a series of different options for a national pricing scheme. What is important is that a national pricing scheme should serve as **a first step towards an international solution**. In the medium term (2030 target horizon), the Federal government should endeavour to extend European emissions trading to all sectors. Until that point, Germany should coordinate with partner countries and attempt to introduce a common system. Ideally, it should also include agriculture.

Making targeted use of carbon pricing revenue and achieving a double dividend

A **double dividend for climate protection** can be achieved if the revenue from a carbon pricing scheme is used to reduce taxes, duties and surcharges levied on low-emission energy carriers: **Firstly,** carbon pricing increases the cost of emissions of climate-damaging greenhouse gases. This also encourages climate-friendly technologies. **Secondly,** revenue is generated which is available for instance for relieving the tax burden on companies which compete internationally and on private households. In addition, low-emission technologies can also be directly promoted with a proportion of the revenue, for instance by means of replacement premiums. An essential element for achieving a double dividend is to bring about a reform of taxes, duties and surcharges which boosts welfare by eliminating existing distortion. This is discussed below.

2 A direct carbon tax is considered inadmissible under Germany's current fiscal legislation. Existing energy taxes may, however, be geared towards carbon content.

Efficient sector coupling by reforming taxes, duties and surcharges

Taxes, duties and surcharges are levied for two reasons: **Firstly** to generate **revenue for the public budget** and **secondly** to reduce unwanted effects, such as environmental harm (**incentive effect**). The present system, however, no longer corresponds to current aims and insights. For example, the incentive effect in climate protection has not resulted in the political aims of emission reduction being achieved. Instead, the system has developed over the course of time and has had numerous piecemeal items of legislation added over the years. Relatively recent examples are Germany's introduction of the electricity tax and the increase in mineral oil tax in the course of environmental tax reform, and the introduction of the EU ETS[3] and the EEG surcharge.

As a result, numerous government price components are imposed on electricity. At the same time, the EU ETS had already introduced a carbon price into power generation, whereas natural gas and heating oil are subject to only low taxation (see figure 1).

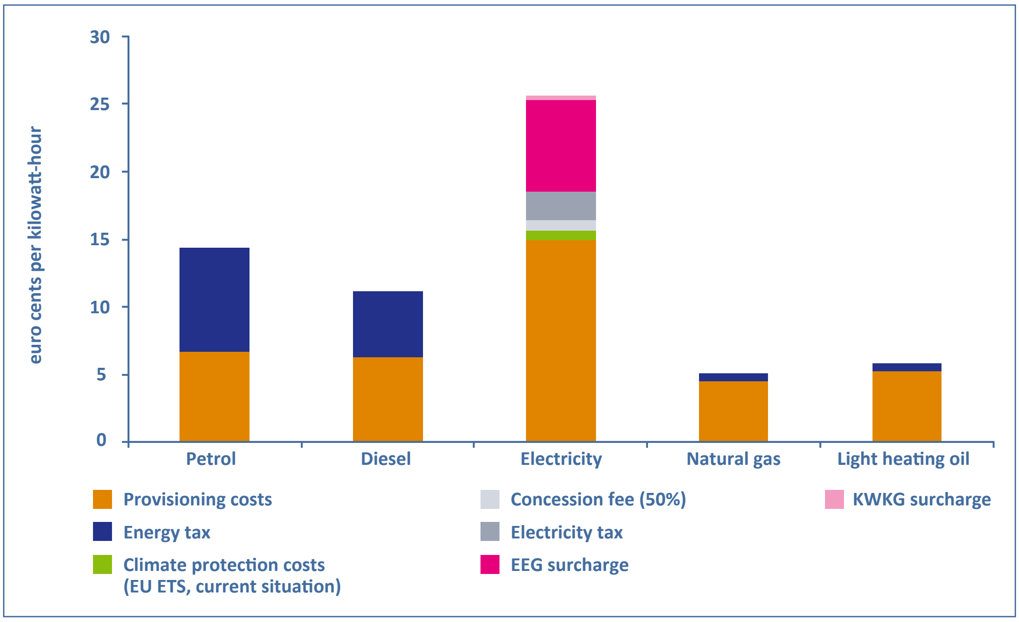

Figure 1: Average final consumer prices for selected energy carriers, broken down into provisioning costs[4] and taxes, duties and surcharges (as at 2018, excluding value-added tax). The figure relates to final consumer prices for private households, no account being taken of exemptions for companies. Sources: own calculations based on BMWi 2019, BDEW 2019, BNetzA/BKartA 2018, Energi Data Service 2019, MWV 2019.

3 EU Emission Trading System.

4 The concession fee in part reflects infrastructure costs for power lines and in part is a public sector (local authority) funding instrument. For simplicity, 50 per cent is therefore reported as a duty and 50 per cent is included in the provisioning costs.

The box below outlines the need for reform of the most important price components. A prerequisite is that a reasonable carbon price is charged in all sectors. But what would an effective reform of the existing system look like? The following options may be considered in order to achieve a **double dividend** with the revenue from the carbon pricing scheme:

- The **EEG and KWKG surcharges** could be reduced or abolished and the corresponding schemes they support funded in another way.
- The **electricity tax** could likewise be reduced while observing the minimum rate set at the European level.

If the revenue is insufficient to completely replace the price components, the EEG and KWKG surcharges in particular could initially be reduced insofar as is financially affordable.

At a glance: where is there a need for reform?

EEG and KWKG surcharges

- **Double taxation**: These two surcharges make up around one fifth of the final customer price for private households. They were introduced to fund the development of renewable energy plants (RE plants) and combined heat and power plants (CHP plants) and so cut greenhouse gas emissions. GHG emissions are, however, already factored into power generation prices by the EU ETS (for all plants >29 MW combustion capacity).
- **No differentiation by type of generation**: Both surcharges are levied on the final customer price and generally do not differentiate in terms of how the electricity was generated. They are thus imposed equally on renewably generated electricity and on that generated with fossil combustion fuels and so cannot have any climate policy effect.
- **Social task:** The development of RE plants and CHP plants only incompletely addresses market failures in power generation. These are therefore at least in part social tasks which cannot be shaped by one-sided taxation of the electricity price.

Electricity tax

- The electricity tax is intended on the one hand to encourage **power-saving behaviour** while on the other hand it is a reliable **source of revenue** for the Federal budget.
- However, from an economic standpoint, there is no need for additional instruments for **reducing consumption** if reasonable account of the harm arising from use of the energy carriers has already been taken in the market design. This can be ensured for climate protection by setting a sufficiently high carbon price. With regard to other environmental harm (*e.g.* fine particulate emissions), the electricity tax has the drawback that it also does not generally differentiate between renewable and fossil generation and thus does not optimally address the causes.
- As a **source of revenue** for the public sector, it distorts consumption signals in the energy sector and considerably complicates sector coupling.

Energy tax on natural gas and heating oil

- **No urgent need for reform**: The level of energy tax on natural gas and heating oil roughly corresponds to the (environmental) harm arising from burning these energy carriers, apart from emissions of climate-damaging greenhouse gases, for instance fine particulate pollution. Abolition would in any event have only a slight effect on the final customer price (see figure 1).

Energy tax on petrol and diesel

- **Infrastructure costs must be secured in the long term**: Energy tax makes up around half the final customer price of petrol and diesel, a proportion which is explained by the road infrastructure costs to which much of the revenue is allocated. Looking ahead, it must be borne in mind that the proportion of vehicles with internal combustion engines will probably fall, while the proportion of vehicles with alternative drive systems will rise. If it is to be possible to cover road infrastructure costs in the long term, all vehicles should contribute to funding road costs.
- **Transport policy challenges** such as noise, road congestion and pollution in cities and differences between rural and urban areas could be addressed more effectively and efficiently by traffic policy instruments. A **usage- and location-dependent toll** could, for example, be considered. Revenue from carbon pricing need not be used for this purpose.

Implementation in the Climate Action Plan 2030

The German Federal government has decided to introduce a carbon price in the heating and transport sectors via a separate emissions trading scheme from 2021. Until 2025, the certificates will have a fixed price which is set annually, after which the price is to be determined by the market. This is a **combination** of the options discussed above (taxation or emissions trading) since emissions trading will have the effect of a tax in the initial years. It is disputed whether this approach is legally admissible because a direct tax on carbon emissions is considered inadmissible under fiscal legislation. The starting price is set to be € 25 per tonne of CO_2 in 2021 and to rise incrementally to € 55 per tonne by 2025. The Federal government furthermore aims to extend the EU ETS to the heating and transport sectors by 2030.

Some of the **revenue from carbon pricing** is to be used to reduce the EEG surcharge. Specifically, it is set to fall by 1.75 ct/kWh in 2021 and by 2.9 ct/kWh by 2025. This corresponds to around forty per cent of today's EEG surcharge. A large proportion of the revenue, however, will be used to fund the many individual measures provided in the Climate Action Plan. These include for example an increase in the commuter's tax allowance and various technology-specific support schemes. Efficient and effective climate protection could be more usefully achieved by focusing on the carbon price as the most important instrument and eliminating existing distortion, in particular by making a greater reduction to the EEG and KWKG surcharges.

Possible next steps

The Federal government has initiated some important measures in the Climate Action Plan. It is, however, disputed whether Germany will achieve agreed European targets with the adopted measures. The following proposals could help to achieve the targets, keep costs as low as possible and drive climate protection forward internationally:

1. Germany should emphatically support **a global carbon pricing scheme**. Only in this way can carbon emissions be reduced globally and, ultimately, the risk of carbon leakage[5] minimised.

2. The Federal government should accelerate negotiations for a reform of European emissions trading: **extending the EU ETS to all sectors** – including agriculture – should be the primary objective of European climate policy. A **minimum price** in the EU ETS could additionally create planning certainty and help to bring about a further reduction in emissions from power generation throughout Europe.

3. Germany should win over **partner nations** for the introduction of carbon pricing. This would diminish the competitive disadvantage of German companies within Europe and could add further impetus to an expansion of the EU ETS.

5 "Carbon leakage" refers to companies which, due to carbon pricing-related costs, relocate their manufacturing activities to countries with less stringent emission requirements.

4. **Revenue** from additional climate protection should primarily be used to cut the EEG and KWKG surcharges and possibly also the electricity tax. This would firstly reduce the electricity price and make electricity from renewable energy carriers more competitive in sector coupling. Secondly, some of the revenue would return to citizens.

5. To ensure **efficient climate protection,** the Federal government could furthermore review whether it can provide further resources to **reduce the tax burden** on the **electricity price**.

6. The Federal government could support the EU Commission's efforts to implement meaningful **reforms to European fiscal directives** since they are not entirely designed for efficient climate protection. For instance, minimum tax rates for the energy tax could be abolished.

7. In the **transport sector**, new technologies (GPS, communication, digitalisation) offer wide-ranging options for addressing not only climate-damaging emissions, but also noise, road congestion and pollution in cities and the differences between rural and urban areas in a more targeted manner. A better market design could make a decisive contribution to solving these challenges purposefully and efficiently. The Federal government should initiate a process to develop suitable solutions.

1 An efficient and effective market design for the energy transition

Energy markets decide which and to what extent different energy carriers and technologies are used. In order to ensure that the market outcome is in line with social aims, a government must set rules or as it were "design" the market.[6] The market design should be efficient and effective so that these aims are not only actually achieved but also at the lowest possible cost. At the same time, issues of distribution must also be borne in mind.

The present position paper focuses on the question of what a suitable market design for the energy transition might look like. The focus is on climate protection because

- it is the greatest environmental policy challenge of our times,
- this field demands major changes to the market design, and
- the energy transition and climate protection are defining the current debate in politics and society, so giving rise to a "window of opportunity" for initiating change.

So where are the specific needs for change in the market design? Two points should primarily be mentioned in this connection. Firstly, current market models inadequately reflect the harm caused by emissions of climate-damaging greenhouse gases. Secondly, very different levels of taxes, surcharges and duties are levied on energy carriers. For example, the high levels of taxation on electricity complicate using renewably generated electricity in the heating and transport sectors. The current design thus hampers efficient climate protection.

1.1 Markets and market design

Supply and demand determine prices on a market and thus the distribution of goods. This is known in economics as **resource allocation.** Government intervention also has an influence on prices on these markets. A government can use this influence to help to ensure that the market outcome is in line with political and social aims and no harm is caused to outsiders or the environment. Stated once again in economic terms, the aim is to optimise **social welfare**.

The government constantly has to strike a balance here between the numerous objectives it is pursuing. Firstly, goods should be economically efficiently distributed (allocated). If this is not achieved, the situation is described as **allocative market failure**. Causes may for instance be the market power of individual companies (monopolies or oligopolies), environmental impact which has not otherwise been taken into

6 An introduction to designing energy markets may for example be found in Müsgens/Ockenfels 2006.

account on the market, such as emissions of toxic gases or fine particulates, or inadequate awareness on the part of market participants. Secondly, the distribution achieved should be perceived to be fair. Thirdly, the government must **generate revenue** which it requires for public tasks, which it does by levying taxes, duties and surcharges. Fourthly, governments intervene in order to pursue further **social aims**, for instance to limit the use of certain goods such as alcohol and tobacco.

With regard to climate change, it is vital for the harm which is caused by emissions of climate-damaging greenhouse gases to be taken fully into account in the price. Since this does not happen without government intervention, this is an instance of allocative market failure. In economics, such harm which has an impact on outsiders is described as a **negative external effect**. It must be ensured that this harm is included (**internalised**) in decision-making by market participants. Various avenues are open to government to achieve this. External costs may be directly included in the price, for instance by taxes, duties or surcharges. Regulatory provisions and rules may, however, also be used to prevent unwanted effects.[7]

A suitable market design thus influences price formation by firstly correcting allocative market failure, secondly effectively raising public sector revenue and thirdly optimally achieving social aims. Two different "instrument tool kits" are required for achieving these economic aims. The external effects of climate change are addressed with **environmental policy instruments**. These include not only regulatory measures which adjust prices indirectly via a modified cost structure (*e.g.* introduction of filters) but also additional price components which directly reflect the costs in the price (*e.g.* European emissions trading). In contrast, interventions for funding public budgets are addressed with **financial instruments**. Various mechanisms are thus used and various aims pursued. These instruments do, however, interact and if the market design fails to take appropriate account of such interaction, unwanted effects may occur.

Sector coupling is one example of this. One important principle for market design in the energy system is that energy carriers should be traded on identical terms ("level playing field"), such that low-emission technologies which cause fewer greenhouse gas emissions than conventional technologies should suffer no competitive disadvantage and be able to establish themselves on the market. A market design of this kind enables **undistorted competition between energy carriers**, in which low-impact technologies can become established. It avoids anticipatory decisions for or against individual technologies and supports the principle of "**market discovery**". These considerations are central to **sector coupling** which in turn is an important prerequisite for a low-emission energy system.[8, 9] If emissions in the heating and transport sectors are to fall, electricity from renewable energy plants will for example probably have to be used to a greater extent in those sectors. It must accordingly be able to establish itself against higher-emission energy carriers such as heating oil and natural gas. At present, however, distinctly higher taxes and duties are imposed on electricity than on other energy carriers. The following section examines whether such taxation is helpful.

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7 Further external effects are also involved in the energy system, for example due to fine particulate pollution and congestion costs in the transport sector, and should likewise be investigated in further research projects.

8 In the present document, the "energy system" includes all value creation levels from extraction to consumption in the transport and heating sectors and in original electricity applications.

9 acatech/Leopoldina/Akademienunion 2017.

1.2 Policy options for an efficient and effective market design

In order to develop a suitable market design for the energy transition, it is thus important to investigate the structure of the final consumer prices for energy carriers and suitable instruments for tackling greenhouse gas emissions. This position paper does this in three steps:

- The prices which are currently formed on the market are firstly analysed (section 2). These prices are already influenced by government intervention such as antitrust rules and environmental requirements for instance for the inclusion of filters.[10] The presentation however deliberately disregards taxes, duties, surcharges and prices for European carbon emissions trading.

- There then follows a discussion of how market design can effectively and efficiently address emissions of climate-damaging greenhouse gases (section 3). The key instrument is a cross-sectoral carbon price which can be of various configurations. To clearly differentiate the various price components, those which arise from pre-existing instruments for internalising climate costs are firstly excluded in section 3. This above all concerns the European Emissions Trading System (EU ETS).

- Finally, current taxes, duties and surcharges are analysed (section 4). These have a significant influence on final consumer prices and thus on the distribution of goods. What is important to examine here is whether they take account of external effects or whether they are primarily levied in order to generate government revenue.

This analysis may then serve as the basis for devising policy options which enable a market design for efficient climate protection. The analysis shows that introducing a comprehensive carbon pricing scheme offers the opportunity of a **"double dividend"**. It firstly ensures that climate-damaging greenhouse gases are efficiently and effectively reflected in energy prices. Secondly, the revenue may be used to eliminate the impediments to undistorted competition. In this way, carbon pricing can take full effect and progress can be made with sector coupling.

10 In practice, however, there are virtually no unregulated markets completely without government intervention.

2 Provisioning costs without costs for EU ETS, taxes, duties and surcharges

The first step in the analysis will be to clarify the provisioning costs on the market which in this case are defined as the prices without including the costs for limiting climate change in the form of carbon prices or taxes, duties and surcharges.[11] On the supply side, these **provisioning costs** thus in particular include costs for generation or extraction, (long-distance) transport, treatment, transformation, distribution and sale of a product. These costs should in principle in each case be borne by the actors who cause them because behavioural incentives are most effective when applied to those who directly cause the costs. One consequence is that the costs arising from extraction and use should be directly associated with each energy carrier.

This position paper focuses by way of example on the final consumption of petrol, diesel, electrical energy, light heating oil and natural gas. From a national standpoint, the path to the final consumer starts with the import or domestic extraction of primary energy carriers, both of which cause costs. Further costs arise for the domestic transformation and transport of the energy carriers. Secondary energy carriers are sold in wholesale trading at a specific price. Finally, the energy carriers are distributed to the final consumers, giving rise to further costs, among other things for sales, administration, margins, storage and possible admixtures[12]. The proportion of primary energy which reaches the final consumer after all the energy conversion and transmission losses (*e.g.* via a household power connection or a filling station) is denoted final energy. Apart from private households, energy users also include commerce/trade/services (CTS), industry and transport. This distinction is important because final consumer prices may vary greatly for the various sectors.[13]

Table 1 shows the provisioning costs of selected energy carriers for private households which arise between wholesale trade and the final consumer. The accompanying published analysis provides more details about how these data are obtained.[14]

11 Provisioning costs do, however, include payments which should be directly assigned to the extraction and transport of energy carriers. These include the offshore liability surcharge, the interruptible load surcharge and the "section 19" Electricity Grid Fee Ordinance surcharge.

12 One example is "E10" motor fuel which contains a specific proportion of bioethanol blended with the fossil fuel petrol.

13 Prices vary, for example, as a function of consumed volume and grid connection level. While the consumption costs of very large industrial consumers are close to the wholesale prices mentioned in this section, small commercial companies pay pretty much household prices. For simplicity's sake, the presentation of prices therefore focuses on final consumption by private households. Details regarding consumption volumes, on the other hand, differentiated in particular by respective sector, are stated for all consumers in that sector.

14 Müsgens/Weyer 2020.

In ct/kWh	Petrol	Diesel	Light heating oil (low-sulfur)	Natural gas	Electricity
Provisioning costs	**6.70**	**6.31**	**5.22**	**4.51**	**14.88**
Wholesale prices (incl. long-distance transport)	5.08	5.06	4.59	2.49	6.08
Additional prices for distribution, sale and profile correction	1.72	1.65	0.63	2.02	8.80

Table 1: Provisioning costs for selected energy carriers for 2018 in ct/kWh. Taxes, duties and surcharges and the costs for EU ETS certificates are not included. One exception is the offshore surcharge which should be assigned to transmission grid costs and is therefore included with the provisioning costs for the wholesale trade in electrical energy. The interruptible load surcharge and “section 19” Electricity Grid Fee Ordinance surcharge are likewise assigned to the provisioning costs. Sources: own calculations based on BDEW 2019, BNetzA/BKartA 2018, Energi Data Service 2019, MWV 2019.

3 Carbon pricing and efficiency in climate protection

Burning carbon-containing energy carriers is harmful to the climate and the environment. Germany's energy supply nevertheless remains largely based on the combustion of coal, oil and gas. Past failures to take sufficient account of the harm caused by CO_2 emitters have led to inefficiencies and welfare losses. Government intervention is therefore necessary to enhance climate protection and maximise welfare.

When it comes to identifying the ideal instrument for such intervention, numerous studies have concluded that carbon emissions should be factored into prices (**carbon pricing**).[15] In principle, the more emissions are included and have the same price applied, the more efficiently are emissions avoided because emission savings are made where it is most advantageous. In contrast, different carbon emission prices in different sectors result in the most advantageous potential not being utilised. **Comprehensive and uniform carbon pricing** is thus the objective. Two important conclusions may be drawn:

1. A pricing system should encompass as many countries as possible since, as the above line of argument would suggest, emissions should also be saved internationally where it is most advantageous. For this reason alone, a global approach makes sense. At the same time, human-influenced climate change has global effects so there is an urgent need for a common approach. Germany should therefore support **a global carbon pricing scheme**. A further advantage of a global pricing system is that carbon emission costs would flow into global production costs which would mean that companies in Germany and Europe would not be put at a competitive disadvantage by carbon pricing. In this way, it is possible to prevent companies which compete internationally and whose production costs increase due to carbon pricing from relocating their manufacturing operations to a foreign country (**carbon leakage**).

2. **Sector-specific carbon prices** lead to climate protection **inefficiencies**. This also means that sector targets, although possibly effective, are not well suited to ensuring an efficient market design since they implicitly specify prices for individual sectors.

3.1 Comprehensive carbon pricing in Europe

Achieving global agreement takes some time, however. Even a European solution is greatly to be preferred on climate and trade policy grounds to national approaches. Germany should therefore push ahead strongly with a **comprehensive pan-European carbon pricing scheme**. Europe can in this way make a contribution to climate

15 See *inter alia* Cramton et al. 2017, Sachverständigenrat 2019, Edenhofer et al. 2019-1, Expertenkommission 2019.

protection and an effective European carbon pricing system can serve as an important starting point for international negotiations.[16] Sensibly, such agreement is being built on existing European instruments and previous negotiations: the **European Emissions Trading System (EU ETS)** and **the effort sharing regulation**. Unlike in the ETS sector, an explicit carbon price is still not implemented in the non-ETS sector in Europe. Effort sharing has, however, established emission reduction targets for all Member States.[17] Member States are free to decide the specific form of implementation.

It makes obvious sense to extend the **EU ETS to all sectors** in order to achieve an overarching carbon pricing scheme in Europe.[18] However, doing this also takes time, in particular because extending the EU ETS requires intense negotiations at the European level. Since the effort sharing agreements in any event apply until 2030, this is a sensible time horizon for extension of the EU ETS. The Federal government should thus set itself the objective of putting a uniform cross-sectoral carbon pricing scheme in place across Europe by **extending the EU ETS by 2030**.

In its current form, however, the EU ETS is controversial. Two points above all have arisen in the public debate: **firstly**, the price fluctuations associated with the system lead to uncertainty for market participants. **Secondly,** the price has sometimes been very low. Between 2012 and 2018, the auction price for emission certificates was continuously below € 10. Both points affect the credibility of climate policy instruments, namely the question as to whether the measures would continue to be supported politically if prices were to fluctuate severely or rise significantly and so put individual sectors under severe pressure to act.[19] The EU could introduce a **minimum price** into the ETS in order to create investment certainty right now and enable long-term price planning. The minimum price need not be constant over the years but could follow a predetermined trajectory. Excessively severe price fluctuations could furthermore also by addressed by a **maximum price** in the ETS.

3.2 Comprehensive carbon pricing in Germany as a stopgap solution

Germany's energy policy objectives have for decades been to ensure economic sustainability, environmental sustainability and security of supply, which are largely uncontroversial and are known as the "triangle of energy policy goals". In practice, the Federal government has set numerous "sub-objectives" for the energy transition which has led to a broad mix of individual measures and support schemes. From a macroeconomic point of view, however, these are not efficient. In this context, an ESYS analysis has concluded that there is a need for prioritisation of objectives in Germany's energy policy.[20] Climate protection and reducing greenhouse gas emissions are for the most part the central objectives.[21] However, the extent to which objectives for energy efficiency, for technology-specific expansion of renewables or for shares of CHP electricity are

16 Edenhofer et al. 2019-1.

17 These targets may be justified more in terms of justice than of efficiency.

18 Numerous advisory committees and institutes have already proposed extending the EU ETS to all or selected sectors. See for example Umbach 2015. The scientific services of the German Lower House of Parliament compiled an overview of selected studies in March 2018 (Wissenschaftliche Dienste 2018).

19 See: Edenhofer et al. 2019-1, section 2 ("lack of credibility").

20 Umbach 2015.

21 See *inter alia* Arvizu et al. 2011, Schmalensee 2012, Fell/Linn 2013, Edenhofer et al. 2013, Murray et al. 2014, Figueres et al. 2017, Müsgens 2018.

necessary should at least be closely examined. Moreover, as already explained above, purely national approaches in climate policy are subordinate to international approaches. However, if the Federal government wished to make a national contribution and pursue objectives specified by the effort sharing regulation until European agreement is achieved, a **carbon pricing scheme for Germany would make sense as the key climate policy instrument.** Such a scheme is

- firstly capable of ensuring efficient climate protection at national level;
- secondly of assisting development of low-emission technologies under market conditions; and
- thirdly of serving as a starting point for European agreement.

However, it is precisely for these reasons that Germany should not act alone but instead attempt together with partner nations to form a **strategic carbon price alliance**. The partner nations in such an alliance would jointly resolve to introduce a cross-border carbon pricing system. If it proves possible to persuade European Member States who are responsible for a significant proportion of Europe's carbon emissions to join such an alliance, this could set under way a dynamic towards a European solution.[22]

In the context of the Climate Action Plan, the Federal government has decided to introduce a national carbon price in the heating and transport sectors. In preparation for the decisive session of the "climate cabinet" on 19 September 2019, the Academies' project ESYS presented at the beginning of that month a discussion paper setting out various options for the introduction of a carbon price with their associated advantages and drawbacks.[23] The individual options will not be explained in detail again here but the most important principles and interrelationships will be briefly outlined and the decisions of the Climate Action Plan included among the options.

A carbon price can be implemented in two ways: either **directly** by explicitly setting a price for the emissions (carbon-based taxation), or **indirectly** by setting an admissible volume of emissions (emissions trading). The price for emissions is then indirectly established via trading. One major advantage of **direct price control** is that it offers market actors greater planning certainty because the price is known. In support of **emissions trading,** in contrast, is the fact that the limited quantity of certificates means that a volume target can be achieved very accurately (high accuracy).

Hybrid systems are often discussed in practice. If, for example, specific reduction targets are to be achieved by price control, the price must be regularly corrected, ideally on the basis of previously established criteria. This limits planning certainty but increases accuracy. Similarly, minimum or maximum prices can be introduced into a system with volume control, so reducing price fluctuations and increasing planning certainty while, however, reducing accuracy in terms of the volume targets. The transitions between direct and indirect price control may thus be fluid in terms of practical effects.

22 In addition to Germany, support for a carbon price alliance has also been signalled by France, Sweden, the Netherlands, Austria and the United Kingdom. Such a strategic alliance would by itself cover around 51 per cent of the EU's greenhouse gas emissions (acatech/Leopoldina/Akademienunion 2019).

23 ESYS 2019.

There are **essentially three options** for introducing a carbon price in Germany: firstly, **extending the EU ETS nationally**, secondly introducing an **additional national emissions trading system in addition to the ETS** and thirdly introducing **national carbon-based taxation**.[24] A national pricing system should be fundamentally **uniform** on macroeconomic grounds.[25] Repercussions on **effort sharing** agreements must also be borne in mind: Germany has undertaken to cut emissions in the non-ETS sector by 38 per cent, in principle following a linear trajectory, by 2030. If Germany does not meet these requirements, it could acquire emission rights from other Member States which have more than achieved their targets. Effort sharing explicitly allows for such trading: "Member States can also buy and sell allocations from and to other Member States. This is an important vehicle to ensure cost-effectiveness as it allows Member States to access emissions reductions where they are the cheapest and the revenue can be used to invest in modernisation."[26] If, however, Germany fails to achieve the effort sharing reduction targets (including purchases and sales), compliance control under the effort sharing regulation comes into play which may lead among other things to an additional reduction in admissible emissions in subsequent years.[27] If an additional price is introduced in the ETS sector in Germany, effects on companies which are competing with companies from other European countries which do not join a strategic carbon price alliance must furthermore be borne in mind.

It is therefore a matter for policy makers to decide the priorities they wish to set. A **cross-sectoral,** uniform carbon price also including the ETS sector is in particular supported by its greater efficiency: the desired carbon reduction is achieved at lower macroeconomic costs. This applies twice over: firstly, to the costs of emission avoidance within Germany. Secondly, further potential energy efficiencies between countries under the effort sharing regulation may moreover be utilised if emission rights are traded. Germany's own declared climate target for the period to 2030 (55 per cent reduction over 1990 according to the Federal government's Energy Plan)[28] could also be directly pursued in this way.[29] If, on the other hand, the focus is primarily on directly meeting effort sharing objectives in the non-ETS sector, **separate pricing** in this sector, which would establish a second carbon price in Germany in addition to the ETS, makes sense. As a result, emission prices would differ between the ETS sector and non-ETS sector. This would increase emission avoidance costs because, while one of the two sectors would indeed offer potential for avoidance at lower cost, costlier emission abatement measures would be taken in the other sector with the higher price.

In addition to accuracy and long-term price planning certainty and the implications for the European effort sharing regulation, still further **criteria** for the various policy options must be noted. These include the **availability of the generated revenue** and **political** and **administrative feasibility** and, as an associated factor, the time scale over which an option might be introduced. It must also be borne in mind

24 Direct taxation of carbon emissions is not admissible under the German constitution. In this position paper, a carbon tax should be taken mean that existing energy taxes are geared towards their carbon content, but account must also be taken of the minimum rates set at European level for the individual taxes.

25 *Inter ali*a including emissions from agriculture, which are therefore included in the following figures. Details regarding the integration of agriculture are, however, beyond the scope of this study and will not be further discussed here.

26 Quotation from European Commission 2016.

27 In the long term, the EU Commission could bring Treaty-infringement proceedings against Germany.

28 BMWi 2010.

29 Against the background of global climate policy effects, excessively fragmented measures such as national climate protection targets are also criticised (Ockenfels/Schmidt 2019, Müsgens 2020) or the resultant additional costs quantified (Kreuz/Müsgens 2017, Kreuz/Müsgens 2018, Engelhorn/Müsgens 2019).

that, where national solutions abate emissions in the sectors covered by the EU ETS, the certificates released as a consequence may be put to further use. As a result, less emissions would be mitigated in Europe (**waterbed effect**). This might be prevented if Germany were correspondingly to purchase certificates and remove them from the market or if the total volume of emissions in the ETS were modified by European negotiations.

3.3 The carbon price in the Federal government's Climate Protection Programme 2030

The cornerstone of the Climate Action Plan adopted in September 2019 is intended to be a carbon pricing scheme for the heating and building sectors for which a dedicated **emissions trading scheme** is to be introduced. Up until 2025, fixed price paths are to apply and the certificates are to be traded without any volume limit. From 2026, certificates are to be auctioned with the maximum volume being specified by the objectives of the effort sharing regulation. The introduction of a minimum and maximum price is to be investigated in the meantime. The system is thus a combination of the options discussed above since emissions trading would effectively act as a direct carbon tax until 2025. It is, however, disputed whether such an instrument is legally enforceable[30] because emissions trading at a fixed price would have the effect of a direct tax on carbon emissions. Such a tax is, however, not thought to be admissible under current fiscal legislation. It would accordingly have to be possible to circumvent any restrictions applying to the introduction of a tax.

A carbon price is, however, only one of many individual measures in the Climate Action Plan, a factor which is likely to limit its effectiveness. Furthermore, the starting price in 2021 was set to be just € 10 per tonne of CO_2 and thus distinctly lower than the level demanded in most scientific studies.[31] The price was subsequently renegotiated in the Mediation Committee and the starting price in 2021 is now to be € 25 per tonne of CO_2 and to rise in annual increments to € 55 per tonne of CO_2 by 2025. It is disputed whether the adopted measures will actually be capable of achieving national climate objectives.[32] There is a risk that the effectiveness of the carbon price will be called into question if it is perceived to be too low to achieve the objectives. As a consequence, further individual measures would probably be required in the absence of a carbon pricing scheme with a sufficiently high price taking effect. The Federal government has therefore sensibly agreed to an annual review as to whether the adopted measures are achieving the objectives of the Climate Protection Programme. The process is to be monitored by an independent committee of experts.[33]

The ETS sector is unaffected by the additional emissions trading. Different prices will thus apply in the ETS sector and the non-ETS sector. The Federal government has thus made it the priority of the Climate Action Plan to meet **effort sharing objectives**. If the objectives are achieved, it will be able to avoid payments for emission rights in the non-ETS sector. If the Federal government simultaneously maintains the

30 See for example Kahles/Müller 2020.

31 Some price proposals from current studies are compared in the accompanying analysis (acatech/Leopoldina/Akademienunion 2019).

32 Edenhofer 2019-1 and UBA 2019 for example consider higher prices necessary if climate objectives are to be achieved.

33 BMU 2019.

objective of reducing Germany's total emissions by 55 per cent by 2030, the costs could however prove to be higher: If the prices in the separate emissions trading scheme rise appreciably in comparison with the EU ETS, high cost emissions in the heating and transport sectors would be avoided, while advantageous potential in the ETS sector, for example arising from greater expansion of renewable energies, would not be utilised. In order to reduce emissions in the ETS sector, the Federal government has, however, resolved to advocate a **pan-European minimum price in the EU ETS**. It has also set itself the objective of extending the **EU ETS to all sectors** by 2030.

3.4 Estimate of achievable carbon pricing revenue

Governmental environmental policy interventions for climate protection have the primary objective of efficiently and effectively correcting negative external effects. If, as in this case, emissions trading or a tax is involved, public sector revenue is generated as a result.[34] This revenue can relieve the tax burden on citizens at another point, in particular by reducing other taxes, duties and surcharges. The following section addresses proposals in this connection. If it is to be possible to evaluate the various options, the available revenue must firstly be estimated.

Revenue depends on the level of the carbon price and the extent of the recorded emissions. This study considers **by way of example** a carbon price of € 30 per tonne of CO_2 and, for simplicity, this price is multiplied by the volume of Germany's emissions in 2018 (760 million tonnes of CO_2).[35] In terms of the level of revenue, it is immaterial whether the price is obtained by emissions trading (indirectly) or by carbon-based taxation (directly).[36] It is furthermore assumed for the **reform of the system of taxes, duties and surcharges** discussed in section 4 that it is intended to neither increase nor reduce overall government revenue (**revenue neutrality**).[37]

Total annual revenue would thus amount to € 22.8 billion at a carbon price of € 30 per tonne of CO_2. This revenue is, however, not available in its entirety for reducing distorting taxes, duties and surcharges in the energy system since it is in competition with an alternative use. The extent to which this limits revenue from carbon pricing is estimated below.

1. Firstly, an estimate is made of the revenue arising to relieve the tax burden on industry in order to limit distortion **in international competition**. One reference point which may be used is the number of certificates in the EU ETS which are today allocated free of charge to **industrial undertakings**. All of Germany's energy-intensive industrial plants which would be particularly affected by a price rise

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34 Regulatory interventions, such as the mandatory inclusion of filters or establishment of limit values, in contrast, do not generally generate revenue.

35 Not only CO_2 emissions, but also emissions of other greenhouse gases such as methane and nitrogen monoxide also have a climate impact. Germany's total greenhouse gas emissions in 2018 amounted to 866 million tonnes of CO_2 equivalents (BMWi 2019). For simplicity, only direct CO_2 emissions are taken into consideration here. In the long term, however, all emissions should be included in the pricing system and be reduced. Including emissions from agriculture will be a particular challenge. How such emissions might in future be included is discussed *inter alia* in the ESYS position paper "Biomass: Striking a Balance between Energy and Climate Policies" (acatech/Leopoldina/Akademienunion 2019).

36 Providing the revenue is fully at the disposal of the Federal government. However, in the event of the EU ETS being extended to non-ETS sectors in Germany, this would not be the case as legislation currently stands.

37 Further measures should in principle also be investigated. This study, however, focuses on the energy system. Interactions with other areas of public budgets are in contrast not addressed by this position paper.

are recorded here. The threat of carbon leakage in the non-ETS sector, on the other hand, is considered to be lower.[38]

In 2018, certificates amounting to 145 million tonnes were allocated free of charge to industrial undertakings in the EU ETS.[39] Relative to Germany's entire carbon emissions, this corresponds to 19 per cent. Although this free allocation will decline over the years, the tax burden on industry might in future also be at least partially relieved over and above the taxation arising from the EU ETS. It is therefore assumed for the illustrative calculations in this study that approx. **19 per cent of the generated revenue** will be spent on **compensating industry**. This proportion is not intended as a political recommendation but merely serves the purposes of the example calculations in this study. In order nevertheless to offer incentives for improving production activities, this compensation may be linked to conditions such as efficiency requirements or the quantity of allocated certificates may be based on the most efficient production lines (**benchmarking**), as already currently happens in the free allocation of EU ETS certificates. These exemptions will account for a proportion of the revenue. At a carbon price of € 30 euro per tonne of CO_2, this corresponds to approx. € 4.4 billion.[40]

2. Secondly, various reimbursement models **for relieving the tax burden on private households** are under discussion. Low-income households above all benefit from a rebate of some of the revenue in the form of a lump-sum per-capita payment.[41] This lump-sum per-capita payment is sometimes also referred to as the "climate dividend". This position paper does not use this term however in order to distinguish the lump-sum per-capita payment from the double dividend. The lump-sum per-capita payment may be topped up for example by a hardship provision in order to support particularly badly affected households.[42] It should, however, be emphasised that abolishing existing taxes, duties and surcharges also relieves the tax burden on households. An investigation by the Mercator Research Institute on Global Commons and Climate Change (MCC) shows that households receive almost exactly the same tax relief due to a reduction in the EEG surcharge as they do from a per-capita reimbursement of the revenue.[43] The same thus also applies to the KWKG surcharge and the electricity tax. With regard to the acceptance of the introduction of a carbon pricing scheme, there are arguments in support of both variants: on the one hand, a **direct rebate** is more visible and can so increase acceptance.[44] On the other hand, a current investigation by Renn et al. concludes that a lump-sum rebate might be contrary to citizens' preferences. Instead, measures should be se-

38 Sachverständigenrat 2019.

39 DEhSt 2019-1.

40 If the EU Commission manages to establish a border tax adjustment, the tax relief for industry could at best fall within the carbon pricing scheme: this would tax carbon-intensive imports from countries without effective carbon pricing on the basis of their climate-damaging emission intensity. On the other hand, exporters would receive rebates in an amount of the previously paid carbon tax so as not to be in competition with international actors not subject to carbon pricing. When it comes to practical implementation, however, border adjustment measures involve the difficulty of differentiating self-serving protectionist interests from justified interests in obtaining compensation for competitive disadvantage due to climate protection measures. This gives rise to potential conflicts with European law and World Trade Organization (WTO) trade rules, see for example Sachverständigenrat 2019.

41 See for example Edenhofer 2019-1, Sachverständigenrat 2019. These studies analyse the distributive effects of various instruments for repaying the revenue from carbon pricing to citizens.

42 Edenhofer et al. (2019-1) and Sachverständigenrat (2019) discuss various models and their effects on various income groups.

43 Edenhofer et al. 2019-2.

44 See *inter ali*a Kalkuhl et al. 2018, Klenert et al. 2018.

lected which, in addition to relieving the tax burden on private households, are also capable of having an incentive effect for climate policy purposes. Reducing the EEG surcharge and so relieving the tax burden on renewably generated electricity might for instance be considered for this purpose.[45]

Against this background, consideration must be given to giving up on the idea of a rebate as a lump-sum per-capita payment, which would moreover involve considerable bureaucratic effort, and instead use the planned resources to provide further tax relief on the electricity price.[46] The example calculation assumes a **lump-sum per-capita payment** in an amount of € 50 per capita in order to illustrate the funds required for it. Making the payment to Germany's some 83 million citizens would cost approx. € 4.2 billion.[47] These resources could, however, be directly used to relieve the tax burden on the electricity price.

3. Thirdly, some of the revenue could furthermore be used to support **low-impact technologies** and so strengthen **research, development and investment** in the energy system or implement agricultural and forestry measures such as afforestation. Options which may be considered are for instance replacement premiums for households to replace older technologies such as oil-fired heating systems or support in the form of subsidies, as are also provided in the Climate Action Plan; loans to companies in order to introduce capital-intensive climate protection technologies or support for emission abatement and climate protection research projects. Some of the earmarked Energy and Climate Fund (ECF) resources which are funded from the auction revenue from German plants in the EU ETS are provided for this purpose below. This revenue amounted to some € 2.6 billion in 2018.[48]

In the event of such use, something of the order of € 12 billion would still be available for **eliminating distortion** in the energy system. If the idea of a climate dividend were given up and the tax burden on private households were relieved by a reduction in the electricity price, for instance via a reduced EEG surcharge, the available resources would increase to around € 16 billion. Figure 2 shows the results of the example calculations in graph form.

It should be noted that these calculations are based on Germany's entire carbon dioxide emissions in an amount of 760 million tonnes (ETS sector and non-ETS sector).[49, 50] It must moreover be borne in mind that revenue from the EU ETS[51] and from the future national emissions trading system is **ring-fenced** by the Energy and Climate Fund Act. This permits *inter alia* financial compensation to relieve the tax burden on the electricity price in connection with the introduction of a carbon pricing scheme.

45 Renn et al. 2019.

46 It is in principle also possible to address higher taxation of households by pre-existing, non-climate policy instruments so as not to overload carbon pricing with other non-climate policy objectives. For instance, an increase in housing allowance might be conceivable.

47 Also adopting a hardship provision for private households would cost approx. € 1 billion according to Edenhofer et al. (2019-1). This amount is, however, not included in the example estimates.

48 DEhSt 2019-2.

49 Other greenhouse gases such as methane and nitrogen monoxide are not included.

50 The EU ETS recorded approx. 422 million tonnes of CO_2 emissions in 2018. Free certificates for 145 million tonnes were distributed (DEhSt 2019-1).

51 This revenue amounted to some € 2.6 billion in 2018. On the basis of the sharp rise in EU ETS certificate prices in 2019, it may be assumed that the resources in the Energy and Climate Fund also rose greatly in 2019.

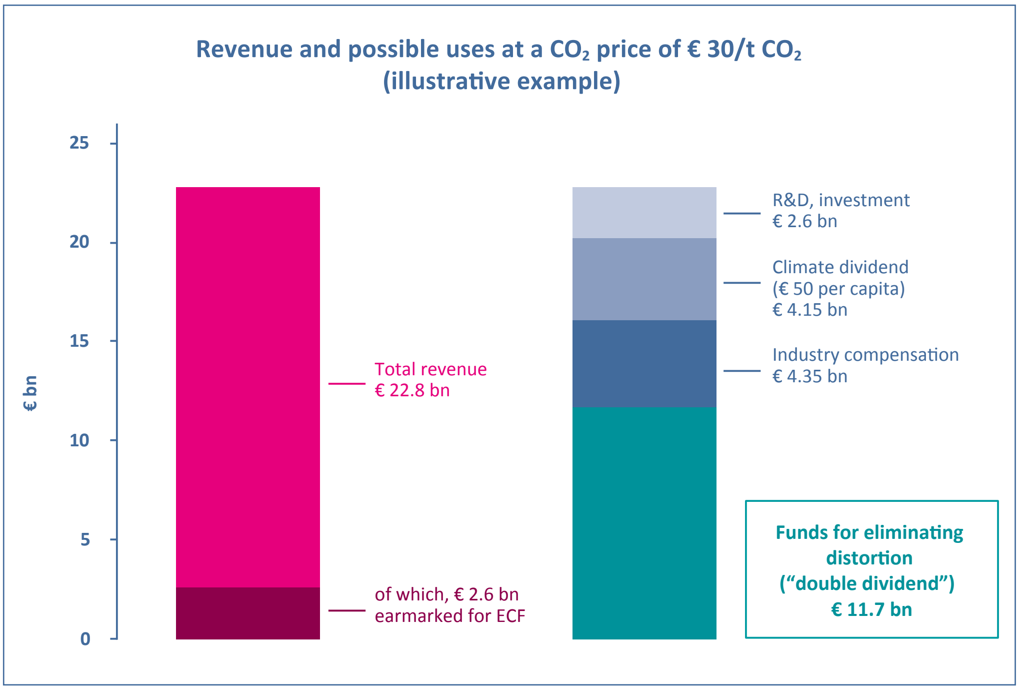

Figure 2: Representation of revenue and possible use in an example carbon pricing scheme in Germany in an amount of € 30 per tonne of CO_2.

4 Efficient and effective funding of public tasks

Correcting external effects with taxes, duties and surcharges instead of with regulatory interventions allows the government to generate revenue. But however efficient and effective the instruments are, further public sector revenue is required for funding the common good. However, the determination of how these additional taxes, duties and surcharges should ideally be levied is guided by economic principles other than the correction of external effects. In particular, greater use is made of financial rather than environmental policy instruments. The taxation required for this purpose, however, generally results in distortion and thus in welfare losses. How such distortion can be reduced in the specific case of the energy sector will be discussed below.

Government revenue in the energy system (excluding value-added tax) **totalled in excess of € 90 billion** in 2018, so amounting to approx. 19 per cent of Federal budget revenue.[52] Table 2 provides an overview of this revenue.

Existing taxes, duties and surcharges	**Revenue in 2018 (in € billion)**
Auctioning of EU ETS certificates	2,6
Energy tax on petrol and diesel	36,8
Energy tax on natural gas and heating oil	4,1
Electricity tax	6,9
Vehicle tax	9,1
Truck toll	5,1
EEG surcharge	25,6
KWKG surcharge	1,1
Concession fee (50 per cent)	1,8
Total	**93,1**

Table 2: Annual revenue from different instruments for funding public tasks in Germany. Sources: BMF 2019-1, BMWi 2018, DEhSt 2019-2, TSO 2019, Agora Energiewende 2017. EEG surcharge: ex-ante projected EEG differential costs. Concession fee: estimate based on Agora Energiewende 2017. KWKG surcharge: total revenue from KWKG surcharge in 2017. Offshore surcharge: total of all transferable costs for 2018 (annual forecast).

- Figure 3 illustrates the **current situation** by way of example for selected energy carriers. The figure shows average final consumer prices per unit of energy for private households[53] and breaks these final energy prices down into the following components: taxes, duties, surcharges, climate costs (only EU ETS) and the remaining provisioning costs. As is apparent, almost no additional financial burden applies to heating oil and natural gas, while the proportion of taxes, duties and surcharges in the final consumer price for electrical energy amounts to over 40 per cent. The

52 Federal budget revenue was approx. € 348 billion in 2018 (BMF 2019-2).

53 In practice there are a number of different consumption categories with substantially differing terms of purchase. We have limited the presentation in this paper to households.

differences in the tax treatment between electricity on the one hand and natural gas and heating oil on the other are thus particularly large. All three energy carriers may, however, be used for heating in the buildings sector. It should be reviewed whether this unequal taxation is justified by the correction of external effects or whether it is a matter of distortion which prevents undistorted competition between the energy carriers.

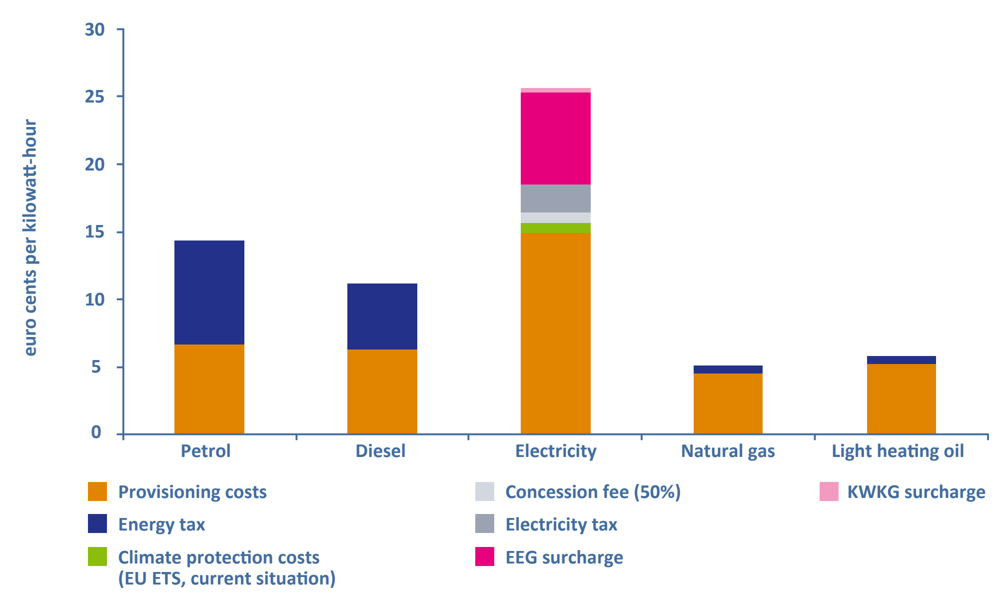

Figure 3: Average final consumer prices for selected energy carriers, broken down into provisioning costs[54] and the various taxes, duties and surcharges (as at 2018, excluding value-added tax). The figure relates to final consumer prices for private households, no account is taken of exemptions for companies. Sources: own calculations based on BMWi 2019, BDEW 2019, BNetzA/BKartA 2018, Energi Data Service 2019, MWV 2019.

4.1 Options for restructuring

When it comes to restructuring taxes, duties and surcharges, it is thus important first of all to examine whether a specific intervention **corrects an external effect** or addresses another allocative market failure. In this case, the tax, duty or surcharge, if correctly designed, increases welfare. Further price components which are intended to generate revenue for the public sector however often lead to distortion and may reduce welfare.

In the illustrative example, at a carbon price of € 30 per tonne of CO_2, approx. **€ 11.7 billion** would be available for eliminating distortion. Since this amount will probably not be sufficient to eliminate all distortion, **measures must be prioritised**.[55] Which taxes, duties and surcharges should actually be replaced and how priorities can be set is analysed below. Figure 4 provides an overview of the taxes, duties and surcharges currently levied on the various final energy carriers.[56]

54 Provisioning costs include grid costs because the latter are required for transporting the energy carrier to the final consumer, as well as 50 per cent of the concession fee which is here set as the costs for space and infrastructure use by power lines. They do not, however, include the EEG surcharge (see section 3.2).

55 The purpose of this approach is not to base the level of the carbon price on the resources desired for eliminating distortion, but rather on the environmental harm associated with the emissions. Should the revenue from a reasonable carbon price prove to be inadequate and further resources be required for eliminating distortion in the energy system, they should be provided in accordance with financial principles.

56 Again presented by way of example for households.

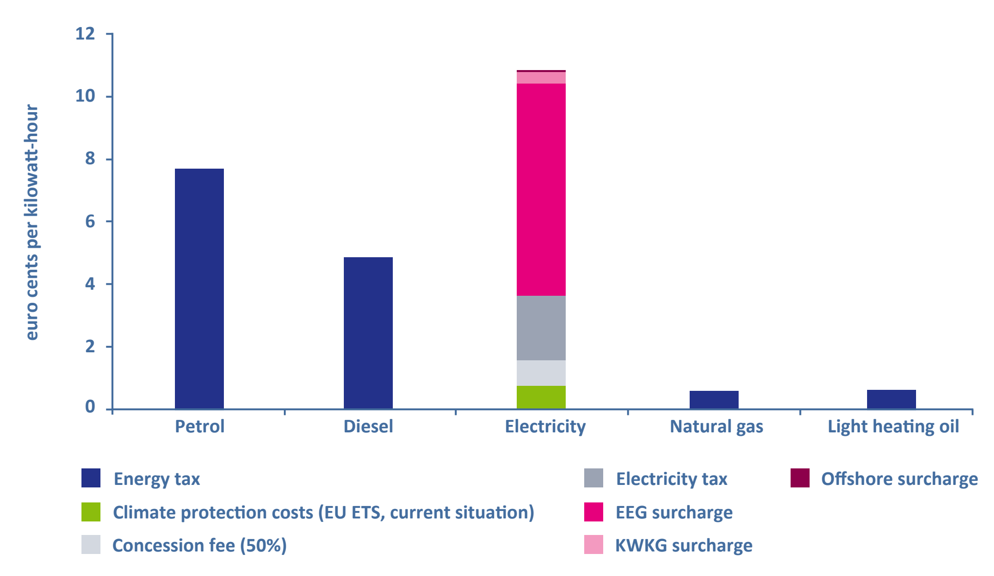

Figure 4: Taxes, duties and surcharges levied on selected final energy carriers (as at 2018). The figure relates to final consumer prices for private households, no account is taken of exemptions for companies. Sources: BDEW 2019, BNetzA/BKartA 2018, Energi Data Service 2019, MWV 2019.

4.1.1 Petrol and diesel

The taxes, duties and surcharges per unit of energy levied on both petrol and diesel are higher than those levied on natural gas and light heating oil but lower than those on electricity. In order to ensure an accurate comparison of the distortion and welfare losses, it is necessary to investigate the extent to which the energy tax factors in other harm, i.e. harm unrelated to climate protection such as fine particulate and noise emissions and congestion and accident costs. Estimates have shown that the internalisation of further external effects approximately corresponds to the level of the energy tax (Coady et al. 2018).

One feature peculiar to the energy carriers petrol and diesel, which are almost exclusively used in the transport sector, is that distortion can also be eliminated revenue-neutrally **without using resources from carbon pricing**: external effects which are primarily attributable to vehicle use, for example congestion and accident costs as well as road damage, could be factored in by **extended vehicle taxation** and a **usage-dependent toll system**. In any event, a utilisation-based and location-dependent toll system can address traffic policy challenges such as congestion management, local fine particulate pollution or the inequality of treatment between urban and rural areas more efficiently and effectively than an energy tax or traffic bans.[57] At the same time, revenue could be secured in the long term in this way, even when the proportion of vehicles with alternative drive systems rises.

There is thus a considerable need for reform in the transport sector which can, however, already be addressed by revenue-neutral market design changes within this sector. From an economic standpoint, there is accordingly no need for the revenue from

57 Cramton et al. 2018, RWI/Stiftung Mercator 2019.

carbon pricing to be put to priority use to relieve the tax burden on the transport sector, in particular not in comparison with electricity.[58]

4.1.2 Electricity

Electricity is of particular significance to the analysis of distortion. **Firstly,** the taxation levied on final energy consumption of electricity is above average. In particular in comparison with natural gas and light heating oil, the difference is very large and moreover subsists even once a uniform carbon price is introduced. Since electricity must enter much more strongly into undistorted competition with other energy carriers than in the past in order efficiently to reduce emissions in the energy system, this taxation is noticeably hampering the use of "green electricity" and thus climate protection. This is the case not only with regard to competition with petrol and diesel, which is occurring in particular in the transport sector through increasing levels of electromobility, but with regard to competition with natural gas and light heating oil, for instance due to the use of heat pumps in the heating sector. **Secondly,** the numerous flat-rate price components such as the EEG surcharge and electricity tax reduce the flexibility with which the energy system can respond to fluctuating feed-in from renewable energy sources. There are thus good arguments for using revenue from carbon pricing to eliminate tax burdens on electricity as a final energy carrier. It must firstly, however, be investigated whether other external effects might possibly be corrected.

This is controversial in the public debate in particular around the Renewable Energy Sources Act (EEG) and the associated **EEG surcharge**. Where the EEG effectively corrects external effects in the electricity system, the resultant costs should be borne by electricity consumers. However, if other instruments are more suitable for reducing emissions of climate-damaging greenhouse gases and if the EEG surcharge does not correct any further external effects in the electricity system, it leads to distortion and thus to efficiency losses. Arguments can be put forward for both perspectives:

- Emissions of climate-damaging greenhouse gases are already addressed by the EU ETS, in which total emissions are fixed for the participating sectors such that any emissions avoided in the German energy sector primarily lead to greater emissions in other sectors or countries (waterbed effect).[59] In addition, the EEG surcharge applies to electricity price. However, when electricity is consumed, it is not possible to differentiate between the various types of generation, the basis instead merely being the average value of the carbon emissions caused by the electricity mix. The **intended incentive effect is thus largely unattainable**. An instrument which is intended to reduce carbon emissions should therefore ideally apply to primary energy carriers. The EEG is thus unsuitable for the purpose, being primarily an industrial or structural policy instrument. The expansion of renewable energy sources is, however, a **project of relevance to society as a whole** which consequently ought not to be exclusively funded via electricity consumption. In this case, the EEG surcharge distorts the electricity price and leads to inefficiencies.

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58 This position paper therefore does not concern policy options for the development of the regulatory framework in the transport sector. Proposed solutions specific to the transport sector are being drawn up *inter alia* by the National Platform "Future of Mobility".

59 The waterbed effect still continues to apply after the introduction of the market stability reserve (MSR) which, with effect from 2023, provides the possibility of cancelling certificates. Its effect is, however, attenuated depending on the year of emission and the size of the MSR (see for example Pahle et al. 2019).

- On the other hand, it is argued that the sometimes low prices in the EU ETS have not completely covered the climate damage caused by carbon emissions, that, in the absence of the EEG, fewer carbon certificates would have been cancelled in previous years when the EU ETS has been adjusted, and that the EEG would correct other environmental harm in the power sector such as fine particulate emissions from conventional power stations. The latter is, however, also addressed in parallel by regulatory requirements. Furthermore, the introduction of a comprehensive carbon pricing scheme makes it pointless to once again internalise harm caused by the emission of climate-damaging greenhouse gases. The EEG surcharge would thus also in this case at least in part lead to distortion in the energy system.

The revenue from carbon pricing should therefore be used to **reduce the EEG surcharge** and so increase welfare. In the light of the considerable overall size of the EEG surcharge of € 25.6 billion per year (see table 2), this is a major opportunity which offers great potential for the energy transition. In exactly the same way as the EEG surcharge, the **KWKG surcharge** for supporting the expansion of combined heat and power generation also leads to further distortion. It could likewise be reduced and the costs funded via the revenue from carbon pricing.

A similar argument can also be made with regard to the **electricity tax:** it too is levied on the final consumer price and, failing to differentiate how the electricity was generated, is thus incapable of having a **targeted incentive effect** for the purposes of climate protection. While the electricity tax's additional price surcharge may indeed provide an incentive to consume less electricity, since all external effects are already taken into account by other instruments no such incentive is any longer necessary from an economic point of view. The electricity tax thus leads to distortion.

It follows from these considerations that the revenue from carbon pricing should be used to **at least partially abolish the EEG and KWKG surcharges** and optionally also to **reduce the electricity tax to the minimum rate specified at European level** in order to eliminate distortion. Such funding should be admissible under state aid legislation[60] and could probably also proceed via the resources flowing directly into the Energy and Climate Fund.

It follows from the example calculations shown that, if a cross-sectoral carbon price of € 30 euro per tonne were introduced and if the entire revenue were used, apart from for relieving the tax burden on industry and households and research funding, for this purpose, the **resources of around € 12 billion** would be sufficient **to reduce the EEG surcharge by just about 50 per cent.** In the absence of a lump-sum per-capita payment, the resources would amount to around € 16 billion.

Two further aspects are important: firstly, the discussed approach is **revenue-neutral** for the government. As a result, there would be no additional funding requirement which would complicate any reform. Secondly, social **welfare** increases equally at two points ("double dividend"), climate damage being better addressed than it is today and existing distortions of taxes, duties and surcharges being reduced.

60 Büdenbender 2019.

4.1.3 Natural gas and light heating oil

Natural gas and light heating oil, which are in particular used as final energy carriers in the heating sector, have previously had only very low taxes, duties and surcharges levied. Natural gas is taxed for household purchasers at 0.55 ct/kWh and light heating oil at 0.62 ct/kWh. The total revenue from energy taxes for natural gas and light heating oil is approx. € 4.4 billion per year. The **introduction of a uniform carbon price** in this area therefore results in the **greatest relative increase** and would thus have a **noticeable effect**.

One question which arises is what happens to the previous energy taxes when a carbon pricing scheme is introduced. The current pricing roughly covers the environmental costs of atmospheric pollutants apart from the greenhouse effect.[61] This price component could thus be retained. If it appears to be desirable for reasons of acceptance or political feasibility, external effects such as fine particulate pollution could also be managed by **regulatory measures**. The revenue from carbon pricing could in this case help to reduce the previous price.[62] It must, however, be investigated financially whether such an approach would maximise welfare.

4.1.4 Effects of a possible reform on energy prices

Figure 5 shows how the final consumer prices of the energy carriers under consideration would change if an overarching carbon price were introduced and distortion simultaneously eliminated. If, for example, a cross-sectoral carbon price of € 30 per tonne of CO_2 were introduced and the EEG surcharge simultaneously reduced by 50 per cent with the revenue, today's electricity price of around 30.4 ct/kWh would fall to 27.7 ct/kWh. For a four-person household with an average consumption of 4,000 kilowatt-hours per year, this would provide savings of around € 110 per year.

4.2 Implementation in the context of the Climate Protection Programme 2030

A major part of the revenue generated by the carbon price which is introduced in the context of the Climate Protection Programme 2030 is to be used to fund a number of individual measures. These include for instance an increase to the "commuter's tax allowance", an extension of the government electric vehicle purchase premium, financial support for railways and a reduction in VAT on long-distance railway tickets, tax incentives for building energy efficiency refurbishment and replacement premiums for heating systems. As a result, only limited resources are left over for eliminating distortion in the existing system of taxes, duties and surcharges. The EEG surcharge is set to fall by 1.75 ct/kWh in 2021. This tax relief is set to rise to 2.9 ct/kWh by 2025,[63] respectively corresponding to around 26 per cent and approx. 43 per cent of the EEG surcharge (as at 2020). Relative to the electricity price, this amounts to tax relief of around six per cent in 2021.[64] The burden on consumers will thus be at least slightly relieved. The Climate Protection Programme 2030 does not provide for a per-capita reimbursement of a proportion of the revenue.

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61 See UBA 2019.

62 If carbon-based taxation is introduced, the previous energy taxes would be geared towards their carbon content. It would thus be possible to completely abolish the previous pricing scheme. If emissions trading is introduced in the heating sector, energy taxes could simply by reduced to the minimum rate set at European level.

63 Hanke 2019.

64 BDEW 2020.

The reduction in the EEG surcharge goes some way to eliminating distortion and the tax relief on the electricity price will make renewably generated electricity more competitive. However, this reduction could have been greater. From an economic standpoint, many individual technology-specific measures, such as those adopted by the Federal government, result in lower efficiency and thus higher costs for climate protection.

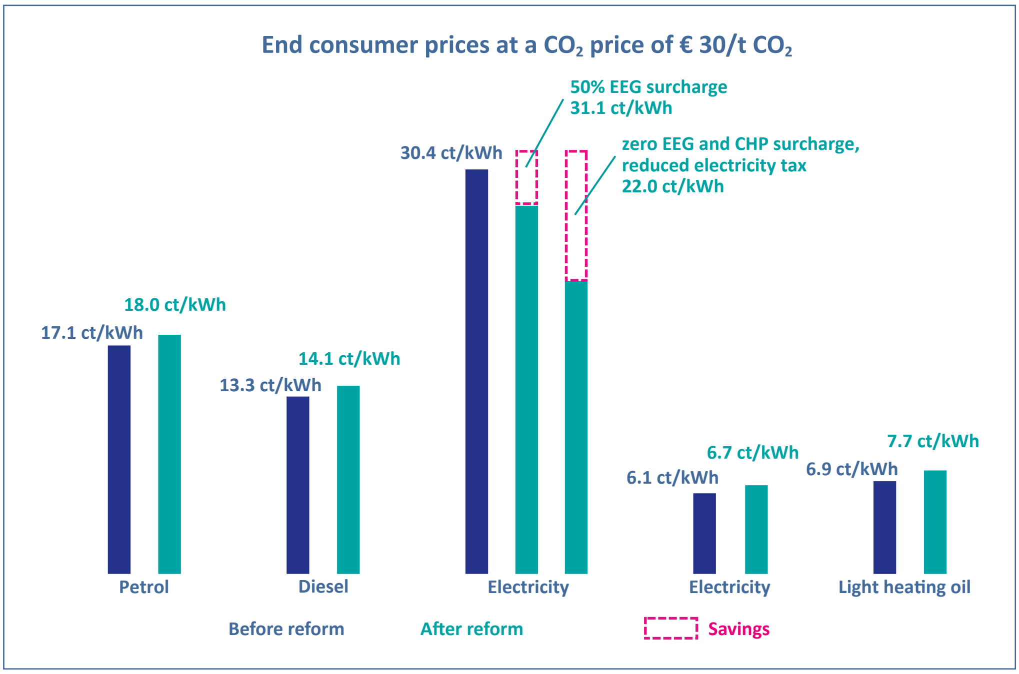

Figure 5: Final consumer prices of selected energy carriers before and after introduction of a carbon price at a level of € 30 per tonne of CO_2 and simultaneous elimination of distortion. Two options are shown: EEG surcharge reduced by 50 per cent (electricity, middle bar) or EEG and KWKG surcharges completely removed and electricity tax reduced to 0.1 ct/kWh (electricity, right-hand bar). Eliminating distortion would require approx. € 12.6 billion for option 1 and approx. € 33.5 billion for option 2.

5 Conclusion

The current momentum in climate policy has led to a vigorous debate around the possible introduction of a comprehensive carbon pricing scheme in Germany and Europe. Against the background of the major possible threats posed by climate change, the increasing need for action and high levels of investment, the Federal government decided in autumn 2019 to introduce a carbon pricing scheme from 2021. However, the selected starting price of € 25 per tonne of CO_2 is low and the profusion of isolated measures creates the risk that the carbon price will not be able to exert its full incentive effect. At the same time, however, the adoption of a carbon price does offer an opportunity to fundamentally reform the inefficient system for pricing energy carriers. The time has now come to gear this system, which has grown over the course of time into an impenetrable thicket of countless interventions and individual regulations, towards climate protection, low-emission technologies and efficiency.

This position paper emphasises that comprehensive solutions have lower macroeconomic costs than fragmented approaches and indicates options for policy makers as to how Germany can efficiently achieve objectives agreed at the European level and drive climate protection forward internationally. The Federal government has adopted some of these points in its Climate Protection Programme and enshrined them in law; its next steps should be to pick up the following points:

1. Germany should emphatically support **a global carbon pricing scheme** which encompasses all sectors, ideally including agriculture. Only in this way can carbon emissions be reduced globally and, ultimately, the risk of carbon leakage minimised.

2. In parallel, the Federal government should pursue **European approaches** because these are preferable to national solo efforts and cross-sectoral approaches are more efficient than specific objectives for individual sectors. It must, however, be noted that the effort sharing regulation has set sectoral objectives for all non-ETS sectors in the Member States and failing to meet them would be costly. The two systems should thus be combined. This can be achieved with a **comprehensive, uniform carbon price in Europe**. The Federal government's decision to extend the European Emissions Trading System to all sectors by 2030 supports this idea.

3. Germany should persuade **partner nations** to join it in its pricing scheme adopted in the Climate Action Plan. This would diminish the competitive disadvantage of German companies within Europe and could add further impetus to an expansion of the EU ETS.

4. The Federal government should regularly review whether the level of the carbon price is sufficient to achieve climate targets and, if need be, raise the price. The Federal government's decision to establish a committee of experts to **monitor** the new climate protection measures is to be welcomed. The Federal government should assign sufficient powers to the committee.

5. Further revenue from the carbon price should be used to eliminate distortion in the existing system ("**double dividend**"). Using the revenue to reduce the EEG surcharge as far as possible or ideally even completely abolish it promises particular gains in efficiency.

6. There is an opportunity in the **transport sector** to reduce distortion without using revenue from carbon pricing by introducing an **extended vehicle tax or a usage-dependent vehicle toll,** which allow traffic policy issues to be addressed in a more targeted way. A better market design could make a decisive contribution to solving these challenges purposefully and efficiently. The Federal government should initiate a process to develop suitable solutions.

7. To ensure **efficient climate protection**, the Federal government could furthermore review whether it can provide further resources to reduce the tax burden on the electricity price.[65]

The Federal government should also actively participate in the process of **reforming European fiscal directives** which has been set in train by the EU Commission, and should advocate changes because these directives are not designed for efficient climate protection. For instance, minimum energy tax rates could be abolished. Further research should therefore investigate how far financial burdens can be shifted between the energy system and other sectors of the economy. Emissions from agriculture must furthermore be factored into prices. This requires practical systems for appropriately calculating emissions from agriculture and due to landscape changes such as afforestation and modified land use.

65 By stabilising the EEG surcharge at 6.5 ct/kWh in 2021 and 6 ct/kWh in 2022 in its COVID-19 pandemic stimulus package, the Federal government is moving in precisely this direction.

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The Academies’ Project

With the initiative “Energy Systems of the Future”, acatech – National Academy of Science and Engineering, the German National Academy of Sciences Leopoldina and the Union of the German Academies of Sciences and Humanities provide impulses for the debate on the challenges and opportunities of the German energy transition. In interdisciplinary working groups, some 100 experts from science and research develop policy options for the implementation of a secure, affordable and sustainable energy supply.

"Electricity market design" working group

Today's regulatory issues in the electricity market differ from those at the turn of the millennium, when corner stones for Germany's energy market design were set by market liberalization. The market design must therefore be adjusted. The interdisciplinary working group set itself two priorities: the management of grid congestion and a reform of energy prices in order to facilitate sector coupling.

The results of the working group’s investigations around energy prices have been made available in two formats:

1. The **analysis** “Energy Prices, Sector Coupling, Climate Protection. Principles for a Cross-sectoral Market Design” comprehensively documents the investigations of the working group into the composition of energy prices and provides a detailed explanation of the proposed policy options for a comprehensive carbon pricing scheme and the use of the revenue it generates.

2. The **position paper** “Pricing Carbon, Reforming Energy Prices. Pathways to a Cross-sectoral Market Design” presents the results in compact form.

The results for congestion management are published separately.

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