
The German Coal Commission

A Roadmap for a Just Transition
from Coal to Renewables

ANALYSIS

Agora
Energiewende



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IMPRINT

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A Roadmap for a Just Transition
from Coal to Renewables

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**Transparency Note: The author worked as
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Cover picture: dpa

Version: 1.0

158/03-A-2019/EN

ACKNOWLEDGEMENTS

This study was supported in part by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH under the German Energy Transition Expertise for China Project, funded and commissioned by the German Federal Ministry for Economic Affairs and Energy (BMWi).

Agora Energiewende is a joint initiative of the Mercator Foundation and the European Climate Foundation. The cooperation of Agora Energiewende and Aurora Energy Research is kindly supported by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) on behalf of the German government.



This publication is available for
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Please cite as:

Agora Energiewende und Aurora Energy Research
(2019): *The German Coal Commission. A Roadmap
for a Just Transition from Coal to Renewables.*

www.agora-energiewende.de

Dear reader,

Coal has been a cornerstone of economic growth and prosperity since the dawn of the industrial era. However, climate change, air pollution, and increasing health and environmental concerns require us to end the age of coal as soon as possible. To be sure, countries with heavily coal-dependent energy systems such as China and Germany will face serious socio-economic challenges in the effort to reduce and eventually phase out coal-fired energy production.

To prevent economic disruption and associated social hardship for workers, coal-dependent countries would be well-advised to initiate a political process on how to transition from coal to clean energy. In the summer of 2018, Germany launched such a process by establishing a “Commission on Growth, Structural Change and Employment” – otherwise known as the

“Coal Commission”. Following in-depth deliberations between key stakeholders, in January of 2019 the Commission presented a comprehensive roadmap for the phase out of coal-fired power generation in Germany by 2038. The federal government has declared its intention to implement the Commission’s recommendations.

In this report, we analyse the Commission’s recommendations with regard to their anticipated impact on the German electricity sector, carbon emissions, and economic development in coal-mining regions.

I hope you find this report both thought-provoking and informative.

Markus Steigenberger
International Director, Agora Energiewende

Key findings at a glance:

1

The recommendations of the Coal Commission are an important milestone in the German energy policy debate: Germany has now resolved to phase out both nuclear energy and coal, and is fully committed to developing renewable energy. For decades, Germany’s economy was reliant on energy from lignite and hard coal; in the future, renewables will serve as a basis for economic prosperity.

2

The Commission’s proposals, if fully implemented, will lead to CO₂ savings of some one billion tonnes by 2038. In the absence of implementation, CO₂ emissions from coal-fired power plants will only decline at a slow rate. However, the Coal Compromise is not sufficient for Germany to meet its 2030 carbon emissions target. Considerable additional measures are required, especially in the industrial, building, and transport sectors.

3

The Coal Compromise will ensure a just transition for coal regions and employees. The compromise guarantees that no worker will be left high and dry and that coal mining regions will have sufficient time and resources to adapt economically. To this end, the compromise foresees 2 billion euros in federal spending per year – which in parts can also be understood as compensation for structural policy failures since German reunification especially in Eastern Germany.

4

While the Coal Compromise envisions full phase-out occurring in 2038, earlier achievement of this goal is likely. Periodic reviews in 2023, 2026, 2029, and 2032 will offer policymakers an opportunity to react to a worsening climate crisis with additional measures. Furthermore, the Commission’s compromise creates a foundation for a socially equitable acceleration of the phase-out.

Executive Summary

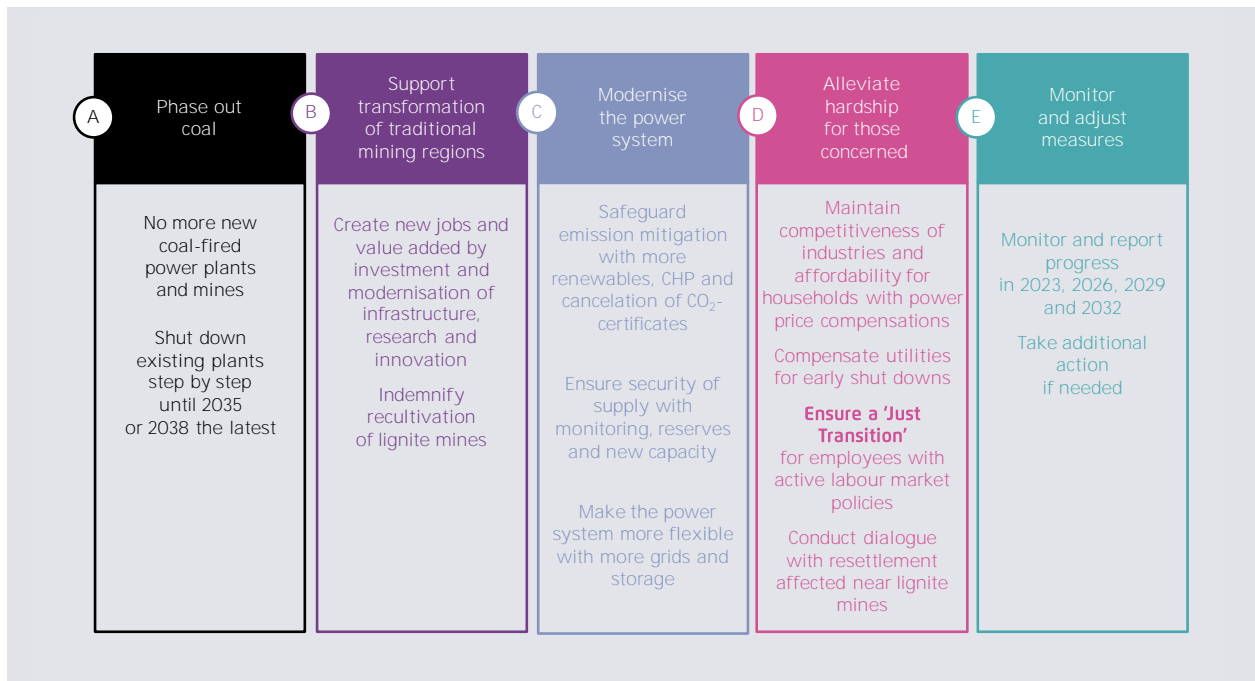
In June 2018, Germany’s federal government established the “Commission on Growth, Structural Change and Employment”, otherwise known as the “Coal Commission”. The Commission was tasked with developing a strategy for phasing out coal-fired power generation that would allow Germany to meet its climate mitigation targets. Furthermore, it was asked to define policy measures that would create economic opportunities for the affected coal-mining regions. The Commission’s final report was adopted almost unanimously in January 2019 (voting ratio: 27:1) and submitted to the federal government in February 2019. The government has announced it will implement the recommendations in 2019–20.

In addition to conducting a comprehensive review of the role of coal in Germany, its impact on the environment, and its significance for the private sector,

the Commission’s final report includes a five-element strategy for phasing out coal (Figure S-1):

- **Element A – Phase out coal step by step:** According to the Commission’s recommendations, the development of new coal-fired power plants and opencast mines should be terminated. Furthermore, existing coal-fired power plants should be withdrawn successively from the market by 2038 at the latest. In 2032, an assessment should be conducted as to whether it is possible to phase out coal by 2035. This schedule means that the phase-out of coal-fired power generation will happen much faster than under a business-as-usual scenario on the basis of existing measures and expected market developments (Figure S-2).
- **Element B – Support the transformation of traditional mining regions:** With the help of investment in advanced energy systems, the expansion of transport and digital infrastructure,

Figure S-1: Overview of the Commission’s recommendations



Authors’ figure based on Kommission „Wachstum, Strukturwandel und Beschäftigung“ (2019)

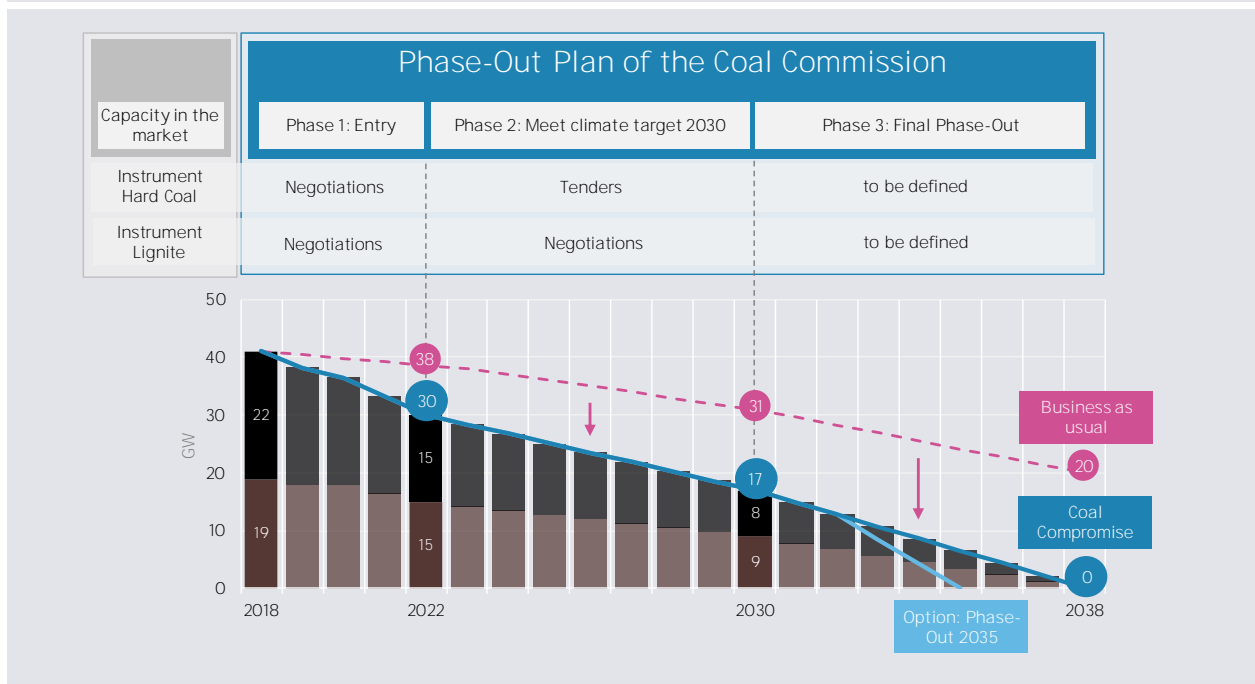
and the promotion of innovation (for example, through the establishment of research institutions), alternative employment and economic opportunities are to be created in today's coal-mining regions. In addition, measures should be taken to minimize the cost risks to impacted regions associated with the decommissioning open-pit mines.

→ **Element C – Modernise the power system:** The decline of electricity generation from coal-fired power plants is to be replaced primarily through renewables by increasing the share of renewable electricity generation to 65 per cent of gross electricity consumption by 2030. The gradual replacement of coal-fired power plants with flexible CHP systems should be encouraged with targeted legislation. Resulting surplus CO₂ certificates within the European Emission Trading Scheme should be cancelled. In order to ensure continued security of supply, existing reserve

instruments are to be used in the medium term. If market mechanisms do not provide for the construction of necessary capacity, the current design of the energy-only market should be reviewed and revised accordingly. The necessary modernisation and expansion of the electricity grid should also take place in good time.

→ **Element D – Alleviate hardship for those concerned:** In order to continue to ensure affordable and competitive electricity prices, consumers should be compensated for part of the increase in electricity prices that is anticipated by the Commission. Power plant operators are to be compensated for the early closure of their assets. Those directly employed in the coal industry are to be supported by targeted labour market policies. In addition, based on a dialogue with those affected, it should be clarified in good time whether and which village resettlement measures in lignite

Figure S-2: Recommended phase-out plan for coal-fired power plants compared to business as usual



Authors' figure based on Commission for "Growth, Structural Change and Employment" (2019), Aurora Energy Research

mining areas should still be carried out in order to provide a solid basis for future planning.

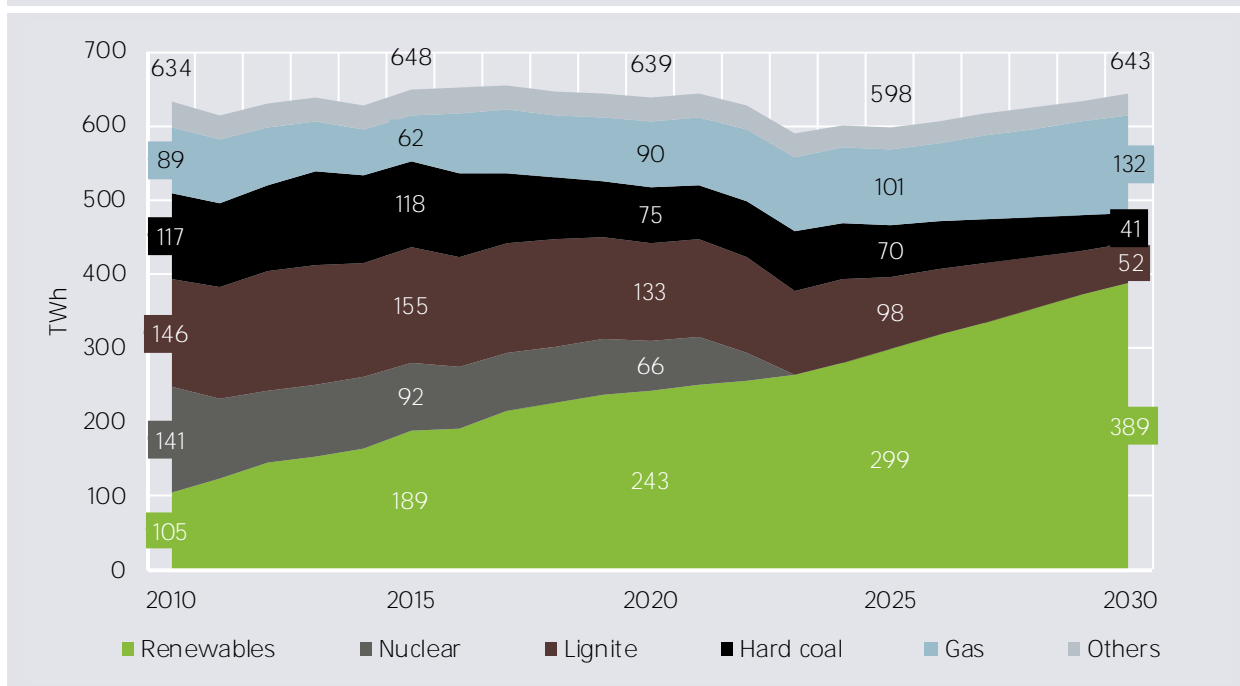
- **Element E - Monitor and adjust measures:** Implementation should be reviewed regularly in a monitoring process that publishes its findings in regular reports. An independent panel of experts should review the measures and their implementation in 2023, 2026, and 2029 with a view to climate targets, electricity prices, security of supply, and employment and structural policy objectives. If the event of a target shortfall, additional measures should be taken.

If the Commission's recommendations are implemented, Germany will become the first country in the world to phase out both nuclear energy and coal-fired power generation and to replace this conventional generation with renewables (Figure S-3). The calculations conducted for this study indicate that it is highly probable that the climate target for the energy sector can be achieved in 2030 if coal-fired

power plant capacity is reduced to 17 gigawatts by 2030 and renewable energy is raised to 65 per cent of gross electricity consumption. By 2038, a total of around one billion tonnes of CO₂ emissions will be avoided compared to the business-as-usual. However, to ensure achievement not only the energy industry target but also the entire German climate protection target for 2030 (that is, a 55 per cent reduction in greenhouse gas emissions compared to 1990), considerable further measures are necessary in the transport, building, industrial, and agricultural sectors (Figure S-4).

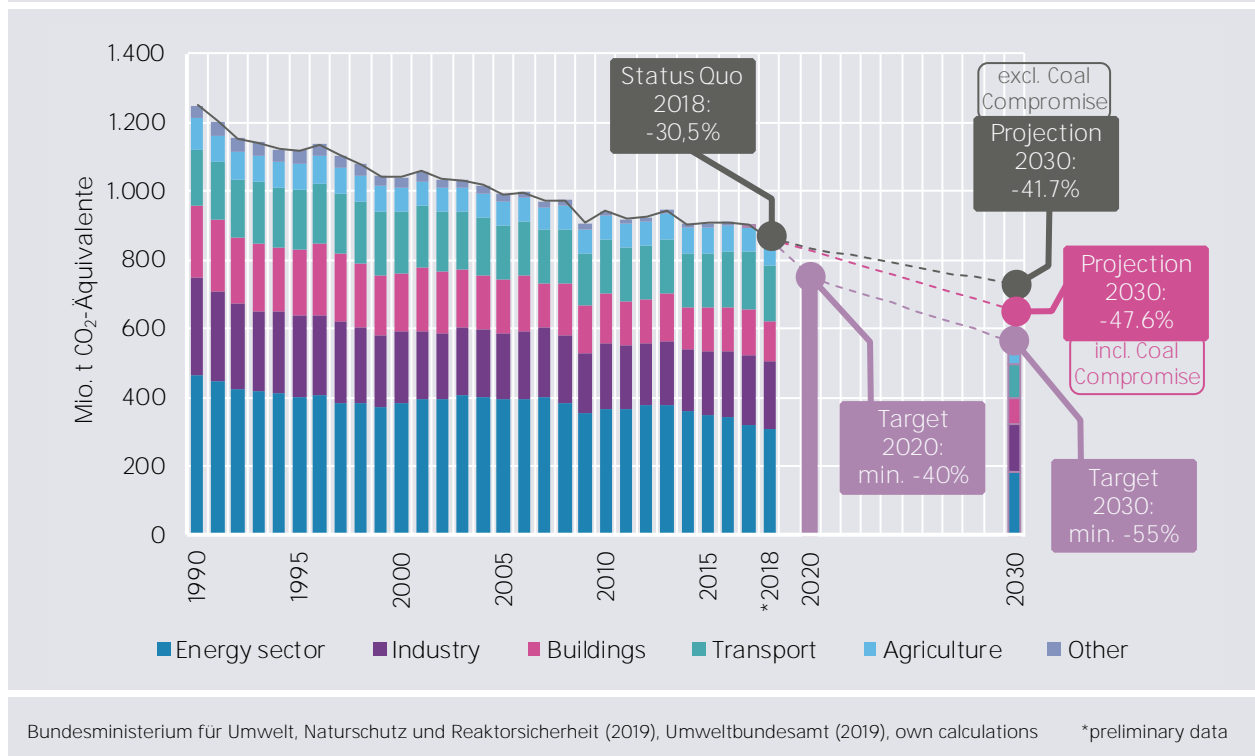
The gradual phasing-out of coal-fired power generation in combination with the expansion of renewable energy to 65 percent of generation by 2030 also means that wholesale electricity prices in 2030 will

Figure S-3: Gross electricity generation in 2010-2030 with implementation of the coal compromise



Data 2010-2018: AG Energiebilanzen (2019); Projection from 2019: own calculations based on Aurora Energy Research

Figure S-4: Greenhouse gas emissions by sector, 1990–2018, targets and projection 2020 and 2030



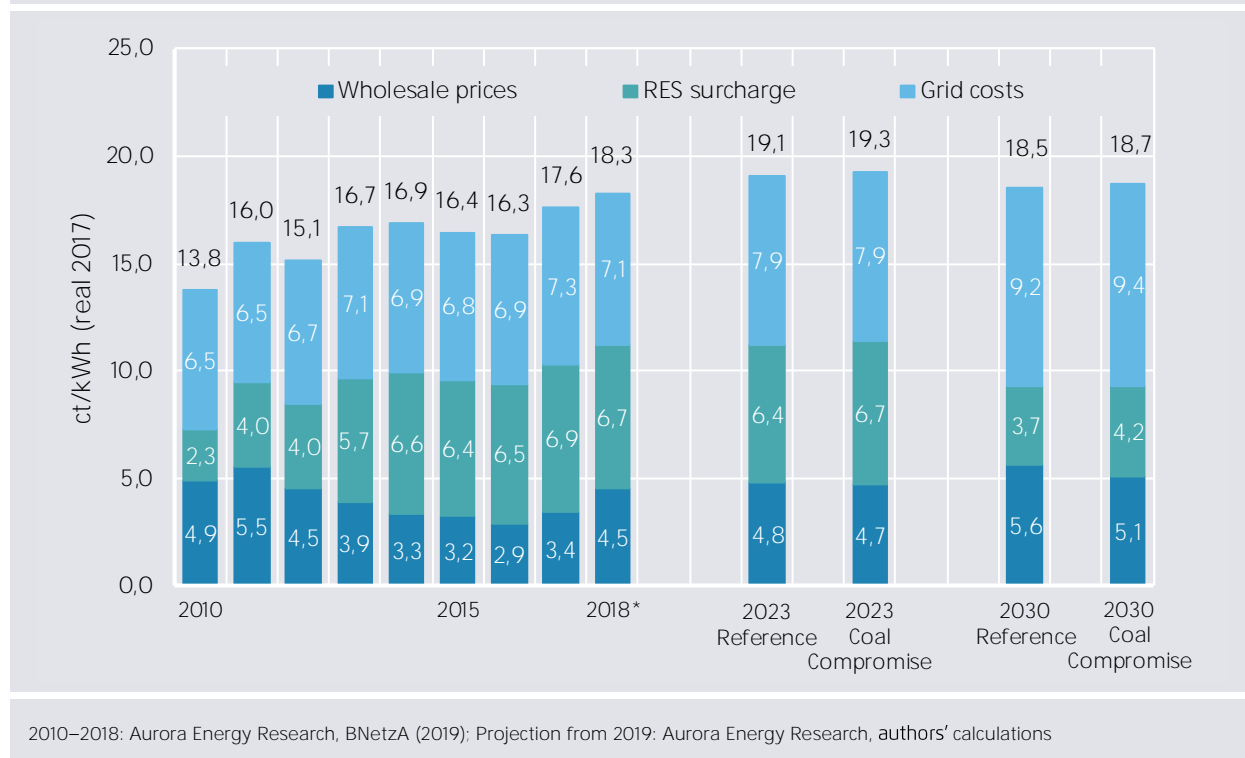
be significantly lower compared to a scenario without further measures (Figure S-5). This offers particular opportunities for energy-intensive industrial companies, whose electricity consumption is almost entirely exempt from green energy surcharges. For non-privileged electricity consumers, electricity prices would rise slightly compared to the reference scenario. This is due in particular to an increase in grid usage fees that arise from modernisation measures. However, according to the Commission's recommendations, this increase will be offset through a reduction in grid charges. This measure will help to keep electricity prices for non-privileged consumers at their current level.

Various instruments will be in place to guarantee security of supply during the coal phase-out: the Federal Network Agency will have veto power on decommissioning in case doubts arise as to continued security of supply; decommissioning will be performed on a consensual basis with operators; the Combined Heat and Power Act will remain in effect;

security of supply will be monitored on an ongoing basis; and existing reserve instruments will remain in place. The model calculations show, however, that in the medium term it will be necessary to build several gigawatts of new gas-fired power plant capacity. Whether the energy-only market will provide sufficient incentive for their construction will have to be closely monitored by the German government in the coming years and, if problems arise, appropriate measures will need to be implemented in good time.

The scale and long-term nature of the recommended structural aid for the coal regions concerned and related investment in energy, infrastructure, and research should enable the regions to enjoy sustainable economic development. Extending the phase-out of coal to 2038 at the latest will also enable the coal regions to tap new opportunities for wealth creation and employment. A comprehensive package of labour policy measures will ensure that no employee in the coal industry is left high and dry.

Figure S-5: Development of wholesale electricity prices, EEG surcharge, and grid fees for non-privileged consumers, 2010 to 2018, 2023, and 2030



The additional costs to the federal budget up until 2038 are still subject to considerable uncertainty. A first estimate indicates that additional costs will run between 69 and 93 billion euros. Up to 2038 this corresponds to about 3.6 to 4.9 billion euros per year, or 1.0 to 1.4 per cent of the annual federal budget (which in 2018 was 348.3 billion euros). The bulk of the costs are attributable to structural aid for the regions (40 billion euros) and the proposed compensation mechanisms for electricity cost increases (16 to 32 billion euros). The compensation paid to power plant operators amounts to between 5 and 10 billion euros, while the compensation paid to employees for labour market policy measures runs at between 5 to 7 billion euros. For the cancelling of CO₂ certificates, about 3 to 4 billion euros will need to be spent.

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1 The German Energy Transition and the discussion on coal

The transformation of the German energy system is guided by a long-term strategy that seeks to change existing energy system in four areas:

- **Reduction of greenhouse gas emissions:** In accordance with the Climate Action Plan 2050,¹ which was adopted by the German Federal Government in 2016, Germany is pursuing the goal of near greenhouse gas neutrality by 2050. On the road to this goal, greenhouse gas emissions are to be reduced by 40 per cent by 2020 and by 55 per cent by 2030 compared to 1990 levels. There are also separate objectives to reach by 2030 for individual sectors (namely, the energy industry, buildings, industry, transport, and agriculture).
- **Nuclear phase-out:** By the end of 2022, Germany will have completely phased out the use of nuclear energy. This goal is anchored in the nuclear phase-out law of 2011.²
- **Expansion of renewable energy:** By 2050, at least 60 per cent of gross final energy consumption should come from renewable sources. In the electricity sector, the share of renewable energy is to be increased to 65 per cent by 2030 in accordance with the current coalition agreement.³ By 2050, it is to be raised to at least 80 per cent, in line with the 2010 Energy Concept.⁴
- **Increasing energy efficiency:** By 2050, primary energy consumption is to be reduced by 50 per cent compared to 2008. Electricity consumption is to be reduced by 25 per cent by 2050 relative to 2008.⁵

In addition, the measures necessary for achieving the above goals are to be based on the guidelines of the "energy policy triangle", which emphasizes the need to consider environmental compatibility, affordability, and security of supply.

The German government has already implemented a number of measures to ensure that this transformation of energy systems is successful. These include, for example, the promotion of renewable energy and combined heat and power generation, as well as the obligatory participation of most CO₂-emitting German power plants and industrial facilities in the European Emissions Trading System (EU ETS). Additional measures include the promotion of electromobility, energy research funding, the promotion of more efficient heating systems, and regulatory efficiency standards for the construction of new buildings.⁶

Thanks to these measures, the energy transition has made good progress in recent years. By the end of 2018, greenhouse gas emissions were 30.5 per cent lower relative to 1990 (Figure 1):

- **Energy industry:** Greenhouse gas emissions from the energy industry have fallen by around 34 per cent since 1990. This reduction is primarily attributable to the age-related decommissioning of old coal-fired power plants, the transfer of some lignite-fired power plants into a reserve in 2016, the expansion of renewable energy in the electricity sector and the increased use of combined heat and power generation.
- **Industry:** Industry has so far seen a 31 per cent decline in emissions. This reduction is mostly attributable to the closure of industrial plants in eastern Germany following reunification, the greater avoidance of process emissions through improved process technology and efficiency measures, and the greater use of natural gas CHP instead of coal to generate electricity and heat.
- **Buildings:** Emissions in the buildings sector have so far fallen by 43 per cent. The main drivers here have been in particular the conversion of old coal stoves and oil-fired heating systems to modern natural gas plants and the expanded use of district heating. Building efficiency standards for new buildings and the energy-efficient

¹ (Bundesregierung, 2016)

² (Deutscher Bundestag, 2011)

³ (CDU/CSU/SPD, 2017)

⁴ (Bundesregierung, 2011)

⁵ (Bundesregierung, 2011)

⁶ (Bundesministerium für Wirtschaft und Energie, 2018)

refurbishment of part of the existing building stock have also contributed to reducing emissions to date.

- **Transport:** Greenhouse gas emissions in the transport sector have only been reduced by 1 per cent in relation to 1990. Lack of progress in this sector is due on the one hand to a significant increase in road-based freight traffic and, on the other hand, to an insufficient reduction in vehicle fleet consumption.
- **Agriculture:** Greenhouse gas emissions from agriculture have fallen by 23 per cent since 1990.

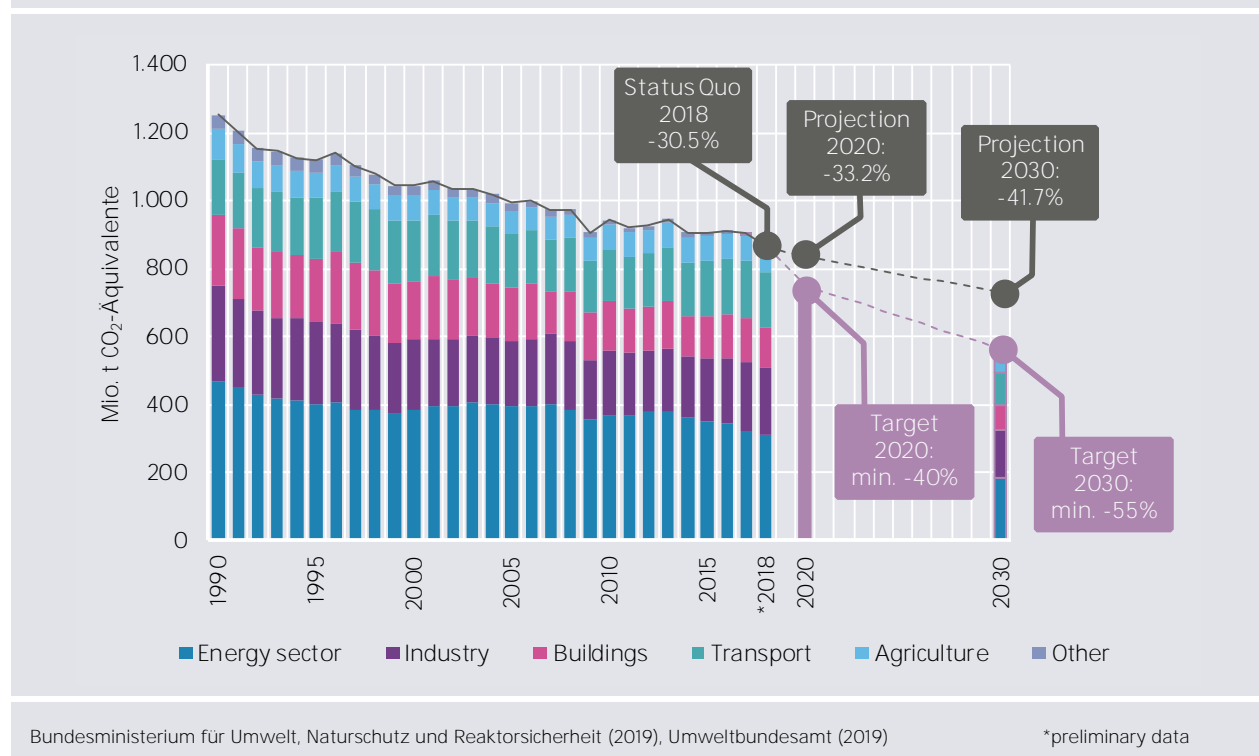
Despite the successes achieved in many areas, the Federal Government's current projection report shows that Germany is likely to miss its target of a 40 per cent emissions reduction below 1990 levels by 2020. On the basis of the measures decided so far, it can be assumed that only a reduction of around 32

per cent will be achieved by 2020. A similar picture emerges with a view to achieving the 2030 climate protection target: while the target calls for a 55% reduction, only a 41.7 per cent reduction can be expected based on currently implemented measures.⁷

One of the reasons for Germany's expected failure to meet its climate protection targets is the high CO₂ emissions released by coal combustion to generate electricity and heat in the energy and industrial sectors. In 2018, these coal emissions accounted for around one third of total greenhouse gas emissions in Germany.⁸ Therefore, German climate mitigation targets cannot be achieved without a reduction and, in the long term, an end to the use of coal.

The looming failure to meet the 2020 climate target is not surprising; indeed, this failure has been repeatedly foreseen in the German government's

Figure 1: Greenhouse gas emissions by sector, 1990–2018, targets and projection 2020 and 2030



⁷ (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, 2019)

⁸ (Bundesministerium für Wirtschaft und Energie, 2019)

biennial projection reports. Since the beginning of the 2010s, environmental associations, civic interest groups, and climate scientists have therefore been calling for additional coal reduction measures in the short term as well as the long-term phasing out of coal-fired power generation. In this connection, a variety of measures have been proposed, including the forced decommissioning of power plants, additional national or regional CO₂ pricing mechanisms, CO₂ emission limits, and annual emission budgets for coal-fired power plants.⁹

At the same time, however, numerous arguments against additional policy measures to restrict coal use or the long-term phase-out of coal energy have been voiced in the public debate. One main argument is that additional climate protection measures at the national level are counterproductive or unnecessary in sectors already regulated by the European emissions trading system. Meanwhile, others have argued that measures to phase out coal could endanger energy affordability and security of supply. Yet a third reason for opposition is the negative economic effects that would result in coal-producing regions, including loss of jobs.

In order to respond to the anticipated failure to meet climate protection targets, in 2014 the German government adopted the "Climate Protection 2020 Action Programme", which defined additional climate protection measures for all sectors in order to reduce the "climate protection gap" up to 2020.¹⁰ Since the measures proposed in this connection by the Federal Ministry of Economics and Energy incited intense opposition by power plant operators and trade unions, the so-called "capacity mechanism" was created as an alternative instrument. Formally, this is a capacity reserve that will retain 2.7 gigawatts of old lignite-fired power plants, for which operators are remunerated generously. The measure should result in 11 to 12.5 million tonnes of additional CO₂ abatement in 2020.¹¹

However, this was not the end of the political debate on the future role of coal-fired power generation. On the one hand, the measures adopted were far from sufficient for ensuring compliance with the 2020 and 2030 climate protection targets. On the other hand, in December 2015 the international community signed the Paris Climate Protection Agreement, which represented an increase in the current level of ambition in global climate protection.¹²

As part of the Climate Action Plan 2050, the long-term climate protection strategy adopted in 2016, the Federal Government declared it would form a Commission for Growth, Structural Change and Regional Development.¹³ This formation of this commission aimed to alleviate the intensifying social conflict over the future role of coal in the German energy system.

In March 2017, the current governing coalition (consisting of the CDU, CSU, and SPD) confirmed that such a commission would be established in their coalition agreement. It stated that the commission would involve stakeholders from the realms of politics, business and the environment, as well as representatives from impacted trade unions and regions, in order to draw up an action programme by the end of 2018 on the basis of the Climate Action Programme 2020 and the Climate Action Plan 2050.

⁹ A comprehensive overview of the instrument options discussed can be found in (DIW Berlin/Wuppertal Institut/Ecologic Institut, 2018)

¹⁰ (Bundesregierung, 2014)

¹¹ (Deutscher Bundestag, 2016)

¹² (United Nations, 2015)

¹³ (Bundesregierung, 2016)

2 The role of coal in Germany's energy system and economy

Primary energy consumption

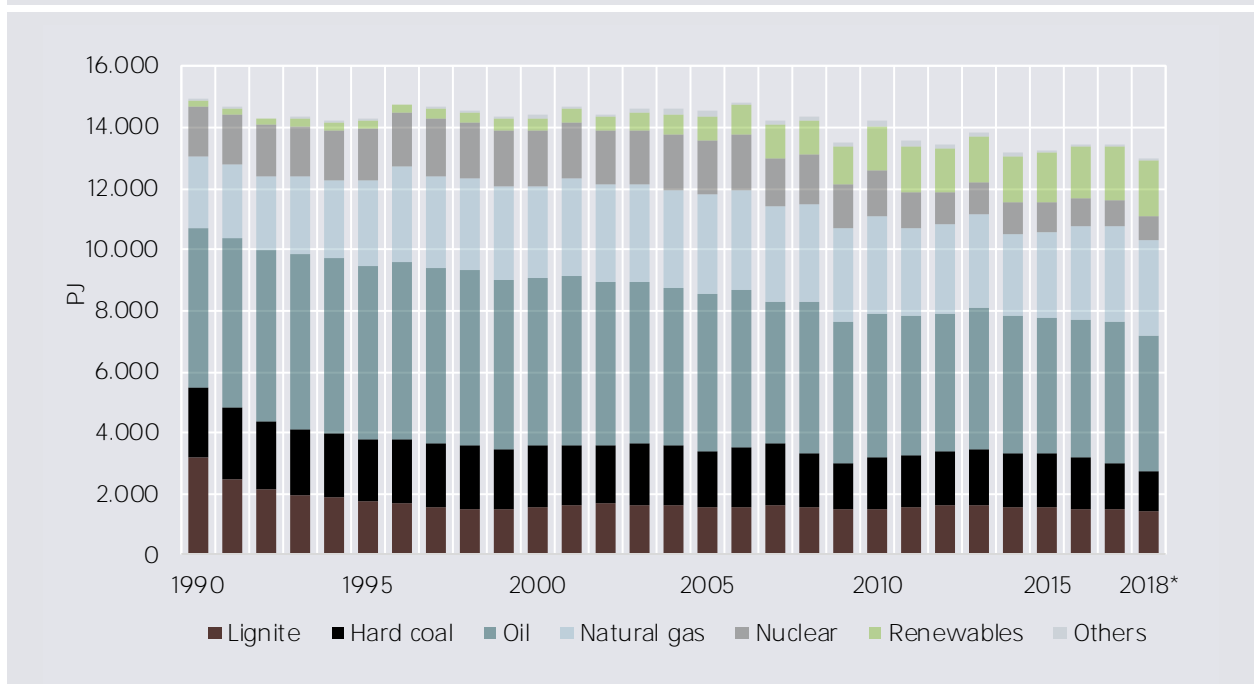
Coal's importance in German energy system has been gradually declining since 1990. This can be explained in particular by the following factors:

- *Falling energy demand:* Since 1990, overall primary energy demand has been gradually declining. This is due, on the one hand, to direct efficiency and modernisation measures, and, on the other hand, to the increased use of energy sources and technologies with lower conversion losses.
- *Increased use of natural gas:* Over time, the use of natural gas has increased, particularly in buildings. In addition, natural gas also is increasingly used in power plants, replacing coal-fired generation.

- *Expansion of renewable energy:* The Renewable Energy Sources Act of 2000 has made a large contribution to the expansion of renewable energy, especially in the electricity sector. In recent years, this has increasingly led to the displacement of coal-fired power plants in the electricity sector.

In 2018, primary energy consumption in Germany totalled around 12,963 PJ (Figure 1). The dominant energy source is mineral oil, which has a share of 34.3 per cent. Gas follows in second place with 23.7 per cent. Coal currently covers about 21.3 per cent, with lignite (11.3 per cent) and hard coal (10.0 per cent) accounting for about half of the total. The share of renewable energy is around 14.0 per cent, and nuclear energy accounts for 6.4 per cent.

Figure 2: Primary energy consumption, 1990–2018



AG Energiebilanzen (2019)

Resources, occurrence and use

While lignite is still mined almost entirely in the three remaining domestic lignite regions in the Rhineland, Lusatia and Central Germany, hard coal is now imported in its entirety (Figure 2). The share of domestic hard coal production in 2017 was still around 18 per cent. But with the closure of the last mines at the end of 2018, hard coal is no longer mined in Germany. The majority of imports in 2017 came from Russia (38 per cent), the USA (18 per cent), Colombia (13 per cent) and Australia (11 per cent).¹⁴

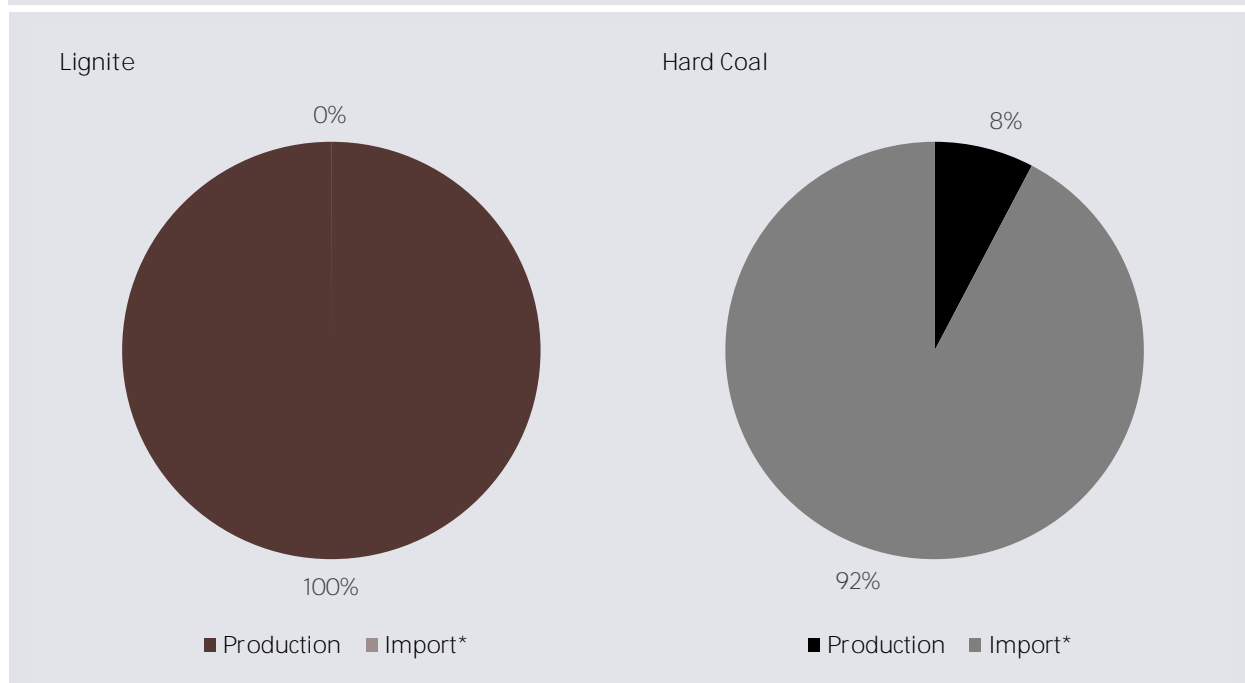
Lignite is currently still mined in 8 large opencast mines in three areas, with the open-cast mines in each area operated by a single company: The open-cast mines in the Rhine mining area (Hambach, Garzweiler and Inden) are operated by RWE, while those in Lusatia (Welzow, Nochten, Reichwalde) are

operated by LEAG. MIBRAG is responsible for the opencast mines in the Central German mining area (Vereinigtes Schleenhain, Profen). RWE and LEAG also operate their own lignite-fired power plants, most of which are in close proximity to opencast mines, which together account for the majority of the lignite-fired power plant capacity still installed.¹⁵

Germany's total lignite resources would be sufficient to keep power generation from lignite-fired power plants at today's level for many decades to come. However, the quantities actually extractable from mines that have already received legal approval are considerably smaller and will last for 10 to 25 years, depending on the mine and power plant network.¹⁶

Open-cast mine operators currently still envisage the resettlement of a total of 13 villages, although only a partially approved framework operating plan

Figure 3: Domestic production and import of lignite and hard coal in 2017



Authors' calculations based on Statistik der Kohlewirtschaft (2019)

* including inventory changes

¹⁴ (Bundesministerium für Wirtschaft und Energie, 2019)

¹⁵ (Öko Instiut, 2017)

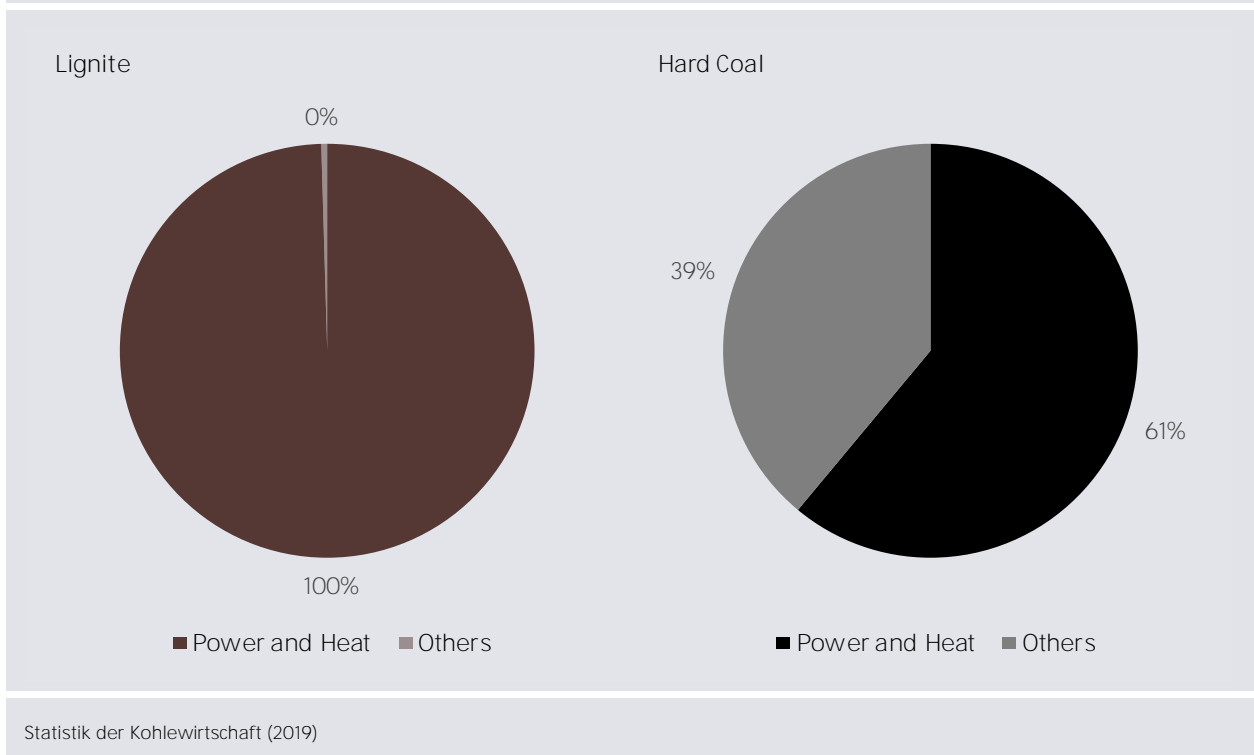
¹⁶ (Öko Instiut, 2017)

has been submitted so far. In almost all villages, re-settlement is rejected by part of the local population, while part of the population has already signed re-settlement agreements with the open-cast mine operators. As of 2018, a total of around 120,000 people had been resettled in today's lignite mining areas of the Rhineland, Lusatia and Central Germany.

The open-cast mine operator RWE is planning to clear the Hambach forest at the Hambach opencast mine. This led to major protests by the environmental movement in 2018.¹⁷

The majority of lignite and hard coal is used to generate electricity and heat in power plants (Figure 3). Lignite in particular is burned almost entirely in power plants or as briquettes in heating stoves. On the other hand, two thirds of hard coal is used to generate electricity and heat, whilst the remaining third is used in industry, particularly in steel and aluminium production.

Figure 4: Lignite and hard coal consumption in 2017



¹⁷ (Zeit Online, 2018)

Installed generation capacity

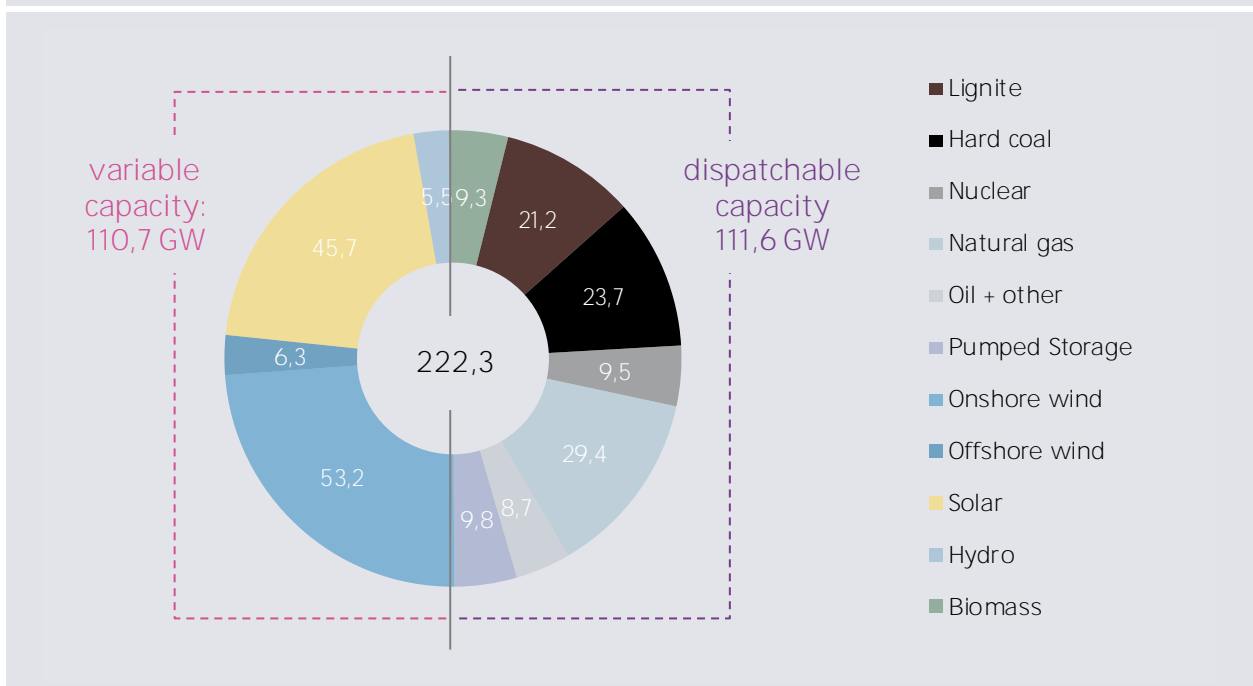
At the end of 2018, Germany had a total installed generation capacity of around 222.3 gigawatts (net). Of this total, around 110.7 gigawatts were accounted for by variable feed-in systems and 111.6 gigawatts by controllable systems. This corresponds in each case to about half of the installed generation capacity.

The installed generation capacity of coal-fired power plants at the end of 2018 was 44.7 gigawatts. Of this total, 21.2 gigawatts were accounted for by lignite power plants and 23.7 gigawatts by coal-fired power plants. There are a total of 145 individual turbines with a minimum size of 10 megawatts. In addition, 113 of the 145 plants are technically capable of generating heat in cogeneration operation, in addition to electricity.

While the lignite-fired power plants are mainly concentrated in the lignite mining areas around the open-cast mines, the hard coal-fired power plants are more widely distributed throughout Germany. Due to the lower transport costs for hard coal when using waterways and the quantities of water required for cooling, these are typically found on larger watercourses or near the coast. However, hard-coal-fired power plants are particularly numerous in the federal states of North Rhine-Westphalia and Baden-Württemberg, not far from traditional mining areas in the Saarland and the Ruhr.

As coal-fired plants are flexibly dispatchable, they still make an important contribution to security of supply. In particular, they provide reserve capacity, ensure system stability thanks to large rotating masses, and also provide control energy. Sufficient alternatives in all of these areas need to be set in place during a phase-out from coal.

Figure 5: Installed generation capacity at the end of 2018



Authors' calculations, see Agora Energiewende (2019)

* including biogenic household waste

Electricity and heat generation

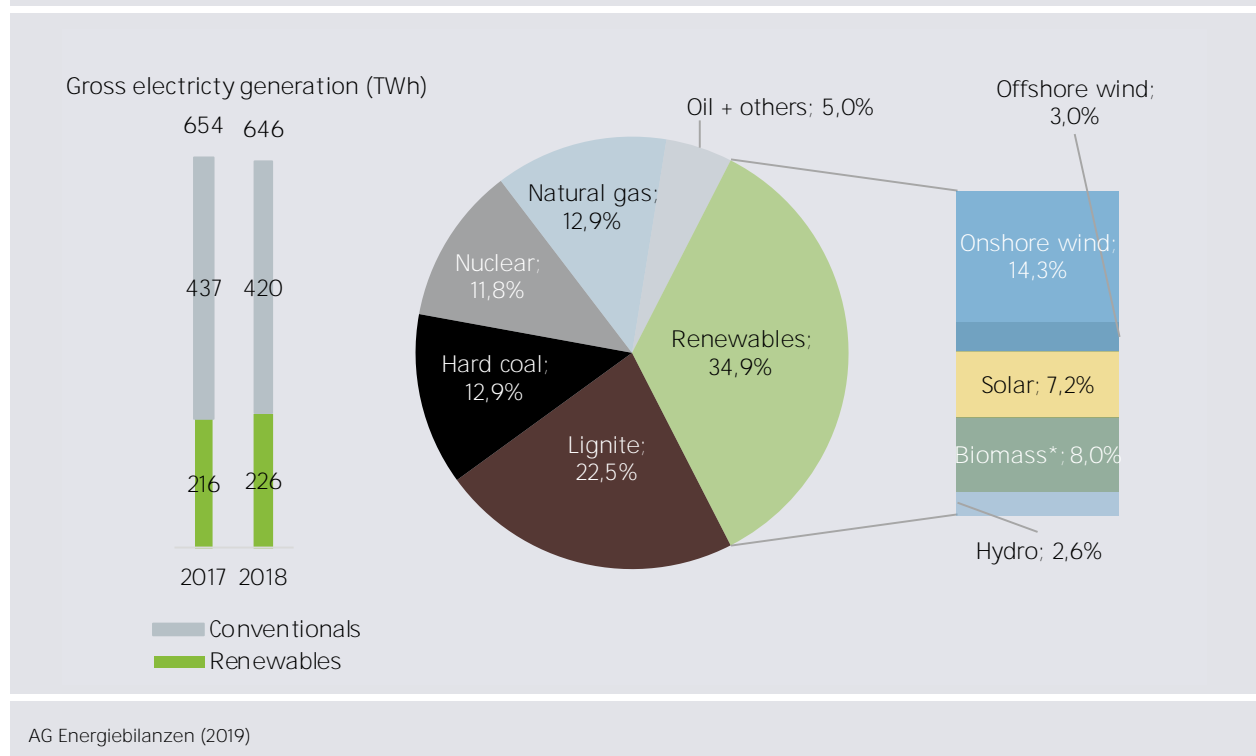
Total gross electricity generation in Germany in 2018 was 646.1 terawatt hours, while gross electricity consumption was only 598.9 terawatt hours. Thus, 51.2 terawatt hours were physically exported to neighbouring countries. 225.7 terawatt hours of electricity were generated from wind, solar and other renewable energy sources (34.9 per cent), while 420.4 terawatt hours were generated from conventional energy sources (65.1 per cent).

A total of 228.7 terawatt hours still came from coal-fired power plants in 2018. This corresponds to a share of 35.4 per cent. Lignite accounted for 145.5 terawatt hours and hard coal for 83.2 terawatt hours. It should be noted, however, that around 8 per cent of the electricity generated by coal-fired power plants is not fed into the electricity grid, but is used to

operate the power plant machinery (conveyor belts, coal mills). The actual net electricity generation of the coal-fired power plants is correspondingly lower (2018: 210.4 terawatt hours).

Heat generation from coal-fired power plants with cogeneration amounted to a total of 46.5 terawatt hours in 2017. Of this amount, 33.5 terawatt hours were attributable to district heating and 12.9 terawatt hours to industrial process steam and heat. This corresponds to a total share of about 3.6 per cent of the final heat consumption.¹⁸

Figure 6: Gross electricity generation in 2018



¹⁸ own calculations based on (AG Energiebilanzen, 2018)

CO₂ emissions and environmental impacts

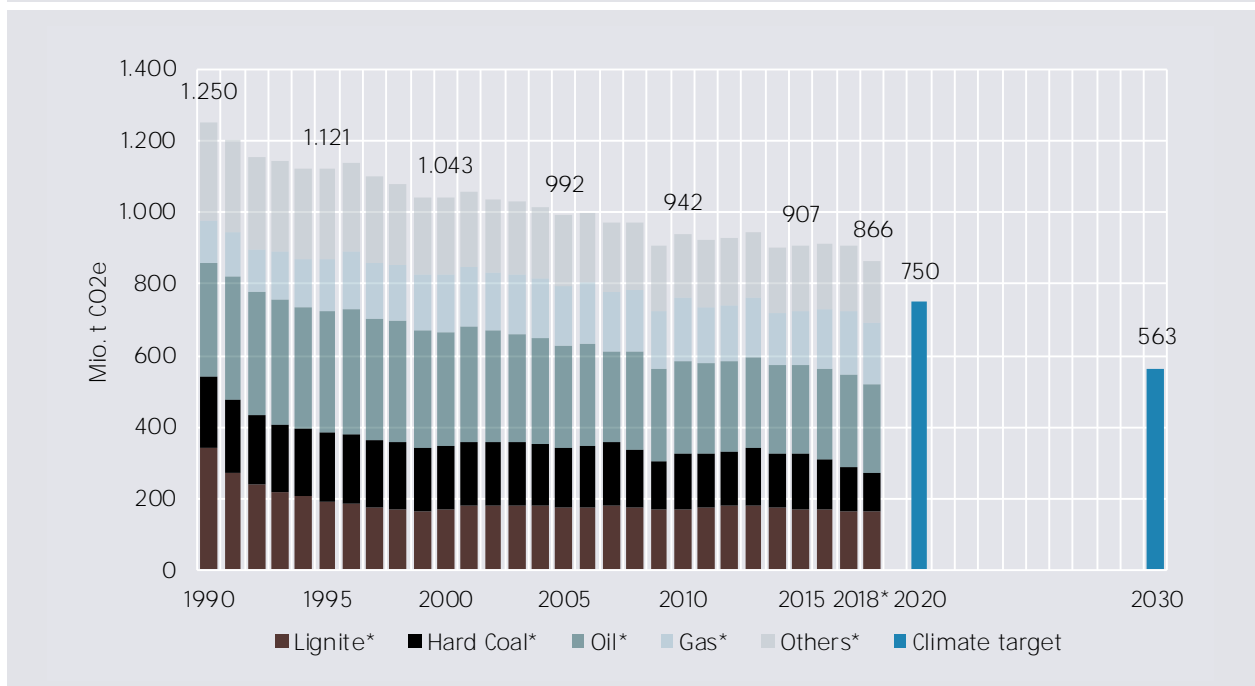
The combustion of coal generates considerable amounts of CO₂. Depending on the efficiency of the power plants and the quality of the coal burned, emissions run at around 0.9–1.1 grams per kilowatt hour (electric) for lignite and 0.7–0.9 grams per kilowatt hour (electric) for hard coal.¹⁹ For coal-fired power plants with simultaneous heat generation (co-generation), the specific emissions from electricity generation are correspondingly lower, as the respective emissions contribute to both electricity and heat generation.

Although CO₂ emissions from lignite and hard coal have declined in recent years, about one third of Germany's CO₂ emissions still originate from electricity and heat generation in coal-fired power

plants (2018: 31.6 per cent). In 2018, this corresponded to 273 million tons of CO₂ (Figure 6).

In addition, the combustion of coal is also associated with considerable environmental pollution, including the release of air pollutants such as mercury, sulphur dioxide, nitrogen oxides, and fine particulates. Air pollutants are usually produced locally and are associated with increased rates of respiratory and cardiovascular disease. Furthermore, open-cast mining operations cause negative environmental impacts due to the necessary lowering of the groundwater level and, in some cases, increased iron inputs into local water resources.²⁰

Figure 7: Greenhouse gas emissions, 1990–2018



BMWi (2019); authors' estimate for 2018 based on AG Energiebilanzen (2019)

* combustion-related CO₂ emissions

¹⁹ Own calculations

²⁰ (DIW Berlin/Wuppertal Institut/Ecologic Institut, 2018)

Employment and gross value added

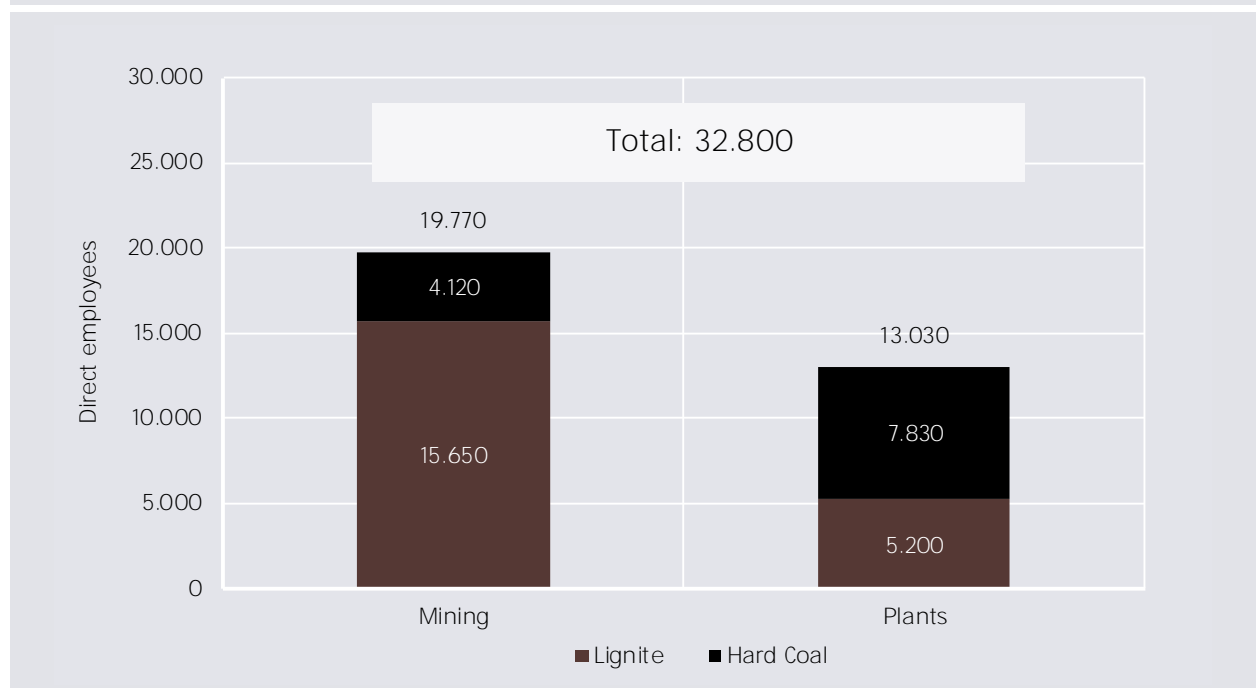
At the end of 2018, a total of around 32,800 people were still directly employed in the lignite and hard coal sector in Germany. This corresponds to 0.1 per cent of employees subject to social insurance contributions (2018: 32.8 million).²¹

- The number of direct employees in the lignite industry totalled around 20,850. Of these, 15,600 were employed in open-cast mining operations and around 5,200 in lignite-fired power plants.
- The number of employees in hard coal mining totalled around 13,030, of which around 4,120 were still employed in hard coal mining. The remaining 7,830 employees worked in the power plants.²²

Along the value chain of these sectors, the employment of around two additional people is either indirectly stimulated or induced.²³ As of the end of 2018, around 86,000 people were still employed directly or indirectly in the coal sector or their employment was induced by the coal sector. This corresponds to 0.26 per cent of the employees subject to social insurance contributions in Germany (2018: 32.8 million).²⁴

In the lignite mining areas, however, the share of employment among employees subject to social insurance contributions is significantly higher at 0.9 per cent (direct) and 1.4 per cent (direct, indirect and induced) due to the regional focus of the industry. In addition, the annual salaries in this sector are above

Figure 8: Employees in the lignite and hard coal sector at the end of 2018



Coal industry statistics (2019); own calculations based on enervis (2017)

²¹ (Statistisches Bundesamt, 2019a)

²² No figures are available in the official statistics for employees in the hard coal-fired power plants. They are therefore estimated on the basis of installed capacity (23.7 GW) and an employment factor of 0.3 BS/MW (enervis, 2016).

²³ For the calculation of the employment effects of the coal industry, numerous studies with different methodologies are available (see in detail (DIW Berlin/Wuppertal Institut/Ecologic Institut,

2018); (Öko Instiut, 2017); (Kommission "Wachstum, Strukturwandel und Beschäftigung", 2019). For reasons of complexity reduction, the Commission therefore agreed that the calculation formula described above should be used as a guideline. Indirect and induced employment in coal mining is not taken into account, as it was discontinued at the end of 2018.

²⁴ (Statistisches Bundesamt, 2019a)

average and are characterised by a comparatively high level of unionisation. The average age of direct employees is 45 years.²⁵

The gross value added of electricity generation in the lignite and hard coal industry is strongly dependent on the development of wholesale power prices, fuel commodity prices, and CO₂ certificates. In 2018, the gross value added of coal-fired power plants was an estimated 5.9 billion euros.²⁶ Of this amount, lignite-fired power plants accounted for around 4.2 billion euros and coal-fired power plants for around 1.7 billion euros.

The total direct gross value added of 5.9 billion euros corresponds to about 0.2 per cent of total gross value added in Germany (2018: 3,055 billion euros).²⁷ In the lignite mining areas, however, this is – similar to the figure for employment – 0.5 to 2.1 per cent higher than the national average.²⁸

²⁵ (RWI Leibniz-Institut für Wirtschaftsforschung, 2018b)

²⁶ Authors' calculations; possible revenues from heat generation or the provision of system services were not taken into account as no data are publicly available for this purpose. However, these only account for a fraction of the total revenues of the power

plants and were therefore neglected for this estimation. The value chain of the mining industry is included.

²⁷ (Statistisches Bundesamt, 2019b)

²⁸ Authors' calculations based on (RWI - Leibniz-Institut für Wirtschaftsforschung, 2018a)

3 Mission, composition, and advisory process of the Commission on “Growth, Structural Change and Employment”

In June 2018, the Federal Government set up the Commission on “Growth, Structural Change and Employment”. The Commission consists of a total of 31 members and is headed jointly by Ronald Pofalla, former head of the Federal Chancellery, Dr. Barbara Praetorius, an energy and environmental economist, and the former minister presidents Matthias Platzeck and Stanislav Tillich. The members of the Commission work on an honorary basis.

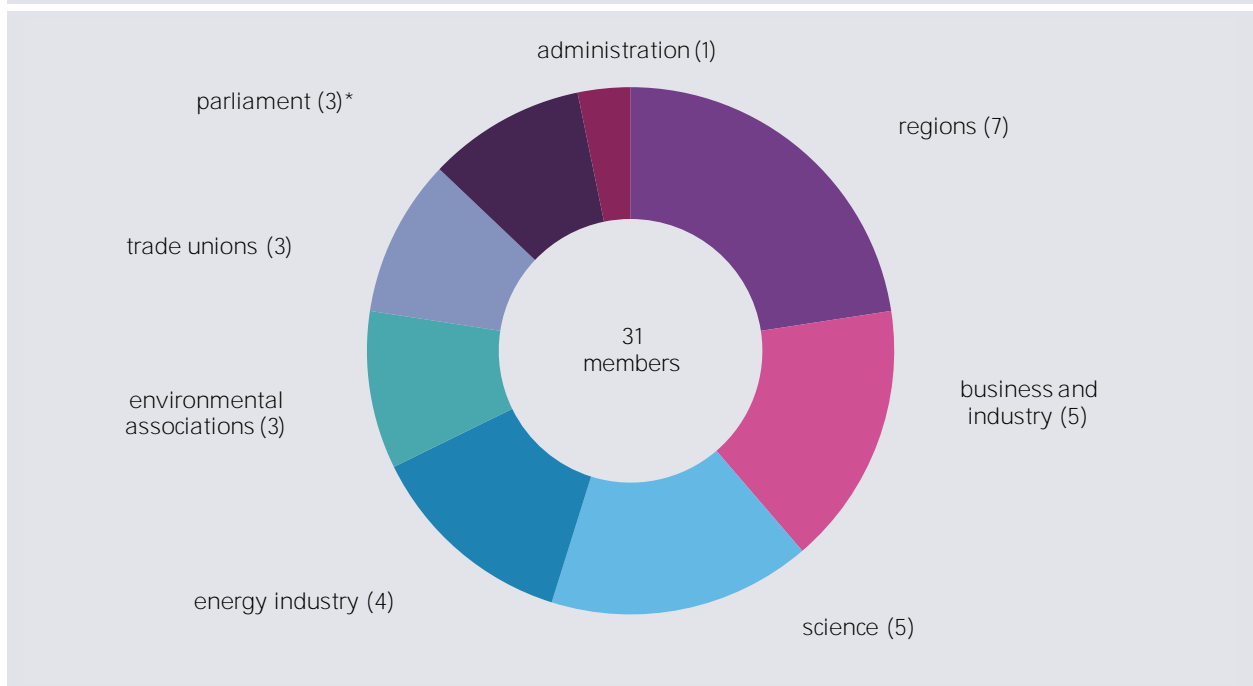
The Commission also includes representatives from the energy sector, lignite mining regions, industry, environmental associations, trade unions, the scientific community, and the coalition parties (Figure 8).

The plenary sessions were also attended by representatives from German states, eight federal ministries, and the Federal Chancellery.²⁹ The Commission’s work was supported in terms of content and organisation by an office attached to the Federal Ministry of Economics and Energy. The chairmen of the Commission also reported regularly to the State Secretaries Committee set up for this purpose, which included representatives from the eight federal ministries concerned (Figure 9).

According to the Federal Government’s decision of 6 June 2018 to establish the Commission, the Commission has the following mandate:³⁰

- “Creation of concrete opportunities for new, future-proof jobs in the affected regions in cooperation between the federal government, states, local authorities and economic actors (e.g. in the

Figure 9: Composition of the Commission on Growth, Structural Change, and Employment



Authors’ figure based on „Wachstum, Strukturwandel und Beschäftigung“ (2019)

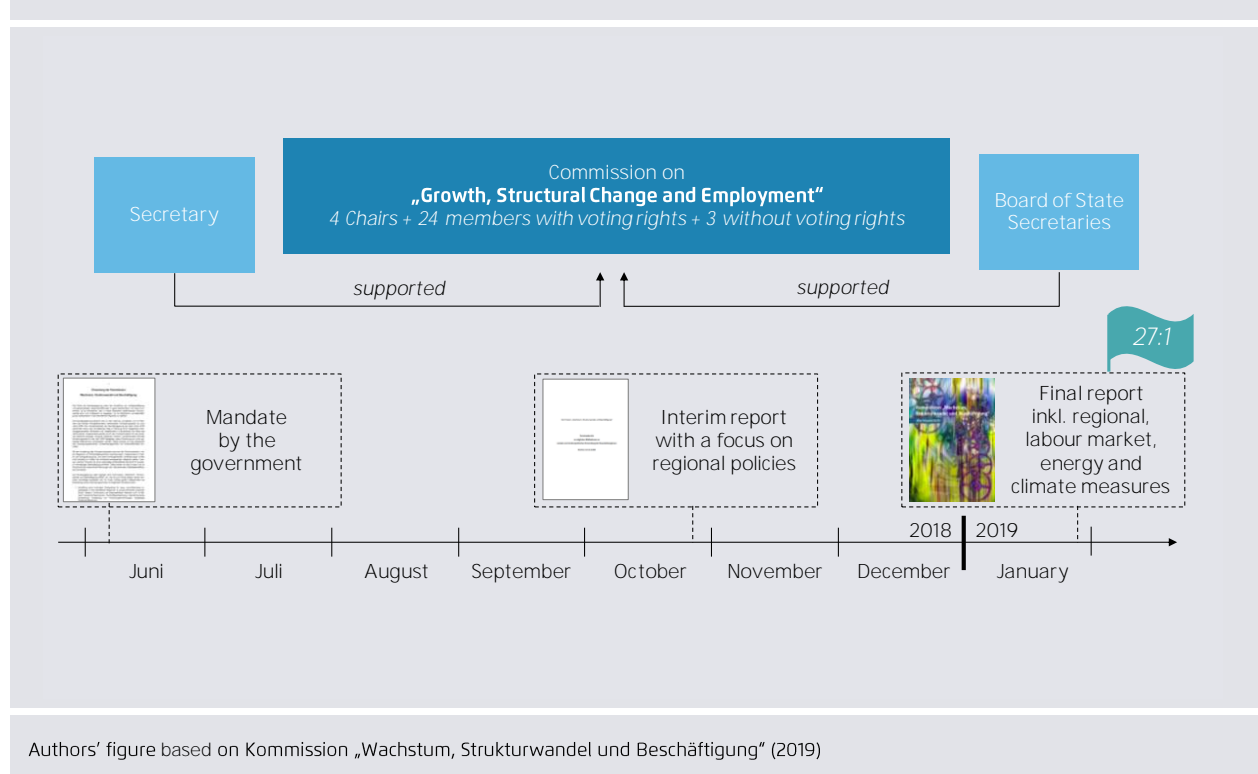
* without voting rights

²⁹ Kommission „Wachstum, Strukturwandel und Beschäftigung“ (2019): Abschlussbericht.

³⁰ (Bundesregierung, 2018)

- field of transport infrastructure, the development of skilled workers, entrepreneurial development, the establishment of research facilities, long-term structural development).
- Development of a mix of instruments that brings together economic development, structural change, social compatibility, social cohesion and climate protection and at the same time establishes opportunities for sustainable energy regions in the context of the energy system transformation.
 - This also includes necessary investment in the regions and economic sectors affected by structural change, for which existing federal and EU funding instruments should be used effectively, purposefully, and as a matter of priority in the affected regions. In this connection, a fund for structural change, consisting primarily of federal funds, should also be used.
 - Measures that reliably meet the 2030 target for the energy sector, including a comprehensive impact assessment. The Climate Change Plan sets the target of reducing emissions from the energy sector by 61 to 62 per cent in 2030 compared to 1990 levels. For the contribution of coal to electricity generation, the Commission will propose appropriate measures to achieve the 2030 sectoral objective of the energy sector, to be included in the 2030 programme of measures for implementing the Climate Change Plan.
 - In addition, to develop a plan for the gradual reduction and phasing out of coal-fired power generation, including a completion date and the necessary associated legal, economic, social, renaturalisation and structural measures.
 - Also, to define measures for the energy industry to reduce as much as possible the gap to reach the 40% reduction target. To this end, the Federal Government will publish a current estimate of the size of the gap to be expected in the context of the Climate Protection Report 2017".

Figure 10: The Commission's organisational structure and timetable



The Commission has held a total of ten plenary meetings. The initial consultations up to autumn 2018 solicited expert input on the topics of structural change, climate protection, security of supply, competitiveness, and affordability. The second set of meetings involved concrete negotiations for the preparation of the final report and its recommendations. The plenary sessions were prepared in the two established working groups “Structural Development and Employment” and “Energy and Climate”.

The final report was finally adopted almost unanimously by the members of the Commission in January 2019 (voting ratio: 27:1) and handed over to the Federal Government in February 2019 by the Chairperson of the Commission.

4 The recommendations of the Commission on “Growth, Structural Change, and Employment”

Overview of the recommendations

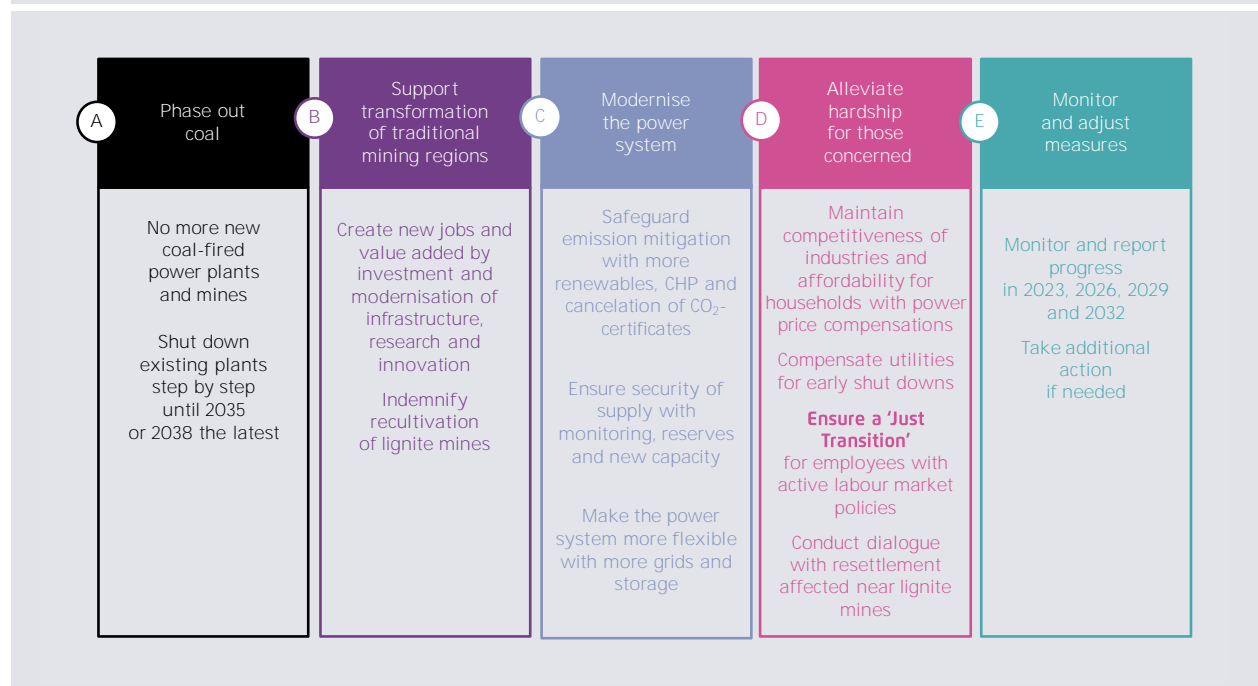
In addition to a comprehensive review of the role played by coal in Germany, the Commission's final report includes concrete recommendations on how to phase out coal-fired power generation (Figure 10). To this end, the Commission has submitted a concrete timetable for the phasing-out of coal-fired power stations in Germany (element A). The Commission also recommends the implementation of supplementary measures in order to take advantage of latent opportunities as well as mitigate negative effects. On the one hand, the current coal regions are to be supported in their transformation through active regional policy (Element B), and, on the other hand, the electricity and energy system is to be

comprehensively modernised (Element C). Furthermore, possible economic hardships for those directly affected by the coal exit are to be cushioned (Element D). Finally, the phase-out and its effects are to be regularly monitored and, if necessary, readjusted (Element E).

Element A: Phase out coal

The Commission recommends that, if possible, no new coal-fired power plants should be connected to the grid; furthermore, no new opencast lignite mines should be developed (Figure 11). The Commission's recommendations provide for a gradual reduction of existing coal-fired power plant capacities in the electricity market. Accordingly, the capacity available on the market from coal-fired power plants is to be reduced to a maximum of 30 GW by 2022 (including 15 GW of lignite and 15 GW of hard coal) and to a maximum of 17 GW by 2030 (including 9 GW of

Figure 11: Overview of the recommendations of the Commission on Growth, Structural Change, and Employment



Authors' figure based on Kommission „Wachstum, Strukturwandel und Beschäftigung“ (2019)

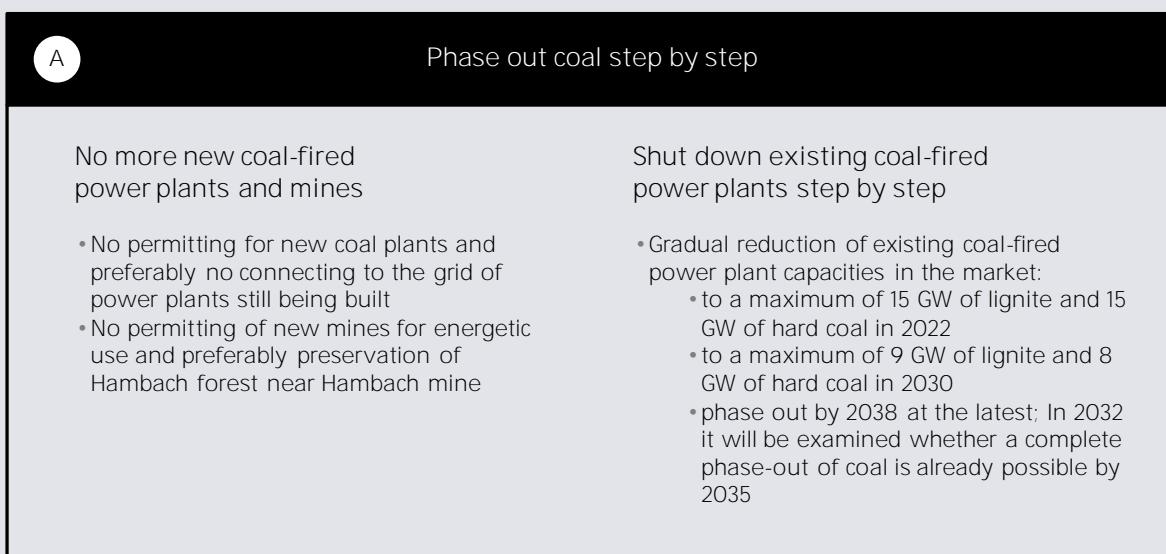
lignite and 8 GW of hard coal) (Figure 11). In addition, an emissions-reduction contribution of 10 million tonnes of CO₂ is to be made by lignite-fired power plants by 2025. All market exits are subject to approval by the Federal Network Agency in accordance with Section 13b of the Energy Industry Act. The latter may refuse a planned decommissioning if it considers that this would jeopardise system stability.

With regard to developments in the interim years up to 2038, the Commission recommends that the phase-out path be designed such that overall emissions reductions are as steady as possible. With this recommendation, this Commission hopes to avoid dislocation in the energy sector and in regional economies. The last coal-fired power plant should be phased out by 2038 at the latest. In 2032 it will be examined whether a complete phase-out of coal is already possible by 2035. The concrete design of the exit timetable should be such that the Hambach

forest at the Hambach open-cast mine can be preserved in its present size.

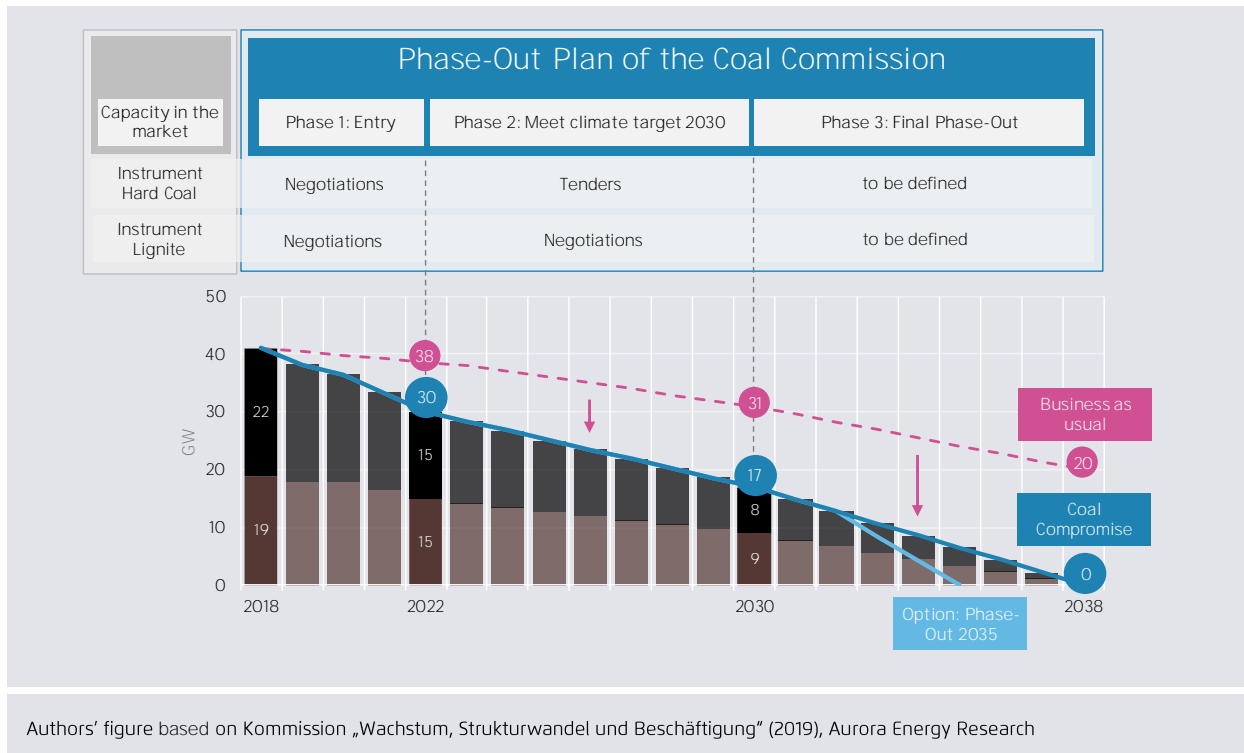
In order to ensure sufficient legal certainty, the Commission recommends that, as an instrument, consensual negotiation agreements, including compensation payments, should be concluded with operators by 2022. These are then to be fixed by law. For the period from 2023 to 2030, the Commission recommends a competitive bidding process to determine which hard-coal-fired power stations will be decommissioned and the level of compensation to be received. By contrast, the phase-out for lignite-fired power plants will continue to be based on negotiated solutions. If no amicable agreement can be reached between the federal government and the operators by 30 June 2020, the federal government should adopt a mandatory decommissioning schedule, including appropriate compensation for power plant operators.

Figure 12: The recommendations of the Commission on “Growth, Structural Change, and Employment” to phase out coal



Authors' figure based on Kommission „Wachstum, Strukturwandel und Beschäftigung“ (2019)

Figure 13: The Commission’s recommended phase-out path for coal-fired power plants compared to capacity change in a business-as-usual scenario



Element B: Support the transformation of traditional mining regions

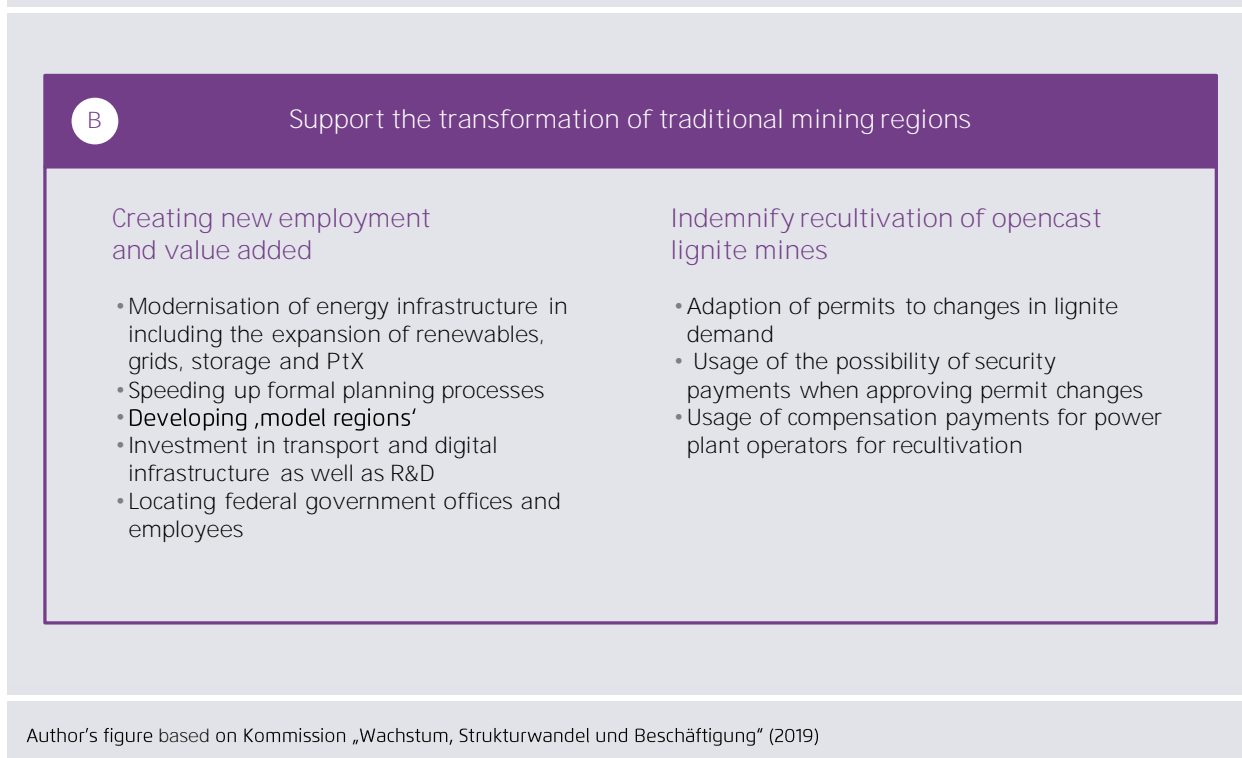
In the Commission's view, supplementary structural and energy policy measures in the coal regions are necessary to support the transformation of traditional mining regions. The declared aim of these measures is to replace the gradual loss of value added and employment with new value added and employment, especially in the industry sector.

To this end, the Commission recommends the modernisation of energy infrastructure in today's coal mining regions, including the expansion of renewables, as well as the replacement of old generation assets with alternative generation and storage technologies. The Commission additionally recommends the acceleration of planning processes, investment in transport and digital infrastructure as well as in local research in order to enhance regional

competitiveness as a location for business and facilitate innovation. In this connection, the regions are to be developed into "model regions" for regulatory purposes in which new industrial processes and systems can be tested and further developed. In the short and medium term, federal government offices with a total of 5,000 employees are to be located in the coal regions by 2028 at the latest. These measures are to be financed by an additional 40 billion euros over the next 20 years for the coal regions.

A further building block is to indemnify the operation of opencast lignite mines with insurance models. This intends to protect regional governments in coal mining regions from the potential bankruptcy of an open-cast mine operator, which would lead to significant public spending for renaturation (Figure 13).

Figure 14: The recommendations of the Commission on Growth, Structural Change, and Employment to support the transformation of traditional mining regions



Element C: Modernise the power system

Another recommendation contained in the Commission's final report is the comprehensive modernisation of the electricity and energy system. In this regard, the Commission notes that the emissions mitigation effect of phasing out coal should be safeguarded by expanding renewable energy to 65% of gross electricity consumption by 2030. To ensure this goal is met, the Renewable Energy Sources Act should be amended accordingly. As part of this amendment, the support mechanism for combined heat and power should be continued (see below). To ensure that the phasing out of coal-fired power generation also has an effect within the framework of European emissions trading and does not lead to a "waterbed effect" over the long term in other countries, the federal government should also cancel the necessary quantity of CO₂ certificates. Appropriate CO₂ pricing in sectors outside emissions trading should also be examined, the Commission advises.

Under the modernization of energy systems, the Commission also foresees the expansion of measures to monitor security of supply. If there are short-term supply bottlenecks, the existing system of reserves is to be used, the Commission advises. However, if the market does not show signs of sufficient investment in new plants in the medium term, the introduction of a capacity market should be examined. In order to ensure a sufficient supply of heat energy, the Combined Heat and Power Act is to be continued until 2030 and, among other things, the replacement of coal-fired power plants with CHP facilities is to be promoted. At the same time, however, the government support system is to be further developed in the direction of flexible CHP systems. The Commission also addresses the need to make electricity and energy systems more flexible as part of the expansion of wind and solar power. This includes, on the one hand, the modernisation and better use of the electricity grids through grid expansion, improved market mechanisms, and the

optimisation of existing capacity. This also includes the promotion of storage facilities – especially in coal-mining regions in the form of pilot projects. Furthermore, the Commission calls for the review of the existing tax and levy system in the energy sector, as it is increasingly proving to be an obstacle to the further integration of energy sectors. In this connection, the Commission recommends examining appropriate CO₂ pricing in sectors outside emissions trading (Figure 14).

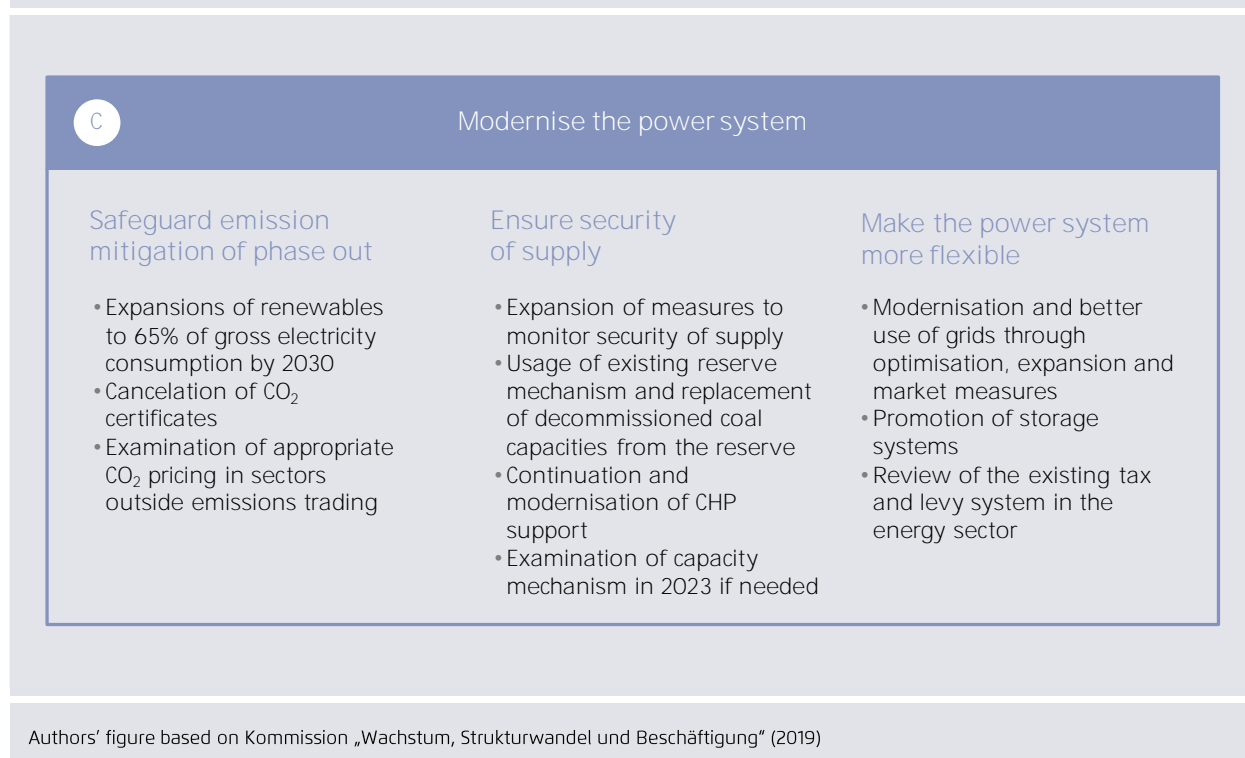
Element D: Alleviate hardship for those concerned

With a view to the phase-out of coal-fired power generation, the Commission takes into account that the proposed measures will have a direct negative impact on individual groups. In order to mitigate or – if possible – avert these effects, the Commission proposes a package of support and compensation

measures. Against this backdrop, the Commission acknowledges the need to ensure that the phase-out is as socially acceptable as possible. In concrete terms, the Commission recommends extensive labour market measures to benefit those currently employed in the coal industry, including protections against dismissal, provisions for retraining, and measures for reallocation to new jobs. In the case of employees aged 58 and up, adjustment funds are to be used to enable early retirement without financial losses.

Furthermore, the Commission calls on state governments to engage in dialog with residents in open-cast mining regions and to adjust the open-cast mining plans as promptly as possible in accordance with the Commission's recommendations. In this regard, the aim is to ensure that those still affected by possible resettlement have a reliable basis for planning.

Figure 15: The recommendations of the Commission to modernise the energy system



At the same time, the Commission acknowledges the need to maintain the competitiveness of energy-intensive industry, and calls on the federal government to continue and further develop CO₂ electricity price compensation at the European level. Similarly, commercial, industrial, and household electricity consumers are to be protected against a possible increase in retail prices by lowering transmission grid charges. The Commission expects a total of two billion euros a year in relief to be needed from 2023 onward. In addition, the costs of phasing out coal-fired power generation are not to be passed on to electricity consumers (Figure 15).

Furthermore, the phasing out of coal-fired power generation should, if possible, take place in agreement with power plant operators. This also means that power plant operators will be compensated for the early shut-down of capacities. The amount of compensation granted is to be determined as part of

a negotiative process or as the result of competitive bidding.

Element E: Monitor and adjust measures

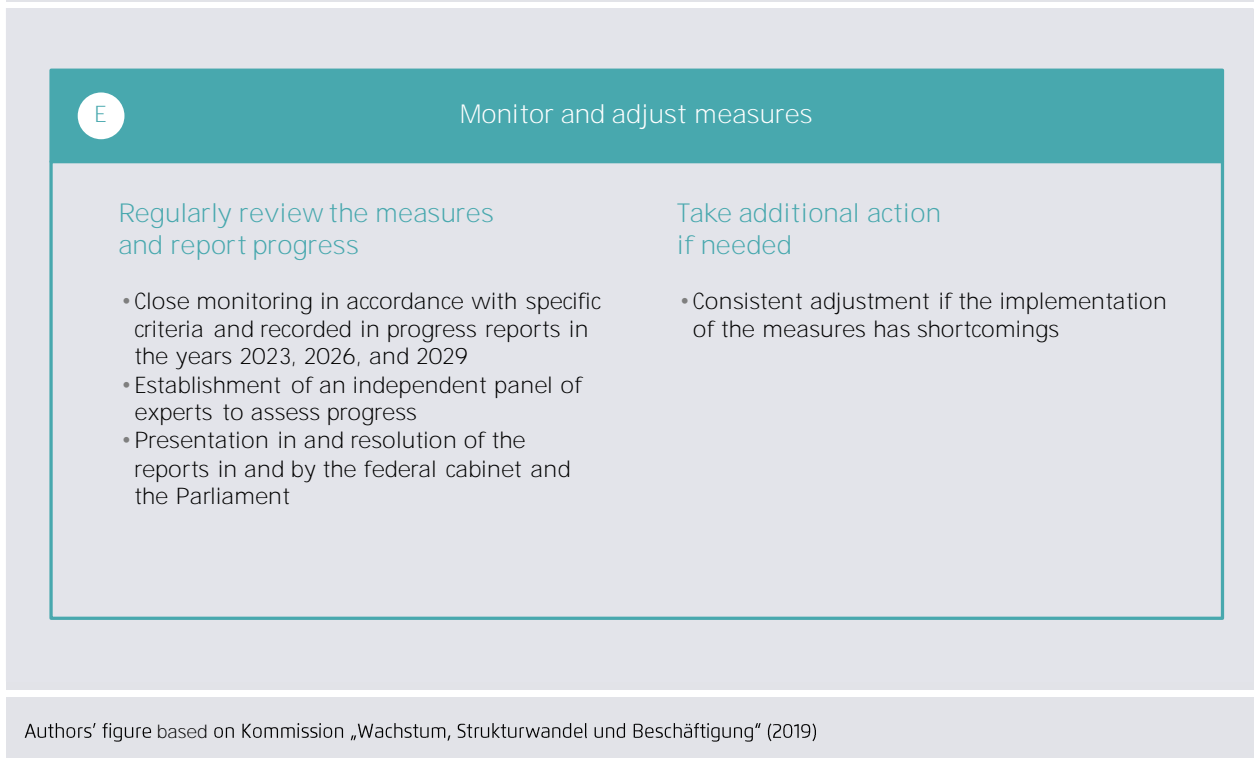
In order to ensure successful implementation in all areas, the implementation of the measures is to be regularly reviewed by close monitoring in accordance with specific criteria and recorded in progress reports in the years 2023, 2026, and 2029. In addition, the progress reports are to be presented by the federal cabinet and the Parliament. Furthermore, an independent panel of experts will be entrusted with the evaluation of the implementation. If the implementation of the measures reveals any shortcomings, the federal government is to make consistent adjustments (Figure 16).

Figure 16: The recommendations of the Commission to alleviate hardship for those concerned



Authors' figure based on Kommission „Wachstum, Strukturwandel und Beschäftigung“ (2019)

Figure 17: The recommendations of the Commission to monitor and adjust measures



5 Effects on the German power sector up to 2023 and 2030

Agora Energiewende commissioned Aurora Energy Research to model the impact of the Commission's recommendations on the power sector up to 2023 and 2030.³¹ The model calculations rely on the comparison of two scenarios (Figure 17):

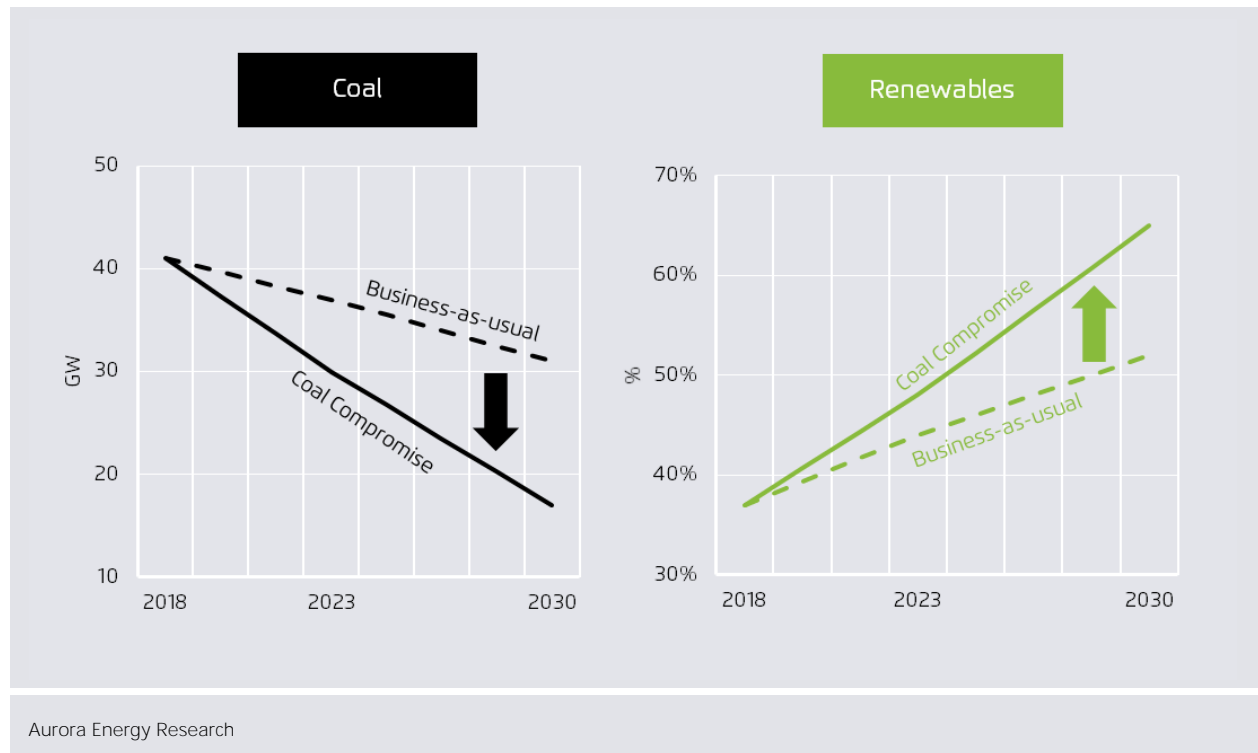
→ The "reference scenario" describes the development in the electricity market in *business-as-usual terms*, i.e. on the basis of measures already implemented. Under this scenario, renewable energy is expanded in line with the capacity amounts in the Renewable Energy Act 2017. With regard to coal-fired power plants, no additional market exits triggered by regulatory intervention

are assumed. Accordingly, continued operation or decommissioning is determined by their economic viability.

→ The "coal compromise scenario" describes the development of the electricity market if the measures proposed by the Commission are implemented. This scenario thus includes both an increase in the expansion of renewable energies to 65 per cent by 2030 and the gradual phase-out of coal under the roadmap proposed by the Commission.

Both scenarios assume nuclear energy will be phased out in 2022. In order to account for the elimination of heat extraction from coal-fired CHP plants due to the exit from coal, it is assumed for these model

Figure 18: Coal-fired power plant capacity and the share of renewable energy in gross electricity consumption in 2018, 2023, and 2030



³¹ The Commission's recommendations set as the first target a reduction in coal capacities by 2022. However, a focus is placed on 2023 in order to take full account of the effects of the phase-out

of nuclear energy by the end of 2022 and the associated effects on the energy industry.

calculations that gas-fired CHP plants serve as a replacement.³²

The development of remaining power plant capacities, including their operational behavior, was calculated endogenously in the model. Accordingly, gas-fired peaking capacities are increased or reduced in line with their economic viability.

The two scenarios are modelled using a European electricity market model that takes into account not only developments in Germany but also expected market developments in the broader European environment. In accordance with the Commission's recommendations, the electricity market model follows the logic of an "energy-only market 2.0". This means that no additional capacity market was assumed for Germany. Due to the permitted peak prices, the expansion of gas capacities in the model, for example, is financed exclusively via the electricity market.

With regard to the expansion of interconnectors, the model assumes realisation of the capacities planned by Entso-e in its Ten Year Network Development Plan. However, the projects that are far from being realised were assigned lower weights.

The grid situation within Germany was not depicted, as this is purely an exercise in market modelling and, furthermore, it was assumed that the necessary grid expansion would be fully implemented in 2030 in accordance with the Commission's recommendations.

In addition, the following assumptions were made, which were not varied between the scenarios:

→ **CO₂ prices:** The price of CO₂ certificates in European emissions trading rises from around 16

euros per tonne in 2018 to 32 euros per tonne in 2030.

→ **Fuel prices:** The price of hard coal falls from EUR 11 per megawatt hour in 2018 to around EUR 9 per megawatt hour in 2030, while natural gas rises from EUR 17 per megawatt hour to around EUR 27 per megawatt hour in the same period.

→ **Gross electricity demand:** Despite some progress in efficiency, electricity consumption rises from 599 terawatt hours in 2018 to 619 terawatt hours in 2030 as a result of energy sector integration.

→ **Lifetime of power plants:** In the case of hard coal-fired power plants, the models assume a technical lifetime of 40 or 45 years for CHP plants and 50 years for lignite-fired power plants, including the possibility of life-extending retrofit measures given the economic viability of continued operation.

→ **Weather year:** All scenarios were calculated on the basis of the weather year 2013.

→ **European power plant fleet:** The development of the foreign power plant park was based on Entso-e's Ten Year Network Development Plan and supplemented by country-specific assumptions based on the respective national energy strategies and current market developments.

The assumptions made represent a plausible framework for the future development of the electricity markets from today's point of view, but in reality, they will most likely turn out differently. The calculations presented here are therefore not forecasts, but scenarios that serve to better understand and evaluate the energy effects of the coal compromise compared to a reference development separately from other external factors.³³

³² This is a simplifying assumption. Although the Commission's recommendations provide for a continuation of the Combined Heat and Power Act, they explicitly advocate further development towards a more flexible cogeneration heat and power system. This also includes the use of renewable energy.

³³ For example, the development of fuel prices or the development of foreign power plants may be different from that shown here. This would have a substantial impact on the model results.

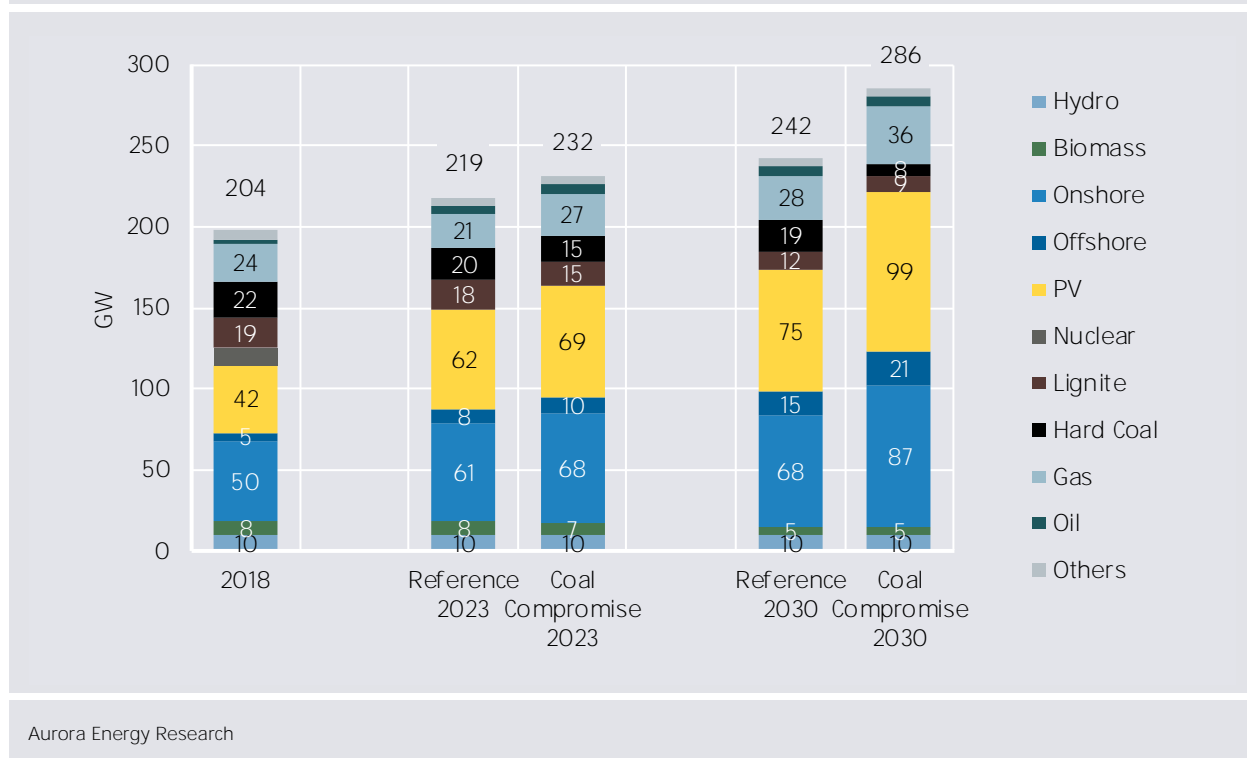
However, the qualitative trends between the scenarios described here would be maintained, as the changes would have to be taken into account in both scenarios. Agora Energiewende has examined in detail the changes that occur in generation between Germany and France, for example, with divergent nuclear power plant capacity developments in France, in the study "Die Energiewende und die französischen Transition énergétique bis 2030".

Development of generation capacities in the electricity market

In the reference scenario, market capacity will increase in the absence of further measures from 204 gigawatts in 2018 to 219 gigawatts in 2023 and 242 gigawatts in 2030, respectively (Figure 18). The majority of the increase in capacity is attributable to renewable energy, in particular wind and photovoltaics. The capacity of nuclear power will be reduced to zero by the end of 2022 in line with the decisions to phase out nuclear power, while the capacity of lignite and hard coal-fired power plants will be reduced to a total of 38 gigawatts by 2023 and 31 gigawatts by 2030 in line with the market framework and age-related shutdowns. The generation output of gas-based plants rises from 24 gigawatts today to around 28 gigawatts.

In the coal compromise scenario, total power plant capacity available on the market will rise to 232 gigawatts by 2023 and to 286 gigawatts by 2030 (Figure 18). These capacity levels are significantly higher than in the reference scenario. The main reason for this significant increase in capacity is the expansion of renewable energy to 65 per cent in 2030. In line with the Commission's recommendations, the installed capacity of coal-fired power plants will fall to a total of 30 gigawatts by 2023 and to a total of 17 gigawatts by 2030. By 2030, this will increase additional natural gas capacity needs from 12 gigawatts to 36 gigawatts. Compared to the current installed capacity of around 29 gigawatts, including moth-balled plants and reserve power plants, this corresponds to a net increase of around 7 gigawatts.³⁴ A prerequisite for this increase, however, is the modernisation of the transmission grid, which will

Figure 19: Generation capacities (net) in 2018, 2023, and 2030



³⁴ (Bundesnetzagentur, 2019)

enable the use of power plants previously held in the grid reserve.

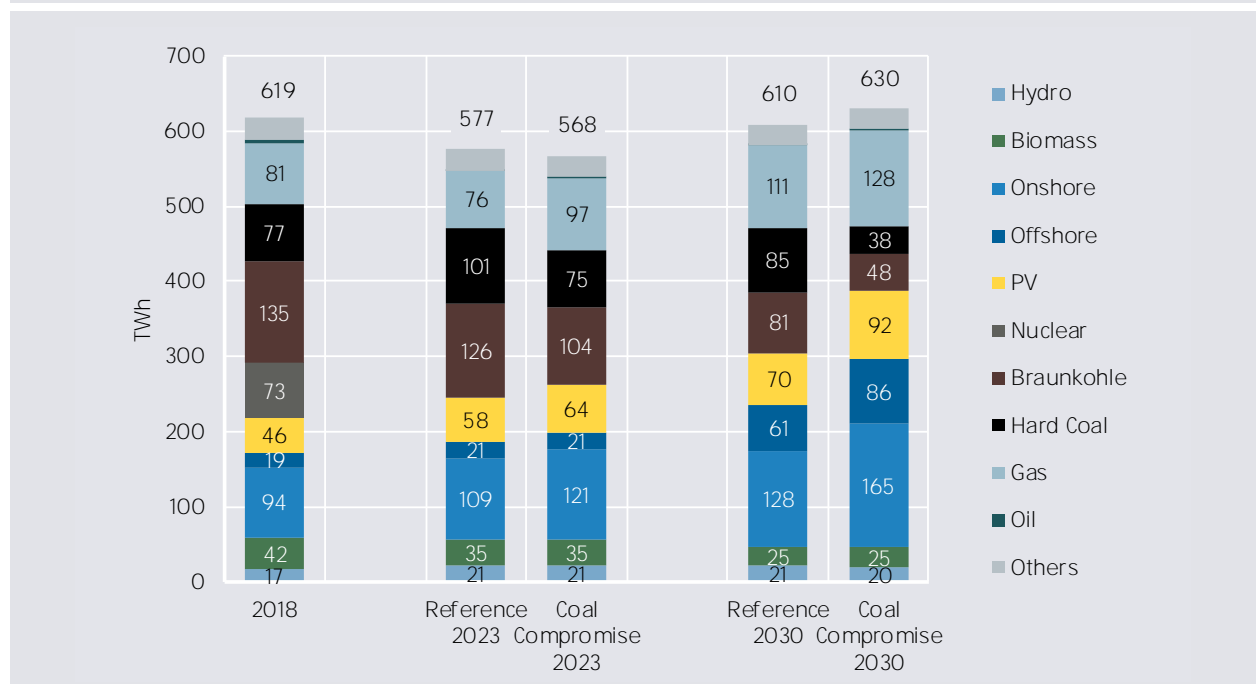
Development of electricity generation

In the reference scenario, net electricity generation decreases from 619 terawatt hours in 2018 to 589 terawatt hours in 2023 (Figure 12). The phase-out of nuclear power leads to a particularly strong drop in terawatt hours; however, this is partially offset by the expansion of renewable energy and, in particular, higher generation from coal-fired power plants. By 2030, net electricity generation reaches 610 terawatt hours. This expansion is attributable to the further expansion of renewable energy to 305 terawatt hours and the increased use of natural gas. Net electricity generation from gas-fired power plants will increase by around 30 terawatt hours from 81 terawatt hours in 2018 to 111 terawatt hours in 2030. The main reason for the increased use of natural gas is, in particular, the anticipated age-

related decommissioning of coal-fired power plants and the higher competitiveness of natural gas given rising CO₂ prices.

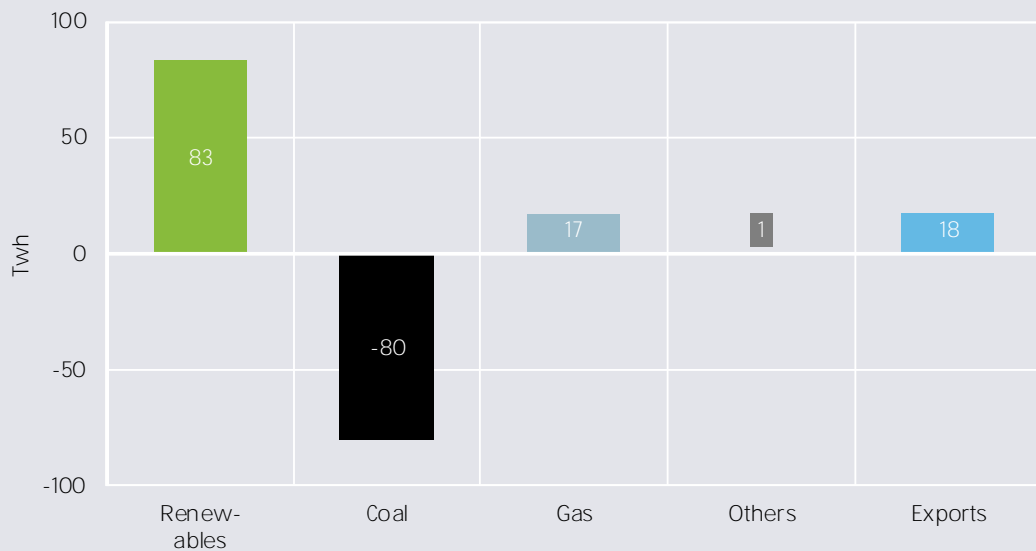
In the coal compromise scenario, net electricity generation falls to 589 terawatt hours by 2023, as in the reference scenario (Figure 12). Given the expansion of renewable energy and a reduction in coal-fired generation, electricity generation from coal-fired power plants is significantly lower in the coal compromise scenario, while generation from renewable energy plants and natural gas is correspondingly higher. By 2030, domestic electricity production will rise to 630 terawatt hours, higher than today's level. Accordingly, lignite and hard coal-fired power plants produce only 86 terawatt hours of electricity per year, which corresponds to a decrease of 126 terawatt hours compared to 2018. By contrast, electricity generation on the basis of renewable energy totals around 388 terawatt hours, with the majority being generated by wind and solar power. Power

Figure 20: Electricity generation (net) in 2018, 2023, and 2030



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Figure 21: Difference in net electricity generation between the reference and coal compromise scenarios in 2030

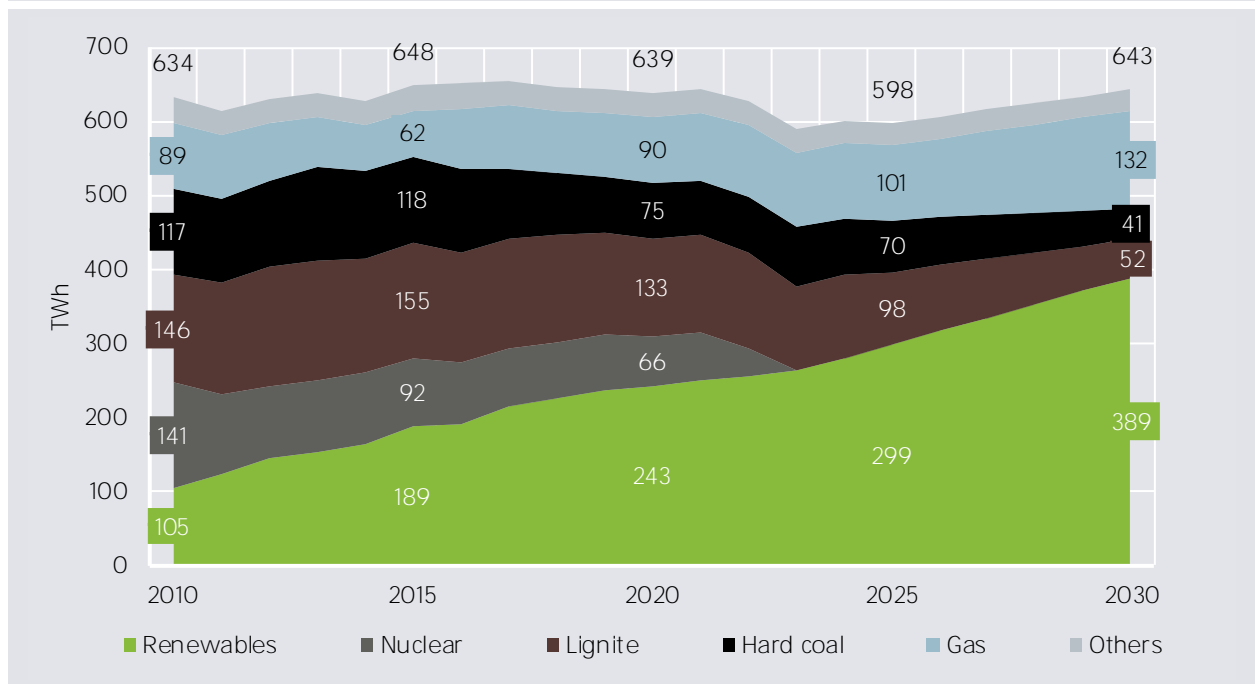


Aurora Energy Research

generation from gas-fired power plants will increase to 128 terawatt hours by 2030.

This means that the coal-fired generation that is eliminated as part of the coal compromise will be mainly replaced by renewable energy. This becomes particularly clear in a direct comparison of the scenarios in 2030 (Figure 20): While coal-fired power generation declines by 80 terawatt hours, generation from renewables increases by 83 terawatt hours. Electricity generation from natural gas, on the other hand, will increase by only 17 terawatt hours. However, this is also reflected in the long-term view of gross electricity generation from 2010 onwards, which foresees renewable energy replacing both the discontinued generation of electricity from nuclear power plants and the reduced generation of coal-fired electricity by 2030, if the compromise is implemented (Figure 21).

Figure 22: Gross electricity generation in 2010–2030 given implementation of the coal compromise



Data from 2010–2018: AG Energiebilanzen (2019); Projection from 2019: authors' calculations based on Aurora Energy Research

Development of electricity trading

In the reference scenario, the export surpluses decline from their current level of 50 terawatt hours to only 5 terawatt hours in 2023, thus producing an almost even balance of trade (Figure 22). The phasing out of nuclear energy is the core driver of this declining surplus. Looking ahead to 2030, the electricity export surplus of 6 terawatt hours will remain roughly at a comparable level, as the loss of electricity generation from coal-fired power plants will gradually be offset by more renewable energy and gas-fired power plants.

In the coal compromise scenario, the balance of trade is also roughly even in 2023 at 5 terawatt hours (Figure 22). This is attributable to the replacement of electricity generated by coal-fired power plants with renewable energy and domestic natural gas. By 2030, the export surplus will rise to 25 terawatt hours, particularly due to the high share of

renewables. Even if trade flows change only slightly or if exports increase over the year as a whole, trade flows fluctuate strongly by season. Exports, for example, tend to increase in the spring and autumn, given high electricity generation from wind and photovoltaics at the same time. In the winter months, on the other hand, there are more hours with higher import shares. In model terms, this is the cost-efficient result of a single European internal energy market. If additional domestic generation capacities in the form of reserves are deemed necessary to assure security of supply during an emergency, this would have no influence on the model results for generation. However, this would lead to an additional financial burden, which was not considered by this study.

The model results indicate that the phasing out of coal-fired power generation in conjunction with an increase in renewable energy will not lead to an increase in the capacity utilisation of nuclear power

Figure 23: Balance of trade for electrical power from 2010 to 2018, 2023, and 2030

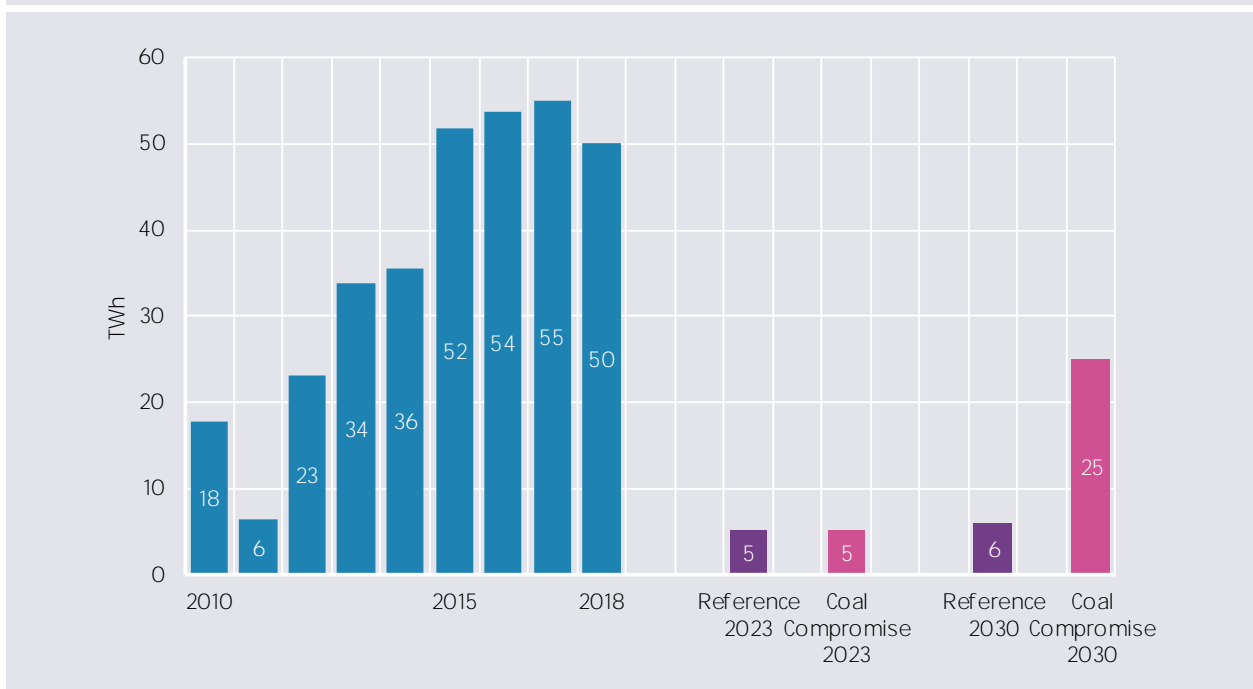
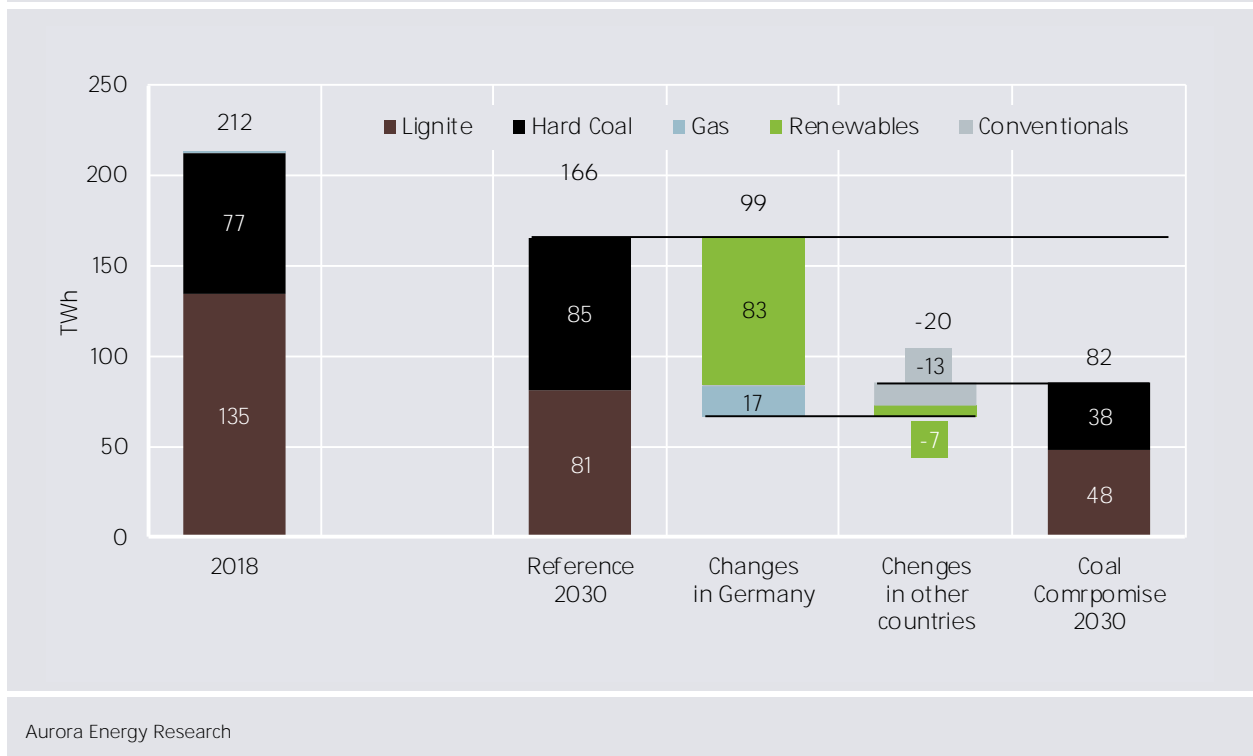


Figure 24: Difference in net electricity generation between the reference and coal compromise scenarios in Germany and abroad in 2030



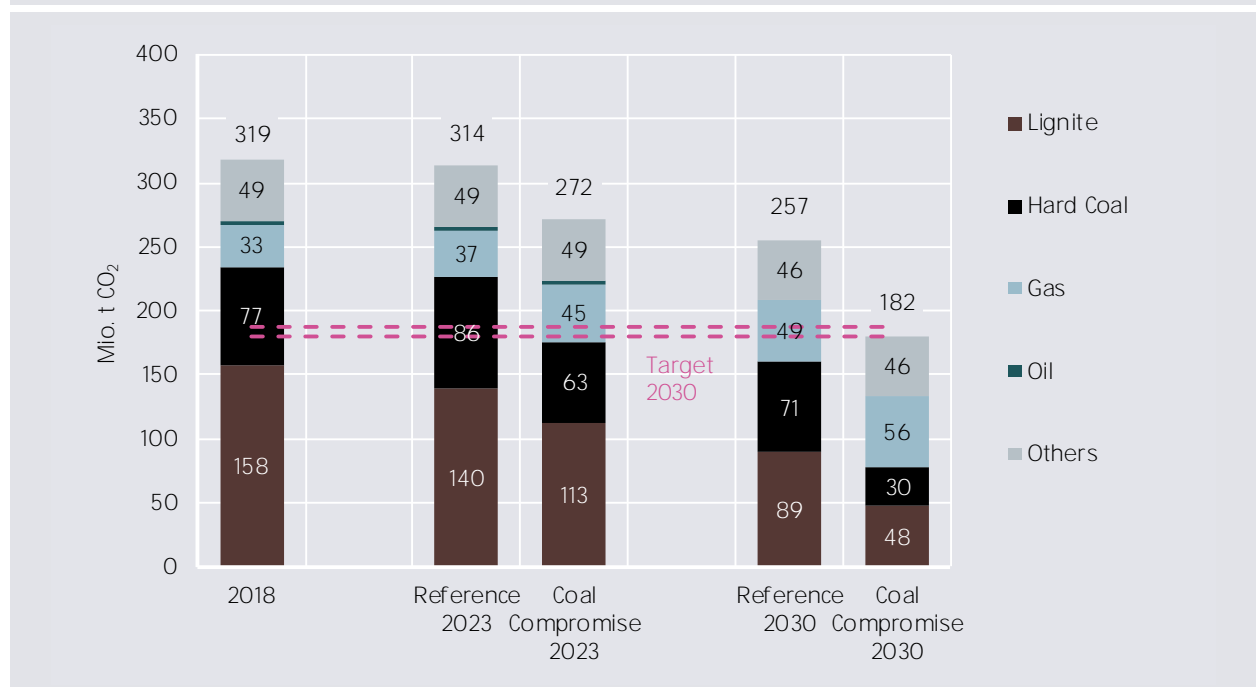
plants in France. The same applies to coal-fired power plants in Poland and the Czech Republic: While the lignite-fired power plants in these countries are already running at almost full capacity even in the reference scenario, the coal compromise does not lead to any additional production of hard coal over the year as a whole. In fact, in 2030 conventional production will even be displaced abroad (Figure 23).

Development of greenhouse gas emissions

In the reference scenario, CO₂ emissions from the electricity sector will fall from around 319 million tonnes in 2018 to only 314 million tonnes in 2023 (Figure 24). The reason for this is a significant increase in generation from hard coal, as the phase-out of nuclear energy leads to additional reliance on these power plants. CO₂ emissions will fall to 257 million tonnes by 2030. This decline is largely the result of the expansion of renewables (in the scope already foreseen by the Renewable Energy Sources Act of 2017), and a rising price for CO₂ certificates (which leads in particular to the age-related decommissioning of coal-fired power plants). The target corridor for CO₂ reductions in the electricity sector of 180 to 186 million tonnes (which are derived for 2030 from the sector targets of energy and industrial sectors) will thus be missed by at least 71 million tonnes.

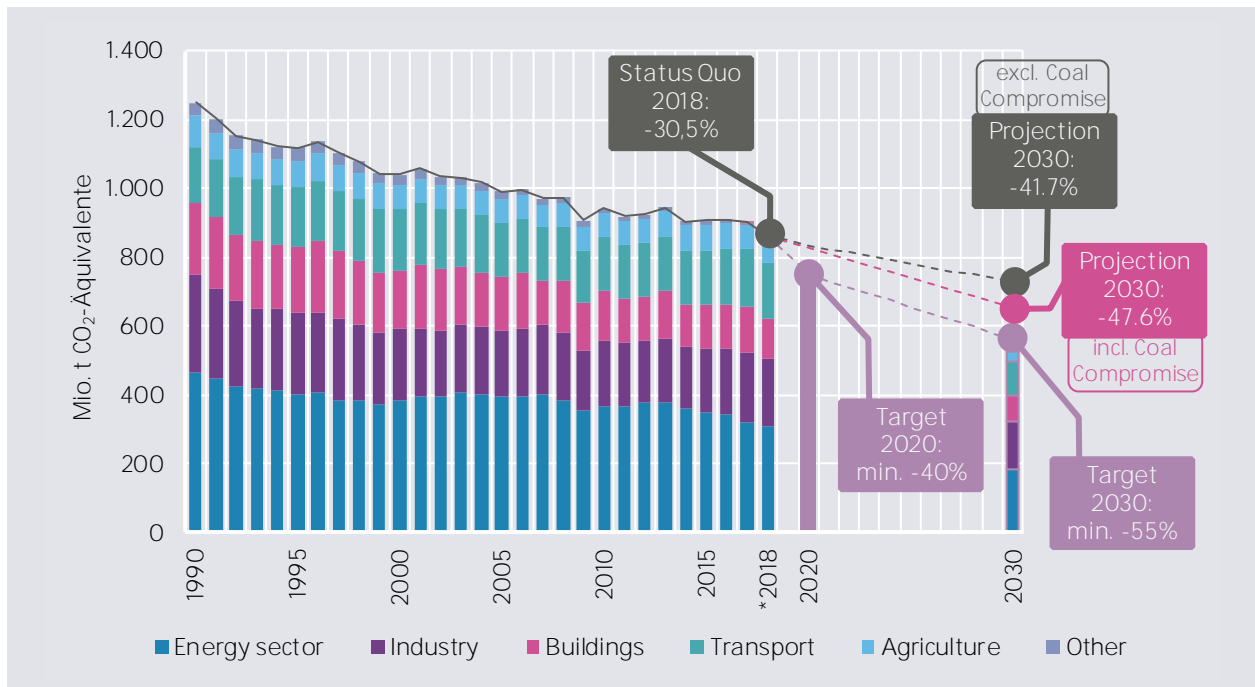
In the coal compromise scenario, on the other hand, CO₂ emissions will fall to 272 million tonnes by 2023 despite the phase-out of nuclear energy, and are thus significantly lower than in the reference scenario (Figure 24). This is because the supplementary measures for renewables and coal will prevent a significant rebound in hard coal emissions. By 2030, CO₂ emissions in the sector will have fallen to 182 million tonnes. The target corridor for the electricity sector will thus be reached. In total, some 350 million tonnes of CO₂ emissions will be avoided between 2018 and 2030. By 2038, total CO₂ emissions will amount to some one billion tonnes. Total greenhouse gas emissions drop by estimated 47.6 percent by 2030 compared to 1990 levels (Figure 25).

Figure 25: CO₂ emissions of the power sector in 2018, 2023, and 2030



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Figure 26: Greenhouse gas emissions by sector, 1990–2018, targets and projection 2020 and 2030



Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (2019), Umweltbundesamt (2019), own calculations *preliminary data

Development of electricity prices

Wholesale prices

In the reference scenario, the exchange electricity price will rise from around 45 euros per megawatt hour today to around 48 euros per megawatt hour in 2023, which is three euros per megawatt hour higher than today (Figure 26). By 2030, wholesale electricity prices will continue to rise to 56 euros per megawatt hour on the back of rising fuel and CO₂ prices.

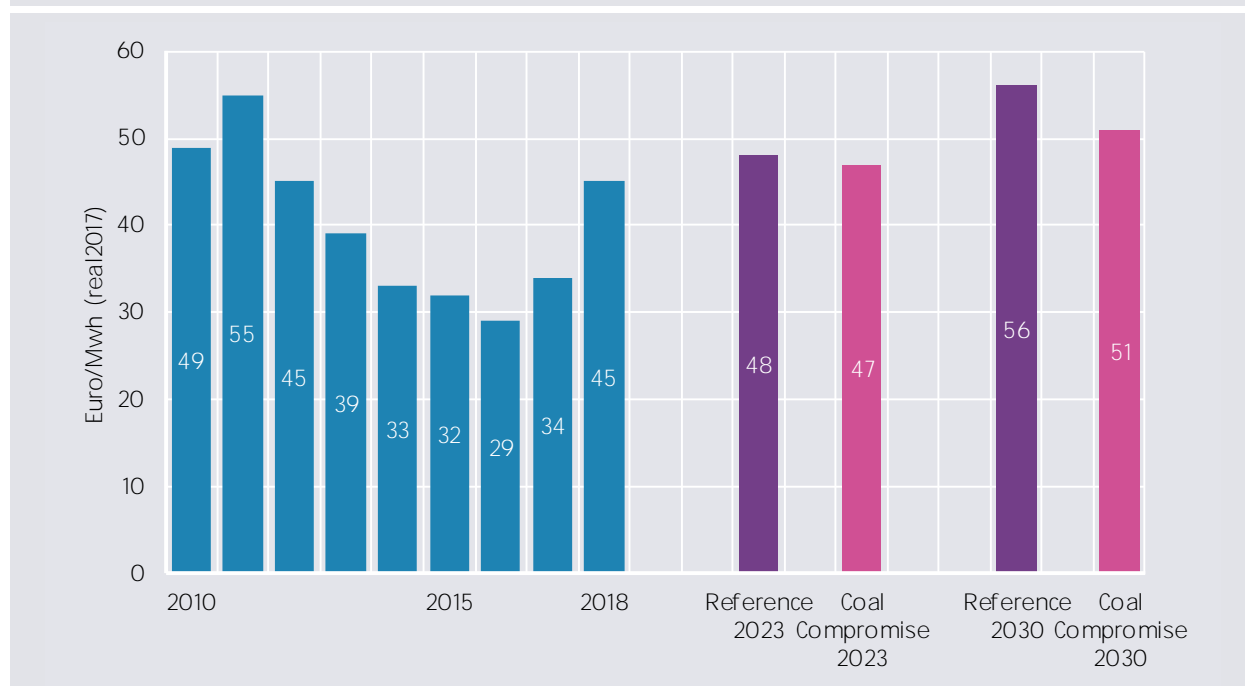
In the coal compromise scenario, the wholesale electricity price will also rise up to 2023 to 47 euros per megawatt hour, a level comparable to that of the reference scenario. A similar picture emerges with a view to 2030, when the wholesale electricity price in the coal compromise scenario is only 51 euros per megawatt hour, and thus around 5 euros per megawatt hour lower than in the reference scenario. This is because the electricity generated by coal-fired

power plants, which is no longer needed, is predominantly replaced by renewable energy with low marginal costs. The 4 euro per megawatt hour price-increase associated with lower coal generation is more than offset by additional renewables generation, which depresses prices by 10 euros per megawatt hour (Figure 27).

Renewables levy

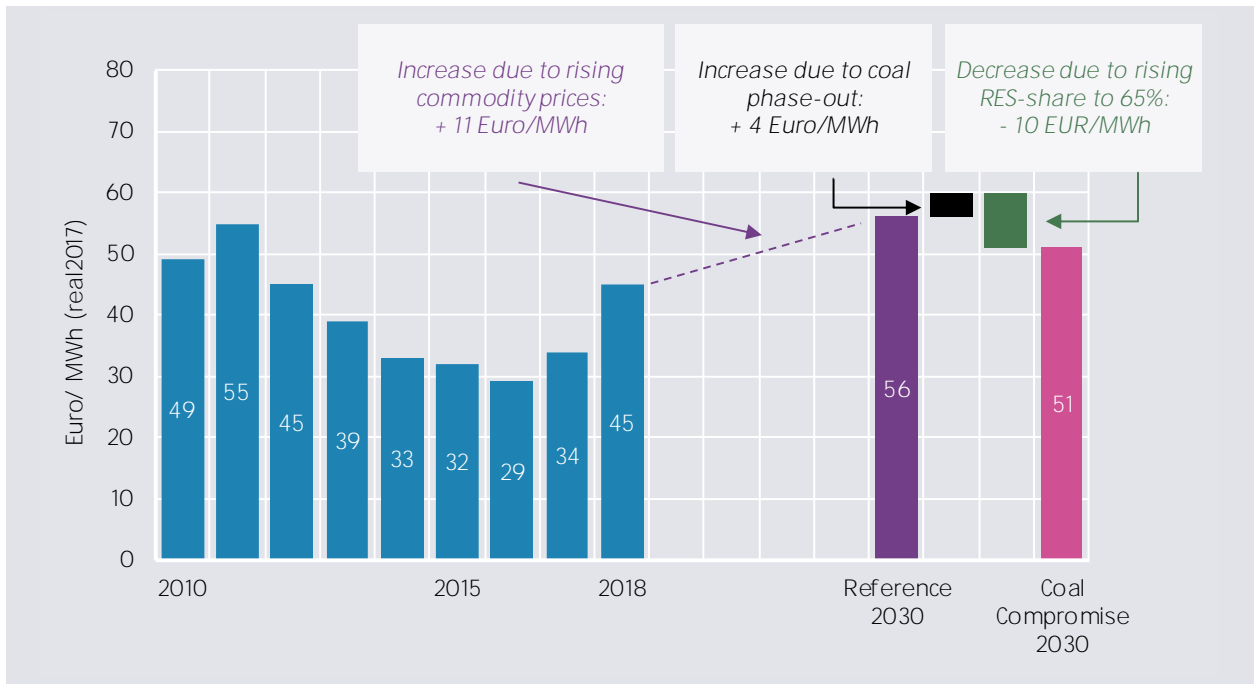
The renewables levy for non-privileged consumers in 2018 was 6.7 cents per kilowatt hour. In the reference scenario, the levy initially falls slightly to 6.4 cents per kilowatt hour despite the further expansion of renewable energy. The levy then drops to around 3.7 cents per kilowatt hour by 2030 (Figure 28).

Figure 27: Wholesale electricity prices from 2010 to 2018, 2023, and 2030



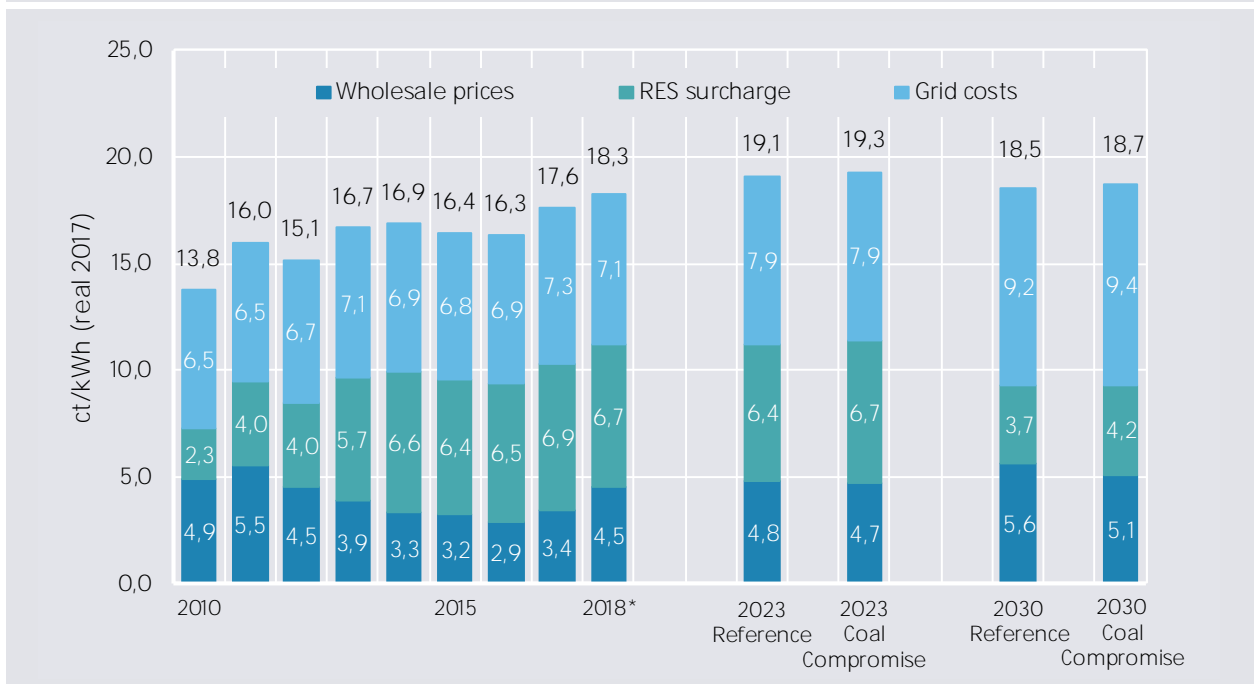
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Figure 28: Wholesale electricity prices from 2010 to 2018 and 2030



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Figure 29: Development of exchange electricity prices, EEG levy, and grid fees for non-privileged consumers, 2010 to 2018, 2023, and 2030



2010–2018: Aurora Energy Research, BNetzA (2019); Projection from 2019: Aurora Energy Research, authors' calculations

In the coal compromise scenario, the levy remains at today's level of 6.7 cents per kilowatt hour until 2023 and is thus around 0.3 cents per kilowatt hour above the expected reference development. Looking ahead to 2030, this is about 4.2 cents per kilowatt hour and thus 0.5 cents higher than in the reference scenario (Figure 28).

The long-term reduction in both scenarios is explained in particular by the fact that old, cost-intensive renewable energy plants from the early days of the EEG law (that was adopted to support the development of renewables) are no longer eligible for support and are replaced by much more cost-effective new plants. In addition, the rising prices for electricity on the wholesale market lead to a decline in the remuneration granted to plant operators.

Grid charges

Grid charges for non-privileged consumers such as households averaged 7.1 cents per kilowatt hour in 2018 (Figure 28). By 2030, an average increase in grid fees of around 2.1 cents per kilowatt hour can be expected in the reference development.³⁵ In 2030 grid fees will thus be around 9.2 cents per kilowatt hour.

With the expansion of renewables to 65 per cent by 2030, there is an additional need for grid modernization and expansion. The resulting increase in average grid tariffs for non-privileged consumers is realistically estimated at around 0.2 cents per kilowatt hour.³⁶

Sum of wholesale electricity price, renewables levy and grid charges

For **non-privileged consumers**, the sum of the wholesale electricity price, EEG surcharge and grid fee thus rise in the reference scenario from 18.3 cents per kilowatt hour today to 19.1 cents per kilowatt hour by 2023. By 2030, the sum of these three cost components will drop to around 18.5 cents per kilowatt hour, slightly above their 2018 level. In the coal compromise scenario, the sum of cost components will rise to 19.3 cents per kilowatt hour by 2023, 0.2 cents more than in the reference scenario. By 2030 the sum will drop again to 18.7 cents per kilowatt hour. In all scenarios, grid charges are the main cost driver, which underscores the need to reform existing regulatory inefficiencies.³⁷

For **privileged consumers** such as the energy-intensive industry, the coal compromise tends to have predominantly positive effects. Large-scale consumers will benefit in particular from falling wholesale electricity prices. However, the compromise scenario assumes continued state aid to companies for the costs related to emissions trading. Currently, the relevant state aid approvals are only valid until 2020.

³⁵ According to (Consentec/Fraunhofer, 2018), in the reference development for household customers, an increase in network charges of between 0.4 and 3.9 cents per kilowatt hour can be expected by 2030.

³⁶ The difference between the grid expansion in 2030, which will be necessary for the 52% renewable (old EEG target) and the new

65% renewable target, is estimated by the transmission grid operators in the 2nd draft of the NEP 2030 (2019) to be relatively small.

³⁷ (Agora Energiewende, 2019)

6 Cost burden to the federal budget

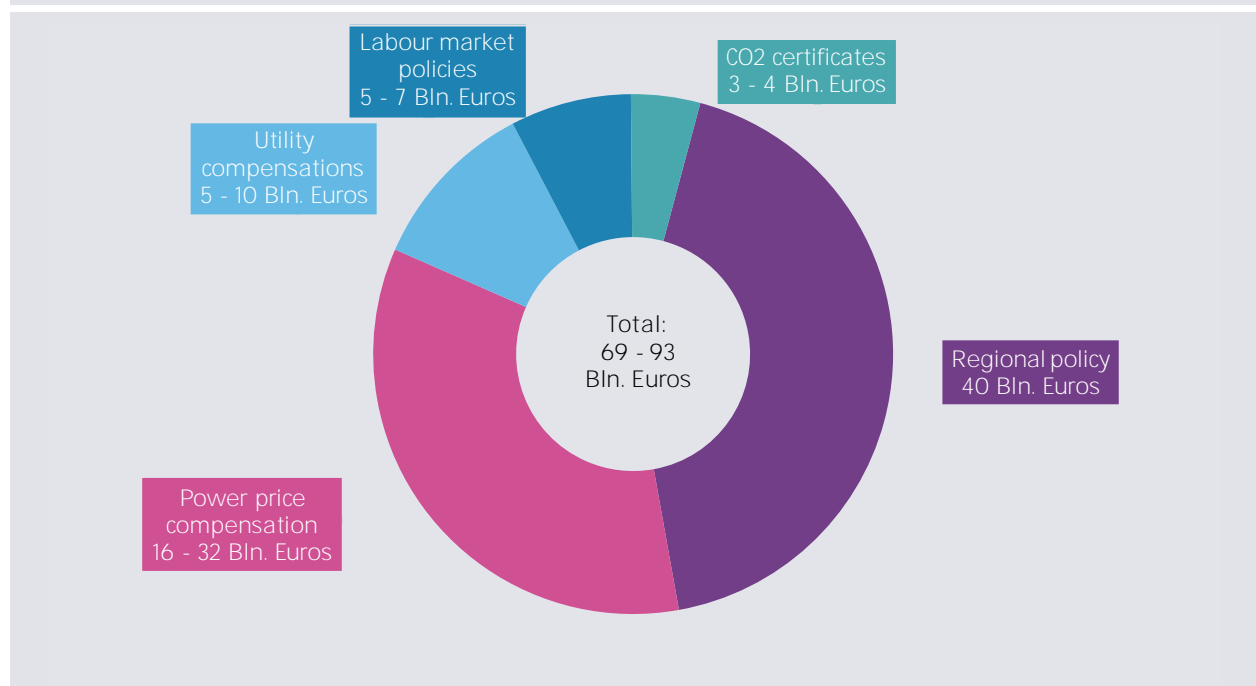
The measures recommended by the Commission on Growth, Structural Change and Employment entail additional financial burdens for the federal budget. However, the total price tag of the compromise is still subject to considerable uncertainty:

- Some of the costs incurred will only be determined following negotiations between the federal government and power plant operators, or, alternatively, following competitive bidding for decommissioning aid.
- With regard to the adjustment allowances for employees, for example, it is unclear how many employees will take part in such a solution.
- The European Emissions Trading Scheme Directive, which contains the regulations for the decommissioning of CO₂ certificates, is imprecisely formulated, thus offering considerable leeway for alternative interpretations.

If the additional costs to the federal budget are to be estimated despite existing uncertainties, the following calculations appear reasonable (Figure 29):

- **Support for coal regions in transition:** The Commission has proposed 40 billion euros in assistance. It should be kept in mind, however, that a substantial share of this amount aims to compensate for the decline in value added from coal-fired power generation, and not to shore up structural policy failures, especially since reunification in the East German lignite mining areas. Nonetheless, the total sum will be paid out of the federal budget.
- **Compensation payments and decommissioning premiums for power plant operators:** If the average cost of safety readiness for the compensation of all lignite-fired power plants is estimated at around 600 million euros per gigawatt and the average cost of hard coal-fired power

Figure 30: Costs* to the federal budget for implementing the Commission's recommendations



Authors' calculations

*The graph is based on the maximum values of the ranges

plants is estimated at around 200 million euros per gigawatt, compensation costs of around 14 billion euros will result by 2038. On the basis of European state aid law, however, it can be assumed that compensation payments will only be made available to a limited extent, over a limited period of time, and are also degressive. In total, the compensation paid to all power plants is thus likely to be between 5 and 10 billion euros.

- **Transitioning support for employees:** For employees of the coal industry aged 58 and up, the goal is to enable early retirement without financial losses. This measure will cost 5 to 7 billion euros.
- **Electricity price compensation:** The Commission estimates that 2 billion euros annually will need to be paid between 2023 and 2038 to compensate firms for the costs of phasing out coal. This yields a total compensation volume of 32 billion euros. In relation to the other calculations presented here, this sum is comparatively high. Since the additional increase in grid charges for non-privileged consumers is estimated of 0.2 cents per kilowatt hour by 2030, an annual compensation volume of 1 billion euros per year seems appropriate. The compensation costs would thus total 16 billion euros.

- **Cancellation of CO₂ certificates:** From today's perspective, a cancellation of allowances seems likely, especially in 2023–2030. This is because existing surpluses will be cancelled by the market stability reserve's deletion mechanism in 2022, and additional reductions after 2030 can be directly taken into account in the new trading period.³⁸ Assuming compensation is paid over five years for the net savings in the electricity sector resulting from the phasing out of coal, this will result in additional costs of between 3 and 4 billion euros.

Thus, in total, the Coal Compromise will result in estimated additional costs for the federal budget of 69 to 93 billion euros up to until 2038. Up to 2038 this corresponds to between 3.6 and 4.9 billion euros per year, or 1.0 to 1.4 per cent of the annual federal budget (2018: 348.3 billion euros).³⁹

³⁸ (Agora Energiewende/Öko Institut, 2018)

³⁹ (Bundesministerium der Finanzen, 2019)

7 Conditions for the success of the compromise

Within six months, the Commission succeeded in drawing up a detailed proposal for phasing out coal-fired power generation. It was adopted almost unanimously at the end of January 2019. This consensus was not easy to predict given the large number of divergent interests represented on the Commission. The following factors were critical to achieving this agreement:

- **A political culture of consensus-oriented conflict resolution:** Germany's political culture traditionally values consensual conflict resolution, even on issues of fundamental disagreement.⁴⁰ This culture was also crucial in facilitating the decisions to phase-out of nuclear energy⁴¹ and gradually reduce subsidies for domestic coal mining.⁴²
- **The Commission was given a clear mandate, but the federal government was otherwise not directly involved:** The federal government granted the Commission a clear mandate with transparent objectives. This enabled the formulation of clear and goal-oriented recommendations. Moreover, the ministries responsible were not themselves part of the Commission, and participated in the plenary sessions only as listeners with the right to speak, but without the right to vote. Furthermore, the advisory committee and administrative office provided sufficient opportunities for feedback. The fact that the federal government and its representatives themselves were not voting members ultimately abetted the definition of a mutually acceptable package of measures.
- **High willingness to reach agreement:** The foreseeable failure to meet the 2020 climate protection target once again made it clear that a more long-term strategy for phasing out coal-fired power generation is necessary to achieve the climate mitigation targets for 2030 and beyond. At the same time, the operators of coal-fired power plants have been under increasing economic pressure for several years due to the progressive expansion of renewable energy and rising CO₂ prices, with attendant risks for the workforce. Between 2013 and 2018, gross electricity generation from hard coal fell by 35 per cent.⁴³ As a result, all actors have played a constructive role in finding solutions.
- **Long-standing attention for the issue:** Discussions surrounding the future role of coal in the German energy system have become increasingly intense in recent years. The phase-out of coal-fired power generation was previously discussed extensively as part of the stakeholder process that informed the Climate Protection Plan 2050. The positions advanced by various interests were in many cases supported by comprehensive studies (see Chapter 1). In this way, thanks to existing knowledge concerning possible policy instruments, their effects and necessary supplementary measures, negotiations were conducted on the basis of informed positions, and could be concluded relatively quickly.

⁴⁰ (Schmidt, 2018)

⁴¹ (Ethik-Kommission Sichere Energieversorgung, 2011)

⁴² (Deutscher Bundestag, 2007); (Deutscher Bundestag, 2011)

⁴³ (AG Energiebilanzen, 2019)

8 Critique and discussion

Although the agreement reached within the Commission was largely welcomed by the public at large, the work of the Commission has also been criticised in various quarters.⁴⁴ A number of Commission members submitted special opinions on individual Commission recommendations.⁴⁵ In particular, the following points were criticised:

- **Insufficient representation of interests:** The composition of the Commission was one point of criticism. For example, representatives from the “Fridays for Future” movement and from human rights organisations argued that the interests of young persons, future generations and those directly affected by climate change were not sufficiently represented on the Commission.⁴⁶

While this complaint is not totally without merit, the composition of the Commission appears balanced overall. Furthermore, enlarging the Commission would be likely to create problems, as the 31-head body is already at the limit of its working capacity.

- **Lack of implementation options:** A further point of criticism is that the Commission developed concrete recommendations for action instead of a range of options while leaving the government to make a final decision on implementation. Offering range of possible options would have preserved the decision-making authority of elected officials.⁴⁷

This point seems valid if one wishes to stress the importance of democratic process. However, in recent years, a great degree of discussion and deliberation has already taken place between stakeholders on this issue. Between 2014 and 2018, for example, numerous studies on the coal

phase-out were published. This issue was also discussed extensively during the stakeholder process surrounding the Climate Protection Plan 2050 (see Chapter 1). In this way, deliberations on this issue among policymakers were already at an advanced stage. Accordingly, the Commission merely had to develop a viable compromise given positions that had been previously advanced as part of a highly democratic process of debate.

- **Lack of compatibility with the Paris Agreement:** The participating environmental associations and climate scientists have argued that the phase-out timetable does not represent a sufficient contribution to reaching the objectives of the Paris Agreement.⁴⁸ This agreement, which was ratified by the German parliament, seeks to limit global warming to well below two degrees Celsius. Environmental associations argue that Germany must phase-out coal by 2030 to honour its commitments under the Paris Agreement.

On the one hand, this criticism is justified, because the emission reduction commitments made thus far by the international community will limit the global rise in temperature to around three degrees Celsius rather than to well below two degrees Celsius. Thus, an increase in the climate protection ambitions of all nations – including Germany and other European countries – is necessary in order to avert a climate crisis. However, the Commission's recommendations explicitly refer to Germany's current climate targets for 2020, 2030, and 2050,⁴⁹ rather than to the more ambitious targets that would be needed.

- **Insufficient basis for reliable long-term planning**
Critics have also argued that the recommendations fail to provide a sound basis for long-term planning on the part of the impacted actors. On

⁴⁴ (Spiegel, 2019), (Süddeutsche Zeitung, 2019)

⁴⁵ (Kommission “Wachstum, Strukturwandel und Beschäftigung”, 2019)

⁴⁶ (E3G, 2019), (Fridays for Future Deutschland, 2019), (Misereor, 2018)

⁴⁷ (Kowarsch, 2019)

⁴⁸ (Kommission “Wachstum, Strukturwandel und Beschäftigung”, 2019), (Spiegel, 2019), (Spiegel Online, 2019)

⁴⁹ (Bundesregierung, 2018)

the one hand, the phase-out timetable only foresees periodic milestone targets. This creates uncertainty with a view to future coal-generation capacity, the volume of available carbon emission rights, and coal consumption levels. As a consequence, the residents of villages slated for resettlement lack clarity as to whether resettlement measures will actually go forward. Furthermore, critics argue that fuel or CO₂ price fluctuations could sabotage progress toward meeting climate targets.⁵⁰ As a response to this criticism, it was argued that the setting of fixed capacity milestones in 2023, 2030, and 2050 would be too far-reaching, as future market developments – e.g. with a view to fuel or CO₂ prices – are not yet foreseeable. Furthermore, the lack of specific capacity targets means that faster CO₂ reductions are also a possibility.⁵¹

In this way, there are compelling arguments both for and against interim capacity milestones. The compromise proposed by the Commission seeks to reconcile these opposing positions.

- **Carbon pricing would be more efficient:** Some stakeholders have argued that the phase-out schedule proposed by the Commission will generate greater economic costs compared to alternative instruments, such as the setting of a price floor for carbon emissions at the national or regional levels.⁵²

However, it is easy to see why the establishment of a price floor only enjoyed minority support on the Commission. A price floor would have meant reduced compensation payments to power plant operators. Furthermore, the adoption of a phase-out schedule has the advantage of delivering clear market signals, thus creating a more stable economic environment for the entire energy industry, especially with a view to the necessary investment in power plants, grid infrastructure,

and energy storage facilities. In the case of electricity consumers, a CO₂ pricing instrument could lead to significantly higher consumer prices, and the effort to refund consumers for the additional price burden would be associated with considerable uncertainties. A phase-out timetable is also preferable from the perspective of employees, as it makes it easier to plan shutdowns and enact necessary labour market policies. Furthermore, environmentalists prefer a phase-out timetable because it makes emission-reduction obligations more specific and binding.

- **Compensation payments for power plant operators:** Critics have also maligned the recommended methods for determining which power plants will be shut down. Specifically, the Commission foresees (a) negotiating the terms of shutdown directly with operators, and (b) holding a competitive bidding process to determine the level of compensation for decommissioning that will be granted. Various legal experts have concluded that the use of such methods to determine how operators will be compensated is not necessarily required by law.⁵³ Accordingly, the use of these methods will create budgetary burdens that could have been avoided, it is argued.

However, this legal opinion is not uncontroversial; other experts have come to the opposite conclusion.⁵⁴ As Germany's Constitutional Court did not have an opportunity to render a judgment on this issue, the Commission understandably adopted a solution that was capable of generating consensus. However, the Commission's recommendation does not mean that power plant operators can demand arbitrarily high levels of compensation. On the one hand, the gradual phase-out schedule provides the federal government with significant room for maneuver, including an ability to conduct negotiations with multiple operators over most of the phase-out timeframe.

⁵⁰ (Pahle M./Edenhofer O. et al, 2019)

⁵¹ (Spiegel, 2019), (Frankfurter Allgemeine Zeitung, 2019b)

⁵² (Kommission "Wachstum, Strukturwandel und Beschäftigung", 2019)

⁵³ (Becker/Büttner/Held, 2017), (Schomerus, 2018)

⁵⁴ (Redeker/Sellner/Dahs, 2018)

The Commission has also set the operators and the federal government an initial negotiation deadline of 30 June 2020. If an amicable solution is not reached by this date, legislators are to adopt a decommissioning timetable (including compensation appropriate from the legislator's point of view). On the other hand, the competitive bidding procedure, which is to govern the decommissioning of hard coal capacities from 2023 onward, will assure that compensation payments are determined in an efficient manner.

- **Risks to security of supply:** In addition to the above points, critics argue that the Commission has not done enough to ensure security of supply.⁵⁵

However, the final report does contain numerous measures that aim to safeguard security of supply. First, operators who slate plants for shut-down must demonstrate they can fulfil their supply obligations in another manner. Second, the Commission has recommended that the Combined Heat and Power Act be reformed by 2030 to ensure sufficient time and incentive for the replacement of coal-fired power stations with co-generation facilities. Third, with regard to the regulatory design of energy markets and the expansion of capacity, the Commission has proposed (a) the further development of the existing system for monitoring security of supply; (b) an improved permitting process for natural-gas-fired power plants; and (c) the reform of the existing design of the energy market, should this prove necessary over the mid-term. Finally, all power plant closures are subject to approval by the Federal Network Agency.⁵⁶

- **Threat to Industrial competitiveness:** Another point of criticism is that the proposed recommendations could lead to a significant jump in

electricity prices for end consumers. It is argued that this could jeopardise the competitiveness of energy-intensive industrial firms and other commercial customers.⁵⁷

However, the analysis conducted for this paper does not lend credence to this fear. The expansion of renewable energy in combination with the phase-out of coal-fired power generation will tend to produce lower wholesale electricity prices. This will benefit rather than harm energy-intensive industrial consumers. Furthermore, only a slight increase in the electricity price can be anticipated for other consumers, as the Commission has proposed a countervailing reduction in grid fees (see Section 5).

- **Significant burden to the federal budget:** The last point of criticism relates to the high level of additional government spending that would be required. In the view of the critics, these costs are excessive, particularly considering the scope of carbon reduction achieved.⁵⁸

To be sure, the Commission's recommendations entail a considerable financial burden (see Section 6), and total costs are difficult to estimate at this stage. Most of the costs incurred, however, stem from spending to cushion the negative impact on those directly affected by the phase-out, including investment to ensure future economic prosperity in coal-mining regions. In this regard, the Commission is concerned with assuring that the transition away from coal occurs in a socially equitable manner. On this point, it must also be noted that market-based solutions do not enjoy majority support in the German parliament or among impacted stakeholders. A final issue bears mentioning in this regard: if the German government had worked to tackle this issue at an earlier date, we could expect lower overall costs to the federal budget.

⁵⁵ (Frankfurter Allgemeine Zeitung, 2019a)

⁵⁶ (Kommission "Wachstum, Strukturwandel und Beschäftigung", 2019)

⁵⁷ (Frankfurter Allgemeine Zeitung, 2019a)

⁵⁸ (Frankfurter Allgemeine Zeitung, 2019a), (Frankfurter Allgemeine Zeitung, 2019b), (Tagesspiegel Background Klima & Energie, 2019)

9 Conclusion

The Commission's recommendations represent an important milestone in the German energy debate.

In recent years, the phasing out of coal-fired generation in Germany has been a subject of intense controversy. The recommendations drawn up by the Commission represent a pragmatic compromise between industrial manufacturers, energy providers, trade unions, and environmental associations. The compromise is yet another example of Germany's ability to solve pressing political dilemmas with negotiated solutions that bring all stakeholders to the table, as it comes in the heels of recent agreements to end of coal subsidies and phase out nuclear power. The federal government would be advised to implement the recommendations in a faithful manner, given the nearly unanimous approval the compromise enjoys. In this way, the compromise almost definitely marks the end the political debate concerning whether Germany will phase out coal power.

The emissions target for the energy sector will most likely be achieved by 2030 if the Commission's proposals are implemented.

Without implementation of the measures recommended by the Commission, coal power and associated emissions would only decline slowly in coming years. The proposed measures will enable Germany to meet its 2030 emissions target for the energy sector and avoid some one billion tonnes of CO₂ emissions by 2038. Since the phase-out of coal-fired power generation is to be replaced primarily by domestic renewable energy and the CO₂ certificates that are freed up will be cancelled, the displacement of CO₂ emissions abroad can be almost completely avoided.

The phase out of coal power enhances the credibility of the German energy transition.

The credibility of Germany's energy transition has suffered in recent years due to slow progress in reducing greenhouse gas emissions. Criticism has focused in particular on Germany's anticipated failure to meet its emissions targets for 2020 and its persistently high levels of coal-fired power generation. If the Commission's recommendations are implemented, this will enhance the credibility of Germany's efforts to transform its energy economy.

While the Coal Commission targets 2038 as the year in which the phase out will be complete, the exit from coal could occur faster.

On the one hand, 2035 is named in the compromise as a possible earlier exit year. On the other hand, periodic progress reviews in 2023, 2026, 2029, and 2032 will offer policymakers an opportunity to react to a worsening climate crisis with additional measures. Furthermore, the Commission's compromise will allow for a socially equitable acceleration of the phase-out timetable.

The measures recommended by the Commission will offer new growth opportunities for the energy sector and energy-intensive industrial companies.

The gradual reduction of coal-fired power generation in combination with the expansion of renewable energy to a 65 per cent share of generation by 2030 means that wholesale electricity prices will be significantly lower than anticipated on the basis of existing energy and climate policy decisions. Energy-intensive industrial firms will benefit in particular from lower electricity prices. Furthermore, non-privileged commercial consumers will not be unduly burdened by the proposed measures, particularly considering the foreseen provisions for lowering grid fees. Last but not least, the energy sector will be in a position to take advantage of new investment

and growth opportunities thanks to the further expansion of renewable energy, the modernisation of the electricity grid, the replacement of coal with natural-gas-fired generation, the further development of CHP subsidies, and incentives for energy storage facilities.

[The Commission's recommendations offer coal regions and workers clear opportunities for the future.](#)

The scale and long-term nature of the recommended structural aid for the coal regions concerned and related investment in energy, infrastructure, and research should enable the regions to enjoy sustainable economic development. Extending the phase-out of coal to 2038 at the latest will also enable the coal regions to tap new opportunities for wealth creation and employment. Furthermore, a comprehensive package of labour policy measures will ensure that no employee in the coal industry is left high and dry.

[Various recommendations are designed to ensure security of supply.](#)

Federal Network Agency will have veto power on decommissioning in case doubts arise as to continued security of supply; decommissioning will be performed on a consensual basis with operators; the Combined Heat and Power Act will remain in effect; security of supply will be monitored on an ongoing basis; and existing reserve instruments will remain in place. However, the model calculations indicate that one new gigawatt of natural-gas-fired generation will be needed by 2030. Accordingly, the federal government will have to closely monitor whether market incentives are sufficient for ensuring this expansion, or whether regulatory intervention will be required in coming years.

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Agora Energiewende is a joint initiative of the Mercator Foundation and the European Climate Foundation. The cooperation of Agora Energiewende and Aurora Energy Research is kindly supported by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) on behalf of the German government..