Eleven Principles for a Consensus on Coal

Concept for a stepwise decarbonisation of the German power sector (Short Version)

IMPULSE

Agora Energiewende

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Concept for a stepwise decarbonisation of the German power sector (Short Version)

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Preface

Dear readers,

Since the historical climate agreement in Paris, the following is now abundantly clear: Decarbonisation is the key issue that will define the debate over the future of the world's energy systems. While Germany has traditionally had a large coal industry, it is also a pioneer in the adoption of renewable energy – accordingly, we can no longer avoid debate on the future of coal. The greenhouse reduction targets that have been set for 2030, 2040 and 2050 inevitably mean that coal must be phased out.

Due to the long time frames of investment decisions in the energy sector, industry actors need legal certainty moving forward. Providing such certainty is possible, as Germany was recently able to resolve two major points of dispute in its energy policy – namely, the decision to phase out nuclear power, and the decision to stop mining hard coal. The time is ripe for reaching a consensus on the future of coal, rather than allow a fundamental conflict in energy policy to become entrenched for decades.

A large number of experts share the view that the time for action is now – not only commentators (among others Süddeutsche Zeitung, Rheinische Post, Handelsblatt, Spiegel), but also by the German Advisory Council on the Environment and The German Association of Energy and Water Industries (BDEW), which has called for a structured dialog process on the future role of coal.

In the following Impulse Paper, we present a concept that highlights eleven principles for a consensus on coal – as a contribution to the unavoidable debate concerning how decarbonisation can be achieved through joint efforts. We look forward to receiving your feedback on the recommendations presented herein.

Yours truly
Patrick Graichen
Director of Agora Energiewende

Eleven Principles for a Consensus on Coal

A

The Foundation

1. Convening a 'Round Table for a National Consensus on Coal'
2. Incremental, legally binding phase-out of coal power by 2040

B

The Coal Phase-Out in Germany's Power Plant Fleet

3. No new construction of coal-fired power plants
4. Determine a cost-efficient decommissioning plan for existing coal power plants based on remaining plant lifespans, including flexibility options in lignite mining regions
5. No additional national climate policy regulations for coal-fired power plants beyond the phase-out plan

C

The Coal Phase-Out in Lignite Mining Regions

6. No additional lignite mines and no further relocation processes of affected communities
7. The follow-up costs of lignite mining should be financed with a special levy on lignite
8. Creation of 'Structural Change Fund' to ensure a sound financial basis for structural change in affected regions

D

Economic and Social Aspects of the Coal Phase-Out

9. Ensuring security of supply over the entire transformation period
10. Strengthening EU Emissions Trading and the prompt retirement of CO_2 certificates set free by the coal phase-out
11. Ensuring the economic competitiveness of energy-intensive companies and the Germany economy as a whole during the transformation process

Content

Executive Summary

The goal of Germany's energy transition is to create a sustainable, economically viable, and reliable energy system that is based primarily on inexpensive wind and solar power as well as greater efficiency in the supply and use of energy. According to resolutions adopted by the German cabinet and parliament, Germany aims to reduce its greenhouse gas emissions by at least 55 percent by 2030, by at least 70 percent by 2040, and by 80–95 percent by 2050 (against 1990 levels). Germany's last nuclear power plants will be taken offline at the end of 2022, and renewable energy is slated to make up at least 80 percent of power generation by the middle of the century. Hence, the German energy sector will be almost totally decarbonised within the next 35 years.

Extended time frames are required for decisions in the energy economy, as investments often have time horizons of several decades. Accordingly, reliable framework conditions that enable planning for the future are essential for the energy sector. In this regard, and in light of Germany's decarbonisation targets, a gradual phasing out of coal-based electricity is ultimately unavoidable. Denying this fact would mean to deceive and create false hopes for stakeholders in impacted regions, companies, and energy service providers. There is thus a pressing need to develop a strategy that sets out how new jobs and new business models can replace the role currently fulfilled by coal. In this way, the key issue at hand is to create reliable framework conditions that enable planning for necessary structural change. This is not a newfangled endeavour, but was previously done when the decision was taken to phase out the mining of hard coal (which will be complete by 2018) and the use of nuclear power (which will be complete in 2022).

Ultimately, there is no alternative to the phasing out of coal power if Germany is to fulfil its climate goals. It is not possible to boost the CO_2 reductions achieved in the transportation and heating sectors to the extent that would be necessary to allow continued coal-based power generation. This is because, first of all, the electricity sector is currently by far the largest producer of national greenhouse gas emissions. Second, the preservation of the current generation mix will only become more problematic in the future if – as expected – the use of electricity is expanded in the transportation and heating sectors. The integration of the electricity, heating, and transportation sectors makes the decarbonisation of the electricity sector all the more pressing. Furthermore, waste management, industrial processes, and the agricultural sector will be less capable of reducing emissions than the energy sector in the future. As a consequence, greater than average emissions reductions are needed in the electricity sector. And, in light of the expanded future use of electricity in other sectors, these reductions need to be realised with particular speed if Germany's emissions reduction targets on the whole are to be achieved.

In specific terms, the "phasing out of coal" means that coal-based electricity generation must be gradually reduced from the 42 percent share it comprises in 2015. In view of trends in the energy sector (including in particular persisting low prices for coal and CO_2 certificates), the consensus among experts is that the gradual reduction of coal-based electricity will not take place in sufficient scope without effective regulatory rules to supplement the EU Emissions Trading System. In order to ensure the climate goals set for 2030 and beyond can be met, it is necessary to take targeted action to begin the gradual phasing out of coal power, for the measures already taken or ratified by the German government as part of the Climate Protection 2020 Action Program are not sufficient.

Like others who are participating in the debate over the future of Germany's energy system, Agora Energiewende would like to propose that a non-partisan, structured dialog process should be initiated with key stakeholders in the near term in order to negotiate the details of an action plan for phasing out coal power in an economically viable and socially responsible way. The goal of this process would be to reach a consensus about the future of coal that is both comprehensive and long-term. Such a dialog process is crucial if the uncertainties surrounding planning and invest-

ment that are currently plaguing actors in the energy economy and other stakeholders are to be overcome.

With this Impulse Paper, we hope to provide a foundation for discussion that will culminate in a consensus on coal. It addresses eleven key issues, and seeks to identify compromise positions between competing interests.

Eleven Principles for Reaching a Consensus on Coal

A. The Foundation

1 Convening a "Round Table on a National Consensus on Coal"

The German cabinet should soon invite impacted stakeholders to a "Round Table on a National Consensus on Coal." This round table should provide a venue for building trust and negotiating key issues of the phase out, thus preventing a fundamental conflict in energy policy from becoming entrenched for decades. The goal should be to reach a consensus with broad political and societal support before the end of 2016. Similar to when the decision was made to phase out hard coal mining and nuclear power, this consensus will ensure that all stakeholders have a sound foundation to plan for the future.

2 Incremental, legally based phase-out of coal power by 2040

The phasing out of coal power in Germany requires clarity in three key respects: The use of coal in Germany requires an "expiration date" that all stakeholders can rely on when making decisions about the future; the phase-out needs a clearly defined reduction path; and all stakeholders need legal certainty about the trajectory of the incremental phase-out to take place. The incremental phasing out of coal power beginning in 2018 and ending in 2040 is compatible with Germany's climate protection goals. The phase-out should be based in law and ratified with a broad majority by the German legislature.

B. Phasing Out Coal in Germany's Power Plant Fleet

3 No new construction of coal-fired power plants

No legal approval should be granted for the construction of new coal-fired power plants, as the construction of new plants is not compatible with Germany's mid and long-term emissions reduction targets.

4 Determine a cost-efficient decommissioning plan for existing coal power plants based on remaining plant lifespans, including flexibility options in lignite mining regions

In order to realise the phasing out of coal power in a cost-efficient manner that avoids highly disruptive structural change, it will be necessary to adopt a binding plan for the decommissioning of existing coal-fired power plants that is based on residual lifespans. The order in which plants are decommissioned should be based on CO_2 abatement costs. In the initial phase from 2018 to 2025, the decommissioning will be limited to three gigawatts per year. In lignite mining areas, the transfer of remaining lifespans from one plant to another should be permitted to avoid domino effects.

5 No additional national environmental policy regulations for coal-fired power plants beyond the phase-out plan

The German government should commit to adopt no additional climate measures that discriminate against the use of coal in a one-sided manner beyond the ratified phase-out plan. Furthermore, the German government should not grant any special benefits for decommissioning coal-fired power plants.

C. The Coal-Phase Out in Lignite Mining Regions

6 No additional lignite mines and no further relocation of affected communities

As the incremental phase-out of power plants up to 2040 will mean that less lignite is needed, no new lignite mines or excavation areas should be exploited. Accordingly, numerous villages would be spared from relocation.

7 The follow-up costs of lignite open-pit mining should be financed with a special levy on lignite

A foundation should be started to finance open-pit mine re-cultivation and other follow-up costs as Germany's lignite mines are decommissioned. This foundation should be funded with a special surcharge that is levied on all lignite that is mined in the future up to 2040. The amount of this levy will be set based on an environmental assessment that estimates future follow-up costs. Costs of approx. 2.5 euros per MWh of lignite-based power are expected.

8 Creation of 'Structural Change Fund' to ensure a sound financial basis for structural change in affected regions

A "Structural Change Fund for Lignite Regions" should be created within the federal budget and outfitted with 250 million euros annually over the entire transformation period. Funding should be allocated to each region based on the number of jobs impacted in each respective lignite mining area. The governments of the *Länder* should decide on how this funding is spent.

D. Economic and Social Aspects of the Coal Phase-Out

9 Ensuring security of supply over the entire transformation period

Policymakers should monitor the phase-out and ensure adequate reserve capacities, thus guaranteeing the usual high level of security of supply in Germany now and in the future. In order to achieve the greatest cost efficiencies, a procurement process that does not give preference to certain technologies should be held for the provisioning of reserve capacities. This procurement process will be monitored on a continuous basis, particularly after 2025, when the construction of new gas-fired power plant capacity is expected to become necessary. At the end of the phase-out period, a portion of the last coal-fired power plants to be shut down will held as reserve capacity for an interim period.

10 Strengthening EU Emissions Trading and the prompt retirement of CO_2 certificates set free by the coal phase-out

The German government should encourage a stronger Emissions Trading Scheme at the EU level, particularly against the backdrop of the pledges made at the Paris Climate Conference for more ambitious efforts in the EU. In this context, a rule should be introduced for the permanent retirement of CO_2 certificates that are set free.

11 Ensuring the economic competitiveness of energy-intensive companies and the Germany economy as a whole during the transformation process

Due to increasing renewable energy generation and the merit order effect in Germany, wholesale prices for electricity are expected to remain low in the future. Policymakers should nevertheless reassure actors in the private sector, particularly energy-intensive companies, that measures will be taken to ward off any negative effects to international competitiveness that are associated with the coal phase-out. At the same time, policymakers should create incentives for greater energy efficiency and the further decarbonisation of the private sector on the whole, for such incentives would not only serve the environment, but also bolster economic competitiveness.

The consensus on coal in the triad of climate/ environmental protection, economic efficiency and security of supply

Achieving a comprehensive consensus on coal will necessitate a broad-based, structured dialog process between political decision-makers and other stakeholders. It will be crucial as part of this process to balance the competing requirements of environmental protection, affordability, and security of supply. Furthermore, for a consensus to be achieved it will be necessary to find a fair compromise between divergent interests as well as establish a framework for long-term structural adjustment in impacted regions.

In specific terms, this means that the phase-out of coal – a necessary step for Germany's climate protection goals to be reached – must be carried out in a manner that helps rather than hurts the German economy. Without a doubt, the future is always uncertain and reality is much more complex than market models predict. In light of Germany's overarching decarbonisation goals, this paper seeks to furnish a foundation for the fact-based discussion of key issues in the phase-out of coal power, as well as to create a sound basis for future planning where uncertainty currently prevails.

The recommendations contained in this paper are economically realistic. Given sufficient entrepreneurial initiative and flexibility, the energy industry will be able to adapt their activities to the new reality of an economy without coal power within the outlined time frame. The recommendations contained herein provide a sound basis for future investment decisions and long-term planning. Redistributional effects between energy producers and consumers can be minimised if Germany abstains from introducing a special levy on coal (viz. *Nationaler Klimaschutzbeitrag*) and also does not grant benefits for the decommissioning of power plants. The structural changes that have been outlined in the foregoing would not threaten the international competitiveness of the German economy as a whole. The recommendations take a cue from the following maxim: "The renewable energy revolution can only be ecologically successful if it makes economic sense."

Security of supply will remain at a high level during the entire transformation process. The foregoing recommendations ensure that the emissions reductions that are needed in the power sector over the mid to long-term will be achieved. The structural transformation that is already underway in the regions that will particularly be impacted by the phasing out of coal power can be managed in a socially responsible way while avoiding highly disruptive change. A sound financial basis for this structural change will be provided, and a special levy will ensure that the ecological consequences of lignite mining are addressed.

1 Introduction and Background

Germany has set itself two overarching goals as part of its energy transition: phasing out nuclear power by 2022 and incrementally reducing environmentally harmful greenhouse gas emissions. Germany aims to cut its greenhouse gas emissions by at least 40 percent by 2020, at least 55 percent by 2030, at least 70 percent by 2040 and 80–95 percent by 2050 (compared to 1990 levels).[1] To achieve these emissions reduction targets, renewable energy will have to grow dynamically.[2] In the power sector almost one third of energy consumption was derived from renewable sources in 2015 already. Furthermore, there have also been initial successes in the efforts to improve energy efficiency in the power sector. As a consequence, despite continued economic growth, energy consumption in 2015 was about 4 percent below the peak level of 2007.[3]

However, it must be noted that greenhouse gas emissions in the power sector have barely fallen since the turn of the century.[4] The use of coal-based electricity in Germany remains at a constantly high level, particularly because a considerable part of the electricity produced by coal-fired power plants that is no longer required thanks to the expansion of renewable energy and the decrease in consumption domestically is exported to neighbouring countries.

In light of this, the heated discussions throughout 2015 about the looming failure to meet the 2020 emissions reduction target led to an uncomfortable but clear insight: Germany makes progress in its energy transition while still deriving the majority of its power from coal. Without additional measures to reduce emissions from coal-based electricity, Germany will clearly fail to meet its climate targets not only in the short term but also in the medium and long term. This is primarily because under current market conditions – including low CO_2 certificate prices, low hard coal prices on the global market, and natural gas prices that are still relatively high compared to coal prices – coal-fired power plants are systematically driving more environmentally sustainable gas-fired power plants out of electricity generation both in Germany and abroad.[5]

The German cabinet has recognised that the current emissions reduction target for 2020 will clearly not be met by the measures implemented to date – and not only in the power sector – and consequently ratified the Climate Protection 2020 Action Program in December 2014.[6] As part of this program, the power sector will have to make further reductions in CO_2 emissions of 22 million tons by 2020 compared to the expected trend without any additional measures in order to meet the climate goals. To achieve this, lignite-fired power plants with a total capacity of 2.7 gigawatts will be transferred to a capacity reserve and then be decommissioned after four years.[7]

Regardless of whether the measures previously adopted by the power sector as part of the Action Program will ultimately be adequate to still reach the 40 percent emissions reduction goal for 2020, it can already be foreseen that to comply with the medium- and long-term emissions reduction targets for 2030, 2040 and beyond, additional substantial efforts are inevitable in this area.[8] In particular, the German power sector will not be able to contribute to the decarbonisation of the entire energy system, either in the short or medium term, simply by participating in the EU Emissions Trading Scheme. The current excess of more than two billion certificates means that the EU Emissions Trading Scheme cannot send effective CO_2 price signals for the foreseeable future, despite the reforms that have been adopted.

1 BReg (2010), BMWi (2015a), AtG (2011).

2 EEG (2014).

3 AG Energiebilanzen (2015).

4 UBA (2015a).

5 enervis (2015a), enervis (2015b).

6 BMUB (2014).

7 BMWi (2015b).

8 enervis (2015b).

Germany therefore requires additional measures to reduce CO_2 in the power sector over the medium and long term as well.

For all actors in the energy economy, planning certainty for the future is critical in light of the long investment cycles and high investment volumes that have defined the sector up to now. The same applies to the energy-consuming sectors of the economy but particularly to energy-intensive industries. For this reason, it now comes down to holding joint discussions with stakeholders and those affected in the near term about the role to be played by coal in the future German energy supply and then making the necessary decisions – all in the spirit of Ethics Commission for a Safe Energy Supply in 2011.

This requires that Germany achieves a broad cross-party and societal consensus to ensure a socially balanced and fair transition to the new energy system and to safeguard it for the decades to come. An energy transition fashioned in this way creates planning security and reliability and can drive the modernisation of the German economy beyond the energy sector. If the consensus fails, the issue of coal-based electricity threatens to ignite a major new societal conflict, comparable with the decades of vociferous debate about nuclear power in Germany. The result would be an ongoing lack of planning security for all stakeholders, declining investments and finally paralysis regarding all efforts to modernise the energy sector. Germany would also quickly lose its role as a leader and driver of innovation in the energy transition which is increasingly propelled by economic needs in more and more regions around the world. Germany would lose many opportunities in the area of technologies that will prove critical for the 21st century.

The principles presented here describe one possible way to actively shape the inevitable decline in and ultimate exit from coal-based electricity in Germany as part of its energy transition. They are based on the experience from the consensus on phasing out the mining of hard coal and the consensus on phasing out nuclear power. These principles also describe the conditions required to ensure that the pending structural transformation can be implemented in a way that is socially responsible, fair and for the lowest costs possible. In parts of this position paper, Agora Energiewende relies on extensive calculations that were carried out by the consulting firm *enervis energy advisors* based on a European power market model. The principles are aimed at achieving a broad consensus and therefore at striking a balance between divergent interests. Hence, they avoid incorporating any extreme positions.

In addition to this abridged version, Agora Energiewende is publishing a long version of this Impulse Paper (in German). This supplements the abridged version with a description of the background analyses that form the basis of the proposed coal consensus path developed here. It contains two additional chapters (one on the consequences of phasing out coal for the energy sector and one on developments in the lignite mining regions) as well as a data appendix.

The long version includes a description of the premises and the scenarios that underlie the calculations in the *enervis* power market model. For selected variants of the successive decommissioning of power plants, the effects of alternative instruments to achieve emission reductions goals, such as additional CO_2 pricing of coal-fired power plants or permanently establishing a coal reserve, are also analysed. Finally, the long version also examines in detail how incrementally phasing out coal-based electricity in the lignite mining regions in the Rhineland, Central German and Lusatian areas could look, and how lignite demand and availability can be harmonised under the conditions of the proposed exit path in the particular areas.

Both the long version and the abridged version can be downloaded at www.agora-energiewende.de.

2 The German Energy System in Flux and the Role of Coal

Without its own hard coal and lignite deposits, neither the industrialisation of Germany in the 19th century nor electrification of the whole country at the start of the 20th century would have been possible. Throughout almost all of the 20th century, coal mined domestically was the most important driver of the developments in the social and economic life of Germany and the establishment of a coal and steel industry which was crucial for the progress of German industry as a whole. The era of coal has now passed its peak. Electrification has extended beyond the traditional applications to the heating and transportation sectors. This new stage of development must – and can – reduce its reliance on power derived from coal under the imperative of environmental protection.

2.1 Coal in Germany: More than a commodity

After World War II Germany continued to rely on coal as the foundation of its economic growth – in both the east and the west. Until 1989 large domestic reserves of lignite assured the economic survival of East Germany with its limited foreign currency reserves. Over decades employees in the lignite industry in East Germany worked under difficult conditions to ensure security of supply not only for the electricity sector but also for heating and the chemistry industry. In West Germany, hard coal and lignite formed the basis of the economic resurgence of the young democracy. Until well into the 1950s, coal remained the absolutely dominant primary energy source in Germany making up almost 90 percent.[9] It was the most important factor assuring success in the early stages of the economic miracle in West Germany.

Coal was firstly cheap, local, and in the years after the war, also without alternative. Increasingly large market shares of the primary energy demand were won first by first petroleum (predominantly in the transport sector but also as a heating fuel) in the 1960s and then by natural gas (as a heating fuel) in the 1970s; coal remained dominant in the power sector of West Germany, however. Coal only lost its absolute dominance in the power supply towards the end of the 1970s with the construction of the first large nuclear power plants. Nuclear power produced about one-third of the national electricity supply in West Germany by the end of the 1980s and also in Germany for the first few years after reunification.

In sectors outside electricity generation such as heating and rail transportation, the role played by lignite and hard coal also became increasingly minor over time. Hard coal, which remained important for steel production as well as electricity generation, was also increasingly imported because of the enormous cost benefits.[10] For lignite, however, domestic production and consumption are closely coupled, because transporting lignite over long distances is only an option in exceptional circumstances thanks to its high water content and low heating value.

Despite the reduction in its cross-sector importance for power supply, hard coal and lignite combined still make up the lion's share of German electricity generation. In 2014 about 44 percent of the electricity produced in Germany still originated from coal-fired power plants.[11] In 2013, coal produced about 41 percent of the world's electricity.[12] Coal maintains a strong position amongst its competitors partly because hard coal in Germany and lignite in many parts of the world is an abundantly available and cheaply mined energy source and partly because the external costs associated with burning coal – particularly regarding climate change – are ignored or, in the case of the EU Emissions Trading System, only inadequately incorporated into total economic accounting. Coal therefore continues to be an important source

9 AG Energiebilanzen (1998), AG Energiebilanzen (2012).

10 BMWi (2015c).

11 AG Energiebilanzen (2015).

12 IEA (2015a).

of energy in Germany. The rapid industrialisation of the emerging markets over the last two decades has been due in large part to the massive expansion of coal-based electricity generation.

Within Germany, the coal economy has developed its own industrial policy and cultural weight that goes far beyond its purely economic importance thanks to its exceptional position in post-war Germany. Hard coal and lignite are part of the regional identity in major industrial areas of Germany. Coal was and is more than simply a fuel or commodity in these regions.

Nevertheless, the relationship is already waning: By the end of 2015, phasing out domestic hard coal mining was almost complete. German hard coal-fired power plants are supplied largely by imported coal because hard coal can be mined more cheaply almost anywhere in the world than in the extremely deep coal seams in the German mining regions. As a consequence, while about 600,000 people were employed in these regions at the peak of mining of hard coal in Western Germany in the 1950s, the number has since fallen to 12,000.[13] In three years, at the end of 2018, this era will end in Germany – regardless of the energy transition.

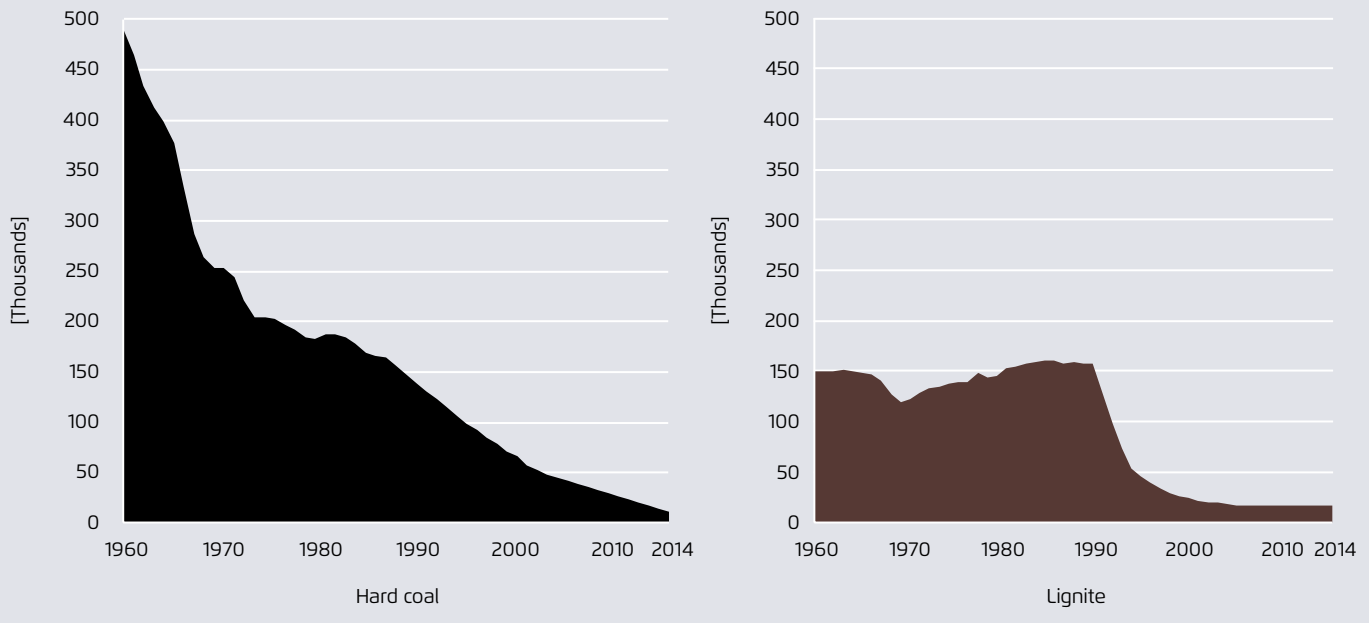
In East Germany a massive structural change has already been completed in the lignite industry. It quickly became clear after reunification that local lignite mining was oversized. The exit was just as dramatic in these regions but was completed in just a few years. Between 1990 and 1995 alone, more than 86,000 jobs were lost in the lignite mining regions of former East Germany (Lusatia and Central German districts). Today about 16,000 people are directly employed in German lignite mining – across both eastern and western parts of Germany (see Figure 1).[14]

The role played by coal in the German energy supply will once again undergo a radical change in the coming decades.

13 Statistik der Kohlenwirtschaft (2015a).

14 Statistik der Kohlenwirtschaft (2015b), Statistik der Kohlenwirtschaft (2015c), authors' calculations.

Employees in German hard coal and lignite mining, 1960–2014 Figure 1



Statistik der Kohlenwirtschaft (2015a); Statistik der Kohlenwirtschaft (2015b), Statistik der Kohlenwirtschaft (2015c); author's calculations

Its quantitative contribution to electricity generation has to fall to the same extent that electricity production from renewable energy will increase as a result of the energy policy decisions made in recent years and the sector must successfully implement energy efficiency measures. This will be reinforced by the necessities of climate policy that require a higher proportion of gas-based electricity generation relative to coal-based electricity generation within the fossil fuel sector because efficient gas-fired power plants emit less than half the CO_2 emissions than coal-fired power plants with the same capacity.

2.2 The era of coal has passed its peak – not just in Germany

The undisputed historic merits of the coal economy as perhaps the most important driver of industrialisation in Germany and the world do not change the fact that the era of coal must come to an end if climate change is to be limited to a controllable level.

The knowledge accumulated over the last few decades by climate scientists can be summarised in the context of fossil energy sources to a simple statement: if the goal of limiting global warming to significantly below two degrees Celsius above preindustrial levels, a goal that has been asserted again and again by international heads of state and government – and was further bolstered at the UN Climate Change Conference in Paris in December 2015 – is to be met, only about 1,000 metric gigatonnes of CO_2 equivalents can be emitted into the atmosphere by the end of the century. The global two-degree limit therefore means that the majority of the coal, oil and gas reserves known today must remain in the ground. Or in more concrete terms, one-third of the oil reserves, half of natural gas reserves and more than 80 percent of known coal reserves can no longer be burnt.[15]

One possible way out of the climate dilemma associated with fossil fuels that was intently discussed a few years ago at national, EU and international levels was mitigation of the CO_2 produced during coal-based electricity generation by capturing, transporting and subsequently storing the greenhouse gas in deep geologic formations (carbon capture and storage, CCS). Discarding this option at the moment in principle and across the entire world would be premature. However, CCS has not got off the ground anywhere in the world to a large degree because of the high associated costs and the lack of necessary technological developments. Of the twelve CCS demonstration projects planned in 2007 in Europe, not a single one is still being monitored.[16] Recently, the British government scrapped a billion pounds from the budget that was intended for a concrete, publicly tendered CCS demonstration project.[17]

In densely populated Germany, simply announcing a possible CCS strategy mobilised citizens in all of the regions that would be affected by such projects. For this reason, the governments of the 'lignite *Länder*' of Brandenburg, Saxony, Saxony-Anhalt and North Rhine-Westphalia have also stopped pursuing this option that enables the use of high CO_2 emitting coal-based electricity to be continued. Particularly if the falling costs associated with wind and solar energy are taken into account, it is increasingly unlikely that CCS will play a significant role for coal-fired power plants, at least in Germany and Europe.

In light of this, the pressure to quickly reduce coal-based electricity generation is growing. In Germany climate protection and the energy transition – despite public criticism of the details of its implementation – are repeatedly supported by a broad majority.[18] In contrast, national acceptance of the burning of hard coal and lignite and the development of new open-pit mines is falling. In a representative survey by the German government on the popularity of various energy sources conducted in 2015, coal was even behind nuclear power in terms of popularity (5 percent compared to 8 percent support).[19]

15 McGlade/Ekins (2015).

16 DIW (2014a).

17 Edie.net (2015).

18 BDEW (2015a).

19 Zeit Online (2015a).

Internationally, the future of coal is increasingly coming under scrutiny in light of climate change discussions. In June 2015, the leaders of the G7 adopted a resolution in Schloss Elmau in Bavaria in which they demanded 'deep cuts in global greenhouse gas emissions' along with 'a decarbonisation of the global economy over the course of this century'.[20] One week later in its special report on climate change, the International Energy Agency (IEA) demanded that old coal-fired power plants be decommissioned sooner than scheduled and that new inefficient plants be prohibited.[21] In recent years increasing numbers of development banks and countries have also stated that they no longer want to approve or finance new coal-fired power plants at all, or only in exceptional circumstances, including the World Bank, the European Investment Bank (EIB), the European Bank for Reconstruction and Development (EBRD), the Nordic Investment Bank as well as major countries such as the US, Great Britain, France and the Scandinavian states. The new OECD export credit guidelines agreed in November 2015 also contained similar demands.[22]

Large investors are increasingly withdrawing financing from businesses that are based on coal as a fuel. In June 2015 the Norwegian parliament voted to divest the Norwegian Government Pension Fund, at almost 800 billion euros one of the largest national funds in the world, from businesses that obtain more than 30 percent of their turnover or the electricity generation from coal.[23] In May 2015 the French insurance company Axa passed a similar resolution and shortly before the climate conference in Paris, Allianz, Europe's largest insurance company, announced a partial divestment from its coal assets.[24]

There is a reason for this development in the financial sector. At the end of September 2015 the head of the British central bank (Bank of England), Mark Carney, warned the international financial sector of major consequences resulting from climate change.[25] Carney, who is also the chair of the Financial Stability Board of the G20 nations, suggested a global standard to evaluate climate risks for businesses based on an analysis previously published by his company and which investors could use to re-evaluate the risks associated with their financial investments. Ultimately, investing in businesses whose business model is based on the burning of coal, oil and gas is a high risk in the long term because with systematic climate protection, these assets would massively depreciate. Following the resolutions passed in Paris, the global risks associated with investments in businesses whose practices harm the climate have become even more severe.

Parallel to this, more and more countries had been actively promoting an exit from coal even before the Paris agreement. The Danish state-owned company DONG Energy passed a resolution to phase out coal-based electricity, which is being gradually implemented.[26] In late November 2015, the British government also announced that coal-based electricity, which currently generates about 30 percent of the electricity in the country, will be completely phased out in Great Britain within 10 years.[27] At almost the same time the Dutch parliament requested the government in Den Haag to retire all coal-fired power plants soon, included three large new plants which were only completed in 2015.[28] Even in smaller EU countries such as Finland and Austria, the decision to phase out coal has already been made. And a bill passed by the Swedish parliament that the state-owned company should be a climate-friendly business is the reason why Vattenfall plans to sell their lignite-fired power plant in Germany.[29]

In the US the Obama administration is also systematically cutting back coal-based electricity using the Clean Power

20 G7 (2015).

21 IEA (2015b).

22 OECD (2015).

23 Handelsblatt (2015).

24 Zeit Online (2015b).

25 Bank of England (2015).

26 Agora Energiewende (2015a).

27 UK GOV (2015).

28 Greenpeace (2015a).

29 DIW (2014a).

Plan announced by the Environmental Protection Agency (EPA) in October 2015.[30] The coal industry in the US, which is under pressure thanks to the oversupply of natural gas triggered by the shale gas boom, must satisfy more stringent requirements for electricity generation in future, making reinvestment decisions (particularly retrofit projects to extend the lifespans of power plants) uneconomical in many cases. While in 2000 more than one in two kilowatt hours in the US was derived from coal-fired power plants, this had fallen to just under 40 percent in 2015. By 2020 the proportion must drop further to about 30 percent.[31]

Finally, the decades' long coal boom in China is also starting to stagnate. In 2014 coal combustion in China fell by about 1.6 percent, the capacity utilisation of Chinese coal-fired power plants fell to the lowest value for more than thirty years, and coal combustion also decoupled further from economic growth.[32] Even if it is a little premature to speak of *peak coal consumption* in China, there is no mistaking that the country responsible for more than 80 percent of the increase in coal combustion worldwide since the turn of the century has initiated a policy to move away from coal. Apart from the growing concern about the costs resulting from climate change, this shift is primarily due to the extreme air pollution experienced by major cities that has developed into a considerable problem.

The global climate protection agreement adopted in Paris marks another step towards decarbonisation of the energy supply. Not only did the agreement confirm the goal of limiting global warming to below 2 degrees compared to pre-industrial levels but there were also demands to limit global warming to 1.5 degrees Celsius if possible.[33] Even if the climate protection plans submitted by the signatories are nowhere near adequate to achieve these targets, the historic agreement has made international climate protection policy virtually irreversible. Different estimates calculated from the national reduction targets (Intended Nationally Determined Contributions, INDCs) submitted to the conference still yield a mean global temperature increase of between 2.7 and 3.5 degrees Celsius. An incremental increase in the level of ambition every five years has already been agreed, however. For all the national activities notified, the continued expansion of renewable energy and the reduction of emissions from the fossil fuels coal, oil and gas are priorities along with the protection of forests. The agreed goal of climate neutrality in the second half of this century will otherwise not be achievable.

The pressure for overall deceleration and an incremental reduction in the use of fuels that harm the environment will increase further in many countries in the wake of the Paris conference. Attention will be focused on Germany and its handling of domestic coal reserves along with the largest emitters, China, the US and India, because Germany is considered a litmus test for whether an energy transition that includes completely transforming its energy system can succeed in a developed industrial country.

Overall, there are more and more signs that the coal era has now passed its peak. The goal must therefore be to shape the transition from coal without incurring major disruptive structural change – particularly in Germany. This is also possible partly because the necessary changes are an order of magnitude smaller than the structural changes that have already been made in the Western German lignite mining industry or the lignite mining regions in eastern and central Germany. The comparably long period available for the transition of at least 20 years also makes easier the task of ensuring the structural change goes as smoothly as possible. It is also economically sensible because a gradual transition in predictable steps will lower transition costs and all those affected will have sufficient time to adjust if the necessary steps are initiated sooner rather than later.

On the other hand, it would be misguided to put the reduction of coal-based electricity on the back burner once again after all the debates and international developments of 2015. The result would probably be having to implement a considerably more radical and faster exit from coal-based electric-

30 EPA (2015).

31 EIA (2015).

32 Bloomberg (2015).

33 UNFCCC (2015).

ity in 10 or 15 years under the pressure of the increasingly serious consequences of climate change. Only in such a scenario – wait a long time but then make drastic decisions – does the disruptive structural change often feared as part of a coal exit become a real threat. In recent years, particularly because of the lack of profitability of gas-fired power plants, the stock of very old coal-fired power plants has grown, some of which have been supplying the grid for well over 45 years. A growing share of the capital stock of coal-based electricity in Germany has therefore well exceeded its lifespan. This creates an opportunity to start phasing out coal by retiring ageing power plants, thus making the power sector considerably more efficient overall.

2.3 Germany's climate goals define the exit from coalbased electricity

Germany's contribution to international activities aimed at limiting the effects of climate change is derived from the energy concept drafted by the previous German coalition government in 2010. The aim is to reduce greenhouse gas emissions by at least 40 percent by 2020, by at least 55 percent by 2030, by at least 70 percent by 2040 and by 80 to 95 percent by 2050, in each case relative to 1990 levels.[34] These targets by the previous government were again confirmed by the current grand coalition in its first progress report on the energy transition in December 2014 and the fourth monitoring report on the energy transition in November 2015.[35] The German parliament also confirmed these goals in November 2015 in a resolution in the lead up to the Paris climate conference.[36]

At the end of 2014, emissions in Germany were about 26 percent below 1990 levels, meaning that a considerable reduction is still required by 2020.[37] This was taken into account by the German cabinet with the Climate Protection 2020 Action Program adopted in December 2014. The aim of the program is to close the climate protection gap of five to eight percent relative to the 40 percent target by 2020 using additional climate protection measures across all sectors. The power sector must contribute to this beyond the previously agreed measures with an additional reduction of 22 million tons of CO_2 by 2020.[38] After an intense public discussion about the initial proposals from the German Ministry for Economic Affairs and Energy for climate change mitigation, lignite-fired power plants with a total capacity of 2.7 gigawatts will now be incrementally decommissioned while still being available as a capacity reserve for another four years in situations of extreme shortage on the electricity market.[39] This measure is expected to result in an additional reduction in emissions of 11 million tons of CO_2. In order to achieve the required 22 million tons of additional CO_2 reduction, the subsidies for combined heat and power will also be augmented with the aim of saving up to four million tons of CO_2. Various other climate protection measures, outside the power sector as well, will also ensure that the additional CO_2 reduction is achieved.

The Climate Protection 2020 Action Program also plans a catalogue of additional measures in the heating and cooling sectors as well as in the transportation sector to close any gaps in climate change mitigation. Additional climate protection measures affect other sectors such as agriculture, waste management or process-related emissions from industry.

For 2016 the German cabinet has announced that, in accordance with the commitments in the coalition agreement that form part of the action program, it will adopt a long-term climate protection plan for 2050 in which concrete measures for the intermediate goals for 2030 and 2040 will be formulated.[40] It is already apparent that achieving the necessary overall reductions in greenhouse gas emissions in the power sector, but in electricity generation in particular, requires this sector to make an above-average contribution because a majority of the greenhouse gas emissions in Ger-

34 BReg (2010).

35 BMWi (2014), BMWi (2015a).

36 Deutscher Bundestag (2015a).

37 UBA (2015b).

38 BMUB (2014).

39 BMWi (2015b).

40 CDU/CSU/SPD (2013).

many are related to energy. Avoiding emissions not related to energy (primarily process-related emissions from industry as well as agricultural emissions) is also more difficult and in some cases considerably more expensive.

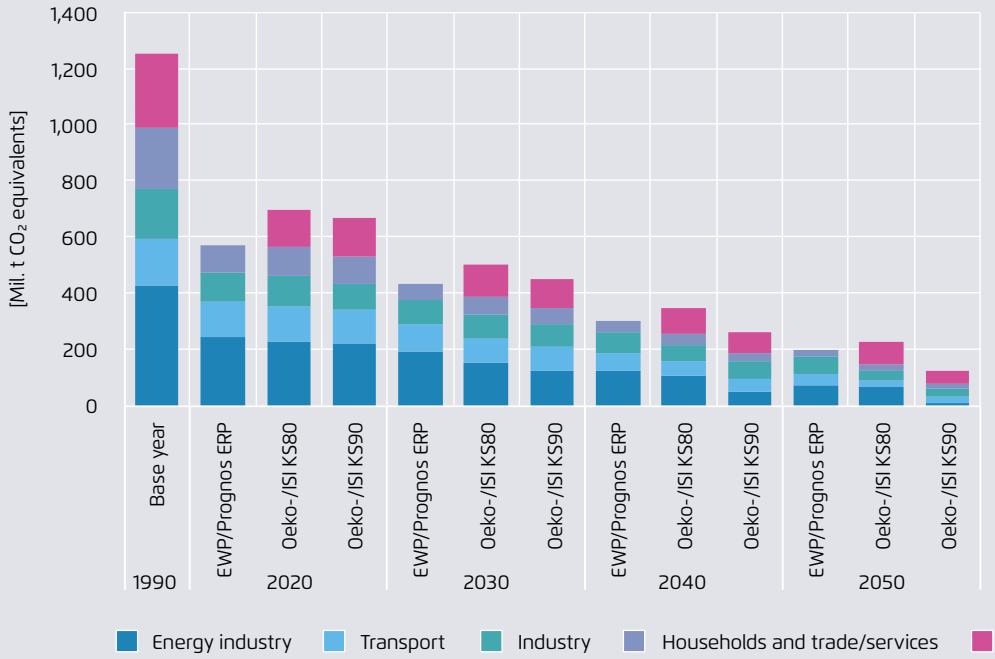
This necessity is also reflected in the results of the central climate protection and energy scenarios which describe projections until 2050 on behalf of the German government.[41] Despite differences in the definition of the climate goals and differentiation of sectors, both the *Klimaschutzszenario 80* (Climate Change Scenario 80, KS 80) and the *Klimaschutzszenario 90* (KS 90) from the Oeko-Institut/Fraunhofer ISI prepared for the German Ministry for the Environment and the target scenario in the current Energy Reference Forecast from EWI/Prognos prepared for the German Ministry for Economic Affairs and Energy show that energy-related emissions must fall significantly in all sectors (see Figure 2). For the public energy sector, this means that emissions must fall from 194 to 126 million tons (corresponding to a reduction of 55 percent to 71 percent) by 2030, from 126 to 48 million tons (71 percent to 89 percent) by 2040 and from 74 to 7 million tons (83 percent to 98 percent) by 2050 in order to ensure cost-effective compliance with emissions reduction targets.[42]

The theory that is occasionally expressed that the energy industry could receive higher budgets because emissions reductions could be made in other sectors is not covered by the scenarios because they assume very considerable falls in emissions in all other sectors as well. If one also considers that EWI/Prognos only models energy-related emissions and disregards the fact that sectors with non-energy related emissions are not likely to make greenhouse gas reductions of minus 80 percent by 2050 (due to process-related emis-

41 EWI/Prognos (2014), Oeko-Institut/Fraunhofer ISI (2014).

42 The emissions associated with the energy industry are defined along the national greenhouse gas inventories and include power, cogeneration and heating plants within public supply as well as other generation plants of the energy industry. Emissions from power and cogeneration plants of the industrial sector are not included but rather assigned to the sector "Industry".

Development of greenhouse gas emissions by sector in different target scenarios — Figure 2



Note:

Most of the differences in the target scenarios considered here result partly from differences in the target definition and partly from slight variations in how sectors are delineated.

- Available total budgets: EWI/Prognos ERP aims at a reduction only in energy-related greenhouse gas emissions of 80 percent by 2050. Non-energy related emissions are not considered. On the other hand, Oeko-Institut/ISI KS80 and KS90 aim at a reduction in total greenhouse gas emissions of 80 percent or 90 percent respectively by 2050. This produces correspondingly lower target budgets for the interim years.
- Sector delineation: EWI/Prognos ERP allocates all emissions to four sectors: energy economy, transportation, industry, household/trade and services. Oeko-Institut/ISI KS80 and KS90 also refer to other sectors that are summarised here under 'Other'; this refers largely to non-energy emissions that are not considered in the EWI/Prognos ERP.

EWI/Prognos (2014); Oeko-Institut/Fraunhofer ISI (2014)

sions in industry and emissions associated with animal husbandry in the agricultural sector), then it becomes clear that the emissions budget for the energy economy in 2050 must lie between the KS 80 and the KS 90 scenarios, that is, at about 64 to 7 million tons (85 percent to 98 percent). Such a level of reduction cannot be achieved without phasing out coal.

2.4 The European Emissions Trading Scheme requires national support

Along with expanding renewable energy and reducing total power demand by introducing energy efficiency measures, the Emissions Trading System is currently a key instrument at both a national and European level for reducing greenhouse gas emissions in the power sector incrementally and cost effectively.

In recent years the contribution of the Emissions Trading System to reductions in greenhouse gases in the power sector has, however, been low. This is due to the consistently low CO_2 prices. Excessive numbers of certificates issued in the early stages, additional emission credits as part of the Kyoto mechanisms Joint Implementation (JI) and Clean Development Mechanism (CDM) and finally, the ongoing economic crisis in Europe have all led to the system accruing surpluses of considerably more than two billion tons of CO_2 emission allowances in recent years.[43]

For this reason, the European Council agreed to a structural reform of the Emissions Trading System in October 2014: from 2019 the market stability reserve (MSR) will be introduced to stabilise the market price for CO_2 certificates. The existing surpluses will be gradually absorbed and temporarily held in a reserve outside the market. In addition, increasing the annual linear CO_2 reduction factor from its current level of 1.74 percent per year to 2.2 percent per year is intended to respond to the over-allocation on the certificate market that has regularly occurred.

The decision by the German cabinet to adopt additional climate protection measures by 2020 to supplement emissions trading, such as the capacity reserve for lignite-fired power plants, is consistent with this. This is because the market stability reserve will only come into effect in 2019. This means that significant effects on emissions from the German power sector cannot be expected before 2020.

If the decarbonisation of the German power sector is to be continued, the creation of another climate protection instrument at a national level is not only necessary temporarily but from 2020 onwards it will be inevitable. Due to the high surpluses in the Emissions Trading System, only a moderate price increase of about 25 euros per ton of CO_2 can be expected by 2030, despite the market stability reserve. The increasingly tight coupling of the German electricity market with those of neighbouring countries means that such a price level will not lead to a significant reduction in the electricity generated by lignite and hard coal-fired power plants in Germany. Instead, electricity from these power plants would in future displace electricity produced by gas-fired power plants nationally and internationally. Emissions reductions in the power sector would only result in ageing coal-fired capacity being decommissioned. Even if the CO_2 price were to increase to about 40 euros per ton of CO_2 by 2040, the proportion of electricity generated by coal in the system would still be too high. As a result, the power sector would fail to meet its target emissions reduction targets for 2030 and 2040.[44]

Not achieving the emissions reduction targets in the power sector would have far-reaching consequences because this sector will have an increasingly important role to play as part of the decarbonisation of the entire energy system. Because of the limited availability of biomass for energy purposes, the answer for decarbonising the heating and transportation sectors – along with increasing energy efficiency, particularly as part of building modernisation – lies in the increasing electrification of these sectors. Electric vehicles and heat pumps are becoming key technologies in the area of transportation and heating. The result is the integration

43 Agora Energiewende (2015b).

44 enervis (2015b).

of the power, heat and transportation sectors based on electricity generated from renewable sources. Because of the expansion of electricity uses, this leads to a slight increase in energy consumption even if considerable efficiency improvements in traditional electricity uses are successful.[45] If the CO_2 intensity of electricity production (currently 569 CO_2/kWh)[46] does not fall adequately because the proportion of electricity being generated by coal remains high, the expansion of electricity uses would mean that emissions in the power sector will be even further from the mark.

This would be synonymous with resigning from the leading role of Germany as an energy transition country. This is because, despite agreeing on joint and Europe-wide instruments such as the EU Emissions Trading System, the political responsibility for developing national emissions still lies with each of the member states. Particularly in light of the fact that individual EU member states are pursuing a lower ambition level, Germany in its vanguard position cannot fail to meet its own national targets and depend on the lower reduction ambitions of other countries.

Finally, a national instrument parallel to the Emissions Trading System is also advisable in order to ensure sufficient planning security regarding the development of new open-pit mines (or expanding current open-pit mines) or forgoing them altogether. Because the price signal in the EU Emissions Trading System will be low for the foreseeable future and will also remain uncertain for the medium term, if and when the price moves to a higher level it has already proven to be an unsuitable instrument for long-term control of open-pit mine planning.[47] If the current CO_2 price expectations should develop, lignite would continue to be mined in all German lignite mining regions until well after 2050. As a consequence, additional open-pit mines would have to be developed. Such a perspective is without doubt incompatible with the emissions reduction targets of Germany.

45 Fraunhofer IWES (2015).

46 UBA (2015a).

47 Emissions trading is now seen less as a comprehensive instrument that leaves no room for other climate policy measures but instead is considered one element of a climate policy mix that dovetails with other instruments in a meaningful way (see IEA (2011) and Oeko-Institut (2010)).

3 Eleven Principles for a Consensus on Coal

After all this, it is clear that Germany should no longer avoid discussing phasing out coal-based electricity. This discussion is essential not only because of the urgency of achieving real results for climate protection but it is also a question of the credibility of Germany and its energy transition around the world as well as the honesty of German policies for the energy regions within Germany that will be affected. With each year that passes, the risk of having to adopt a rather unplanned exit from coal grows, which would have considerable impacts on society, the energy economy and regional economies. The dubious model would be that of the exit from nuclear power which finally succeeded after decades of political controversy in response to the external trigger of the reactor disaster at Fukushima, and its implementation was unexpectedly abrupt for the businesses involved.

In 2016 there is a huge opportunity to negotiate an economically and socially responsible exit from coal-based electricity in a controlled process that enjoys broad societal and political support and to pass the relevant laws in this legislative period. The necessary negotiations should begin soon and be completed by the end of 2016.

Like the entire energy transition, phasing out coal remains a cross-generational project, however. It requires broad societal support to survive the rigors of daily politics and not repeatedly require justification. This is the only way that a reliable, long-term framework can be created for the regions and investors that will be affected.

The goal should be to bring about a societal consensus on phasing out coal-based electricity that includes a schedule and the necessary conditions and is supported by representatives from all political parties, the energy economy and civil society. Analogous to the consensus agreements for phasing out nuclear power and closing hard coal mines, the consensus for phasing out coal-based electricity would be legislated after agreeing on the contents and then adopted by a broad majority in the German parliament and the legislature.

In this document, Agora Energiewende details eleven principles for reaching just such a societal consensus on coal that can be used as a basis for discussions. The principles are based on comprehensive analyses and power model runs that were completed by the consultancy *enervis energy advisors* on behalf of Agora Energiewende over the last few months (see Chapter 5 and 6 of the long version).

Principle 1: Convening a "Round Table on a National Consensus on Coal"

The German cabinet should soon invite impacted stakeholders to a "Round Table on a National Consensus on Coal." This round table should provide a venue for building trust and negotiating key issues of the phase out, thus preventing a fundamental conflict in energy policy from becoming entrenched for decades. The goal should be to reach a consensus with broad political and societal support before the end of 2016. Similar to when the decision was made to phase out hard coal mining and nuclear power, this consensus will ensure that all stakeholders have a sound foundation to plan for the future.

Discussions in 2015 centred on the proposal for Germany's contribution to emissions reductions and the lignite capacity reserve, with major demonstrations held at the Brandenburg Gate in Berlin and throughout lignite mining regions along with the occupation of lignite mines. These discussions were a preliminary taste of what establishing the new intended energy system in Germany means when debates about the future role for coal in the power supply permanently degenerate into conflict for decades.

The German cabinet now has an opportunity to avoid decades of fundamental conflict in the same pattern as the discussion about nuclear power, and it can instead initiate a cross-party, structured dialogue with all key stakeholders to find a comprehensive consensus solution. After the resolutions passed on the emissions market design and the renewable energy law, the result would be another urgently required contribution to planning and investment security, the lack of which has been a justifiable complaint made by all actors in the energy industry. If the procedures for phasing out coal are not clarified, it cannot be assumed that there will be any new investments in power plants in Germany. Phasing out coal within a consensus between key stakeholders secures Germany's role as a leader in global climate protection and with it the drive to innovate across the entire economy that is associated with this role.

Agora Energiewende therefore suggests that a political process be initiated very soon that enables mutual agreement about the process for phasing out coal-based electricity in Germany within the current legislative period. The German cabinet should start a dialogue as part of the forthcoming consultations on the Climate Protection Plan 2050 which represents all interests relevant for a coal consensus. The common goal should be to achieve formulated outcomes by the end of 2016 and to submit these to the German legislature for consultation and decision making. The principles in this Impulse Paper presented by Agora Energiewende should be considered initial input to the proposed Roundtable for a National Consensus on Coal.

The deadline for reaching an agreement about a coal consensus in this legislative period is very tight. The past has shown, however, that constellations such as those currently in place – a grand coalition in the cabinet and varying majorities in the German upper house – increase the chances of a cross-party consensus that will create the necessary planning security.

Principle 2: An incremental, legally based phase-out of coal power by 2040

The phasing out of coal power in Germany requires clarity in three key respects: The use of coal in Germany requires an "expiration date" that all stakeholders can rely on when making decisions about the future; the phase-out needs a clearly defined reduction path; and all stakeholders need legal certainty about the trajectory of the incremental phase-out to take place. The incremental phasing out of coal power beginning in 2018 and ending in 2040 is compatible with Germany's climate protection goals. The phase-out should be based in law and ratified with a broad majority by the German legislature.

Every stakeholder in the energy sector is expecting that the use of coal in Germany has had its day. However, there are highly divergent opinions on the expiry date for coal use. Greenpeace demands that generating electricity from lignite is ended by 2030 and from hard coal by 2040, for example.[48] Bündnis 90/Die Grünen want to phase out coal within the next 20 years[49] while BUND (Friends of the Earth Germany) considers it plausible to phase out coal use within the next 15 years.[50] In contrast, in the target scenario in the Energy Reference Forecast, EWI/Prognos assume that in 2050 there will still be 26 TWh of coal-based electricity generated.[51] And the auditing firm Warth & Klein Grant Thornton, which conducted an expert review of energy suppliers' withdrawal from nuclear power for the German government, assume that coal will only be completely phased out by 2060.[52]

Agora Energiewende proposes selecting 2040 as the final date for coal mining and use. This is the logical outcome of the national medium-term emissions reduction targets and gives the energy industry a 25-year transition period in which it can complete the conversion of its business model and business structures.

The analytical background for the proposed final date is derived from the calculations and model runs that were completed by *enervis energy advisors* on behalf of Agora Energiewende over the last few months (see Chapter 5 and 6 of the long version). The starting point for these calculations was the undisputed goal of a comprehensive reduction in Germany in greenhouse gases of 80 percent to 95 percent by 2050 relative to 1990 levels. If an average scenario is assumed (in concrete terms: minus 87 percent) and taking into account the fact that in the industrial and agricultural sectors certain residual emissions will be unavoidable, even in the long term (see Chapter 2), by 2050 the power sector must have reduced its greenhouse gas emissions by at least 90 percent compared to 1990 levels. According to the current analyses, this implies an incremental exit from the use of lignite and hard coal completed by the end of 2040. The final date of 2040 also means that there is no need to develop new lignite mines to supply lignite-fired power plants with adequate fuel (see Principle 6).

An incremental approach is advisable when implementing the emissions reduction target so that ongoing and plannable development is assured. Agora Energiewende therefore suggests aligning the reduction of coalbased electricity with a sectoral CO_2 target that plans a reduction in emissions of 40 percent by 2020 and of 90 percent by 2050. On a linear path, the intermediate goals then require a reduction of 57 percent by 2030 and 73 percent by 2040. The public would not consider it credible to announce a final date without stating the intermediate concrete steps. Model calculations nevertheless show that old coal-fired power plants can be gradually retired without any additional measures.[53]

48 Greenpeace (2015b).

49 Bündnis 90/Die Grünen (2015).

50 BUND (2015).

51 EWI/Prognos (2014).

52 Warth & Klein Grant Thornton (2015).

53 In light of the expected CO_2 price level, however, retrofit decisions to extend the lifespan of coal-fired power plants could possibly be expected in the 2020s (enervis (2015b)).

In this reference case, in 2040 the emissions produced by the German power sector would still be about 40 million tons above the CO_2 target each year on average, however.

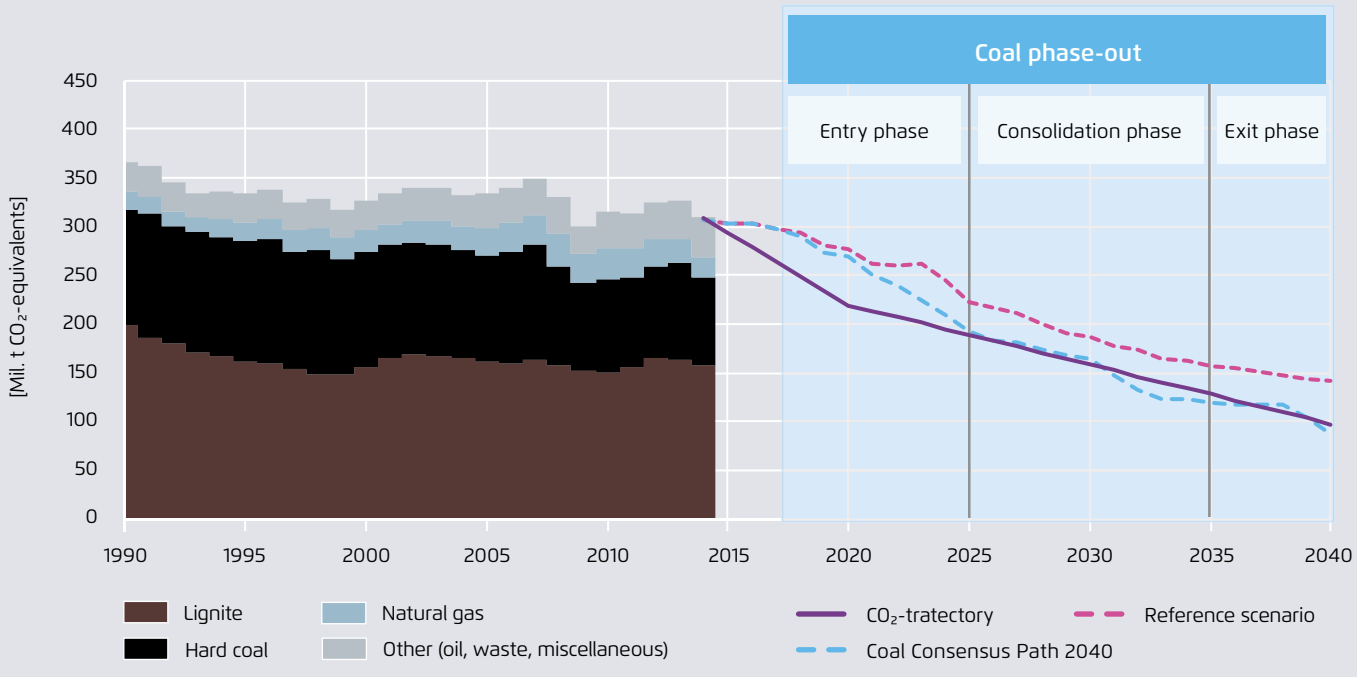
If, however, Germany's power sector emits an excess of 40 million tons of CO_2 every year for 25 years, this not only means a clear failure to reach the German emissions reduction targets for 2030 and 2040 but it will also mean a gigatonne more CO_2 in the atmosphere. Because for the global climate the sum of CO_2 emitted from 2015 to 2050 is relevant rather than reaching the 2050-target. Adhering to a steady CO_2 reduction from now to 2040 is therefore mandatory if the goal announced by the German government recently at the climate conference in Paris is to limit global warming to well under two degrees, possibly to 1.5 degrees Celsius.

By 2014 CO_2 emissions from electricity generation had only fallen by 16 percent and therefore were considerably below the levels achieved overall in emissions reductions (minus 26 percent).[54] To follow the CO_2 path for the power sector, it will first be necessary to close up any current gaps in climate protection by incrementally aligning the emissions produced by electricity generation with the CO_2 path. The entry phase would last seven years from 2018 to 2025 in the Coal Consensus Path 2040 proposed here (see Principle 4). However, this is not adequate to ensure that the CO_2 path is then adhered to permanently and the sector does not return to a business-as-usual level of emissions. Further emissions reductions must instead be achieved after 2025. In the consolidation phase between 2026 and 2035, the rate of these reductions does not have to be as high as in the initial years. The exit period between 2036 and 2040 then completes the market exit from the last coal-fired power plants.

Phasing out coal-based electricity should – analogous to phasing out nuclear power and the mining of hard coal in Germany – be given the force of law. The law would regulate the key issues covered in the following principles on the

54 UBA (2015a), UBA (2015b).

CO_2 emissions in the reference scenario and the proposed Coal Consensus Path 2040 Figure 3



UBA (2015a), own presentation

basis of the consensus discussions and should be adopted by cross-party consensus in the German legislature where possible. Only in this way all stakeholders can achieve the greatest possible legal certainty. The German cabinet and the governments of the *Länder* that are affected will thus be committed to comply with the key conditions framing the transition to a decarbonised power supply, and businesses can adjust to the incremental ephase-out from coal-based electricity in good time and with the best possible outcomes.

Principle 3: No new construction of coal-fired power plants

No legal approval should be granted for the construction of new lignite and hard coal-fired power plants, as the construction of new plants is not compatible with Germany's mid and long-term emissions reduction targets.

Coal-fired power plants have a technical lifespan of at least 40 years. New coal-fired power plants built after 2015 would therefore generate electricity that would be an environmental burden well beyond 2050. Prohibiting the construction of new coal-fired power plants must be a mandatory feature of a coal consensus, analogous to prohibiting the construction of new nuclear power plants as part of the nuclear power consensus. Ultimately, this principle means no more than embedding the status quo in law as there are currently no investments planned for new coal-fired power plants. Nonetheless, laying this prohibition down in law means in concrete terms that the construction projects at the Niederaußem (RWE), Profen (MIBRAG) and Stade (Dow Chemicals) sites that are currently still formally in the approval process[55] and the plans for a power plant at the Jänschwalde (Vattenfall) site must finally be abandoned.

This measure also becomes necessary because of the large coal-fired power plant capacities that still exist in Germany. The model runs also show a steady decline in the capacities of coal-fired power plants, even in the business-as-usual version thanks to the decommissioning of ageing plants, to around 23 gigawatts in 2030 and to 18 gigawatts in 2040 (see Chapter 5 of the long version). However, the reduction in CO_2 emissions associated with electricity generation will be insufficient, particularly because the lignite-fired power plants still on the grid will be utilised to their full capacity even in the long term because there is expected to be only a moderate increase in the CO_2 price.

This also applies to the case where newly constructed power plants replace older, less efficient coal-fired power plants although they have not yet reached the end of the operational lives.[56] New power plants generally have a greater specific efficiency and thus lower specific CO_2 emissions. Compared to the business-as-usual model, in which older power plant units are gradually decommissioned as they age and thus no longer emit greenhouse gases, constructing new coal-fired power plants would once again lead to significant additional emissions well beyond the time when ageing power plant units would have been decommissioned having reaching their end of their lifespan. On balance, the atmosphere is burdened with even more emissions.

55 BDEW (2015b).

56 For example, this is currently planned at the Niederaußem site where the construction of a new lignite-fired unit (BoA+) is intended to replace four ageing power plant units with about the same capacity as part of the 'Power Plant Regeneration Program'.

Principle 4: Determine a cost-efficient decommissioning plan for existing coal power plants based on remaining plant lifespans, including flexibility options in lignite mining regions

In order to realise the phasing out of coal power in a cost-efficient manner that avoids highly disruptive structural change, it will be necessary to adopt a binding plan for the decommissioning of existing coal-fired power plants that is based on residual lifespans. The order in which plants are decommissioned should be based on CO_2 abatement costs. In the initial phase from 2018 to 2025, the decommissioning will be limited to three gigawatts per year. In lignite mining areas, the transfer of remaining lifespans from one plant to another should be permitted to avoid domino effects.

In principle, a range of political instruments are suitable for realising the exit from coal-based electricity by 2040, including regulatory requirements (e.g. efficiency regulations, emissions limits, power plant lifespans) and economic instruments (e.g. carbon tax, CO_2 floor prices).[57] Three approaches are currently the focus of the debate:

→ 1. Agreements on binding residual lifespans throughout the exit period, analogous to the phasing out of nuclear power
→ 2. Additional CO_2 pricing of coal-fired electricity generation, such as that included in the climate contribution proposed in spring 2015 by the German Ministry for Economic Affairs and Energy
→ 3. Decommissioning premiums for old coal-fired power plants analogous to the recently agreed capacity reserve for old lignite-fired power plants

Agora Energiewende proposes to phase out coal on the basis of residual lifespans for power plants along the CO_2 path for the power sector derived from the general emissions reduction targets. The order in which the power plants are decommissioned should be determined in principle by the CO_2 abatement costs for the power plants because this corresponds to the most efficient path (see Chapter 4 in the long version). Because the CO_2 abatement costs also depend on future changes in the particular fuel prices, however, the phase-out plan schedule must be linked to an objective and less mutable criterion in any legislation. The calculations carried out for Agora Energiewende by *enervis energy advisors* show that the age of plants is highly correlated with their efficiency and thus also with the CO_2 abatement costs. Therefore, a phase-out plan along the commissioning years of the power plants[58] is proposed below.

In order that the operation of power plants and of the lignite mines in each of the lignite regions can be optimally adjusted to one another and disruptive structural change can be avoided, operators should be issued with flexibility options for the remaining operational lifespans of the lignite-fired power plants. Agora Energiewende therefore proposes to allow residual lifespans for lignite-fired power plants (in gigawatts per year) to be transferred within a lignite mining region. Enabling the transfer of residual lifespans amongst hard coal-fired power plants is not necessary because, unlike lignite-fired power plants, domino effects are not to be expected, and the capacities of these power plants are utilised to very different degrees, meaning that transferring residual lifespans for hard coal-fired power plants can lead to higher CO_2 emissions compared to the case with lignite-fired power plants.

A phase-out model based on residual lifespans has the following merits:

→ **Long-term planning security and avoidance of disruptive structural change:** A binding definition for a decommissioning schedule for power plants ensures comprehensive planning security for politics, the energy industry and mining regions. The necessary structural assistance measures can be incrementally initiated at the

57 Refer to IZES (2015), DIW (2014a), DIW (2014b) IASS (2014) in particular for the discussion about instruments for phasing out coal.

58 If a boiler has been replaced, the age of the boiler would be decisive.

right time and with the right intensity so that the transition costs can be optimised. At the same time, the phase-out model guarantees operators of lignite-fired power plants the necessary flexibility to optimise their mining and power plant operations.

→ **Reliable and effective mitigation:** Because of a mandatory decommissioning of coal capacity, avoiding CO_2 emissions can be quantified and achieved more reliably compared to price-based instruments.

→ **Low transaction costs, low distribution effects:** Regulatory approaches are in principle economically less effective for achieving emission reduction targets. If the emissions budget that has been established (by defining a CO_2 trajectory) is adhered to using an instrument based on economic criteria (decommissioning according to CO_2 abatement costs), however, such an approach implicitly follows the operating principles of an economic instrument. An coal phase-out plan on the basis of CO_2 abatement costs therefore 'simulates' an economically effective solution while avoiding the negative side effect of high redistribution effects. Such a solution also enables transaction costs to be kept low, particularly in the lignite mining regions, by ensuring the structural change is systematic.

Agora Energiewende proposes to organise the phasing out of coal-based electricity in three phases along with a Coal Consensus Path 2040 (see Figure 4):[59]

→ During the *entry phase*, which starts in 2018 and lasts until 2025, three gigawatts' capacity of lignite and hard coal-fired power plants are decommissioned every year based on their age. In this way, the existing climate protection gap is incrementally closed and the CO_2 trajectory is followed again. The result is that by 2025 all coal-fired power plants that were constructed up to and including 1985 will be decommissioned. This corresponds to a capacity of about 12 gigawatts for lignite-fired power plants and about 15 gigawatts for hard coal-fired power plants. These power plants would thus reach an operating lifespan of at least 40 years or even considerably more.[60]

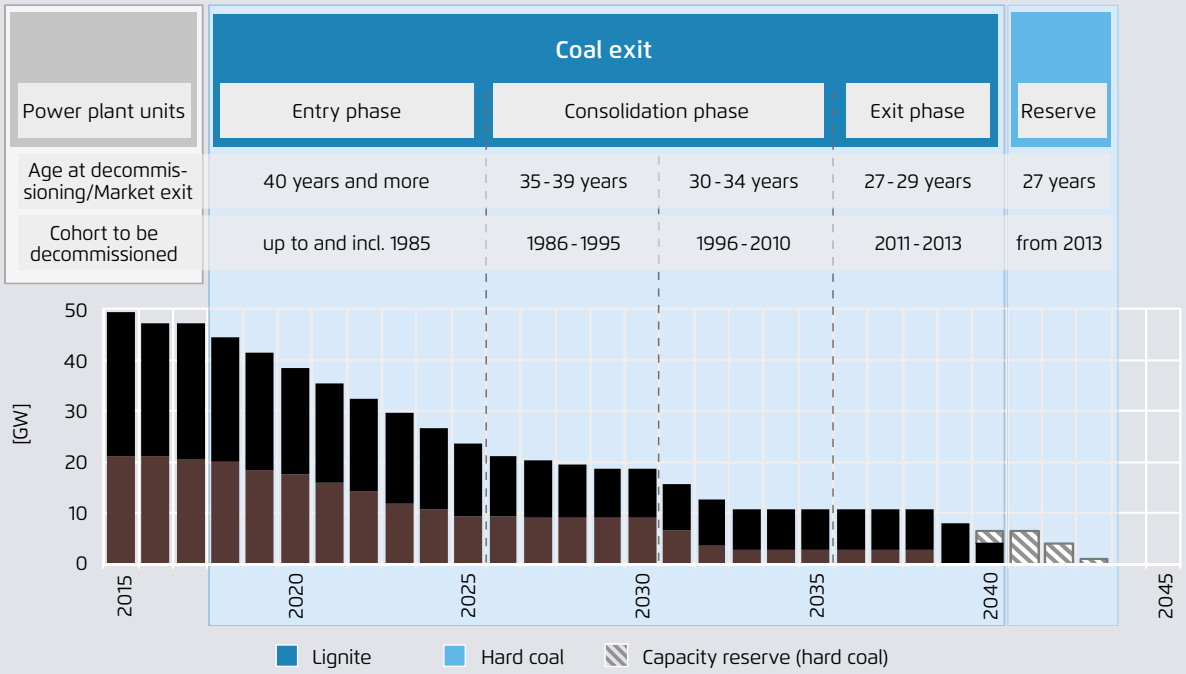
→ Based on the already emissions reductions by 2025, the intensity of the measures that are necessarily adopted to remain on the CO_2 path can be considerably reduced during the subsequent *consolidation phase*. To achieve this, all coal-fired power plants that were commissioned between 1986 and 1995 inclusive must be going offline between 2026 and 2030. These power plants will thus reach an operating lifespan of between 35 and 39 years. Between 2031 to 2035, all power plants that were put into operation between 1996 and 2010 will then be decommissioned. These power plants will still achieve an operating lifespan of 30 to 34 years. Overall, during the *consolidation phase* just under 7 gigawatts of lignite-fired power plants and 6 gigawatts of hard coal-fired power plants will be decommissioned.

→ During the *exit phase* between 2036 and 2040, the remaining coal-fired power plants (three gigawatts of lignite and eight gigawatts of hard coal) that were connected to the grid since 2011 will be removed from the market. To enable adequate amortisation of all plants, it will also be agreed that the operating lifespan of coal-fired power plants may not be reduced to less than 27 years. Coal-fired power plants which nevertheless must be removed from the grid to adhere to the CO_2 path will therefore be transferred to the capacity reserve until the end of their 27th year of operation. This will affect all power plants that were connected to the grid after 2014. Providing this capacity reserve would be compensated in accordance

59 The Coal Consensus Path 2040 proposed here deviates slightly from the *intermediate phase-out scenario* modelled by *enervis energy advisors* in Chapter 4 of the long version (Coal Phase-out 2040): While power plants in the *intermediate phase-out scenario* will be decommissioned between 2036 and 2040 based on a maximum operating lifespan of 25 years, the Coal Consensus Path 2040 outlined here proposes a somewhat longer operating lifespan of 27 years for the same period. The effects of the change in the operating lifespan in the Coal Consensus Path 2040 for the years concerned (2038, 2039 and 2040) are therefore statistically estimated based on the *intermediate phase-out scenario*.

60 Adhering to a proportional emissions reduction of minus 40 percent by 2020 means that about 13.7 gigawatts of the oldest and least efficient coal-fired power plants need to be decommissioned in addition to the plants decommissioned because of their age. Such an approach appears to be very difficult to implement in practice, however (enervis 2015a). It was therefore discarded as being less realistic.

Installed capacity in the proposed Coal Consensus Path 2040 Figure 4



UBA (2015), own presentation

with the regulations for the capacity reserve specified in the current draft of the German Electricity Market Act. This measure moreover helps to assure security of supply during the final *exit phase* (see Principle 9).

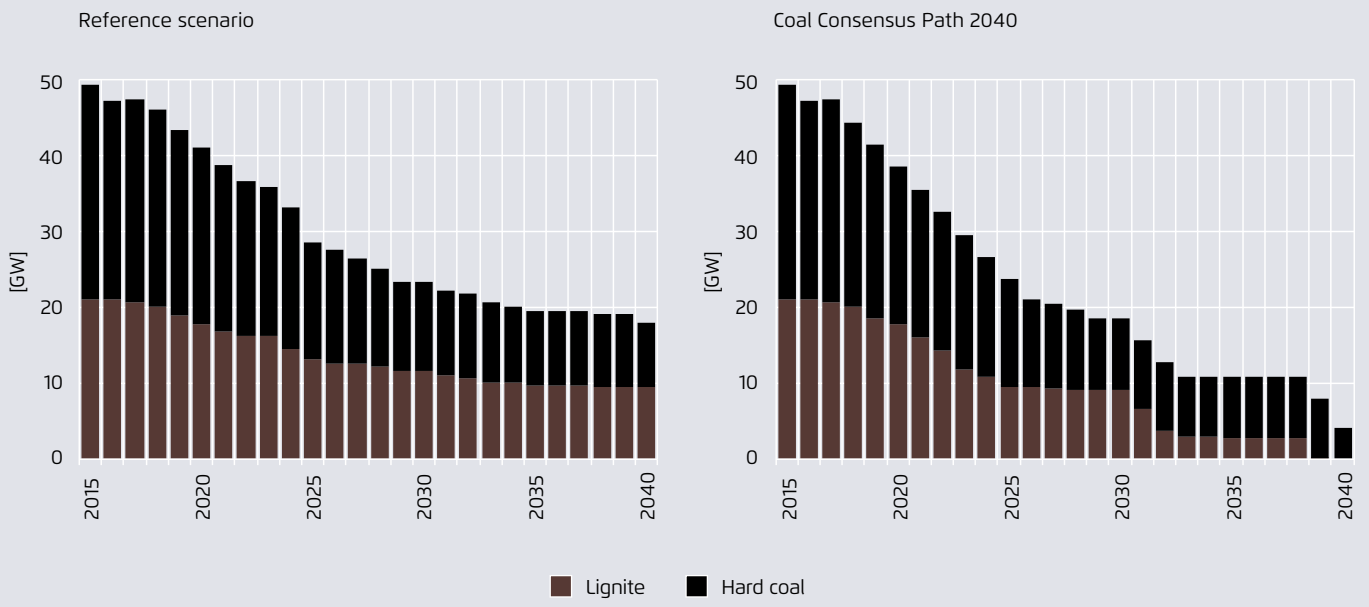
Such a phase-out plan would have the following consequences compared to the reference scenario (see Figures 5 and 6):

→ During the *entry phase* between 2018 and 2025, a total of about 3.8 gigawatts of lignite-fired power plants and about 1.1 gigawatts of hard coal-fired power plants will be decommissioned in addition to the reference scenario in which hard coal-fired power plants are decommissioned after 40 years and lignite-fired power plants after 50 years of operation. The total installed capacity of coal-fired power plants in 2025 in the business-as-usual scenario corresponds to about 4.9 gigawatts more than in the Coal Consensus Path 2040.

→ Between 2026 and 2035 a total of about 3.8 gigawatts (3.0 gigawatts lignite-fired power plants; 0.8 gigawatts hard coal-fired power plants) will be decommissioned during the *consolidation phase* in the Coal Consensus Path 2040 in addition to the reference scenario. As a result, in the reference scenario about 19.6 gigawatts of coal-fired power plants are still online in 2035. In the Coal Consensus Path 2040 it is a total of 10.8 gigawatts.

→ During the *exit phase* of the Coal Consensus Path 2040, all remaining coal-fired power plants are then decommissioned step by step. In the reference scenario only slight changes are expected regarding capacity development with 9.5 gigawatts of lignite-fired power plants and 8.5 gigawatts of hard coal-fired power plants still in operation in 2040.

Installed coal-based capacity in the reference scenario and the proposed Coal Consensus Path 2040 Figure 5



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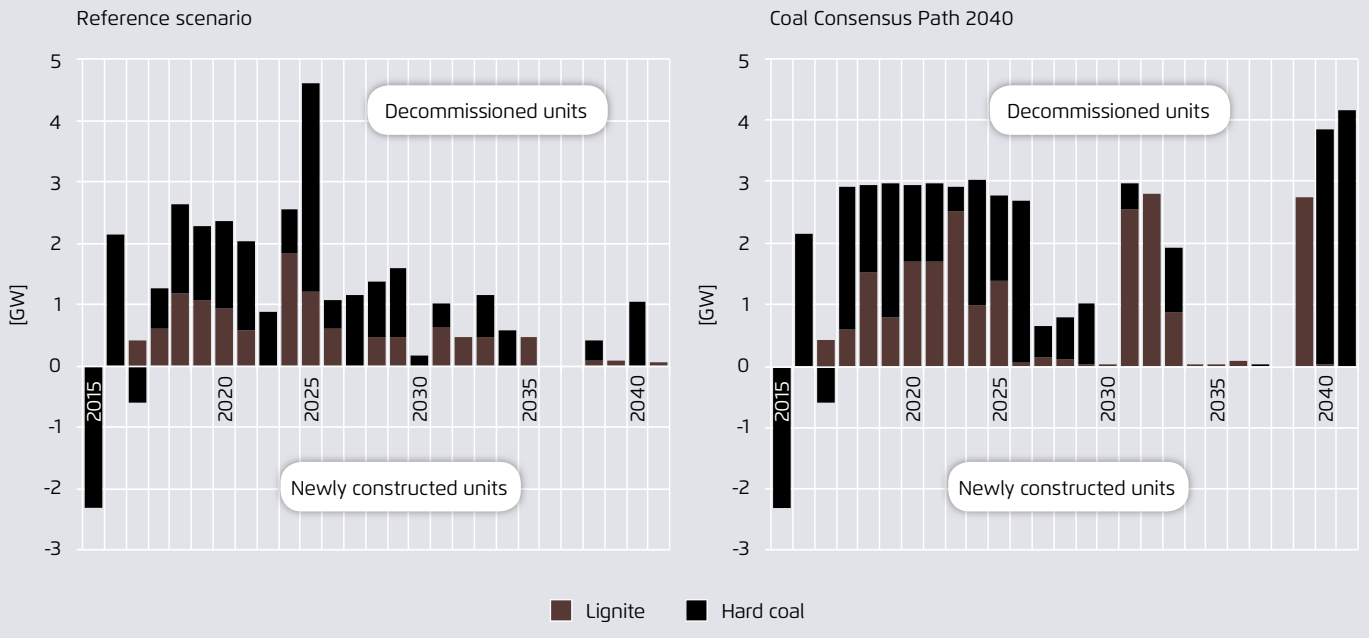
Annual capacity changes in the reference scenario and the proposed Coal Consensus Path 2040 Figure 6



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Principle 5: No additional national climate policy regulations for coal-fired power plants beyond the phase-out plan

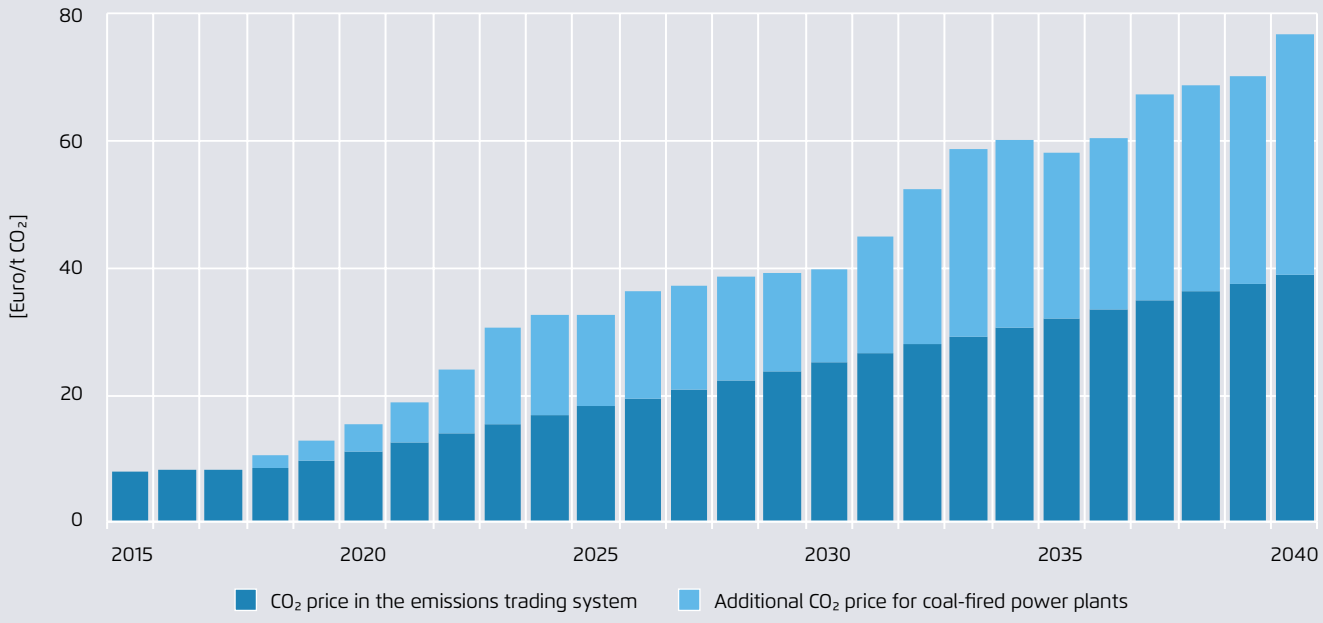
The German government should commit to adopt no additional climate measures that discriminate against the use of coal in a one-sided manner beyond the ratified phase-out plan. Furthermore, the German government should not grant any special benefits for decommissioning coal-fired power plants.

A consensus on coal based on an phase-out plan with residual lifespans is based on the regulations underpinning the consensus on nuclear power from 2000 and thus deliberately rejects the alternatives presented in 2015: Neither an additional CO_2 price for coal-fired power plants, as was proposed by the German Ministry for Economic Affairs and Energy in spring of 2015, nor a continuation of the lignite reserve, as it will now be implemented for 2016 to 2023, would be implemented. The reason is that both models require large cash transfers and thus cause pronounced redistribution effects.

If incrementally phasing out coal-based electricity were regulated in line with the Coal Consensus Path 2040 based on an additional CO_2 pricing for coal-fired power plants, there would have to be an additional coalspecific CO_2 price of about 15 euros per tonne in 2025. By 2035 it would need to be 26 euros per tonne and by 2040 it would have to rise further to just under 40 euros per tonne (see Chapter 4 of the long version).[61] This gives a total CO_2 price for coal-fired power plants of about 80 euros per tonne in 2040 (see Fig-

61 Due to adjustments in capacity, there are slight deviations in the results obtained for 2038, 2039 and 2040 in the Coal Consensus Path 2040 compared to the intermediate exit scenario (*Coal Phase-Out 2040*).

Necessary level of an additional CO_2 price for coal-fired power plants for emissions reduction in accordance with the proposed Coal Consensus Path 2040 Figure 7



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ure 7).[62] The result would be that coal-fired power plants are successively forced out of the market, linked with corresponding income transfers from the operators of coal-fired power plants to the state. In the hours during which these older coal-fired power plants set the price, the result would also be correspondingly higher average spot electricity prices.

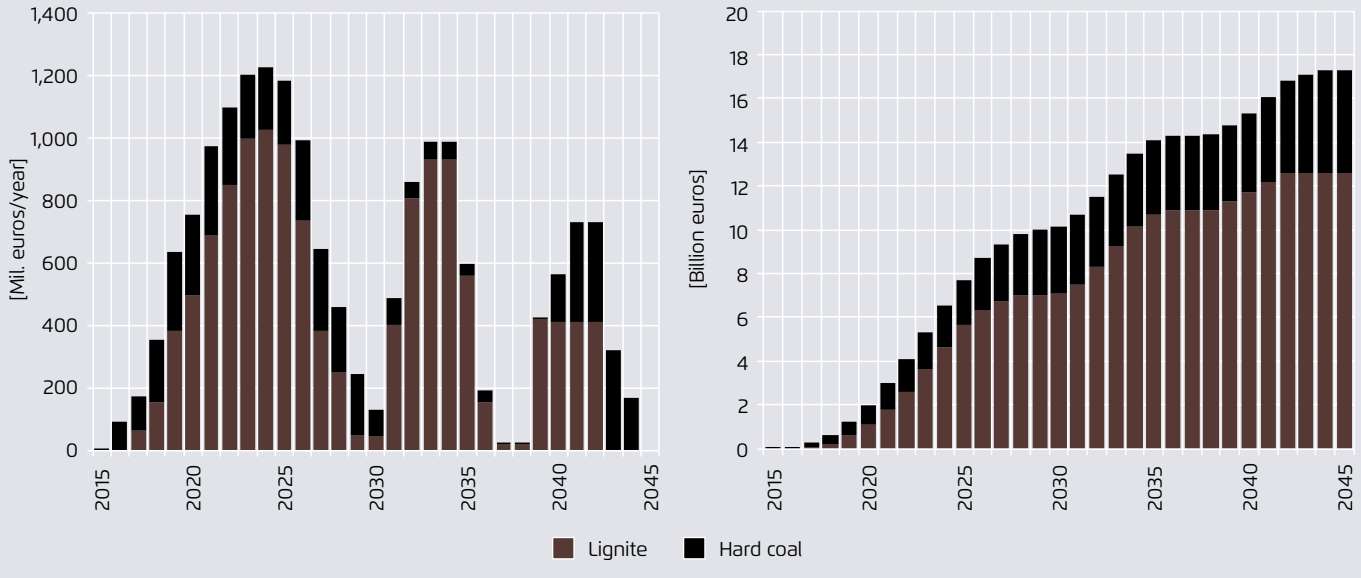
If the incremental phasing out of coal in line with the Coal Consensus Path 2040 were implemented based on a premium for decommissioning for all coal-fired power plants (similar to the principle of the lignite reserve as planned in the current Electricity Market Act), such a reserve would very quickly become very expensive (see Chapter 4 of the long version).[63] It is estimated, for example, that annually decommissioning three gigawatts of coal-fired power plants during the initial phase in the 2020s with four years spent as part of the capacity reserve would over time produce a 12-gigawatt coal reserve.

A reserve of this size would not be necessary neither from an energy economy perspective (12 gigawatts corresponds to just under three times the currently required capacity reserve) nor could it be technically implemented in any meaningful way because of long notice periods. In addition, it would also generate enormous additional costs that would be carried by electricity consumers: assuming the compensation of lignite-fired power plants in a future reserve would be about the same as reimbursement premiums that are currently paid in the lignite reserve (149 euros

62 These additional CO_2 prices are calculated in the *enervis* model using particular coal and gas price assumptions. Differing fuel price assumptions would lead to the different CO_2 prices; due to the difference in price between lignite and gas, total CO_2 prices of 80 euros per tonne until the last of the lignite-fired power plants are decommissioned are absolutely plausible, however.

63 Due to adjustments in capacity, there are slight deviations in the results obtained for 2038, 2039 and 2040 in the Coal Consensus Path 2040 compared to the *intermediate exit scenario* (*Coal Phase-Out 2040*).

Necessary payments (annual and cumulative) to operators of coal-fired power plants with a four-year coal reserve for decommissioning capacity as per the proposed Coal Consensus Path 2040 Figure 8



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per kilowatt and year) and compensation for hard coal-fired power plants that is slightly above the average fixed costs (40 euros per kilowatt and year), the decommissioning premiums would amount to 1.2 billion euros per year. By 2045 additional costs totalling about 18 billion euros could be expected.

The proposal by Agora Energiewende to not pursue either approach therefore balances out interests: there is no need for high income transfers from operators of coal-fired power plants to society – nor conversely, from the society to the operators of power plants. However, one component of balancing out interests in this way would be – analogous to the consensus on nuclear power – a binding assurance from the German government to not adopt any initiatives in future that would make coal-based electricity unilaterally more expensive as a result of measures agreed as part of the consensus.

Principle 6: No additional lignite mines and no further relocation processes of affected communities

As the incremental phase-out of power plants up to 2040 will mean that less lignite is needed, no new lignite mines or excavation areas should be exploited. Accordingly, numerous villages would be spared from relocation.

Developing new lignite mines or the further development of existing mines is not compatible with Germany's medium- and long-term emissions reduction targets nor is it necessary if coal-based electricity is phased out by 2040.

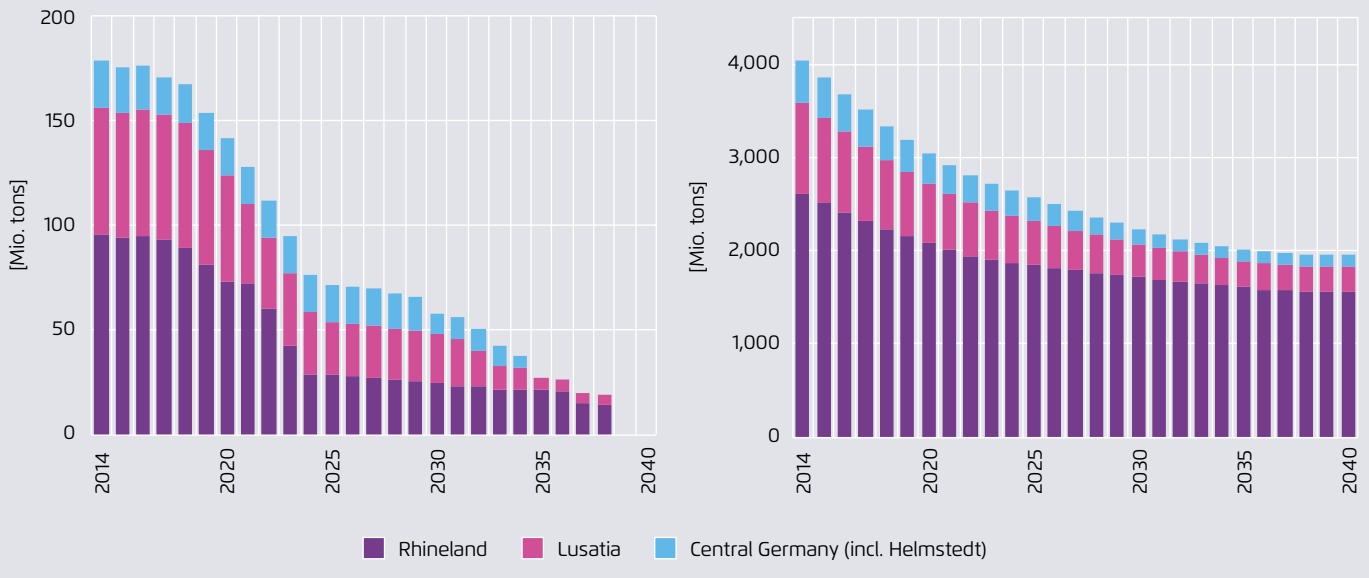
The additional analyses based on the results from *enervis energy advisors* show that the lignite requirement in line with the Coal Consensus Path 2040 in all three still active lignite mining regions is clearly declining compared to the current level (see Chapter 5 of the long version):[64]

- → In the Rhineland region, the annual lignite requirement will fall from the current 96 million tonnes to only 25 million tonnes in 2030 as power plants are decommissioned. In the final year of operation in 2038, only about 14 million tonnes would be required.
- → In Lusatia, the annual lignite requirement will fall from the current 61 million tonnes to only 23 million tonnes in 2030. In the final year of operation of lignite-fired power plants in 2038, only about five million tonnes will be required.
- → In Central Germany, the current quantity of lignite required of about 20 million tonnes will fall to 10 million tonnes yearly by 2030 and will no longer be required by

64 Due to adjustments in the changing capacity, there are slight deviations in the results obtained for 2038, 2039 and 2040 in the Coal Consensus Path 2040 compared to the average *exit scenario* (*Coal Exit 2040*).

Scenario for the annual lignite requirements and the quantities remaining in the lignite mines in the proposed Coal Consensus Path 2040

Figure 9



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the time the last lignite-fired power plant is decommissioned in 2032.

The open-pit mines currently being exploited are sufficient to cover the lignite requirement, taking into account the differences in the quality of the lignite from the various mines and the available mining and transport capacities. Developing new open-pit mines is therefore not necessary in any of the three regions (see Figure 9).

For the Rhineland region, the decision not to develop new lignite mines would not have any effects because no expansions to mines are currently planned in this region. So even taking into account the key decision regarding lignite passed by the North Rhine-Westphalia state government in 2015 to reduce Garzweiler II, sufficient quantities of lignite will still be available throughout the entire region.

For Lusatia the result would be that the new developments that are still planned by Vattenfall for Nochten II, Welzow-Süd II and Jänschwalde Nord need to be axed. In Central Germany the possible expansion of the Lützen mine is obsolete because it would only be necessary if a new lignite-fired power plant were developed at the Profen site.

By not developing any new lignite mines, the planned relocation of a number of villages will not be necessary. This affects primarily Lusatia, meaning that the residents of Rohen, Mulknitz, Schleife, Mühlrose and Trebendorf (Nochten II), Proschim and Welzow (Welzow-Süd II), and Grabko, Kerkwitz and Atterwasch (Jänschwalde Nord) do not need to be relocated. In Central Germany the development of the existing open-pit mines could be organised in such a way that it would no longer be necessary to relocate the village of Pödelwitz.

In the Rhineland region the government of North Rhine-Westphalia has already announced that the relocation of Holzweiler, Dackweiler and Hauerhof is no longer necessary as part of its key decision. Declining lignite demand will also enable one of the two open-pit mines Hambach or Garzweiler to be decommissioned in the middle of the 2020s, which is earlier than planned. However, this depends on optimising the operations of the open-pit mines as well as the power plants supplied by these mines. The corresponding reduction in the size of the Garzweiler II and/or Hambach mines (and associated with this, the question of whether the relocations that have already been completed should be re-evaluated as a result) would form part of a further development of the regional and state planning that the government of North Rhine-Westphalia would undertake.

Principle 7: The follow-up costs of lignite mining should be financed with a special levy on lignite

A foundation should be started to finance open-pit mine re-cultivation and other follow-up costs as Germany's lignite mines are decommissioned. This foundation should be funded with a special surcharge that is levied on all lignite that is mined in the future up to 2040. The amount of this levy will be set based on an environmental assessment that estimates future follow-up costs. Costs of approx. 2.5 euros per MWh of lignite-based power are expected.

With the foreseeable end of lignite mining in Germany, the question arises – analogous to the end of hard coal mining and phasing out the use of nuclear power – of how to finance the follow-up costs associated with mining once coal-based electricity is phased out. Clear handling of this issue is an essential component of a consensus on coal because, unlike the still controversial issue of nuclear power, there is still an opportunity here to agree to a solution that makes sense over the long term and is acceptable to all stakeholders many years before major rehabilitation obligations eventuate.

According to the German Federal Mining Act, the operators of lignite mines are obliged to bear the follow-up costs associated with the closure of open-pit mines and to rehabilitate any areas used after mining activities cease. To meet these obligations, the lignite mine operators have created liability provisions totalling 4.1 billion euros in their company balance sheets in 2014, the majority of which do not apply to the businesses RWE and Vattenfall.[65] The provisions are liabilities in the balance sheets that are covered financially by corresponding positive assets. Both for RWE and Vattenfall, tangible assets represent the majority of the long-term positive assets (RWE: 57 percent; Vattenfall: 73 percent). The value of the existing power plant park is considered to be part of the tangible assets, which in turn is derived from the proceeds expected from the power plants. In concrete terms, this means that the money to cover any obligations arising from lignite mining payable by the operators of the open-pit mines must still be generated from future operation of the power plant.

The current regulation results in the following disadvantages both for society and operators:

- **Appropriate level of the liability provisions is unclear:** It is not clear whether the provisions set aside by the operators totalling 4.1 billion euros to cover rehabilitation costs associated with the mines is actually sufficient. This is particularly important given that previous experience has shown that rehabilitation processes are often longer, more extensive and thus more expensive than initially planned.[66]
- **Availability of the provisions is uncertain:** Rehabilitation costs associated with mining are largely covered on balance sheets from expected proceeds by existing power plant parks. The change in proceeds in the future is, however, fundamentally determined by developments in the prices of fuel, CO_2 and electricity as well as possible changes in the regulatory frameworks. Forecasts for proceeds are therefore highly sensitive to assumptions. It is also not clear whether the operators of the lignite mines or their legal successors will be sufficiently solvent after the sites are closed to meet the requirements. If an operator is unable, for whatever reasons, to cover the full costs of mine site rehabilitation, these must be borne by society. Society thus has a justified interest in the transfer of mining-related provisions into liquid reserves.
- **Balancing the provisions as a barrier to economic development:** As part of the discussion about the provisions for decommissioning of and disposal of nuclear waste from nuclear power plants, the operators of the nuclear power plants proposed setting up a state-owned nuclear foundation in which the provisions are placed either in full

65 RWE (2015), Vattenfall (2015), MIBRAG (2013), FÖS (2014).

66 FÖS (2014).

or in part and at the same time the tasks required for the decommissioning and/or permanent disposal are transferred to the nuclear foundation. The advantage of this proposed fund is that, in light of the current legal situation, it is difficult for the affected businesses to obtain fresh capital from the financial markets to establish new areas of business. The same is also true regarding the question of the long-term rehabilitation costs associated with lignite.

To secure financing of the mining-related rehabilitation costs that will be incurred after the phase-out from lignite-based electricity, the following three-stage process is therefore proposed:

→ In the first stage, an independent expert report prepared on behalf of the German government, analogous to the KPMG report from 2006 on calculating the long-term liabilities associated with hard coal mines prior to phasing them out in 2007, will be used to check how much the expected mining-related rehabilitation and follow-up costs are likely to be. This check will be based on agreements made on phasing out coal-based electricity and closing open-pit mines by 2040.

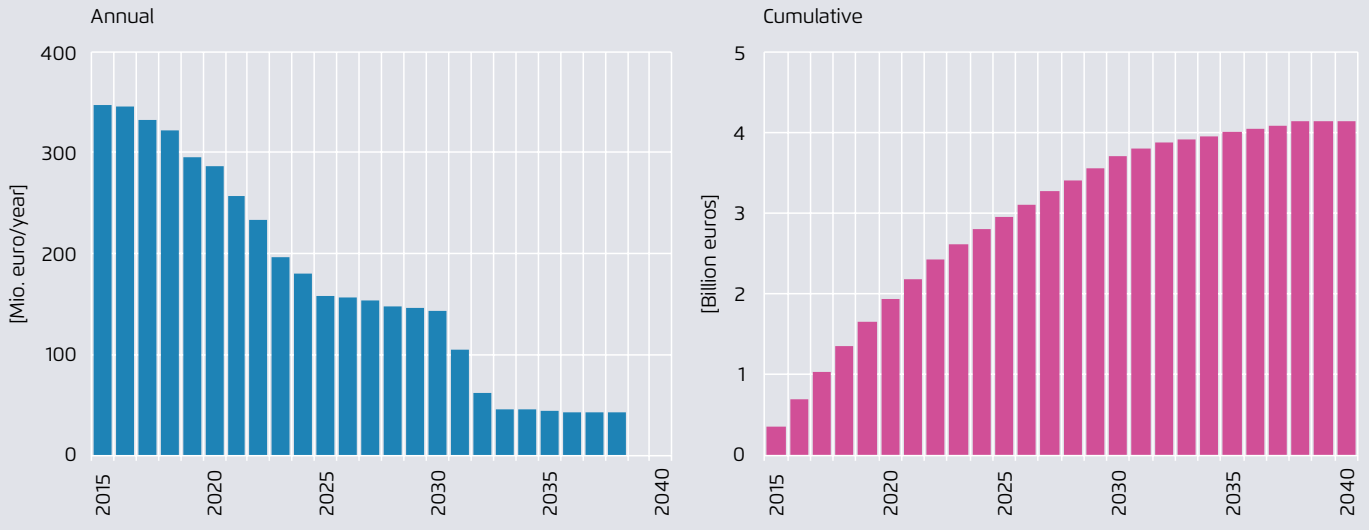
→ In a second stage, a lignite rehabilitation levy will be introduced from 2018 that will be collected and continuously paid per tonne of lignite mined. The levy will be transferred to a public 'fund for rehabilitation of open-pit mines and financing the follow-up costs associated with the mining of lignite', which will be organised as a foundation. This will take over the task of rehabilitation after mining has ceased.[67] Any rehabilitation measures required during ongoing operation of the open-pit mines remain, as always, the responsibility of the operator of the mine.

→ From 2018 onwards the operators of the lignite mines could then reverse their provisions for the rehabilitation

67 For some of the open-pit mines in eastern Germany, there is already a federally-owned organisation (LMBV) that carries out the rehabilitation of old open-pit mines from the former GDR. This organisation could also be commissioned to carry out the rehabilitation of the open-pit lignite mines after they have ceased operation.

Annual and cumulative payment of contributions* to a 'fund for rehabilitation of lignite mines and financing the follow-up costs associated with the mining of lignite' based on a levy on future electricity generation from lignite

Figure 10



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*based on the expected lignite generation in the Coal Consensus Path 2040 (according to Principle 4) and a lignite rehabilitation levy of 2.5 euros per MWh.

measures after the closure of the mine, because the funds required for this would then be generated via the lignite rehabilitation levy. Their balances would then be adjusted regarding this issue.

Because lignite is used essentially in electricity generation, such a levy increases the variable costs associated with the use of lignite. If it is assumed that the provisions to date are a suitable indicator of mining-related rehabilitation and follow-up costs for open-pit lignite mines once the coal exit is complete and these are linked to the electricity generation expected from lignite-fired power plants in the Coal Consensus Path 2040[68], this results in a lignite rehabilitation levy of about 2.5 euros per MWh.[69] Increasing the marginal costs for lignite electricity by such an order of magnitude is manageable for all stakeholders, barely changes the position of lignite in the merit order above hard coal and gas-fired power plants and creates planning security for both the community and the operators. Failing this, in 2030, shortly before the final closure of many open-pit lignite mines, the subject of rehabilitation costs associated with lignite will threaten to develop into a debate similar to that about the obligations associated with decommissioning nuclear power plants and permanent disposal of nuclear waste.

As an alternative to the procedure proposed here, it would also be possible to oblige the businesses operating the open-pit mines to not only cover the provisions on their books but also to hold them in liquid form as reserves and to plan legislation to ensure the availability and use of these reserves. It would also be plausible to set up a public fund as proposed, but instead of raising the necessary funds using the levy suggested here, it could be supplied by an obligatory transfer of the current provisions on the balance sheet. The most sensible way to resolve the issue should be agreed as part of the consensus on coal between the Federal and state governments and the operators. In any case, as part of the consensus on coal it is necessary to come to a long-term, workable agreement about how to finance long-term rehabilitation measures because otherwise high follow-up costs would be have to be borne by the particular *Länder*.

68 A payment bond for the lignite mined for electricity generation would also be plausible, for example.

69 The energy suppliers have created provisions in 2014 totalling 4.1 billion euros to cover their mining-related obligations. If the provisions set aside are divided by the lignite generation still expected with the Coal Consensus Path 2040, this produces a mean lignite rehabilitation levy of about 2.5 euros per MWh.

Principle 8: Creation of 'Structural Change Fund' to ensure a sound financial basis for structural change in affected regions

A "Structural Change Fund for Lignite Regions" should be created within the federal budget and outfitted with 250 million euros annually over the entire transformation period. Funding should be allocated to each region based on the number of jobs impacted in each respective lignite mining area. The governments of the *Länder* should decide on how this funding is spent.

The structural change accompanying the proposed phase-out does not pose a serious problem for the German economy as a whole. However, the impacted regions will be hit significantly. In the Rhine region, as in the Lusatia and Central German lignite regions, the fuels that are exploited are those that have provided a reliable source of electricity for the economies of the East and West for over half a century. In the face of climate change, however, the old business models cannot be followed indefinitely, and the old must make way for the new. Guiding the process of structural change in the lignite regions, which in 2015 still accounted for around a quarter of the electricity produced in Germany, must therefore be an integral element of the energy transition and of any consensus on coal.

In order to ensure that the structural change occurs in an orderly, socially responsible and timely manner, both the workers and families impacted by it and the affected regions will require coordinated assistance. This assistance should be sufficient to reassure both those affected and the relevant local and regional governments of its long-term sustainability.

"Coordinated assistance" means that the structural change should be implemented in a socially responsible, goal-oriented manner, involving intensive cooperation between authorities at the EU, federal, state and regional levels, and close consultation with those affected. Successfully managing the process of structural change in the lignite mining areas will call for more than just tried and tested strategies such as adjustment assistance, early retirement, social planning and other compensation mechanisms. Financial and other assistance from business-oriented and civil society initiatives will lay the foundations for forward-looking and sustainable development in the affected regions.

Responsibility for incentivising and supporting the structural change in the lignite mining regions lies principally with the federal government. This is because the political and social framework governing the energy transition and Germany's climate goals is set at a federal, and increasingly at a European or even global level – as the Paris Climate Conference recently reconfirmed. Managing the far-reaching consequences of structural change and ensuring they are integrated into a positive and sustainable regional development process is thus primarily a task for supra-regional authorities. Those whose livelihoods are affected by the energy transition have a right to expect that the political and civil society decision-makers who have instituted it, however valid their reasons, will show their solidarity and practical support by putting appropriate structures in place.

First and foremost, then, the federal government must implement reliable and sustainable measures to manage structural change, and these must go beyond the existing structural resources for economically disadvantaged areas. Such an intervention on the part of the federal government is not only necessary; it is indeed possible. The impending structural change – which in fact is already underway – can potentially be managed far more successfully than its larger – scale precursors, as long as those affected by it are brought on board. Today's Germany is a more prosperous country than the West Germany that had to deal with structural change within its hard coal mining industry in the 1970s. And it is also a more prosperous country than the newly reunited Federal Republic that had to cope with the (partial) collapse of lignite mining in East Germany in the early 1990s.

An appropriate framework should link the structural assistance awarded to the respective lignite regions to the amount of value added that will be lost through the early closure of the lignite power stations and the gradual reduction of output relative to the reference scenario. According to figures from the *Bundesverband Braunkohle* (DEBRIV), the direct and indirect gross value added generated by the average job in the lignite industry is around 300,000 euros per year.[70] Comparing the expected value added on a business as usual scenario[71] to the value added on the proposed Coal Consensus Path 2040 results in a gross value added loss of 17.6 billion euros between 2015 and 2040. On average, this amounts to a loss of 700 million euros per year over these 25 years.

Agora Energiewende thus proposes that a structural assistance fund (a 'Structural Change Fund for Lignite Coal Regions') be established within the national budget and outfitted with 250 million euros annually over the entire transformation period. This figure represents just over a third (35 percent) of the gross value added that will be lost due to the phasing out of coal. Through the distribution of these funds, the aim will be to create roughly as many jobs as will be lost through the early decommissioning of lignite power stations and the reduction of lignite mining over the next 25 years. The funding level of around a third of the gross value added corresponds to the investment assistance level in the federal programme for economically disadvantaged areas (tasked with the 'improvement of regional economic structures'), which in 2016 is outfitted with 624 million euros.[72] In addition, the new jobs will indirectly create added value, thereby triggering a multiplier effect.

The 250 million euros should be used in a targeted manner to provide economic and structural assistance to the impacted regions and distributed according to the number of employees in the lignite industry in each federal state. This would mean that the funds would be divided roughly equally between western and eastern Germany. The funds will serve to stimulate the economies of the impacted regions, particularly since the figure of 250 million euros will initially exceed the lost value added, as lignite extraction and energy production will only gradually be reduced.[73]

As in the GRW program, the funds should be administered by the impacted *Länder* of North-Rhine Westphalia, Brandenburg, Saxony and Saxony-Anhalt. Funds from the 'Structural Change Fund for Lignite Regions' should be allocated by the *Länder* in which the impacted regions are located, through a clearly defined assessment procedure. This is because the *Länder* have a better understanding of the needs of particular regions and are thus better placed to ensure the efficient use of the funds than the federal government or European institutions. Potential projects may include:

- → Expansion of infrastructure for regional development in all of the impacted regions (e.g. along the lines of the 'Innovationsregion Rheinisches Revier' project in North-Rhine Westphalia – which has nevertheless still not been provided with adequate funding).
- → Support for initiatives undertaken by traditional power plant operators,[74] e.g. the establishment of new gas-fired power plants on the sites previously occupied by coal-fired power plants.
- → Support for the establishment of new energy generation facilities using renewable energy or maximising energy efficiency.

70 According to DEBRIV (2015), the lignite industry's total gross value added in 2014 was around 6.5 billion euros. With around 21,500 people directly employed in the industry at present (Statistik der Kohlenwirtschaft (2015a/b), this equates to around 300,000 euros per job per year.

71 Reference scenario (Chapter 5 of the long version).

72 German Bundestag (2015b).

73 By way of comparison: in addition to the financial assistance provided by the European regional development fund and the European Social Fund ERDF/ESF, in 2014 economic stimulus packages in the whole of Brandenburg totalled 230 million euros, in Saxony 247 million euros and in Saxony-Anhalt 156 million euros. In addition to the ERDF funding, North-Rhine Westphalia was endowed with a special regional development fund for economically disadvantaged areas worth 84 million euros.

74 IÖW (2015).

- → Targeted funding and relocation assistance for civil society initiatives and companies that contribute to the (further) diversification of the regional economic structure beyond the energy sector.
- → Funding for infrastructure (particular in eastern Germany), e.g. improving rail, road and IT connections in the impacted regions.
- → Funding intelligent uses of decommissioned industrial and power plant premises by businesses and industry (e.g. as logistics centres).
- → Funding research that enables the impacted regions to move forward as innovative energy centres in renewable energy and energy efficiency.
- → Development of cross-border relocation projects with the neighbouring countries of Poland, Belgium and the Netherlands.
- → Creating opportunities for exchange with regions in Germany and abroad that have successfully implemented innovative and sustainable energy initiatives while undergoing similar processes of structural change.[75]

75 One example is the 'Sustainable Cleveland 2019' initiative, which has been implemented in a US coal-mining region undergoing a process of structural change.

Principle 9: Ensuring security of supply over the entire transformation period

Policymakers should monitor the phase-out and ensure adequate reserve capacities, thus guaranteeing the usual high level of security of supply in Germany now and in the future. In order to achieve the greatest cost efficiencies, a procurement process that does not give preference to certain technologies should be held for the provisioning of reserve capacities. This procurement process will be monitored on a continuous basis, particularly after 2025, when the construction of new gas-fired power plant capacity is expected to become necessary. At the end of the phase-out period, a portion of the last coal-fired power plants to be shut down will held as reserve capacity for an interim period.

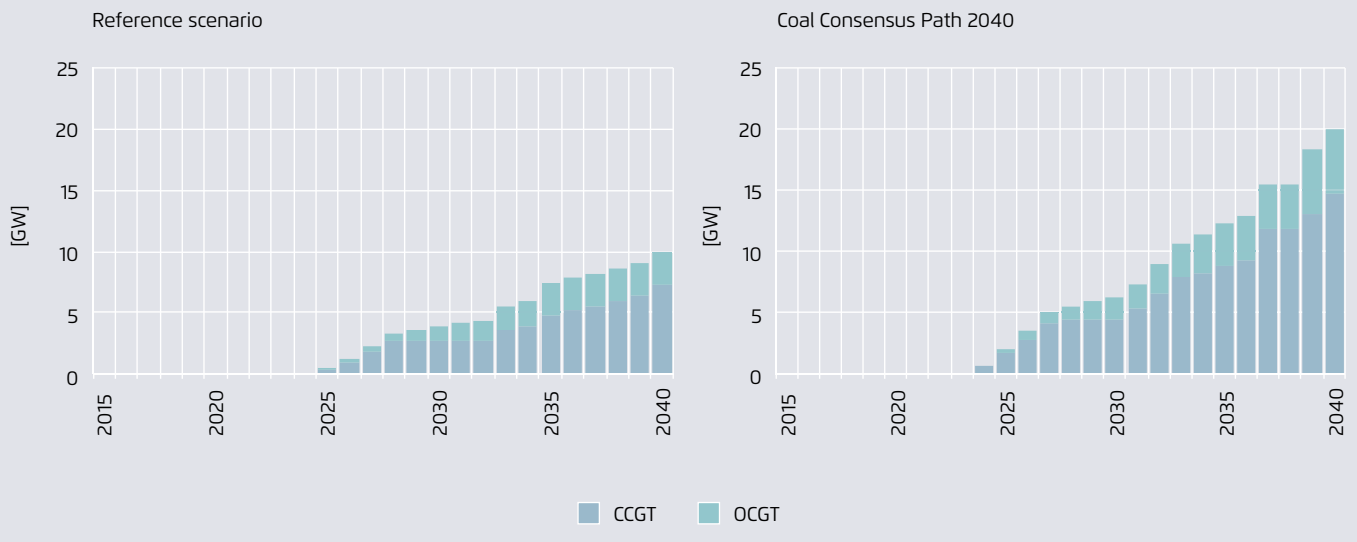
In comparison with other countries worldwide, Germany has an extremely reliable electricity supply. On average, there are only 12 minutes of unplanned power outages per year,[76] and none of these outages are due to insufficient electricity generation capacities. This reliability must be maintained throughout the coal phase-out.

This requires risks to be identified early on. In accordance with §51 of the Energy Economy Act (*Energiewirtschaftsgesetz – EnWG*), the Federal Ministry for Economic Affairs and Energy regularly monitors the security of the electricity supply, and its assessment will soon also take into account the regional integration of the electricity markets. This amalgamation of the European electricity markets will ensure security of supply at a lower cost, since peak loads and generation capacities will be harmonised in the regional

76 BNetzA (2015).

Model-based capacity additions of the new natural gas-fired plants required on the reference scenario and on the proposed Coal Consensus Path 2040

Figure 11



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network, thus requiring lower overall generation capacities.[77]

A portion of the capacity previously provided by the decommissioned power plants will nonetheless need to be provided by new domestic gas-fired power plants. In supplementing the energy generated using renewable sources, these will ensure that demand is met and that sufficient capacity is maintained at all times. The existing load flexibility presupposed by the model ensures that the decommissioned power plant capacity will not need to be replaced on a one-to-one basis.

Nevertheless, the model produced by *enervis energy advisors* predicts that a significant number of new gas power plants will need to be constructed during the middle stage of the phase-out, particularly after the decommissioning of the surplus capacity in 2025. According to the model, a coal phase-out in line with the Coal Consensus Path 2040, as opposed to the reference scenario, will require up to 10 gigawatts of extra capacity to be built, thus resulting in the construction of 20 gigawatts of new capacity by 2040.[78] In order to further guarantee security of supply, the 2015 draft electricity market law provides for a reserve capacity of around five per cent of the average yearly peak load, which will function as an emergency fall-back option. This will only be drawn upon if a balance between supply and demand has not been reached on the electricity exchange even after a second tender offer has been issued. The power plants contractually bound in to the reserve scheme will remain outside the electricity exchange and licenses for these facilities will be awarded through a process of competitive tender.

The overall structure and size of this safety net should be continually monitored. From 2025 in particular, when a significant expansion of the gas-fired power station network will be required, market conditions will need to be continually and carefully observed. Should it not be possible to bring sufficient new power plant capacity on to the market in time, the capacity reserve may need to be increased.[79] Furthermore, toward the end of the phase-out and for a few years after its completion (2040–2043), the reserve capacity should be temporarily expanded to include a number of the decommissioned hard coal-fired plants. This is necessary because the phase-out plan will involve taking eleven gigawatts of coal-based electricity off the market in a relatively short space of time. Since they were only commissioned in 2014/2015, the hard coal power plants will not yet have been in service for 27 years by 2040 and should thus be added to the reserve capacity for one to three years in order to guarantee Germany's high security of supply during the end phase of the energy transition.

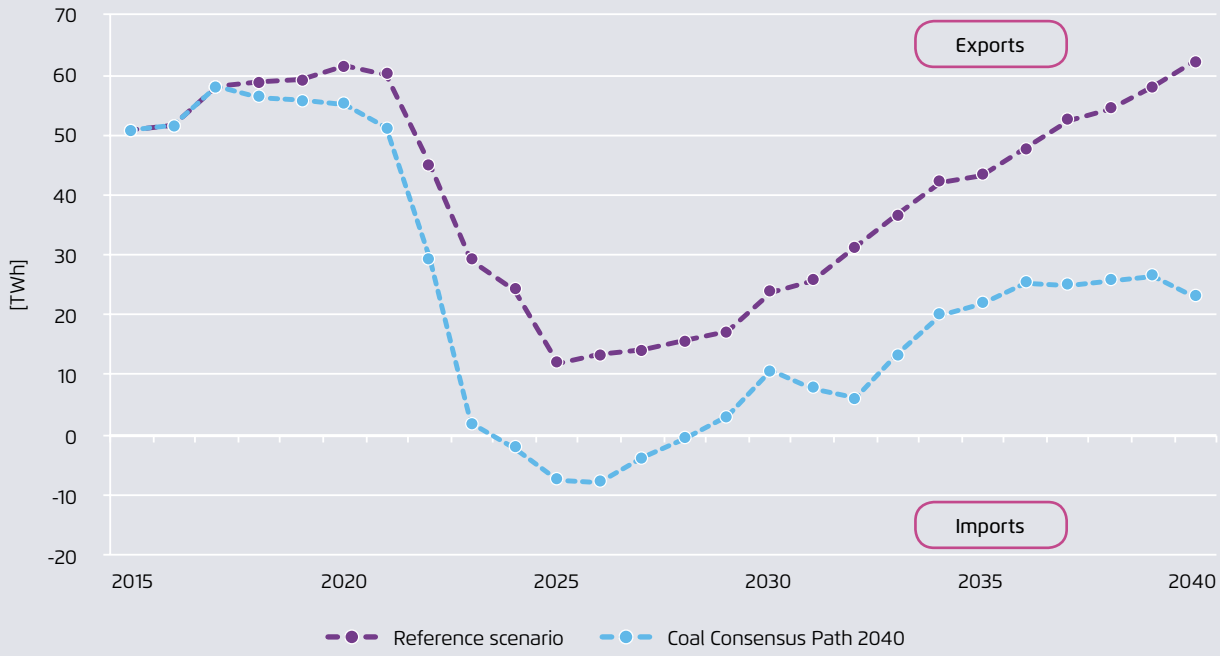
The change in capacity levels will also affect Germany's energy relations with other countries. For some years now, Germany has been a net electricity exporter. This will gradually change as the coal-phase out progresses; the structural export surplus will be successively reduced and Germany will become a net electricity importer during a transitional period between 2023 and 2028. The current export balance of around 35 terawatt hours in 2014 will temporarily be reduced to an import balance of 8 terawatt hours in 2025 and 2026. This will result from economic optimisation measures undertaken by power plant operators in Germany and neighbouring countries within the European energy market. The expansion of renewable energy generation in Germany will lead to the reversal of the import surplus by 2029, when Germany will again become a net electricity exporter.

77 Consentec/r2b (2015).

78 Due to the adjustment of capacity, small deviations can be observed between the Coal Consensus Path 2040 and the *Intermediate Phase-Out Scenario* (*Coal Phase-Out 2040*) in 2038, 2039 and 2040.

79 In this case, it would be advisable to reconsider whether a capacity market may be a more efficient means of securing the security of supply.

Electricity import/export balance in the reference scenario and the proposed Coal Consensus Path 2040 Figure 12



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Principle 10: Strengthening EU Emissions Trading and the prompt retirement of CO_2 certificates set free by the coal phase-out

The German government should encourage a stronger Emissions Trading Scheme at the EU level, particularly against the backdrop of the pledges made at the Paris Climate Conference for more ambitious efforts in the EU. In this context, a rule should be introduced for the permanent retirement of CO_2 certificates that are set free.

The EU Emissions Trading Scheme is a key instrument to reduce GHG emissions in the energy sector. In all EU countries, it forms part of a policy mix[80] with a number of other instruments, particularly those pertaining to renewable energy and energy efficiency. In Germany, these include the Renewable Energy Act, which ensures funding for renewable energy projects, and the regulatory and funding measures provided for in the National Action Plan on Energy Efficiency (NAPE).

Nevertheless, since CO_2 prices seem set to remain low for the foreseeable future, it is necessary to establish other instruments to work alongside emissions trading, such as a coal phase-out schedule.[81] Other EU member states have already introduced similar national measures, such as Britain's CO_2 floor price and planned coal phase-out by 2025, and the Netherlands' energy agreements and parliamentary resolution on phasing out coal.

The ultimate goal should nonetheless be to bolster the Emissions Trading Scheme as the key climate instrument in the European policy mix. Following the 2014 resolution to establish a Market Stability Reserve and raise the linear reduction factor to 2.2 percent per year by 2021, further reforms are not expected for the time being. Nevertheless, the pledge made by the Paris Climate Conference signatories to raise their climate protection ambitions every five years will make 2019 a significant year, since the next World Climate Conference will take place in 2020. In 2019, there will be greater pressure to discuss the reform and intensification of the EU Emissions Trading Scheme, so as to increase the EU contribution to climate protection at the 2020 World Climate Conference. The German government should prepare for this debate in good time and use it as an opportunity to bolster the Emissions Trading Scheme.

An important question in this debate will be how to deal with emissions surpluses. In line with current EU law, the German coal phase-out will result in lower emissions both in Germany and in Europe as a whole, since the lost coal-based electricity will be replaced by power from domestic and foreign fossil fuel plants that is half as CO_2-intensive.[82] Yet this process will also set free EU emissions certificates which – alongside the two billion surplus certificates already in the system – will generate further surpluses. These certificates represent emissions entitlements within the EU Emissions Trading Scheme, which in principle can be redeemed at any time and place in Europe. Were this to happen, it would nullify the climate protection achievements of the coal phase-out.

The Market Stability Reserve that will come into effect in 2019 will help guard against this eventuality. In future, the over two billion surplus certificates currently on the market will gradually be withdrawn until the surplus is reduced to 833 million tonnes. Nevertheless, since this will be a slow process and since it is likely that that the demand for electricity will be further reduced on the back of poor economic performance in parts of Southern Europe and energy efficiency advances across Europe, the Market Stability Reserve can be expected to grow to around three billion certificates by 2025.[83]

80 IEA (2011), Öko-Institut (2010).

81 Agora Energiewende (2015b).

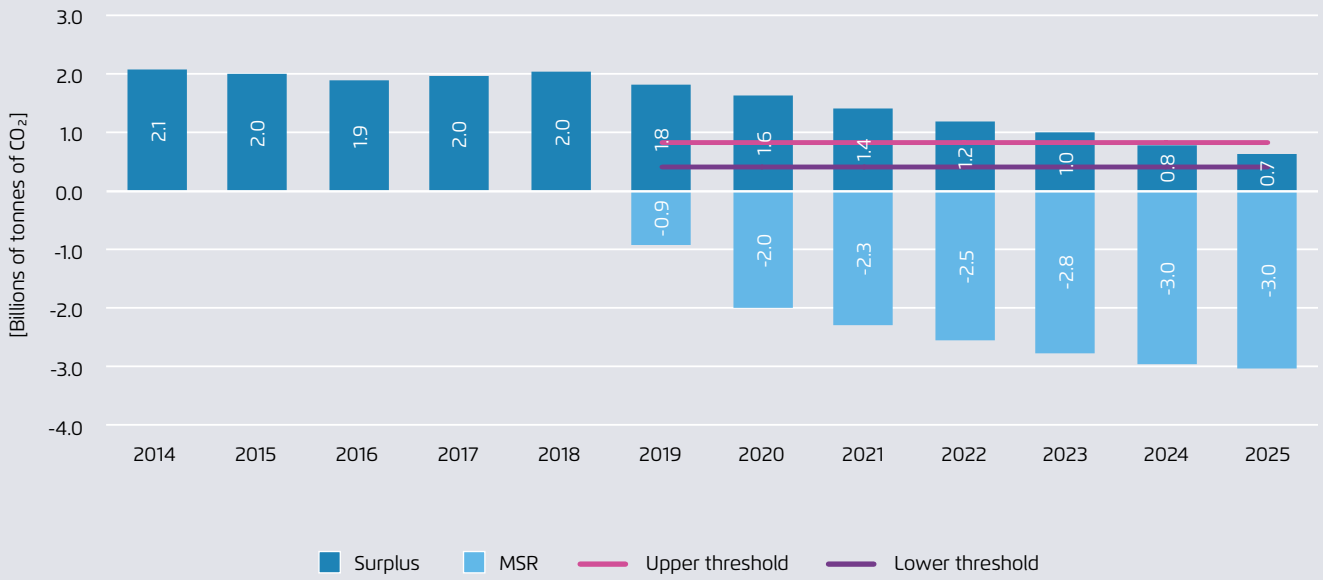
82 enervis (2015b)

83 Agora Energiewende (2015b).

Current regulations state that if the surplus on the emissions market falls below 400 million tonnes, the certificates in the Market Stability Reserve should be returned to the market. Such an eventuality – which on all of the scenarios analysed would not occur until 2025 at the earliest – would result in the certificates set free through the coal phase-out being released back on to the market, thus resulting in additional CO_2 emissions.

Agora Energiewende thus proposes that when the EU emissions trading guidelines are next revised, the German government should push for a rule ensuring the permanent retirement of CO_2 certificates set free through special national initiatives. In addition, any certificates in the Market Stability Reserve above a certain level (e.g. 500 million certificates) should also be permanently retired, since releasing them back on to the EU emissions market would undermine the shortage necessary for a functioning market. The elimination of two to three billion surplus certificates from the EU Emissions Trading Scheme, thereby effectively removing two to three gigatonnes of CO_2 from the atmosphere, would constitute a significant contribution to the 2020 World Climate Conference and would send a strong message concerning the need to raise climate protection ambitions.

Expected development of EU Emissions Trading Surpluses and the Market Stability Reserve — Figure 13



Own presentation, Agora Energiewende (2015b)

Principle 11: Ensuring the economic competitiveness of energy-intensive companies and the German economy as a whole during the transformation process

Due to increasing renewable energy generation and the merit order effect in Germany, wholesale prices for electricity are expected to remain low in the future. Policymakers should nevertheless reassure actors in the private sector, particularly energy-intensive companies, that measures will be taken to ward off any negative effects to international competitiveness that are associated with the coal phase-out. At the same time, policymakers should create incentives for greater energy efficiency and the further decarbonisation of the private sector on the whole, for such incentives would not only serve the environment, but also bolster economic competitiveness.

Germany has a strong industrial sector, with numerous highly competitive international companies in the sectors of machine building, systems engineering, and other fields. The coal phase-out should therefore be managed in such a way as to maintain the competitiveness of, and generate new opportunities for, German industry. Intelligently shaping the energy transition and the associated economic policy will serve to prevent bad investments and promote innovation.

Wholesale electricity prices are not only low at present; electricity forward contracts up to 2021 are also listed at under 30 euros per megawatt hour. This is due to current low fuel and CO_2 prices and to the large (and constantly growing) market share held by renewable energy (the merit order effect). The model-based analysis conducted by *enervis energy advisors* presupposes that electricity prices will rise in the coming years – both on the reference scenario and the Coal Consensus Path 2040. This is based on the underlying assumption that coal, oil and gas prices will continue to rise on world markets. In its current World Energy Outlook (2015), the International Energy Agency (IEA) also predicts that these prices will rise significantly in future. Nevertheless, at the present time, such predictions appear rather optimistic. Should they fail to materialise, as a number of indicators would seem to suggest, the overall energy price will also remain low. On the whole, it can then be assumed that wholesale electricity prices in Germany will remain below the European average, particularly considering the ever increasing market share held by renewable energy.

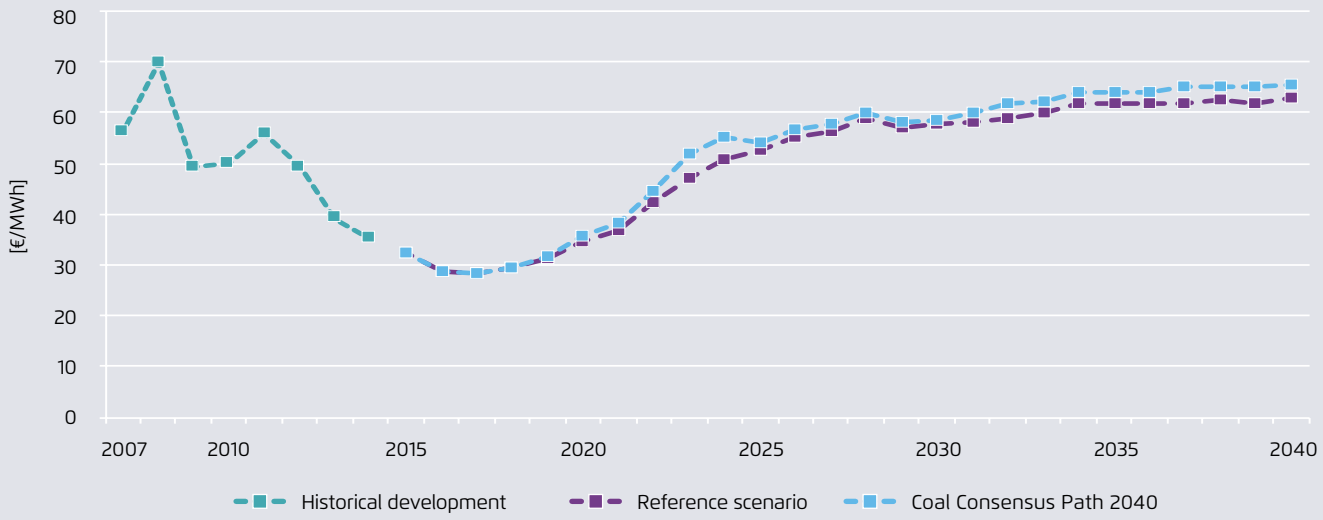
Where the coal phase-out is concerned, however, what is important is not the absolute price, but rather the price difference between the scenarios. The analysis shows that on the Coal Consensus Path 2040 the wholesale electricity price will only be moderately higher than on the reference scenario, as long as the coal phase-out takes place gradually and in line with CO_2 abatement costs. On average, the wholesale electricity price will be around 2.5 euros higher per megawatt hour on the Coal Consensus Path 2040 than on the reference scenario (Figure 14).

Though all electricity users would be hit by these additional charges of 2.5 euros per MWh, the consequences for German industry as a whole would be negligible, since electricity costs as a percentage of gross output[84] in many branches of industry is around two per cent (see Figure 15). An electricity price rise of five per cent would thus only increase total production costs by 0.1 percent.

Nevertheless, the electricity price does have a significant effect on the competitiveness of energy-intensive compa-

84 The gross output percentage is only one possible measure of energy costs. These costs can also be measured as a percentage of the gross value added. Indeed, the expert commission on monitoring the energy transition recommended using the relation between direct energy costs and gross value added as an indicator of energy unit costs (Expertenkommission, 2015). This energy cost indicator (expanded to incorporate the direct energy costs from intermediate products, thus making it an indicator of the 'total energy unit costs') shows that although energy costs in Germany have risen, they remain low in comparison to Europe as a whole, and that costs have risen more sharply in Europe as a whole than in Germany.

Wholesale electricity price (base) in the reference scenario and the proposed Coal Consensus Path 2040 Figure 14



EEX, own presentation

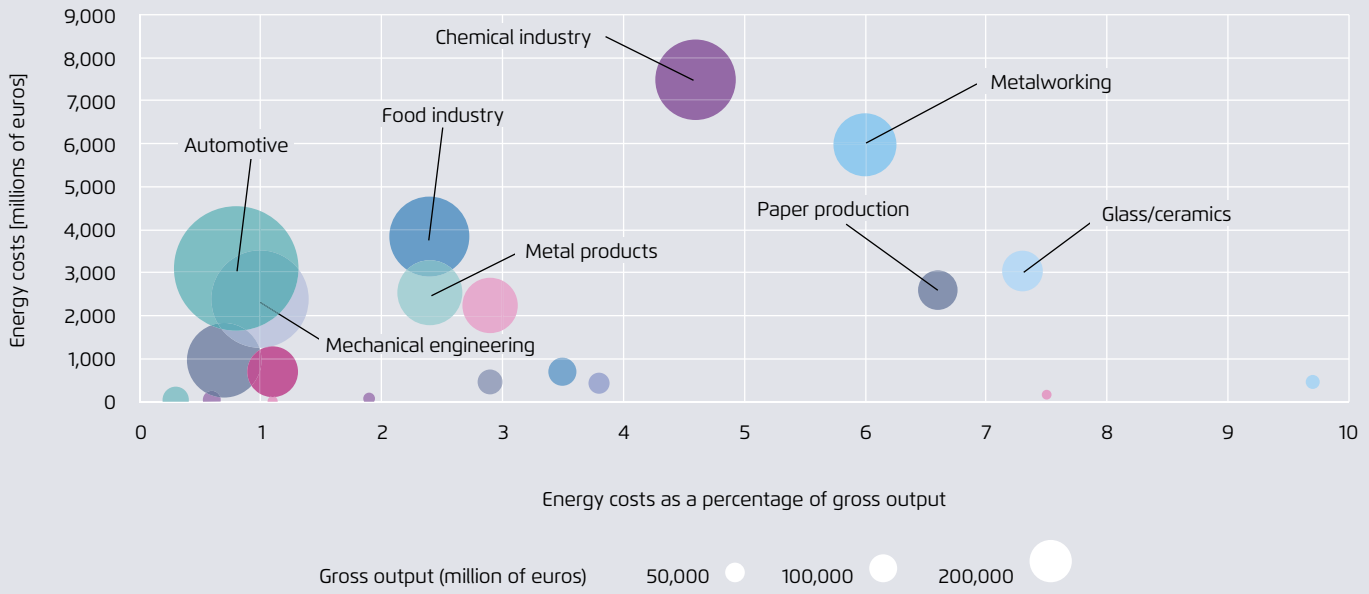
Note: The electricity price rises expected on all scenarios between 2018 and 2025 are primarily based on the assumption that CO_2, coal and gas prices will rise, in line with the long-term expectations of the IEA's World Energy Outlook (2015). The price projections developed on this basis are thus sometimes significantly higher than those expected by market players, which indicates that the latter also predict lower commodity prices. For the further analyses and conclusions of the study, however, these absolute electricity prices are only of limited relevance, since what is important is the difference between the two scenarios.

nies. Though the crucial factor here is the relation between future price trends in Germany and in the relevant competitive markets, there is justified concern that a significant rise in electricity prices in Germany over against other markets would impair the competitiveness of energy intensive companies – even if the current wholesale electricity price in Germany is well below the European average. In the past, the German government has therefore granted extensive derogations in order to support energy-intensive companies. In order to prevent undue burdens being placed on such companies, the German government should commit to ensuring their continued competitiveness through the implementation of appropriate measures. It should also consider how best to create incentives to improve energy efficiency and further decarbonise the energy supply, both within energy intensive industry and in other economic sectors. There is still a great deal of potential for process innovation in these areas.

The energy transition is a transformative process which involves the creation of new technologies. This process requires new business models that are capable of fostering industrial innovation and opening up new markets. In this context, German economic policy should aim to ensure that German industry is prominently positioned on the global growth markets for renewable energy and energy efficiency. In the coming years, the lower cost of establishing wind and solar energy facilities will give rise to a global mass market for renewable energy, particularly since there is great demand for energy in newly industrialising and developing countries, and wind and solar facilities can be built comparatively quickly. Across the world, efforts will be focussed on establishing a secure electricity supply based on wind and solar power. Germany will thus be well placed to utilise the expertise and technological advances developed in the course of the energy transition.

In doing so, it will be important to learn from the mistakes of the past and to play to the traditional strengths of German industry. This means servicing world markets through the provision of mechanical and plant engineering, systems technologies, and expert services. Drawing on the techno-

Gross output, energy costs, and energy costs as a percentage of gross output by sector in 2013 Figure 15



BMWi (2015c), on the basis of data from the Federal Statistical Office

logical and scientific advances Germany has made through the construction of a large number of wind and solar facilities as part of its flexibility options, German companies will be able to take advantage of new export opportunities. Three of the ten world-leading wind farm manufacturers, for example, are German companies. The leader in this field, however, remains a company from Denmark – a country known for its pioneering approach to wind power. Forging a sustainable energy policy thus requires recognising global trends at an early stage and mobilising innovative forces to ensure that German companies play a leading role on the world stage.

4 Conclusion

Since 1990, there have been three major constants in Germany's climate and energy policy:

1. **Leading the way in climate politics.** Since the 1992 Rio Earth Summit and the National Climate Protection Programme launched in the same year under Chancellor Helmut Kohl, Germany has been leading the way in climate politics, and continues to do so today. In the last 25 years, Germany has pushed for integrated and ambitious policies at all international climate negotiations. In this it has been represented – independently of their party affiliations – by environment ministers Klaus Töpfer, Angela Merkel, Jürgen Trittin, Sigmar Gabriel, Norbert Röttgen, Peter Altmaier, and now Barbara Hendricks. In addition, every German government since 1990 has set out an extensive national climate protection programme and has implemented legal measures to ensure that Germany lives up to its responsibilities as the world's fourth largest industrial nation. This tradition was continued during Germany's presidency of the G7, when it made an important contribution to the success of the Paris Climate Conference through its hosting of the prior summit at Schloss Elmau. Likewise, Germany also played a leading role at the Paris conference itself.

2. **Reaching consensus in major debates.** Germany's national energy policy has long been marked by major disagreements on questions such as the future of hard coal mining or the phasing out of nuclear energy. Nevertheless, all of these conflicts have ultimately been resolved through cross-party, consensual agreements. Agreement was reached in 2007 over the future of hard coal mining, and in 2011, following the Fukushima disaster, over the phasing out of nuclear power, through recourse to the nuclear power consensus of 2000. Ultimately, all stakeholders came to recognise that a consensual resolution of the party-political differences would be the most desirable outcome – including the impacted employees and companies, for whom planning security and reliability were preferable to the uncertainty that would accompany a continuation of the dispute.

3. **Reorienting the energy system towards renewable energy while supporting German industry.** The decision to promote renewable energy was made official with the Energy Feed-In Act of 1991, whose stipulations were subsequently taken further by all governments. As a result, renewable energy now accounts for almost a third of total electricity consumption in 2015. The various governments were also concerned to maintain the competitiveness of German industry – particularly in Europe – as an essential pillar of German prosperity. This led to the establishment of extensive derogations for German companies with respect to eco-taxes, emissions trading, network fees and the renewable energy law.

In light of these constants, a consensus on coal would be a natural step, if not an urgent one. For Germany cannot both preside over an energy transition and maintain a dependence on coal – particularly after the Paris agreements. A coal phase-out is thus unavoidable. In order for it to be conducted in a fair and responsible manner that leaves adequate time for preparation, it should be planned as soon as possible and on the basis of cross-party consensus, rather than in five-to-ten years at the end of a long conflict, with all the negative consequences the latter would bring. A consensus on coal is thus necessary to ensure that Germany's climate goals are reached and that there remains adequate planning and investment security in the German economy.

The time is ripe for negotiations on a consensus on coal that will pave the way for the gradual phasing out of coal-based power. This has become even clearer following controversial debates around Germany's contribution to climate protection and lignite security in the second half of 2015, which is why Agora Energiewende has elaborated the above principles through an intensive process. Though the future will always remain uncertain, their practical applicability has also been established to the best of our knowledge. These eleven principles for a consensus on coal are intended to provide an impetus for an engaged and goal-oriented discussion that we hope will get underway early in 2016.

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How do we accomplish the *Energiewende*? Which legislation, initiatives, and measures do we need to make it a success? Agora Energiewende helps to prepare the ground to ensure that Germany sets the course towards a fully decarbonised power sector. As a think-&-do-tank, we work with key stakeholders to enhance the knowledge basis and facilitate convergence of views.

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