Submission No 248

SUSTAINABILITY OF ENERGY SUPPLY AND RESOURCES IN NSW

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To the attention of Mr. Alex Greenwich, Chair of Inquiry on "Sustainability of energy supply and resources in NSW"

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Dear Mr Greenwich

I would like to draw your attention to the final report of the "Commission on Growth, Structural Change and Employment" of the German government that was issued in January 2019. In this report, the Commission proposes a stepwise decline in coal-based electricity generation in Germany. I personally was a Co-Chair of this commission.

I consider our process of consensus-finding round table as a role model for designing a just transition towards a sustainable energy system and a strong economy and society.

The Commission consisted of 28 members from electricity industry and business associations, unions, non-governmental associations, local governments in the regions affected by coal mining and/or an earlier phase-out, and scientists (engineers, climate physicists, economists). They unanimously (27 votes, 1 anti-vote from a town to be destroyed anyway) agreed that a phase-out will lead to a future that is advantageous to all of them.

Germany has large resources in lignite with mines concentrated in two regions (mostly Northrine-Westphalia and Lusitia). At the time of the Commission (June 2018-January 2019), about 20 Gigawatt installed capacity in lignite power generation and about 23 Gigawatt of hard coal power plants were active in the electricity supply system, delivering approximately 37 Percent of the total electricity in Germany. Germany actually closed down its hard coal mines in another "just transition" of stepwise decline and ended hard coal mining in December 2018.

The main arguments are economic and social. The business associations cleary state that renewable energy will become cheaper than fossil energy soon. Consequently, they insist on increasing the share of renewables in electricity as proposed by government (65% of electricity to come from renewables in 2030, and 80% in 2050). The unions and regions worry about their future (jobs, regional welfare) and will be compensated for income losses as well as with infrastructure investment to attract new industry in time. A stepwise, foreseeable decline in coal seemed more acceptable than continued struggles and fears around an insecure future.

I attach an electronic copy of the report in English which can also be found on the website of the German Ministry for the Economy:

https://www.bmwi.de/Redaktion/EN/Publikationen/commission-on-growth-structural-change-and-employment.html

Australia has abundant coal reserves and abundant solar and wind potential at the same time. Climate change will change the economics of coal in the near future. We highly recommend that Australia starts a similar societal consensus / commission process to start the transformation of the energy sector in time.

Please do not hesitate to contact me if you have further questions.

Kind regards,

Barbara Praetorius

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Commission on Growth, Structural Change and Employment

Final Report

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Content

1. Introduction

In its appointment resolution of 6 June 2018 the Federal Government convened the Commission on Growth, Structural Change and Employment to develop a broad social consensus around structural changes to energy and climate policy in Germany. The primary focus here is on providing concrete prospects for new, future-proof jobs in the regions affected. The members of the Commission represent a broad cross-section of societal, political and economic actors. This will provide the foundation for a sustainable social consensus that all participants will be able to rely on in the years ahead.

The incremental reduction and ending of coal-fired power generation is a historic task. Coal has been a key component of Germany's secure energy supply for many decades. It has played a central role in Germany's growth to becoming one of the world's leading industrialised nations. This has been achieved, first and foremost, by the efforts of those employed in the lignite and coal industry. They have decisively shaped Germany's coal regions over many generations, not just economically but also socially and culturally. This growth has brought financial prosperity and affluence to these regions, but it has also required the people living there to make a lot of sacrifices. Industrial production, which accounts for a large share of value creation in Germany, builds not only on a reliable, affordable energy supply but also on integrated value chains, entrepreneurship and a high degree of technical expertise on behalf of workers thanks to excellent education and training.

The reduction and ending of coal-fired power generation, which is required if we are to successfully protect the climate, can only succeed and show a good example if a range of requirements are reconciled. These include the retention and creation of new jobs protected by collective labour agreements in the regions affected, the secure and affordable supply of power and heat at all times, and the preservation and ongoing development of coal-mining areas to ensure that they continue to remain liveable, attractive regions. Communities affected by open-cast mining must be offered new prospects, while ensuring that the benefits and burdens are distributed in a balanced way. We must succeed in allowing all actors to reliably plan for the long term and enable new business models to be developed. In doing so, we must protect the competitiveness of skilled crafts and trades, commerce, industry and services. In addition, we must also ensure that we can manage the substantial follow-on costs of lignite-fired power generation at the high prevailing levels that exist, even in the longer term.

Germany requires a broadly-accepted social consensus to smooth the way for a socially balanced and equitable transition to a new energy system and safeguard it for the coming decades. Only such a consensus, borne by all actors, can provide for the necessary reliable planning and dependability, thereby acting as the engine for the long-term conversion of the German energy system. The Commission on Growth, Structural Change and Employment stresses that a successful structural development in lignite mining areas is an essential prerequisite for this social consensus. In some cases, the structural change related to the reduction of lignite-fired power generation has already begun. Meanwhile, in the Federal States of eastern Germany the root and branch structural change required in the wake of German reunification has still not been completed. Lignite mining areas and areas where coal-fired power stations are located face the challenge of safeguarding existing value chains and developing new ones, but also the opportunity to shape the impending structural change through innovation in a sustainable way.

Germany is not alone in facing this challenge. A series of countries have already resolved to end coal-fired power generation and begun to take action. Other countries have yet to take this step, because the global phasing out of coal-fired power generation is absolutely essential if we are to effectively protect the climate. However, as a highly industrialised export nation where coal accounts for a comparatively large share of electricity production, bringing an end to coal-fired power generation represents a particular challenge for Germany. If Germany manages to successfully implement structural change processes here and to find the right balance between climate action, the creation of good jobs, strengthening the country's position as a centre of commerce and industry and successfully developing the regions affected, then the energy transition and the associated ending of coal-fired power generation may provide an example for other countries. The success of the energy transition in the context of global challenges will be decided not only by the question as to whether and how the major opportunities will be exploited by new technologies and business models, but rather also by the question as to whether developments such as the accelerated ending of coal-fired power generation can be accomplished without bringing unmanageable structural interruptions.

With its energy transition, Germany has already successfully begun its journey to adapt its energy sector. It has made enormous strides in expanding its use of renewable energy.

If the right groundwork is laid, opportunities will open up for innovation and sustainable industries. Climate action offers the opportunity to successfully manage this change, and also acts as the driver for new business areas and further development of existing industries. Successful climate action efforts require the comprehensive modernisation of every sector of the German economy and can offer German companies further opportunities for potential growth markets, especially for climate-compatible technologies. At the same time, this impending process of transformation will also present Germany with significant implementation challenges. The energy transition describes a path involving the politically-driven, structural adaptation of the energy system. These changes resulting from climate change policy initiatives at a national, European and international level, and in the context of rapid technological change, affect every possible type of technology. In addition, the process touches on economic, corporate and employment structures as well as fundamental spatial development.

The proposals of the Commission on Growth, Structural Change and Employment are the product of a balanced assessment of the various interests. They will ensure that Germany closes the undershoot on its 40% climate target as far as possible while meeting its stated objectives of supply security, affordability and the safeguarding of jobs and value-added, and that the energy industry reliably meets its sector goal for 2030. The proposals also provide an end date for coal-fired power generation in Germany. In developing its recommendations the Commission therefore listened to many different scientists and interest groups, extensively discussed current knowledge and progress, and weighed up the various positions against each other.

- Effective and efficient measures for ambitious climate action: Climate change has already begun. The Earth's average surface temperature has increased by approx. 1°C compared with pre-industrial levels. This is being reflected ever-more clearly by extreme weather events. At the UN Climate Conference in Paris in December 2015, 197 countries under the Framework Convention on Climate Change settled on a global climate action agreement, the implementation of which was substantiated at the climate conference in Katowice in December 2018. Under this agreement, they committed to limit global warming to well below 2°C, and if possible to 1.5°C, compared with pre-industrial levels. The increase in temperature is primarily driven by the accumulated CO_2 emissions that collect in the atmosphere over time. To meet the UN climate targets, Germany has set ambitious climate action targets to achieve a largely greenhouse-gas- neutral economy and society by 2050. A transition on this scale requires a contribution from every sector. At the same time, all of the future scenarios that the Commission looked at highlight the key role of the energy industry and the ending of coal-fired power generation as part of this process. Furthermore, numerous calculations have shown that the global discontinuation of coal-fired power generation as quickly as possible represents a particularly effective approach to slow down the further warming of the Earth's climate. Looking at society as a whole, however, abruptly phasing out coal would have massive, disproportionate consequences when we consider those still employed in the coal industry today, the regions affected, the costs of a secure power and heat supply and the safeguarding of industrial competitiveness.

- Safeguarding the prospects of those employed in coal regions: The cessation of coal-fired power generation also means that structural change in the coal regions affected will progress more quickly. The political decision to accelerate the withdrawal from coal-fired power generation brings a particular responsibility on the German federation to support the structural development of these regions in the short-, medium- and long-term, in order to compensate for the loss of jobs and value creation with new, sustainable infrastructure and companies and to open up new prospects for a good living and successful economic development in the affected regions. Lignite and coal companies have had a decisive impact on the employment structure of these regions for decades. The jobs here are of good quality, protected by collective pay agreements and characterised by cooperation and social partnership between employers and employees. The collapse of large portions of eastern German industry following German reunification also left deep wounds in the lignite industry. Operational restructuring in the energy industry in subsequent years also led to further sharp slashes in employment that escaped public attention. This economic slump was a key contributor to a significant drop in greenhouse gas emissions in Germany, particularly in the 1990s. The regions and the people living there rightly expect solidarity from society and policy-makers. Structural policy measures must therefore be particularly cognisant of people's experiences in the Federal States of eastern Germany. The Commission is aware that successful struc-

tural development in all mining areas is an ongoing process and a reactive structural policy is not enough. The common objective must therefore be proactive structural development so that the regions, which currently still place an economic emphasis on coal-fired power generation, can, with political support, develop other sustainable industrial value-creation models that build on existing strengths.

- A secure underlying framework for long-term investment and the creation of new jobs and prospects for companies: Structural change must be permanently and reliably safeguarded irrespective of short-term decision-making processes. This is essential in order to enhance people's acceptance for the structural change process in mining areas. In addition, planning dependability is of paramount importance given the long investment cycles and large investment volumes. In order to shape their future growth themselves, residents, employees, municipalities and companies require broad societal and state support from the EU, Federal Government and Federal States with reliable underlying conditions that will remain effective in the long term and, at the same time, broad-based regional prospects for future development as far as possible. It is therefore now vital, based on the Commission's recommendations in dialogue with the parties involved and those affected, to establish the necessary legal and institutional framework to allow structural development aid to begin immediately.

- Binding, long-term financing of measures to finance the structural change: Structural development requires planning reliability and sufficient financing. This must be ensured through a comprehensive legislative package to strengthen growth, structural change and employment in lignite mining areas and at the coal-fired power station sites affected.

- Taking into account the interests of those affected by resettlement: 120,000 people have already had to leave their villages and homelands for lignite in the past. Even today, villages are still affected by resettlement. In the interests of the people and companies affected, we need to provide them with the certainty they need to plan their lives, and for their corporate planning, as quickly as possible. This particularly affects the residents of localities that are already undergoing a resettlement process.

- Security of supply, safeguarding industrial competitiveness and retaining and developing industrial value chains: An internationally competitive, reliable and interruption-free supply of power and heat is a key factor that industries competing on the international stage consider when choosing a location. Germany will continue to count on these industries in the future and must therefore continue to preserve a secure underlying framework. Where additional pressures arise for value creation due to the reduction and ending of coal-fired power generation, these must be relieved by taking effective measures. Success will also mean using new technologies and business models to recognise and exploit major opportunities. Conditions must be put in place to allow energy to be supplied in a way that protects the climate, is secure and comes at a socially and financially acceptable cost. This provides for planning dependability and reliability and can become an engine for modernising Germany as a centre of commerce and industry, beyond the energy sector. In this way, Germany can protect its role as a pioneer and innovation driver of the energy transition, which is now also being driven economically in more and more regions around the world. This will allow Germany to protect its opportunities in this critical technology area for the 21st Century.

- Socially balanced and equitable distribution of the advantages and burdens: To ensure that the end of coal-fired power generation, and the energy transition, can continue to be borne by society in the future, this fundamental reorganisation must be equitably designed overall. This means that the advantages and burdens are spread as equitably as possible across society.

The energy transition and associated reduction and ending of coal-fired power generation is taking place within a dynamic environment. This also means accessing emerging economic structures and value chains that are hugely important to Germany as a highly-developed industrialised nation. This process involves economic, technical, political and legal uncertainty that limits the forecasting power of the actors affected. The members of the Commission are conscious of the associated responsibility. Progress in implementing the measures recommended must therefore be carefully and regularly examined, with readjustments made if necessary.

The Commission on Growth, Structural Change and Employment believes that the Federal Government will promptly and comprehensively implement the recommendations it puts forward. The necessary planning reliability also includes providing legal certainty for every component of the package of measures. The Commission therefore expects the Federal Government to ensure that subsequent legal changes to environmental and planning laws, for example, will not threaten or undermine the result that the Commission is seeking.

2. Commission on Growth, Structural Change and Employment

2.1. Appointment resolution and brief

The Federal Government appointed the Commission on Growth, Structural Change and Employment (GSCE) on 6 June 2018 (see Appointment resolution, Annex 1). The appointment resolution sets out the Commission's brief. This brief includes the development of a programme of action focusing on the following areas:

1. *Establishment of a concrete perspective for new future-proof jobs in the regions affected through cooperation between the Federal Government, the Federal States, municipalities and economic actors (for example, in the areas of transport infrastructure, development of skilled labour and entrepreneurship, location of research institutions and long-term structural development).*

2. *Development of a mix of policy instruments that bring together economic development, structural change, social acceptability, social cohesion and action on climate change and, at the same time, establish perspectives for sustainable energy-producing regions as part of the energy transition.*

3. *This also includes necessary investments in the regions and economic sectors affected by structural change for which existing federal and EU support instruments will be deployed in the regions affected on an effective, targeted and priority basis and for which, in addition, a structural change fund, comprising primarily federal resources, will be deployed.*

4. *Measures to ensure that the energy sector is on a reliable course to reach the 2030 target, including a comprehensive impact assessment. The target established by the Climate Action Plan is for the energy sector to reduce emissions by 61% to 62% by 2030 compared with 1990 levels. For the contribution resulting from coal-fired power generation, the Commission should propose appropriate measures for the energy sector to meet the 2030 target for inclusion in the programme of measures to reach the 2030 targets in implementation of the Climate Action Plan.*

5. *In addition, a plan for the step-by-step reduction and termination of coal-fired power generation, including an end date and the necessary legal, economic, social, renaturation and structural policy support measures.*

6. *Also measures to be taken by the energy industry as a contribution towards minimising the undershoot on the 40% reduction target. The Federal Government will publish an updated estimate of the anticipated undershoot as part of the Climate Action Report 2017.*

The Commission on Growth, Structural Change and Employment set out its results in relation to structural change in an interim written report on 31 October 2018 and made initial recommendations for measures to promote the social and structural development of lignite mining regions. The Commission hereby submits its final report.

2.2. Composition

The following persons were appointed to the Commission on Growth, Structural Change and Employment:

Chairpersons

Matthias Platzeck
Ronald Pofalla
Professor Barbara Praetorius
Stanislaw Tillich

Members

Professor Jutta Allmendinger (until 21 August 2018)
Antje Grothus
Gerda Hasselfeldt
Christine Herntier
Martin Kaiser
Steffen Kampeter
Stefan Kapferer
Professor Dieter Kempf
Stefan Körzell
Michael Kreuzberg
Dr Felix Matthes
Claudia Nemat
Professor Kai Niebert
Professor Annekatrin Niebuhr
Reiner Priggen
Katherina Reiche
Gunda Röstel
Andreas Scheidt
Professor Hans Joachim Schellnhuber
Christiane Schönefeld (from 22 August 2018)
Dr Eric Schweitzer
Michael Vassiliadis

Professor Ralf Wehrspohn
Professor Hubert Weiger
Hannelore Wodtke

In addition the following three members of the German Bundestag were appointed as persons having the right to speak but without the right to vote:

Andreas G. Lämmel, MdB
Dr Andreas Lenz, MdB
Dr Matthias Miersch, MdB

Representatives of the Federal States of Brandenburg, Lower Saxony, North Rhine-Westphalia, Saarland, Saxony and Saxony-Anhalt also participated in the Commission meetings as persons having the right to speak but without the right to vote.

In addition, the Federal Government comprehensively supported the Commission's work. The Commission was supported by a committee of state secretaries consisting of representatives of the Federal Ministry for Economic Affairs and Energy, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, the Federal Ministry of the Interior, Building and Community and the Federal Ministry of Labour and Social Affairs. The Federal Chancellery had guest status.

2.3. Consultation and technical experts

The Commission on Growth, Structural Change and Employment was constituted at its first meeting on 26 June 2018. Nine meetings followed more or less on a monthly basis until the closing meeting on 25.01.2019 (see Meeting plan, Annex 2). At the initial meetings the Commission listened to technical experts from the Federal Government, the Federal States, industry, trade unions, the sciences and civil society. A list of the technical experts who addressed the Commission is provided in Annex 3.

In addition to the meetings in Berlin, the Commission undertook three trips to the lignite mining areas. On 24 September 2018 the Commission visited the Central German mining area, on 11 October 2018 the Lausitz mining area and on 24 October 2018 the Rhineland mining area. There the Commission members spoke to representatives of the relevant Federal State governments and from municipalities, regional companies, third-level institutions, churches and citizens' groups (see Programme for the Three Mining Area Trips, Annex 4).

2.4. Benchmarks

Environmental sustainability, security of supply, profitability (affordability, competitiveness), energy infrastructure, planning and legal security

The Commission on Growth, Structural Change and Employment believes that the following benchmarks are key to design the successive reduction and ending of coal-fired power generation in tandem with the target energy policy triangle. The balanced energy policy target triangle consisting of environmental sustainability, supply security and profitability is at the heart of the Commission's deliberations. The sequence in which these elements are named does not imply any order of priority. The Commission considers all of the points to be of equal importance:

- Energy supply is climate-compatible and environmentally friendly. By incrementally reducing and ending coal-fired power generation, Germany is contributing to the implementation of the Paris Climate Agreement. The energy industry will reach its sectoral goal from the Federal Government's German Climate Action Plan 2050 for 2030, thereby contributing to closing the undershoot on the 40% reduction target as much as possible. Climatic impact is primarily determined by the volume of accumulated greenhouse gas emissions.

- Every sector must contribute appropriately. The conversion to a greenhouse-gas-neutral society is a joint effort to which every sector must contribute appropriately under the German Climate Action Plan 2050. This is not just about being equitable, rather it is also a matter of cost efficiency to achieve climate goals at reasonable economic cost.

- Germany's energy supply is secure and will remain so. Our attractiveness as a centre of commerce and industry is built on the secure supply of energy. Security of supply means that supply is reliable, needs-oriented and of the required quality at all times. In addition to a secure power supply, the reliable supply of heat and fuel is also essential for industry, municipalities and citizens.

- Our energy supply is affordable and provides value for money, and energy prices are appropriate and reliable. Internationally competitive electricity prices safeguard Germany's attractiveness as a centre of commerce and industry. Our citizens also expect their electricity bill to remain affordable. The same ultimately applies to charges from fees, duties and allocations.

- Germany remains a highly attractive location. Industry and the economy are the bedrock for growth, prosperity and employment. They are the foundation that has proven itself in times of financial and economic crisis. At the same time, many energy-intensive sectors must compete on an international stage. Their value creation is often closely linked to the energy industry and the value chains of additional sectors. These interdependencies are considered when decisions are made about reducing and ending coal-fired power generation and designing accompanying measures.

- The energy infrastructure is prepared to meet future requirements. This includes sufficient power station capacity as well as sufficient grid capacity – even at the regional level – to safeguard supply reliability and system security. Key elements include the modernisation and digitisation, as well as the continued needs-oriented expansion, of electricity networks, gas infrastructure, storage capacity and demand flexibility. The district and local heating grid infrastructure is also being expanded as required.

- German companies exploit the opportunities that present themselves. The worldwide conversion of energy systems into more local, digitised and flexible solutions offers a multitude of possibilities for a high-technology, export-oriented country such as Germany – not just for renewable energy but also for storage and efficiency technologies or for networking. Where necessary and economically sensible, underlying regulatory conditions are adapted to enable new innovative business models.

- New value creation in the energy sector: Technological skill and innovative capabilities will be developed and the use of renewable energy, storage and green hydrogen (powertogas) will be strengthened as technologies of the future in the affected regions.

- Legal certainty allows companies in the energy industry to plan ahead. Property rights are protected. In particular, legal certainty allows for long-term planning for actors in the energy industry. The measures recommended must therefore be implemented in conformity with the Constitution and in compliance with European and EU state aid rules, in other words, in a way that is legally watertight.

- These measures will provide planning and legal certainty for everyone involved. The future course of lignite mining and coal-fired power generation affects many different people. This ranges from those employed in the various companies to the residents of open-cast mine areas who would be, or are, impacted by open-cast mining operations or potentially by resettlement. A transparent, reliable and legally watertight path for the incremental reduction and ending of coal-fired power generation can help to largely dissipate the uncertainty and insecurity in the various areas of life planning for these parties involved.

- Regular reviews will bring together flexibility and plannability. On the one hand, investors, workers and other parties affected demand plannability. On the other hand, the process of incrementally reducing and ending coal-fired power generation involves significant economic, technical, political, social and legal uncertainty. In order to meet all of these needs in a balanced way, the effects of reducing and ending coal-fired power generation will be continuously monitored and examined at regular intervals in order to provide a concerted response if required.

- The ending of coal-fired power generation in Germany is closely linked to developments at a European and international level. The approach taken allows for interdependencies arising, for instance, from EU emissions trading and in the domestic energy market, and considers developments in European and international climate policy. The process will also be implemented in close coordination with neighbouring European countries.

Structural development, the avoidance of structural interruptions, safeguarding value creation, new prospects for innovation, new business models and social cohesion

The appointment resolution gives the Commission on Growth, Structural Change and Employment the following brief:

"The implementation of the Climate Action Plan will accelerate structural change in many regions and economic areas, particularly in the energy generation sector. The associated changes must not be borne uniquely to the detriment of coal-fired power generation regions, rather they must open up opportunities for a lasting economic dynamic offering high-quality employment. We want to actively

exploit this, thereby avoiding structural interruptions and an adverse impact on international competitiveness."

With this in mind, the Commission has formulated the following criteria for the successful designing of structural development and to avoid structural interruptions in the affected regions. Its goal is the development of lignite mining regions into European model regions to enable successful transformation as part of policy-based structural change. Again, the sequence in which these elements are named here does not imply any order of priority. The Commission considers all of the points to be of equal importance:

- A successful structural development will make an important contribution to preserving the basic free, democratic order.
- Structural development is far-sighted and seeks to equally address the objectives of economic performance, environmental and climate action, social cohesion, cultural identity and quality of life in the regions for everyone.
- The people and actors in the regions affected shape the structural change in their homeland through their engagement and their ideas. Policymakers can support this development while allowing the necessary freedom.
- Structural development is a long-term task for society as a whole. It is the joint responsibility of the Federal Government, Federal States and municipalities as well as local social partners, companies and people and is jointly shaped and borne by them.
- Structural development must be socially sustainable. It protects existing, high-quality, co-determined jobs or provides new, high-quality and sustainable jobs. Jobs for all levels of qualification are required for the long-term. This will ensure a positive employment balance.
- Structural development makes the regions sustainable and opens up new prospects for them. It helps the regions to reposition themselves for the future and to exploit the opportunities that arise. In this way, the regions will become pioneers of successful structural change and will provide an example for the transformation process in Europe towards becoming a broadly climate-neutral industrialised society.
- Compulsory redundancies will be avoided and employees will not suffer any unfair social or economic disadvantages.
- Impacts from the ending of coal-fired power generation on Germany as a centre of commerce and industry, for instance looking at the associated industries and local value chains, must be avoided as far as possible and otherwise compensated for. Economic development should build on existing industrial foundations.
- In parallel to the continued development of existing value chains, new and innovative value chains will be linked, building on the existing strengths in mining areas and supporting the development of new value chains. Investments in a modern infrastructure will not only close existing gaps against the overall German average, but rather will also set new standards. Attractive infrastructural conditions are a basic prerequisite for private investments.
- Social and cultural infrastructures are safeguarded and developed throughout the structural change.
- Structural development must address the particular features of the regions. It must take into account the mining areas' different starting positions and prospects and follow mining-area-specific strategies. Structural development supports and strengthens the cultural identity of the regions. The short-, medium- and long-term structural growth dimensions must be considered in a balanced way.
- The structural change process itself builds trust in the change and new identification.
- Monitoring and professional management allow adjustments to be made to the structural change process.
- Similarly, the shape of the structural change requires respect for the motives on which the energy transition is based, as well as respect for those who are particularly impacted by the structural change, and their lifelong achievements.
- The existing structural policy instruments serve in particular to align structurally weak regions with structurally strong regions and contribute to bringing about comparable living conditions. An accelerated climate-policy-driven structural change process therefore

requires appreciable additional structural policy support measures. These must be financed as required. In addition to public investment in social, cultural and sustainable transport infrastructure, for example, as a priority we need targeted incentives for private, industrial investment in mining areas and in areas where power stations are located.

- The financial safeguarding of structural change must take appropriate consideration of climate-policy-based energy production interventions.

- The goal of structural policy measures must be to sustainably develop industrial value chains in Germany. The goal must be to provide for the adequate replacement of value creation and employment in mining areas to compensate for the fall in, or loss of, value creation from coal. The goal is the sustainable modernisation of Germany as an industrialised country, the protection and creation of co-determined work protected by collective labour agreements, and a largely greenhouse-gas-neutral society by 2050.

The Commission on Growth, Structural Change and Employment has based its work on the geographical demarcation of the four lignite mining areas that were agreed in 2017 between the Federal Ministry for Economic Affairs and Energy and the Federal States affected. The Commission thus deliberately chose to define the mining areas broadly in order to also include regions that are closely dependent on the lignite industry. Within the mining areas it is still possible to differentiate according to the actual impact and the cross-regional implications of the structural change.

Furthermore, the Commission was agreed that in exceptional cases, projects can also be included in the assistance programme, or can receive other support measures that are not in the mining area itself but that are of great importance for development in the mining area.

Lausitz mining area	**Central German mining area**
Brandenburg: Dahme-Spreewald district Elbe-Elster district Oberspreewald-Lausitz district Spree-Neiße district Town of Cottbus Saxony: Bautzen district Görlitz district	Saxony: Town of Leipzig Leipzig district North Saxony district Saxony-Anhalt: Burgenland district Saale district Town of Halle Mansfeld-Südharz district Anhalt-Bitterfeld district Thuringia: Altenburger Land district
Helmstedt mining area	**Rhineland mining area**
Lower Saxony: Town of Braunschweig Helmstedt district Wolfenbüttel district Town of Wolfsburg	North Rhine-Westphalia: Rhine-Neuss district Düren district Rhine-Erft district Aachen region Heinsberg district Euskirchen district Town of Mönchengladbach

A key criterion for deciding which coal-fired power station sites should receive structural aid from special funding is the contribution that the coal industry makes to local employment and value creation.[1] Here the Commission bases its deliberations on the report it has commissioned entitled "Structural Data for the Commission on Growth, Structural Change and Employment".[2]

This report shows that the coal industry is generally of lesser importance in the relevant districts and urban districts than is the case for lignite in the mining areas.[3] Nevertheless, this is attributable to a significant degree to the fact that the coal industry is concentrated to a much lesser degree on particular areas than the lignite industry. Instead, coal-fired power station sites tend to be spread over the entire federal territory. Regardless of this, the coal industry also plays a significant role in some districts for value creation and employment.

In order to provide for comparability with lignite mining areas, the Commission recommends that structural aid be provided if the coal industry accounts for a substantial share of the regional value creation[4,5] Under this criterion, coal-fired power station sites should have access to the structural policy measures and instruments developed by the Commission if power stations are to be shut down at these sites as part of the initiatives described in Chapter 4.

1 The Commission on Growth, Structural Change and Employment uses the term "coal industry" in relation to ascertaining employment and value creation as a result of coal-related economic activity. This includes both direct employment and value creation in power stations as well as the value creation and employment that depend on it, for instance in upstream industries or for the transportation of, or trade in, coal. The term "coal-fired power station sites" describes the districts or urban districts where coal-fired power stations are located. This kind of demarcation is required in order to be able to calculate the coal industry's contribution to regional value creation, for example.

2 RWI-Leibniz-Institut für Wirtschaftsforschung 2018: Structural data for the Commission on Growth, Structural Change and Employment. Project report for the Federal Ministry for Economic Affairs and Energy. Hereinafter referred to as: RWI 2018b.

3 See Table 5.1 in RWI 2018b; compare in particular the presentation of mining areas in Chapters 3.4 and 5.1.1 to 5.1.4.

4 The measure that is used here is the value creation in the relevant districts and urban districts with coal-fired power station sites. Compare also RWI 2108b and the "Volkswirtschaftliche Gesamtrechnung der Länder (VGRdL)", Bruttowertschöpfung auf Kreisebene (Gross value at district level).

5 The assessment of the material relevance should also be based on objective criteria. The contribution of coal-fired power stations to regional value creation is an appropriate consideration here, for example. As a comparative measure we can draw on the situation in lignite mining areas, for example: If we disregard the particular situation in the Helmstedt mining area, lignite's share of regional value creation is lowest in the Central German mining area. There it totals 0.9% – see also Chapter 5.1.4.

3. Baseline

The emissions of the energy industry[6] have been falling sharply since 2013. By 2017 Germany recorded a 29% reduction in emissions compared with 1990. Lignite made a major contribution here. In 1990, emissions from lignite in the energy industry still totalled 237 million tonnes CO_2. By 2017, energy industry emissions had fallen to 155 million tonnes CO_2 (35%). By 2020, emissions are expected to fall by a further 12.5 million tonnes CO_2 through contingent standby. Even in applications beyond the energy industry (domestic fuel, industry, etc.), lignite is making substantial contributions to emissions reductions. In these areas, emissions from lignite use fell from 102 million tonnes CO_2 in 1990 to around 10 million tonnes CO_2 in 2017, in other words by around 90%, principally through energy substitution.

Current studies available forecast that energy industry emissions will fall significantly by 2030 even without additional initiatives. This is due, among other things, to the fact that some of the coal-fired power stations that are on the market today will be removed from the grid. They will reach the end of their technical service life and, given rising prices for CO_2 certificates and increasing fuel prices, the growing supply of electricity from renewable sources and stricter environmental regulations, it will probably no longer be possible to operate them economically.[7] Nevertheless, most surveys predict that this alone will not reduce the energy industry's greenhouse gas emissions sufficiently to allow the 2030 sectoral target (175 to 183 million tonnes CO_2, see Chapter 3.1, *National targets*, Figure 1) to be reached.

In order to reach the 2030 sectoral target, emissions in the energy industry must fall further. Emissions from coal-fired power stations totalled around 256 million tonnes CO_2 in 2016. This amounts to 28% of Germany's total emissions. Of this figure, 5.7 million tonnes CO_2 relates to industrial power stations and 250 million tonnes CO_2 to energy industry power stations.[8] Coal-fired power stations accounted for around 70% of total energy industry emissions here (343 million tonnes in 2016). Emissions from coal-fired power stations fell sharply in 2017. According to figures from the Energiebilanzen[9] (energy balances) working group, total lignite use fell by 11.2% year-on-year in 2018, while lignite use fell by 1.9%. Based on preliminary calculations, for 2018 the Energiebilanzen working group expects energy-related CO_2 emissions to fall by a hefty 6%.[10]

By 2030, emissions from gas-fired power stations will be trending upwards. In order to maintain security of supply at today's high levels, Germany will foreseeably need an adequate amount of guaranteed power station output. At the same time, the power stations used will only be allowed to cause limited CO_2 emissions in order to meet climate targets. Based on current technology, gas-fired power stations are best placed to do this. In addition, combined heat and power stations (CHP) for industrial process heat supply and communal heat supply increasingly use gas.[11] Nevertheless, this necessitates corresponding underlying market and regulatory conditions. The available studies show a range of resulting coal-fired output installed in 2030, depending on the assumptions made. The latter are between 14 and 21 GW.[12] This means that a reduction in emissions from coal-fired power stations will be required in order to meet the 2030 target.

6 The emissions from the energy industry as defined in the Climate Action Plan comprise emissions from power stations, combined heat and power plants and district heating plants for the energy industry, refineries, lignite refinement and coking plants and diffuse and point emissions sources for oil and gas production and the distribution and transportation of natural gas.

7 Boston Consulting Group and Prognos (2018): Klimapfade für Deutschland (Climate paths for Germany); Löschel, Andreas (2018): Bedeutung der Klimaziele für die Kohleverstromung in Deutschland und das übrige Stromerzeugungssystem (Significance of climate targets for coal-fired power generation in Germany and the rest of the power generation system).

8 Response from the Federal Government to Question 2a of the Commission on Growth, Structural Change and Employment of 21 August 2018; Oeko-Institut (2018): Sektorale Abgrenzung der deutschen Treibhausgasemissionen mit einem Schwerpunkt auf die verbrennungsbedingten CO_2-Emissionen (Sectoral breakdown of German greenhouse gas emissions with a focus on combustion-related carbon emissions).

9 Working group press release Energy balances 5/2018.

10 Working group press release Energy balances 5/2018.

11 Boston Consulting Group and Prognos (2018): Klimapfade für Deutschland (Climate paths for Germany); dena (2018): dena pilot study 'Integrierte Energiewende' (Integrated energy transition). Frontier Economics (2018): Strompreiseffekte eines Kohleausstiegs (Effects of phase-out of coal on electricity price).

12 Not all of the calculations presented reach the 2030 sectoral targets under the Climate Action Plan. The upper and lower band (14 and 21 GW) are drawn from the BCG/Prognos study "Klimapfade für Deutschland" (Climate paths for Germany). On the one hand, sectors were delimited slightly differently to the Climate Action Plan, while on the other, the sectoral targets are exceeded (14 GW) or fallen short of (21 GW).

3.1. Climate policy baseline

Global developments and classification under international law

The Earth's average surface temperature has already increased by approx. 1 °C compared with pre-industrial levels.[13] This is attributable to greenhouse gas emissions (particularly CO_2), which are in turn caused by human activity such as the burning of the fossil fuels coal, petroleum and natural gas as well as industrial processes, agriculture and changes in land use. This trend is described as 'anthropogenic global warming' and it has accelerated since the 1970s.

In its fifth progress report, the Intergovernmental Panel on Climate Change (IPCC) observes that should emissions trends continue unchecked ('business as usual'), anthropogenic global warming could reach 4 °C or more by the end of this century. This environmental change would trigger enormous harm and carry massive risks for industry and for society. These would be borne not only by especially vulnerable developing countries,[14] but also by industrialised countries that currently still enjoy temperate climates. The impact of climate change can already be felt in Germany today.[15] The number of extreme weather events in Germany has more than doubled in the last 50 years. Scientific studies have shown that extreme weather events are increasing in response to anthropogenic global warming, both in terms of drought and heat and heavy rainfall.[16]

In October 2018 the IPCC presented a special report comparing limiting anthropogenic global warming to 2 °C and to 1.5 °C – both in terms of the impact and in terms of the measures that would be required to achieve these targets. This report makes it clear that the negative impact of climate change will be significantly milder if we limit warming to 1.5 °C than if temperatures are allowed to rise by 2 °C. The IPCC further makes it plain that a rapid conversion to a greenhouse-gas-neutral society will be necessary in any event, preferably by halving global greenhouse gas emissions in each of the coming decades.[17] A more recent publication underscores this assessment and also points out that without a dramatic reduction in emissions, the Earth could even be propelled into a 'hot age' with average temperatures from 5 to 6 °C higher and a sea level rise of 10 to 60 metres.[18]

At the UN Climate Conference in Paris in December 2015, 197 countries under the Framework Convention on Climate Change settled on a global climate protection agreement.[19] Germany and the European Union ratified the agreement on 5 October 2016. The agreement took effect in November of the same year. Under the Paris Agreement, countries committed to limit global warming to well below 2 °C compared with pre-industrial levels and to strive to limit the increase in average temperature to 1.5 °C.[20] Nevertheless, this reduction, which is based on the existing national contributions (Nationally Determined Contributions, NDCs), is not enough to reach the targets under the Agreement, but rather would allow for warming of over 3 °C.[21]

13 IPCC (2013): Working Group I Contribution to the IPCC Fifth Assessment Report, Climate Change 2013: The Physical Science Basis. Summary for Policymakers.

14 World Bank (2013): Turn down the heat: climate extremes, regional impacts, and the case for resilience.

15 Brasseur, Guy P., et al. (Ed.) (2017): Klimawandel in Deutschland. Entwicklung, Folgen, Risiken und Perspektiven. (Climate change in Germany. Development, consequences, risks and prospects). Berlin, Heidelberg: Springer.

16 Michael E. Mann, Stefan Rahmstorf, Kai Kornhuber, Byron A. Steinman, Sonya K. Miller, Stefan Petri, Dim Coumou (2018): Projected changes in persistent extreme summer weather events: The role of quasiresonant amplification. Science Advances, Vol. 4, no. 10; D. Coumou, G. Di Capua, S. Vavrus, L. Wang, S. Wang (2018): The influence of Arctic amplification on midlatitude summer circulation. Nature Communications.

17 J. Rockström et al. (2017): Science, 355(6331), 1269–1271.

18 Will Steffen, Johan Rockström, Katherine Richardson et al. (2018): Trajectories of the Earth System in the Anthropocene. Proceedings of the National Academy of Sciences of the United States of America.

19 The USA has announced its withdrawal from the Agreement. The EU and other major emitters have committed to the targets. Major states in the USA and other societal actors in the USA have announced that they continue to feel bound by the targets under the Agreement and intend to take measures accordingly.

20 Paris Agreement, PA. Can be viewed at https://www.bmu.de/fileadmin/Daten_BMU/Download_PDF/Klimaschutz/paris_abkommen_bf.pdf.

21 See Climate Action Tracker (2018): For the Talanoa dialogue: Input from the Climate Action Tracker. April 2018: New Climate Institute, Ecofys, Climate Analytics.

The Paris Agreement therefore provides for a mechanism under which every country under the Agreement must regularly submit an updated NDC. This will represent progress compared with the previous NDC and will reflect the most ambitious level possible.[22] This mechanism first takes effect at the UN Climate Conference 2018 in the Polish town of Katowice *(facilitative dialogue)* and then every five years *(global stocktake)*. Previously, the NDCs were formulated under the individual responsibility of the relevant parties to the Agreement, they did not follow a uniform standard and they were not coordinated at an international level. A corresponding system of rules and standards was adopted at the UN Climate Conference 2018.

Accumulated CO_2 emissions, that is to say, the volume of emissions accumulating in the atmosphere over time, are critical to limiting global temperatures.[23] The Paris climate targets (limiting the rise in temperature to well below 2 °C, and if possible to 1.5 °C) allow us to deduce a remaining global emissions budget. A budget means: Emitters now only have a limited free volume of CO_2 emissions for the coming decades. Various paths can be taken within these constraints. The level of ambition for reducing emissions at the start of the process decides the remaining emissions budget going forward. If a comparatively high volume of emissions are produced at the start of the process, this will only leave a limited emissions budget later on. Conversely, if CO_2 emissions are reduced sharply at the outset, subsequent emissions reductions can be more modest. However, the Paris Agreement does not provide for an obligation under international law for the contracting parties to set down their own budgets.

There are very different approaches for defining such a budget. Sweeping assumptions must also be made. The extent to which a global budget can be broken down across the individual regions of the world has not been decided and cannot be definitively answered. The literature discusses a wide range of possible approaches.[24] It is nevertheless clear that, regardless of the criteria used to distribute the budget, planned efforts must be strengthened worldwide in order to meet the climate goals under the Paris Agreement.

European growth and emissions trading

The European Union also contributes to international climate action. As part of its energy and climate policy, the European Union has set itself the target of reducing Europe-wide greenhouse gas emissions by at least 40% by 2030, compared with 1990 levels.[25] It also submitted this commitment as a contribution to the Paris Agreement.[26] The long-term goal is to reduce annual European greenhouse gas emissions by between 80% and 95% by 2050, compared with 1990 levels.

The EU's regulatory framework differentiates between the emissions that are recorded by EU emissions trading (energy industry and energy-intensive industries) and emissions from the transport, construction and agriculture, waste and commerce sectors and industry that is not recorded via EUETS. The latter fall under Effort-Sharing Regulation.

European emissions trading (EUETS) was introduced in 2005. It is a central instrument for reaching the European Union's targets. EUETS sets a limit for the CO_2 emissions permitted for the plants covered. In order to be allowed to emit CO_2, these plants must hand in corresponding certificates. This gives rise to a price for CO_2 emissions. For many years, the price for CO_2 certificates under EUETS was comparatively low. At their lowest point in 2013, emissions were only priced at €2.46/t CO_2. A year ago, in September 2017, the price was still barely €7/t CO_2. Since the beginning of

22 See Art. 4. 9 PA "Each party shall communicate an NDC every five years", Art. 4. 3 PA "Each Party's successive NDC will represent a progression beyond the Party's then current NDC and reflect its highest possible ambition".

23 Edenhofer, Ottmar (2018): Internationale, europäische und nationale klimapolitische Rahmenbedingungen (International, European and national climate policy framework conditions). Presentation to the meeting of the Commission on Growth, Structural Change and Employment on 13 July 2018; IPCC (2018): Global Warming of 1.5°C, Summary for Policymakers, Section C 1. 3.

24 For example, the German Advisory Council on the Environment (Sachverständigenrat für Umweltfragen, SRU) deduces the budget for Germany from the German share of the world's population (1.1%). This gives it a remaining budget of 9.3 bn. tonnes CO_2. According to the SRU's deductions, this gives a maximum volume for coal-based emissions totalling 1.5 bn. tonnes CO_2 from 2017. See Lucht, Wolfang (2018): CO_2 budget and phasing out coal. Presentation to the meeting of the Commission on Growth, Structural Change and Employment on 18 September 2018. See also the German Advisory Council on the Environment (SRU), "Kohleausstieg jetzt einleiten" (Start the coal phase-out now), SRU statement of 17 October 2017.

25 European Commission (2018): A Policy Framework for Climate and Energy in the Period to 2030. Available at https://ec.europa.eu/clima/policies/strategies/2030_de.

26 Dröge, Susanne and Geden, Oliver (2015): Die EU und das Pariser Klimaabkommen. Ambitionen, strategische Ziele und taktisches Vorgehen (The EU and the Paris Climate Agreement. Ambitions, strategic goals and tactical approach). SWP-Aktuell, 42/2015.

2018 the price has risen sharply as the regulations are set out for the fourth trading period (2021 to 2030), and trebled from October 2017 to the end of 2018 to around €20.[27]

Under EUETS around 12,000 plants from the energy industry and energy-intensive industries are obliged to submit tradeable certificates for their greenhouse gas emissions. Since 2012, intra-European aviation is also included in the EUETS scheme. Following the start of the fourth trading period from 2021 the previous annual reduction rate for issuing the certificates will be increased from 1.74% to 2.2%. This should bring European emissions in these sectors down by 43% compared with 2005 levels by 2030. However, recent years have seen substantial surpluses of emissions certificates forming. In order to strengthen the EUETS incentives to invest in climate action, a so-called 'market stability reserve' was introduced. The market stability reserve will reduce the supply of certificates where there is a surplus and increase them when there is a scarcity. Specifically, from 2019 to 2023 24% each year – and 12% from 2023 – of the surpluses on the market will be posted to the market stability reserve if these surpluses exceed a threshold of 833 million certificates. From 2023, large portions of the excess volumes from the market stability reserve will be erased in emissions trading. Furthermore, where fossil-fuel-based electricity generation is reduced, from the beginning of the fourth trading period from 2021 every member state can erase the corresponding CO_2 certificates that are released in order to ensure that such a reduction is not in vain.[28]

Opinion is sharply divided with respect to assessments of short- and long-term CO_2 price trends: Some experts expect further price increases as certificates become increasingly scarce. Others believe that current price growth is fundamentally not justified. They believe that, given the expected shortage from 2019 due to the deployment of the market stability reserve, market participants will stock up in advance on CO_2 certificates and also speculate on price increases at least to some extent.

There is a separate climate action target for emitters that are not affected by EUETS (so-called effort-sharing). These include the transport, construction, agriculture and waste management sectors as well as individual companies from the energy industry and industry. European member states are obliged to reduce greenhouse gas emissions in these sectors by a total of 10% by 2020 compared with 2005 and by a total of 30% by 2030. These European targets have been broken down by individual member state.[29] For Germany a reduction of 14% is planned by 2020 compared with 2005 and of 38% by 2030.[30] Germany is not expected to meet its 2020 effortsharing targets. Emissions rose in Germany in the nonETS sectors between 2014 and 2017. A reduction of no more than 11% is expected by 2020.[31] This means that Germany will need to buy emission rights, potentially incurring costs in the billions to the German federal budget. Emissions reductions from the shutting down of coal-fired power stations or other plants from the ETS area are not allowable for this binding target.

National targets

Germany has set ambitious national climate action targets in order to largely achieve greenhouse gas neutrality by 2050. The Federal government's energy concept from 2010 and the Climate Action Plan 2050 from 2016 provide the basis for Germany's energy and climate action policy. According to this plan, Germany's total greenhouse gas emissions will be reduced by at least 40% by 2020, by at least 55% by 2030 and by 80% to 95% by 2050 compared with 1990 levels. For 2030 the Climate Action Plan 2050 sets out so-called 'sectoral targets'. These are targets for CO_2 emissions

27 European Energy Exchange (EEX): Market data, spot market European Emission Allowances (EUA).

28 Following the revision of 14 March 2018, the newly-introduced Article 12 (4) of the EU Emissions Trading Guidelines provides for the option that every member state "in the event of the shutting down of electricity production capacity in its territory due to additional national measures [can] delete […] certificates from the total volume of certificates to be auctioned by it pursuant to Article 10 (2), at the most in the amount of the average volume of emissions tested for the relevant plant during a period of five years prior to the shut-down". See Agora Energiewende and Oeko-Institut (2018): Vom Wasserbett zur Badewanne. Die Auswirkungen der EU-Emissionshandelsreform 2018 auf CO_2-Preis, Kohleausstieg und den Ausbau der Erneuerbaren (From the waterbed to the bathtub. The impact of the EU Emissions Trading Reform 2018 on CO_2 prices, the phasing out of coal and the expansion of renewable energy).

29 European Commission (2018): Effort sharing 2021–2030: targets and flexibilities. Available at https://ec.europa.eu/clima/policies/effort/ proposal_en.

30 Decision No. 406/2009/EG of the European Parliament and Council of 23 April 2009; Ordinance (EU) 2018/842 of the European Parliament and Council of 30 May.

31 BMU (2017): Projection report 2017 for Germany pursuant to Ordinance (EU) No. 525/2013. The reduction of 11% relates to WAMS.

in the energy industry, construction, transport, industry and agriculture sectors. Under the Climate Action Plan 2050, CO_2 emissions from the energy industry will be reduced to 175 to 183 million tonnes CO_2 eq. by 2030 (see Figure 1). This equates to a reduction of 61% to 62% compared with 1990 levels.[32]

In order to reach these targets, the Federal Government is pursuing a long-term energy strategy known as the 'energy transition'. The goal of the energy transition is to achieve almost complete greenhouse-gas-neutrality by the middle of the century and to phase out nuclear energy by the end of 2022. In doing so, power generation is to incrementally shift to renewable energy and energy is to be used more efficiently.

German CO_2 emissions fell continuously between 1990 and 2010. However, they have been largely stagnating since 2010 with relatively small fluctuations up and down. In 2016, total German emissions were 909 million tonnes CO_2 eq. This equates to a reduction of around 27% compared with 1990 levels. According to current estimates from the German Federal Environmental Agency (Umweltbundesamt, UBA), emissions fell in 2017 to 905 million tonnes CO_2 eq. (see Figure 2). Based on preliminary calculations, for 2018 the Energiebilan zen working group expects energy-related CO_2 emissions to fall by a hefty 6%.[34] From the total decline in the use of primary fossil fuels (petroleum, lignite and coal, natural gas), for 2018 we can deduce a reduction in CO_2 emissions of over 40 million tonnes compared with the prior year.

Figure 1: Emissions from the various sectors according to the Climate Action Plan 2050
Emissions from the areas of activity included in the target definition

Areas of activity	1990 (in million tonnes CO_2 eq.)	2014 (in million tonnes CO_2 eq.)	2030 (in million tonnes CO_2 eq.)	2030 (reduction in % compared with 1990)
Energy industry	466	358	175 – 183	62 – 61
Construction	209	119	70 – 72	67 – 66
Transport	163	160	95 – 98	42 – 40
Industry	283	181	140 – 143	51 – 49
Agriculture	88	72	58 – 61	34 – 31

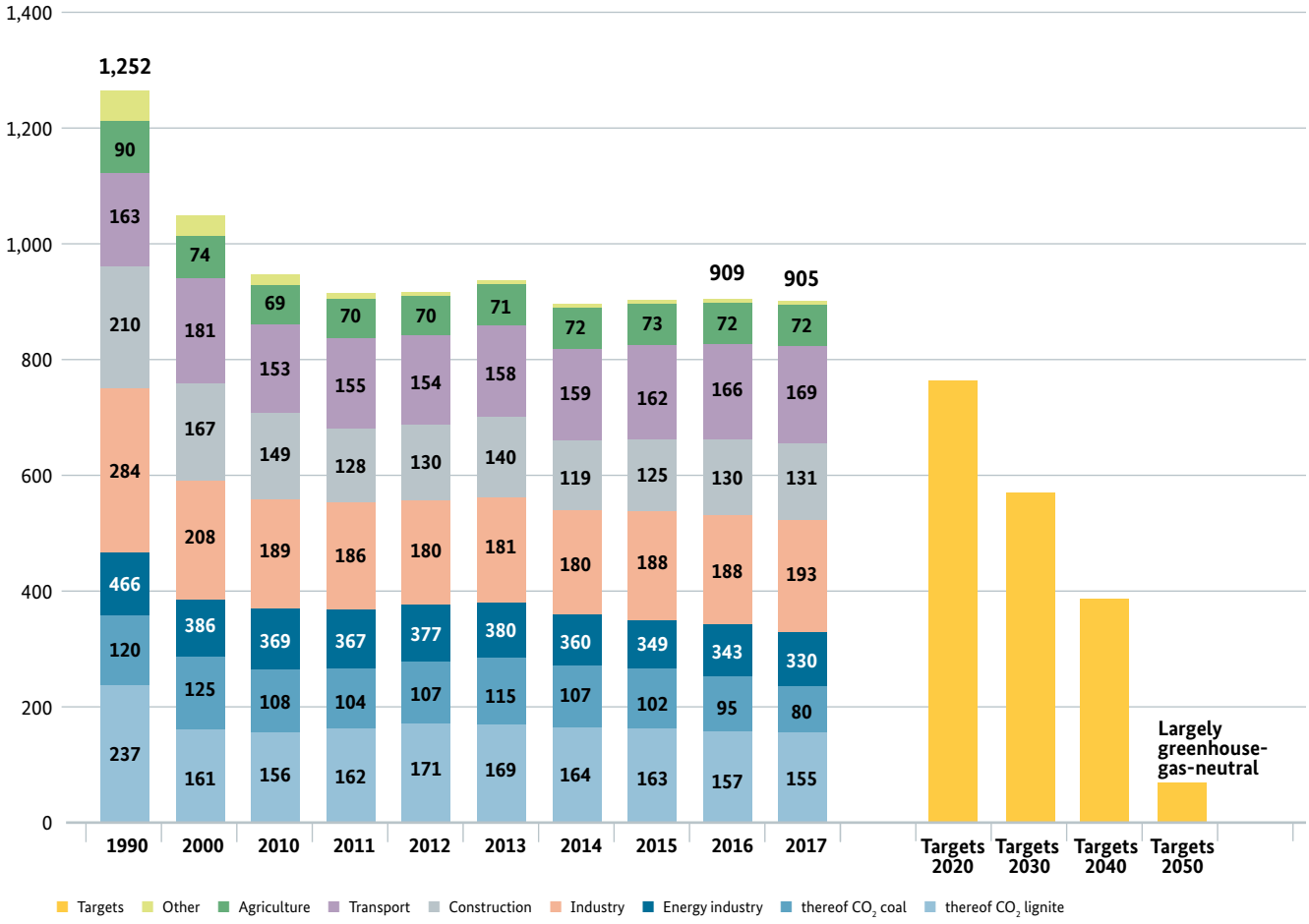
Source: BMUB[33]

32 Climate Action Plan 2050. Cabinet decision of 14 November 2016.

33 The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMUB) (2016): Climate Action Plan 2050. Climate action policy principles and objectives of the Federal Government.

34 Working group press release Energy balances 5/2018.

Figure 2: Greenhouse gas emissions by sector as defined under the Climate Action Plan
in million tonnes CO_2 equivalent



Source: German Federal Environmental Agency[35]

Greenhouse gas emissions have grown very differently in the individual consumption sectors:[36] Greenhouse gas emissions in the energy industry have fallen by around 29% since 1990. This fall is primarily attributable to the shutting down of old coal-fired power stations, the expansion of renewable energy in the electricity sector, the European emissions trading scheme and the increased use of combined heat and power stations.[37] Industry recorded a decrease of 32%. This decrease can be explained by structural changes and shut-downs of industrial units in the east of Germany after reunification, the greater avoidance of process emissions thanks to improved process technology and efficiency and the greater use of natural gas CHP instead of coal for producing electricity and heat. Emissions fell by 38% in the construction sector. The main driver here was the conversion of old coal ovens and oil-fired heating systems to modern natural gas-fired systems or the greater use of district heating. High energy efficiency standards for new builds

35 German Federal Environmental Agency (2018): Report under the United Nations Framework Convention on Climate Change and the Kyoto Protocol 2018. National inventory report on Germany's greenhouse gas inventory from 1990 to 2016; German Federal Environmental Agency (2018): Climate balance sheet 2017: Slight decrease in emissions, joint press release by the German Federal Environmental Agency and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety; BMUB (2016): Climate Action Plan 2050. Climate action policy principles and objectives of the Federal Government. Figures quoted for 2017 are preliminary figures. Actual emissions for 2017 are expected to be lower.

36 German Federal Environmental Agency (2018): Report under the United Nations Framework Convention on Climate Change and the Kyoto Protocol 2018. National inventory report on Germany's greenhouse gas inventory from 1990 to 2016; DIW Berlin, Wuppertal Institute, Ecologic Institute, "Die Beendigung der energetischen Nutzung von Kohle in Deutschland – Ein Überblick über Zusammenhänge, Herausforderungen und Lösungsoptionen" (The phase-out of the use of coal for energy in Germany – an overview of interrelationships, challenges and possible solutions), September 2018; Agora Energiewende (2017): Das Klimaschutzziel von -40 Prozent bis 2020: Wo landen wir ohne weitere Maßnahmen? (The climate target of -40% by 2020: where will we land without further measures?).

37 Emissions savings from CHP totalled 26 to 59 million tonnes CO_2 in 2016. See Prognos et al. (2018): "Evaluierung der Kraft-Wärme-Kopplung. Analysen zur Entwicklung der Kraft-Wärme-Kopplung in einem Energiesystem mit hohem Anteil Erneuerbarer Energien" (Evaluation of CHP. Analyses of the development of CHP in an energy system with a high proportion of renewable energy). Study commissioned by the BMWi, in publication.

and the energy-oriented refurbishment of part of the building stock also contributed to the reduction in emissions. Transport is the only sector that emitted more greenhouse gases in 2016 than 1990. Agricultural greenhouse gas emissions have fallen by 20% since 1990.

According to the Projection Report from the Federal Government, although Germany's total greenhouse gas emissions will continue to fall in the coming years, the 2020 target is unlikely to be reached. The current Projection Report 2017[38] concludes that German emissions in 2020 will fall to around 816 million tonnes CO_2 eq. in the WMS scenario and to around 806 million tonnes in the WAMS scenario.[39] This would bring emissions around 35% below the base year, which would mean Germany missing its climate action target for 2020 by around five percentage points. In the 2018 Climate Action Report the Federal Government examined the analyses of the Projection Report using updated data and came to a lower reduction in emissions.[40] According to this analysis, Germany would miss its national climate action target by around eight percentage points or around 100 million tonnes CO_2.

Growth in emissions in the energy industry, the current expansion being seen in renewable energy capacity and the market-driven dismantling of coal-fired capacity is largely in line with the assumptions in the Projection Report 2017. Despite higher electricity consumption as a result of a strong economy and higher population growth than assumed in the projections, the energy industry is expected to reach the reduction in emissions of approximately 38% assessed in the Climate Action Programme 2020 and in the Projection Report 2017 by 2020. The transfer of power stations to contingent standby alone is expected to save up to 12.5 million tonnes CO_2 by 2020. Under certain assumptions (CO_2 and fuel price growth, current developments in the Hambach open-cast mine, etc.), the reduction from the energy industry could even be higher. Rapid implementation of the special invitations to tender for wind power and PV, and sustained high CO_2 prices, would even put a 40% emissions reduction for the energy industry sector within reach.

It is questionable whether the undershoot to meeting the 2020 climate action target can be closed by means of additional short-term measures. The 2020 target affects all sectors. There is no doubt that the other sectors will also have to make substantial contributions to emissions reductions without delay. Even in the absence of additional measures, the energy industry will already make a major contribution to reducing German emissions by 2020. Experts estimate that the energy industry – and within the energy industry, particularly the power stations for generating electricity – will provide the largest share of total emissions reductions, at almost 75%, in the period from 2014 to 2020.[41] The primary reasons for this reduction in emissions are the EUETS (see 3.1, European growth and emissions trading), the further expansion of renewable energy, the promotion of combined heat and power stations and contingent standby.

38 BMU, Projection report 2017 for Germany pursuant to Ordinance (EU) No. 525/2013.

39 WMS refers to the "WithMeasuresScenario", that is, measures that have already been resolved, while WAMS refers to the "WithAdditionalMeasuresScenario" with measures that have already been resolved plus additional measures.

40 BMU (2018): Climate Action Report 2018. The Federal Government's Climate Action Programme 2020.

41 Oeko-Institut, IREES (2017), "Überprüfung der Emissionsminderung 2020 im Projektionsbericht 2017" (Review of the 2020 emission reduction in the 2017 projection report).

3.2. Energy industry baseline

3.2.1. Underlying European conditions

"Clean energy for all Europeans" legislative package

With the legislative package "Clean energy for all Europeans" (also known as the "Winter package"), the European Union has redesigned its legal framework for energy through to 2030. In June 2018 the European Parliament, the European Council and the European Commission reached a compromise with respect to the first part of the Clean Energy Package (Renewable Energy Guidelines, Governance Ordinance, Energy Efficiency Guidelines). The second part was resolved in mid-December 2018. This part comprises an ordinance in relation to the electricity market, and guidelines in relation to the electricity market, an ordinance in relation to an agency for collaboration between energy regulation authorities (ACER) and an ordinance in relation to provision for risks. It this includes central requirements for the design of the electricity market in Europe. In particular, the electricity market ordinance provides for various regulations for capacity mechanisms. Accordingly, generating plants may only participate in a capacity mechanism capacity market or strategic reserve) if they adhere to an emissions value (emissions performance standard) of no more than 550 grams of CO_2/kWh. The rules apply to new plants from 2020 and for existing plants from 2025. Existing plants emitting more CO_2/kWh may only participate in a capacity mechanism if they only operate for a few hours. An emissions budget of 350 kg/installed kW output per year is provided for this. Power stations that have a higher emissions value and that are not earmarked for participation in a capacity mechanism may operate on the market but may not receive any aid. The electricity market ordinance also provides that, in assessing any capacity mechanisms, the European report on supply security from the European Network of Transmission System Operators for Electricity ENTSOE is also taken into account, in addition to national reports. Until 2030 the efficiency target has been set at 32.5% and thereafter it has an upwards revision clause by 2023. The 2030 target for the renewable energy portion of total consumption is now 32% for all sectors.

European emission limits for power stations (Large Combustion Plants – Best Available Techniques, LCP BREF)

In July 2017, the European Commission issued new Europe-wide bands for harmful emissions from large combustion plants.[42] In particular, this covers emissions of dust, sulphur, nitrous oxides and mercury. The Federal Government rejected the BREF in the Council because it believes that the emissions bands for nitrous oxide emissions and for mercury were incorrectly deduced. Numerous actions are currently pending from member states, Federal State governments and companies. The new emissions bands must be implemented in national law, with discretionary scope for implementation being granted to the national legislature. They must be observed no later than from August 2021. Under the Federal Emission Control Act, the new requirements should have been implemented by an amendment to the relevant federal emission control regulations by August 2018. Nevertheless, to date the Federal Government has not put forward any proposals for implementation. For nitrogen oxide the Federal Government considers an upper emissions band for nitrogen oxide of 190 mg/m³ (milligrams per cubic metre) to be appropriate.[43] The Federal Government also believes that the incorrect deduction of the threshold values for mercury does not result in any greater protection for human health.[44] Approximately 600 large combustion plants in Germany are affected including, in particular, coal and lignite power stations and gas turbine and gas and steam turbine power stations. In particular, annual threshold values for emissions of nitrous oxides of no more than 175 mg/m3 have been stipulated for existing coal-fired power stations from 300 MW_{th}. Most of the average annual values for nitrous oxide for the existing lignite-fired power stations, at 160 to 190 mg/m3, are currently above the new threshold values.[45] In the view of the German Federal Environmental Agency, even if the national annual

42 Implementation resolution (EU) 2017/1442 of the Commission of 31 July 2017 on conclusions on the best available technology (BAT) pursuant to guideline 2010/75/EU of the European Parliament and Council of 24 November 2010 for large combustion plants.

43 Response of the Federal Government to the Short Survey of the BÜNDNIS 90/DIE GRÜNEN parliamentary group, p.p. 18/8540; response of the Federal Government to Written Question No. 48, p.p. 18/12021.

44 Response of the Federal Government to the Short Survey of the BÜNDNIS 90/DIE GRÜNEN parliamentary group, p.p. 18/8292.

45 German Advisory Council on the Environment, "Kohleausstieg jetzt einleiten" ("Phase Out Coal Now"), October 2017.

average value were to be set at the upper end of the band (175 mg/m³), currently only four lignite-fired block-unit power stations in Germany would be sure to remain within this threshold value.[46] For pulverised hard coal firing systems there is an upper limit of 150 mg/m³ from a thermal firing capacity of 300 $MW_{th.}$ Coal-fired power stations usually have SCR catalysers, that is, catalysers with selective catalytic reduction. Nevertheless, some of these must be upgraded in order to meet the new emissions band, which could negatively impact on their cost-effectiveness.

For mercury the LCP BREF provides for an emissions band for an average annual value of between <0.001 and 0.007 mg/m³ for existing lignite-fired power stations with a thermal firing capacity from 300 MW_{th}. For existing coal-fired power stations with a thermal firing capacity from 300 MW_{th} this band is between <0.001 and 0.004 mg/m³. Under the applicable law, an average annual threshold value of 0.010 mg/m³ is applicable from 2019.

The new nitrous oxide requirements being introduced for gas turbines to be operated for more than 1,500 hours a year are much stricter than the current requirements for the 13th BImSchV and are no longer limited to the range above a 70% load. It is expected that in the future, gas turbines will increasingly be operated in the emissions-intensive partial-load range below 70%. In most cases, the retrofitting of existing gas turbines with catalyser technology is not economically feasible. In many cases the annual operating hours will therefore need to be limited, the plant will have to be decommissioned, or the plant will need to be replaced.

For new gas-fired power station projects the delay can represent a significant barrier to investment, thus impacting on security of supply.

3.2.2. Energy markets

Current production capacity for electricity and heat in Germany

At the end of 2017, electricity production plants with a total installed output of 216 GW were connected to the German grid. For the first time ever, more than half of the electricity production plants were based on renewable energy (112 GW), accounting for at least 36% of gross domestic electricity consumption.[47] The output from renewable energy thus more than trebled compared with 2007 (35 GW). At the beginning of 2018, seven nuclear power plant units with a combined output of 9.5 GW were still connected to the grid. These will be successively shut down by the end of 2022.

Coal and lignite-fired power stations are operated both by private and by municipal companies (municipal utilities or "Stadtwerke").[48] At the end of 2017, coal-fired power stations with a (net) output totalling 42.6 GW were active on the market (including 19.9 GW lignite-fired and 22.7 GW coal-fired).[49] In addition there are also other coal-fired power stations that are not active on the market. This comprises lignite-fired power stations in the grid reserve (2.3 GW at the end of the year)[50] and lignite-fired power stations on contingent standby (2.0 GW at the end of 2018).[51] In 2017, coal-fired power stations covered a total of 37% of electricity production in Germany.

Growth of renewable energy

The growth of renewable energy is already well advanced, now accounting for a share of at least 38% of gross domestic electricity consumption.[52] The current coalition agreement has formulated a target bringing the renewable energy

46 Written notification from the German Federal Environmental Agency to the German Advisory Council on the Environment of 13 July 2017, see here the German Advisory Council on the Environment, "Kohleausstieg jetzt einleiten" ("Phase out Coal Now"), October 2017.

47 Energiebilanzen working group, Stromerzeugung nach Energieträgern ("Electricity production by energy source") 1990 to 2018 (version: December 2018).

48 Municipal companies currently operate 9 GW of coal and 0.5 GW of lignite. Added to this is a thermal output from coal-fired power stations of around 6.4 GW (based on surveys from the VKU).

49 Federal Network Agency (Bundesnetzagentur) power station list (Germany-wide; all grid and transformer levels), version: 19.11.2018; annexes "in Betrieb zzgl. endgültig stillgelegt 2018".

50 Overall there are 6.9 GW in the grid reserve, including 3 GW of natural gas and 1.6 GW of petroleum. Source: Federal Network Agency (Bundesnetzagentur) power station list (version: 19.11.2018).

51 From October 2019, an additional 0.8 GW of lignite-fired plants will be in contingent standby. They will then comprise a total of 2.7 GW. Source: Federal Network Agency (2018): Federal Network Agency power station list.

52 Figures for 2018 based on the Energiebilanzen working group, Stromerzeugung nach Energieträgern ("Electricity production by energy source") 1990 to 2018 (version: December 2018).

share to 65% by 2030. The expansion of renewable energy will be grid-synchronised. Renewable energy is the central element of the new electricity production system and will replace the existing system, which is based on fossil fuels.

Nevertheless, the addition of installed renewable energy output alone is not enough to meet demand at all times. A range of challenges must therefore be overcome:

- Renewable energy will increasingly assume the tasks of conventional power stations in the field of grid-friendly services, for example idle power.
- Rapid grid expansion and optimised grid operation are required, as well as progress with the integration of storage and sector coupling (see Chapter 4. 4).
- At the same time, demand must be made more flexible by using better underlying conditions.

With a renewable energy share of 65% in 2030, the measures outlined in Chapter 4 in the energy industry sector for climate action will be achievable without further cost increases from inefficiencies, without impacting on security of supply.

Expanding renewable energy to 65% will require sufficient land-use planning. In particular, areas of the required size will need to be planned, accepted and approved for wind-powered installations and ground-mounted PV installations.

Implications for grid expansion

However, the electricity that is generated can only be used if it can be transported to the consumer. In the last approved grid development plan (NEP 2017), the grid expansion was designed to accommodate a renewable energy share of gross electricity consumption of up to 52.5% (scenario B). However, the expansion of the transmission systems planned to date with a total length of 7,700km is only progressing slowly. Only 950 km were realised in the third quarter of 2018, and 30 km in 2017. 1,800 km have been approved, while 5,900 km (77%) have yet to be approved and 6,750km (88%) have yet to be implemented. The further expansion and optimisation of the electricity grids, and making the energy system more flexible, are therefore a prerequisite for ensuring that system security remains assured into the future.

A substantial portion of the grid expansion will fall to additional extra-high-voltage DC (HVDC) transmission lines. At the same time, new options also arise thanks to modernisation and digitisation, in order to better use existing grids. The opportunities offered by the introduction of innovative grid infrastructure and the flexible operation of fossil-fuel power stations should be used to integrate as much electricity as possible from renewable energy into the grids.

Production here is primarily supply-dependent, that is, dependent on the availability of wind and sunshine. With the objective of expanding renewable energy to 65%, there is a growing responsibility and challenge for transmission and distribution system operators to maintain system stability at all times.

At the distribution system level, 97% of renewable energy sources (wind, photovoltaics, biomass) have been connected. Today, almost 40% of German electricity production is fed through distribution systems into the overall electricity grid, and the figure is rising. This takes place across a 1.7 million km network. Almost all private households, commercial and industrial companies are supplied through the approximately 50.5 million connections to the distribution systems. There are around 550 connections at the level of the Transmission System Operators (TSOs).

The receipt of mass storage (such as pumped-storage plants) and the expansion of localised storage help to smooth out the volatile infeed of renewable energy without triggering additional CO_2 emissions. All storage systems benefit from an increasing price spread. They will therefore increasingly make an important contribution to a secure energy supply.

If hydrogen and other powertoX technologies are now tested, for instance in field testing, and further researched, and the underlying regulatory conditions are adapted to them, they can successively contribute to the greenhouse-gas-neutral reconfiguration of the energy system, in keeping with the goals of the Paris Agreement.

Provisional and final shutdowns

Pursuant to Section 13b EnWG, planned shutdowns of plants for producing or storing electrical energy from a nominal output of 10 MW must be announced 12 months prior to the planned shutdown. The Federal Network Agency (Bundesnetzagentur) will then examine the system relevance of the power station. If the power station is categorised as not system-relevant, it may be shut down. If a

power station with a nominal output of more than 50 MW is categorised as system-relevant, it is moved to the grid reserve.

Grid reserve

The grid reserve currently includes coal-fired power stations totalling 2.3 GW and no lignite-fired power stations. Of this, 1.4 GW have announced a preliminary shutdown and 0.9 GW have announced a final shutdown. The power stations that have only been flagged for temporary shutdown can return to the market. Power stations in the grid reserve that have been announced for final shutdown (in the future, this will also apply to the capacity reserve) can still continue to be operated in the reserve for an extended period of time, but they cannot return to the market.

Expected growth

The period from 2017 to 2022 will see the growth shown in Figure 3.

Expected growth from the end of 2017 to 2020

By 2020 the output of coal-fired power stations will fall. During 2018, five hard coal-fired units with a combined output of 0.9 GW[53] were already finally shut down. Furthermore, additional final shutdowns of coal-fired power stations at an output of 1.6 GW by 2020 have already been reported to the Federal Network Agency.[54] Overall, the installed output of coal-fired power stations on the market will reduce by 3.2 GW between the end of 2017 and 2020.[55] Furthermore, additional lignite-fired power stations have been, or are being, moved to contingent standby (1.8 GW in 2018 and 2019). This will bring down the installed output (power stations on the market) of coal-fired power stations to 19.5 GW and those of lignite-fired power stations to 18.1 GW in 2020. The commissioning of the Datteln 4 power station unit would see an increase in the output of coal-fired power stations on the market back to 20.5 GW in 2020.

Figure 3: Federal Network Agency list of power stations

	Power stations on the market*		Grid reserve, coal**		Contingent standby*
	Lignite (GW_{el})	Coal (GW_{el})	final (GW_{el})	provisional (GW_{el})	Lignite (GW_{el})
2017	22.7	19.9	0.9	1.4	0.9
2020	20.5	18.1			2.4
2022	19.3	18.0			0.8

Notes: *Figures refer to the end of the year in each case; **current version: 12/2018, it is not possible to precisely predict future growth

Source: Federal Network Agency list of power stations (19.11.2018); Federal Network Agency list of power stations following expected additions and retrofitting from 2018 to 2021 (19.11.2018); own calculations

53 The coal block-unit power stations Lünen 6 and 7 (470 MW) were not included in these calculations because, while they left the grid in December 2018, they cannot be definitively shut down until March 2019.

54 Added to this are 760 MW from a power station without a shutdown announcement with the Federal Network Agency, source: Federal Network Agency power station list following expected additions and retrofitting 2018 to 2021, version: 19.11.2018.

55 879 MW + 1,557 MW + 760 MW = 3,196 MW.

Growth from 2020 to 2022 following replacement of coal capacity with gas capacity

After 2020 it is likely that additional coal-fired power stations will be shut down, particularly due to the incentives under the Combined Heat and Power Act (Kraft-Wärme-Kopplungsgesetz, KWKG). Replacement projects that are well advanced will lead to the shutting down of 0.2 to 1.2 GW of coal and 0.18 GW of lignite. Power station output on the market will then still total 19.3 to 20.3 GW of coal and 18 GW of lignite in 2022.

It is not possible to accurately predict reference growth for coal-fired power stations. This depends on the implementation of the individual projects. The installed output of coal-fired power stations could also be higher in 2022 for the following reasons:

- Power stations in the grid reserve that are provisionally shut down could come back onto the market (1.4 GW),
- Operators could revoke final shutdowns that have been announced to a volume of 2 GW and potentially continue to operate the power stations on the market,
- It is not certain whether the CHP projects that are well advanced will really be implemented in the period from 2020 to 2022 within the assumed schedule and the block-unit power stations shut down (up to 1.2 GW).

In summary, in the most extreme case the coal-fired power station output on the market in 2022 could end up being up to 4.6 GW higher.

Growth through to 2030

Reference growth is likely to see a reduction in the installed output of lignite-fired power stations based on existing planning to around 16 GW in 2030.[56]

In the field of lignite-fired power stations, installed output will also fall by 2030. Current studies have calculated an installed output for the reference growth of coal-fired power stations of 11 GW (r2b), 12 GW (ENavi), 15 GW (BCG/Prognos) and 17 GW (Aurora).

According to current studies, in order to reach the 2030 climate action targets under the Climate Action Plan 2050, there will need to be a reduction in the installed output of coal-fired power stations to 16 GW (7 GW lignite/9 GW coal, Aurora), 17 GW (9 GW lignite/8 GW coal, r2b), 18 GW (7 GW lignite/11 GW coal, ENavi) and 20 GW (9 GW lignite/11 GW coal, BCG/Prognos).

The exact reference growth and the results for the target phases of the studies depend on the underlying conditions (such as fuel prices, CO_2 prices, the regulatory framework, the addition of renewables) and the resulting full load hours.

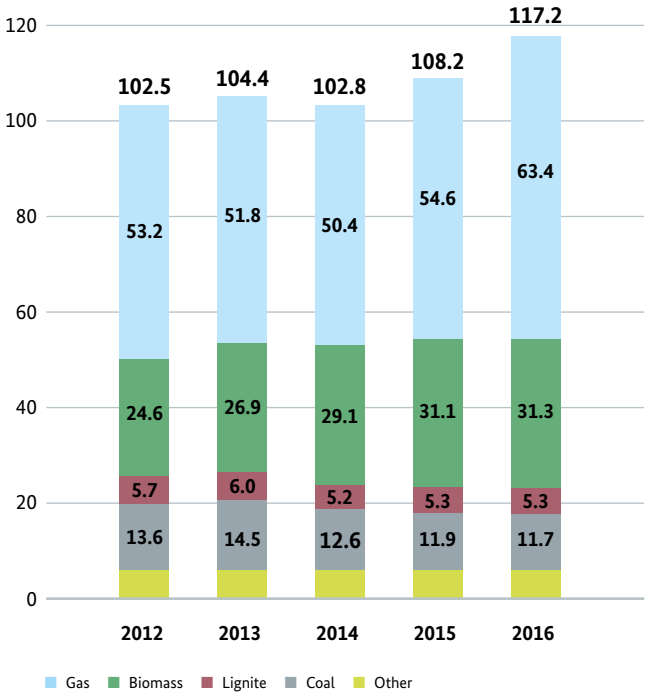
These underlying conditions each involve uncertainty that can have varying impacts. Significantly higher CO_2 prices will shift production structures primarily from coal-fired power stations to natural-gas-fired power stations, and potentially from old lignite-fired power stations to new coal-fired power stations, and will cause reductions in emissions. Increasing price differences between natural gas and coal are shifting production patterns from natural-gas-fired power stations to coal-fired power stations, thereby causing an upward trend in CO_2 emissions. Low coal prices will increase pressure to shut down older lignite-fired power stations, thereby tending to bring down CO_2 emissions from the energy industry. Lower electricity production based on renewable energy sources will lead to a higher capacity utilisation in the overall fossil-fuel-based power station stock and will cause CO_2 emissions to rise. Coal-phaseout policies in Germany's neighbouring countries will tend to lead to rising production levels for German coal-fired power stations, rising net electricity exports and higher greenhouse gas emissions in the German region.

56 See also Chapter 3.2.5, Mining area plans.

Combined heat and power

A good two-thirds of the coal-fired power stations not only supply electricity, but also discharge heat as combined heat and power plants. In doing so, they form a component of the heat supply system in district and local heating networks. 80% of CHP heat production is accounted for by smaller plants (less than 400 MW for coal, less than 200 MW for lignite).[57] In 2016, coal-fired power stations accounted for around 10% of total CHP net electricity production. Lignite-fired power stations accounted for 4.5% (see Figure 4). 68% of district heating in German grids comes from CHP. Since 2016 it is no longer possible to fund new, modernised or retrofitted CHP plants that run on coal or lignite. Instead, gas CHP and the replacement of coal CHP with gas CHP are being funded. The funding of CHP plants is currently limited until 2025.

Figure 4: CHP net electricity production by energy carrier in TWh



Source: Energiebilanzen working group[60]

CHP accounted for 44% of the municipal power station stock in 2017, measured by municipal utilities' total production output.[58] A good 80% of the projects under construction or undergoing the approval process are CHP plants, 19% are renewable energy projects. Only 0.3% now involve conventional coal- or gas-fired power stations where the heat is not harnessed.[59]

Contingent standby

Contingent standby was resolved as part of the Electricity Market Act (Strommarktgesetz) in the summer of 2016. The Electricity Market Act provides that a total of 2.7 GW of lignite-fired power station capacity will be moved to contingent standby for four years and then finally shut down (Section 13g EnWG). The goal is to save up to 12.5 million tonnes CO_2 by 2020. The first power station to be moved to contingent standby was the Buschhaus power station (Mitteldeutsche Braunkohlengesellschaft mbH, MIBRAG) with effect from 1 October 2016. All of the dates for moving block-unit power stations into contingent standby are shown in Figure 5. The plants that are in contingent standby are only deployed as a very resort by the transmission system operators, for example in the event of prolonged extreme weather phenomena. For the contingent standby and the shutdown of a plant, lost electricity market revenue and, if applicable, additional costs (for example for conversion measures) are remunerated in the four years of the limited contingent standby period (for contingent standby this means €600 million per GW for four years, corresponding to a total of €1.61 billion). The Electricity Market Act includes a formula for calculating this remuneration. The precise remuneration is set down by the Federal Network Agency each year. The costs are borne by industry through grid usage fees and private households.

57 Oeko-Institut (2018): Aktueller Stand der Steinkohle-KWK-Erzeugung in Deutschland (Current status of coal-fired CHP generation in Germany); Oeko-Institut (2017): Die deutsche Braunkohlenwirtschaft. Historische Entwicklungen, Ressourcen, Technik, wirtschaftliche Strukturen und Umweltauswirkungen (The German lignite industry. Historic developments, resources, technology, economic structures and environmental impacts).

58 29% of municipal CHP plants are operated using coal (based on the findings of the VKU).

59 Based on the findings of the VKU.

60 German Federal Environmental Agency (2018): CHP electricity production. Available at https://www.umweltbundesamt.de/daten/energie/kraft-waerme-kopplung-kwk#textpart-3.

Figure 5: Transfer of lignite block-unit power stations to contingent standby under Section 13g EnWG

Block-unit power station	Operator	Installed output rounded (MW)	Date of transfer	Shutdown date
Buschhaus	MIBRAG	400	01.10.2016	30.09.2020
Frimmersdorf P	RWE	300	01.10.2017	30.09.2021
Frimmersdorf Q	RWE	300	01.10.2017	30.09.2021
Niederaußem E	RWE	300	01.10.2018	30.09.2022
Niederaußem F	RWE	300	01.10.2018	30.09.2022
Neurath C	RWE	300	01.10.2019	30.09.2023
Jänschwalde F	LEAG	500	01.10.2018	30.09.2022
Jänschwalde E	LEAG	500	01.10.2019	30.09.2023

Source: EnWG, own research

Operation of the German electricity market

Electricity is traded on the stock exchange and outside the stock exchange. Standardised products are bought and sold on the electricity exchange – for Germany the European Energy Exchange EEX in Leipzig and the European Energy Exchange EPEX SPOT in Paris. However, overwhelmingly companies continue to conclude direct supply agreements with electricity producers. Trade using these off-exchange supply agreements is described as "over the counter". Although trade on the electricity exchanges only amounts to around 20% of the total trading volume, the exchange electricity prices are considered as an indicator for general wholesale prices.[61] Prices on the derivatives market are primarily determined by coal import prices and the CO_2 price.

The electricity market consists of various submarkets. There, products are traded with varying lead times from the purchase until the electricity is actually supplied. On the derivatives market, electricity suppliers and electricity customers can agree contracts up to six years in advance. On the *day-ahead* market electricity deliveries are auctioned for the following day. On the *intraday* market, market actors can buy and sell electricity volumes on a very short-term basis.

The *day-ahead* prices, which are calculated for each hour of the following day, are an important reference value for the electricity market.

Both conventional and renewable energy plants can offer electricity on the electricity market. In doing so, electricity supply and demand must be in equilibrium at all times. The grid operators organise the grid operation so that the electricity that is traded arrives safely with consumers (see Chapter 3.2.3, Security of supply). The electricity price on the wholesale market is formed based on the *merit order*:[62] The plants with the lowest fuel and CO_2 costs (variable short-term costs, also known as marginal costs) offer their electricity until the demand for electricity has been met in full.

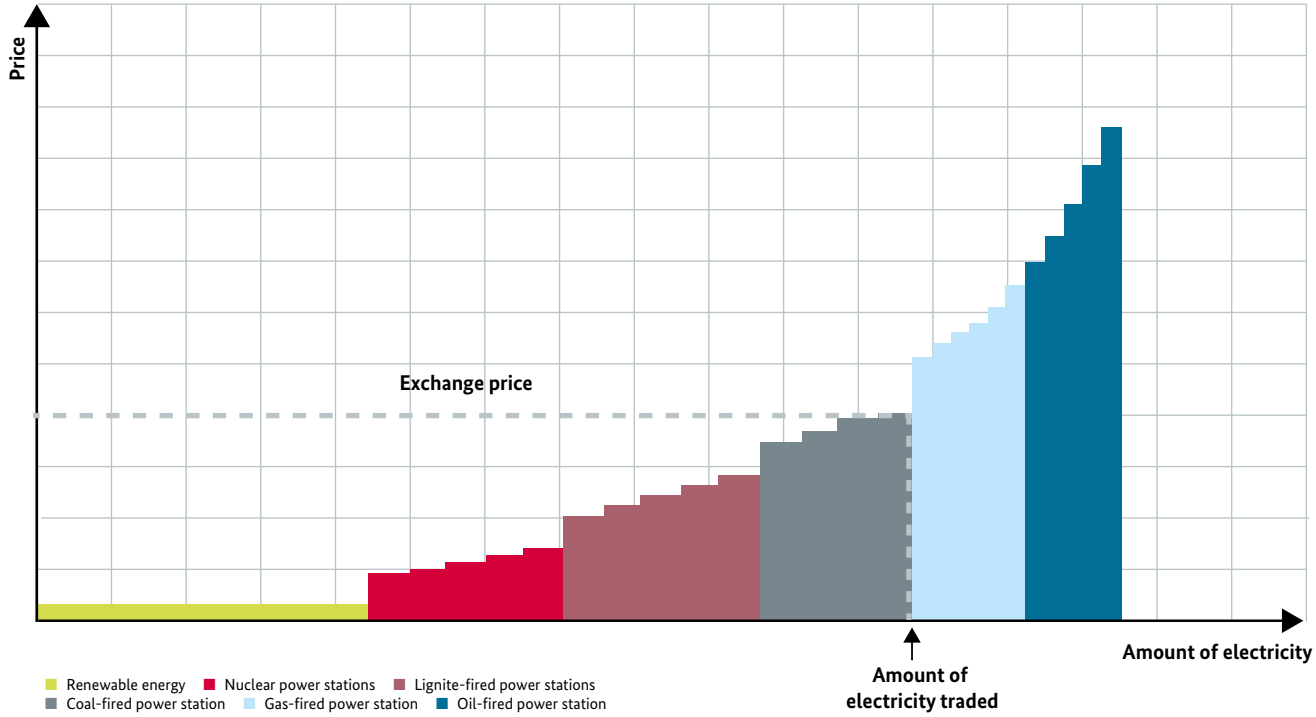
The last offer, to which an additional charge is also applied, determines the price. Accordingly, the additional charge is first applied to renewable energy plants, which neither emit CO_2 nor require fuel and whose marginal costs are therefore close to zero.[63] At the other end of the *merit order* are older coal- and gas-fired power stations, which have higher marginal costs (see Figure 6). The higher the price for CO_2 certificates, the greater the competition is between newer, more efficient gas-fired power stations with low specific CO_2 emissions and coal-fired power stations.

61 BMWi (2014): Ein Strommarkt für die Energiewende (An Electricity Market for Germany's Energy Transition). Discussion paper by the Federal Ministry for Economic Affairs and Energy (Green Paper).

62 Sensfuß, Frank (2018): Electricity market: An introduction. Presentation on the meeting of the Commission on Growth, Structural Change and Employment on 13 July 2018.

63 The marginal costs do not cover the complete renewable energy costs here; in order to cover the remaining costs (capital costs), renewable energy plants benefit from funding from the Renewable Energy Sources Act (RESA).

Figure 6: Merit Order



Source: smard[64]

The German electricity market is integrated into the European electricity market. Electricity suppliers and customers issue their bids in their national markets. In an iterative process the electricity demand is then met by the cheapest electricity offerings from all market areas until the links between the markets (interconnectors) have been exhausted.

The construction of new gas-fired power stations, for example, will be an important future option for providing electricity production output. In addition to the conventional power station projects in this segment already under construction, additional projects are also currently being planned or awaiting approval. Given the realisation period of between four and seven years, it is unlikely whether it will be possible to complete these by the time Germany phases out nuclear energy at the end of 2022 and until the contingent standby period ends in 2023, and very much uncertain. For many projects, the investment decision is therefore linked to trends for other underlying market and statutory conditions.

In principle, the electricity market can supply suitable investment incentives here. Irrespective of whether power stations, storage or flexibility on the part of the consumer are used to smooth out supply and demand, in making an investment decision the investor will also consider the plant's reliability and flexibility, as well as the maximum period for which the plant will be available.

However, an investor must also consider whether, in addition to the variable operating costs (particularly fuel and CO_2 costs) he can also cover the fixed operating costs on the market in the short term (personnel, maintenance and servicing costs) and, in the long term, the capital costs of the investment. Since gas-fired power stations tend to be at the upper end of the merit order because of their cost situation, if they are used these are then also the power stations that set the price. While they do cover their short-term variable costs, they do not manage to adequately cover their fixed and capital costs. This can only happen if there are sufficiently high and sufficiently frequent price peaks. Since

64 Federal Network Agency (2018): So funktioniert der Strommarkt (How the electricity market works). Available at https://www.smard.de/home/wiki-article/446/384.

these are difficult to assess from today's perspective, the amortisation of the investment combined with an extended capital commitment involves considerable risk. The lead times for commissioning a gas-fired power station also present a further problem. Currently, realisation periods for planning, approval processes and construction total around four to seven years. This means that even if the electricity market sends sufficient pricing signals for the investment decision, these plants are not available to the market until after a considerable time delay.

3.2.3. Electricity prices and electricity costs

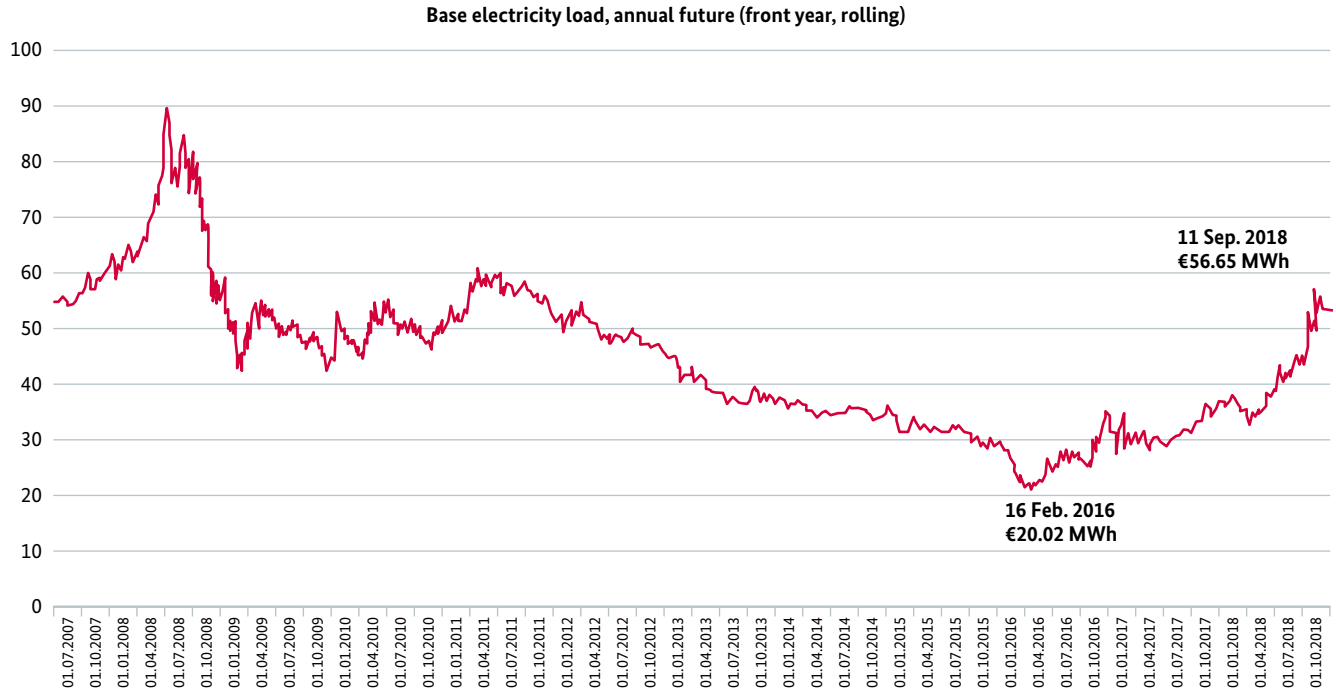
Electricity prices in general

Electricity prices for end consumers comprise the costs of electricity production (these are determined by the market, such as electricity procurement and sales and distribution), state-induced elements such as taxes, fees and allocations, and state-regulated grid fees. The degree to which these price components make up the total electricity price varies considerably depending on the category of customer and from Federal State to Federal State. This differences between individual regions and Federal States also give rise to advantages and disadvantages in terms of the attractiveness of the location.

Wholesale electricity price

The last decade has seen significant volatility in wholesale prices for electricity. A continuous rise in wholesale electricity prices has been observed since 2016 (see Figure 7). In September 2018 the electricity price averaged at around €56/MWh (annual future). In September 2017 it still averaged at €36/MWh[65] – an increase of around €20/MWh. This trend has primarily been driven by the increased price for CO_2 emissions certificates and higher fuel prices.

Figure 7: Price growth for electricity on the EEX derivatives market – 2007 to 2018
in €/MWh

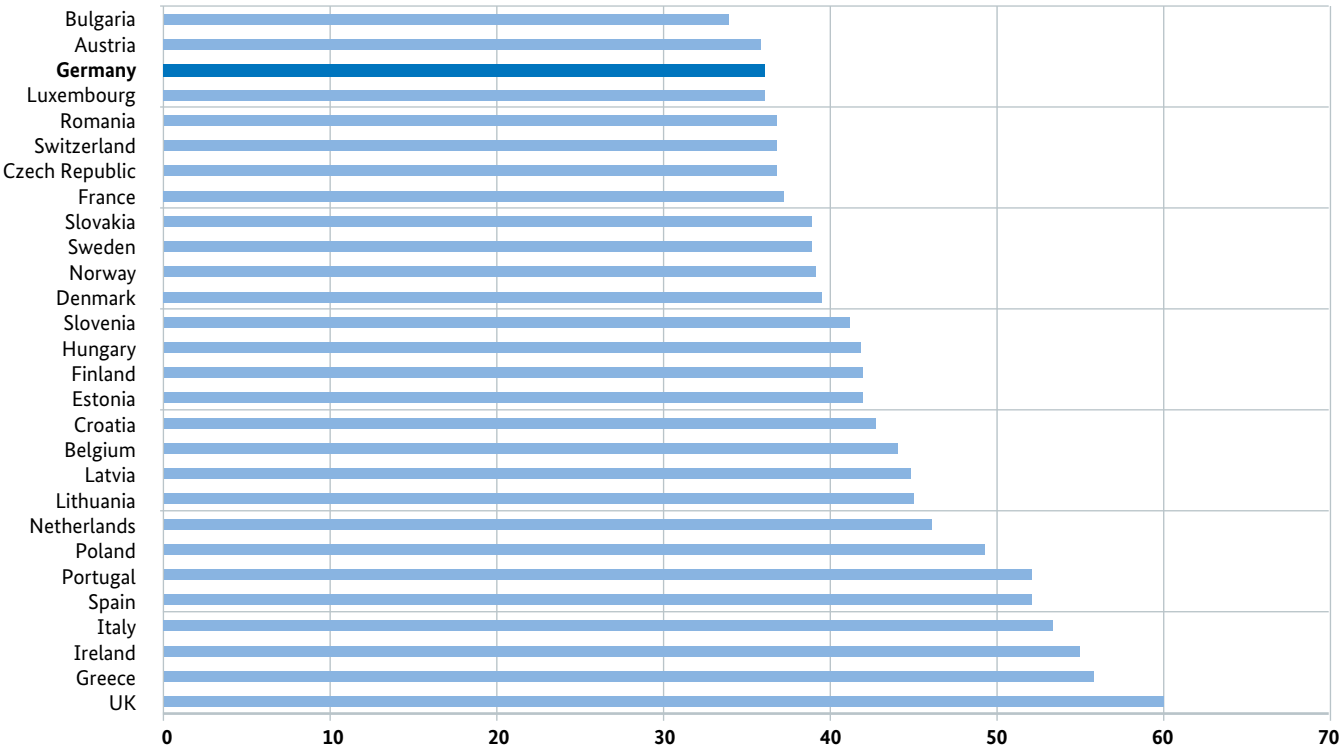


Source: EEX[66]

65 Fraunhofer ISE: https://www.energy-charts.de/price_avg_de.htm?year=2017&price=nominal&period=monthly.

66 EEX (2018): Electricity market data, available at: https://www.eex.com/de/marktdaten#/marktdaten.

Figure 8: Electricity exchange prices by European comparison, 1st half of 2018
in €/MWh



Source: Platts[67]

Compared with other European countries, electricity prices on the stock exchange for the first half of 2018 were comparatively low, averaging around €36/MWh.

Electricity costs for end consumers

In 2016, end-consumer expenditure on electricity was around €74 billion. Of this figure, around €13 billion related to production and sales and distribution (including the market value for renewable energy), around €38 billion to state-induced elements and €22 billion to regulated elements such as grid fees or electricity tax.[68] Overall, end-consumer expenditure for electricity between 2013 and 2016 was broadly stable. Occasionally, the increase in state-regulated price elements could be compensated by falling procurement costs. In 2017 and 2018, procurement costs and thus end-consumer expenditure increased, however (see Figure 9).

Measured by gross domestic product, the share of expenditure for electricity in 2016 fell to the lowest level since 2010. In 2016 the share of end consumer spending on electricity as a proportion of nominal gross domestic product was 2.4%, compared with 2.5% in 2015.

67 Platts (2018): Global Electricity Prices & Power Market Data.

68 BMWi (2018): Sixth monitoring report on the energy transition. Die Energie der Zukunft [The future of energy]. Reporting year 2016.

Figure 9: End consumer spending on electricity in € billions

	2010	2011	2012	2013	2014	2015	2016
Total expenditure (€ billion)	**65.6**	**68.6**	**69.4**	**76.7**	**76.0**	**75.3**	**74.1**
State-induced elements	**21.9**	**27.9**	**28.4**	**35.6**	**37.9**	**37.1**	**38.4**
Thereof:							
VAT	4.7	4.9	5.1	5.6	5.7	5.8	5.7
Electricity tax	6.4	7.2	7.0	7.0	6.6	6.6	6.6
Licence fee	2.1	2.2	2.1	2.1	2.0	2.0	2.0
RESA allocation	8.3	13.4	14.0	19.8	22.3	22.0	22.7
Allocation under the Combined Heat and Power Act (KWKG)	0.4	0.2	0.3	0.4	0.5	0.6	1.3
Offshore liability surcharge and surcharge for interruptible loads	0.0	0.0	0.0	0.7	0.8	0.0	0.2
State-regulated elements	**16.9**	**17.6**	**19.0**	**21.2**	**21.4**	**21.4**	**22.3**
Thereof:							
Grid fees for transmission system	2.2	2.2	2.6	3.0	3.1	3.5	3.8
Grid fees for distribution system	14.7	15.4	16.4	18.2	18.3	17.9	18.5
Market-driven elements	**26.8**	**23.1**	**22.0**	**19.8**	**16.6**	**16.8**	**13.4**
Thereof:							
Market value RESA electricity	3.5	4.4	4.8	4.2	4.1	4.7	4.3
Production and sales and distribution		18.6	17.2	15.6	12.5	12.1	9.1

Source: BMWi[69] and calculations and estimates from the expert commission on the "Energie der Zukunft" monitoring process based on StBA and ÜNB (2017). Calculations of overall expenditure are based on the revenues from electricity sales less tax incentives from subsequent discharge procedures. VAT is only shown for private households due to companies' ability to apply an input tax deduction.

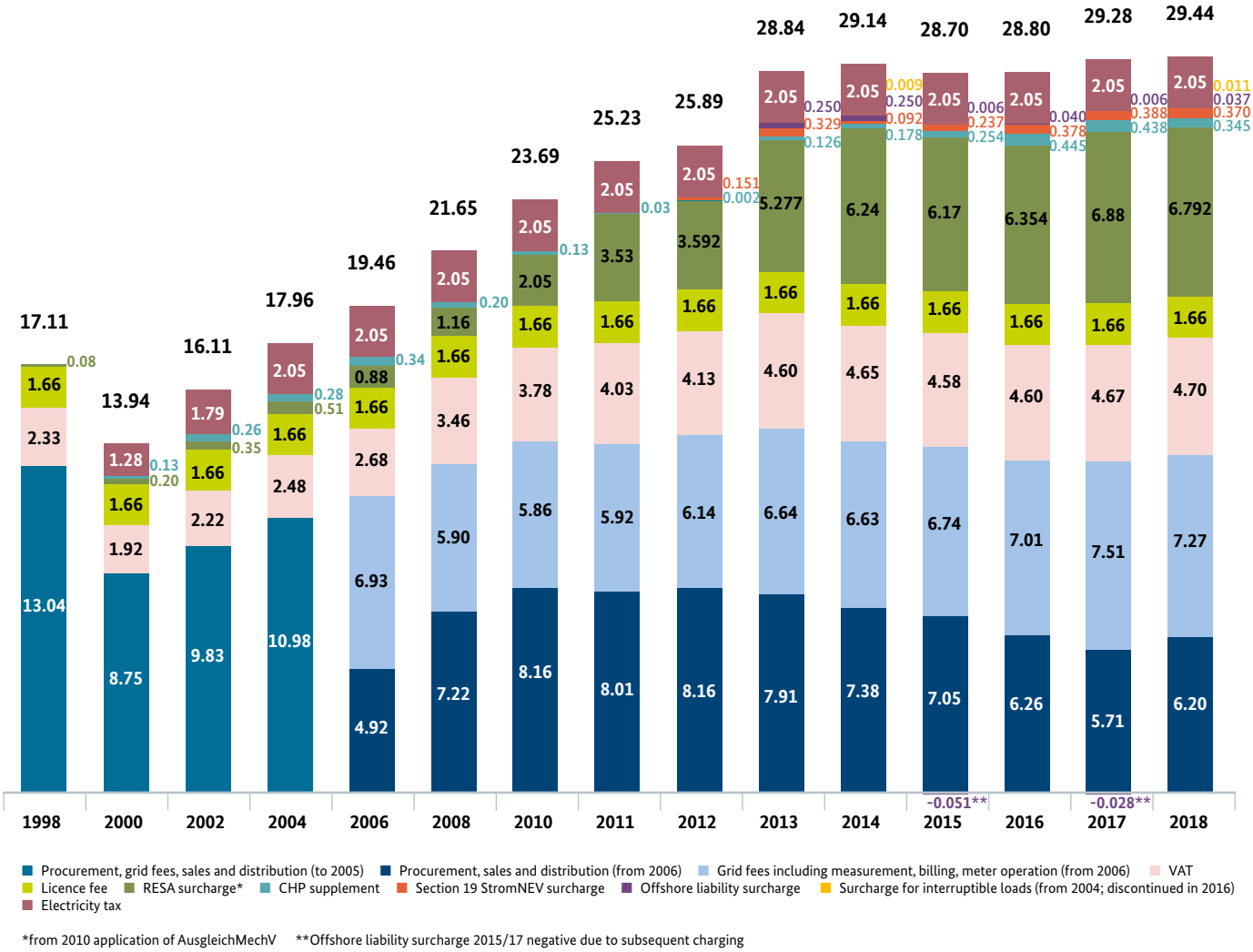
69 BMWi (2018): Sechster Monitoring-Bericht zur Energiewende. Die Energie der Zukunft. (Sixth monitoring report on the energy transition. The energy of the future). 2016 reference year.

Electricity prices for private households and industry

The average electricity price for private households rose at the beginning of 2018 by around 72% compared with 1998 and by 110% compared with 2000. The price-adjusted increase compared with 1998 is 32%. Since 2013, domestic electricity prices have stabilised at a level of around 29 cent/kWh. The current average electricity price comprises around 54% of taxes, charges and surcharges and around 25% of grid fees. The portion determined by the market (electricity procurement and sales and distribution) of the end consumer price is 21%.

The electricity costs structure for companies in industry, skilled crafts, trade and services is broadly similar to that for private households. In addition, for many businesses the

Figure 10: Electricity prices for private households (annual electricity consumption 3,500 kWh)
in ct/kWh



*from 2010 application of AusgleichMechV **Offshore liability surcharge 2015/17 negative due to subsequent charging

Source: BDEW[70], version: 05/2018

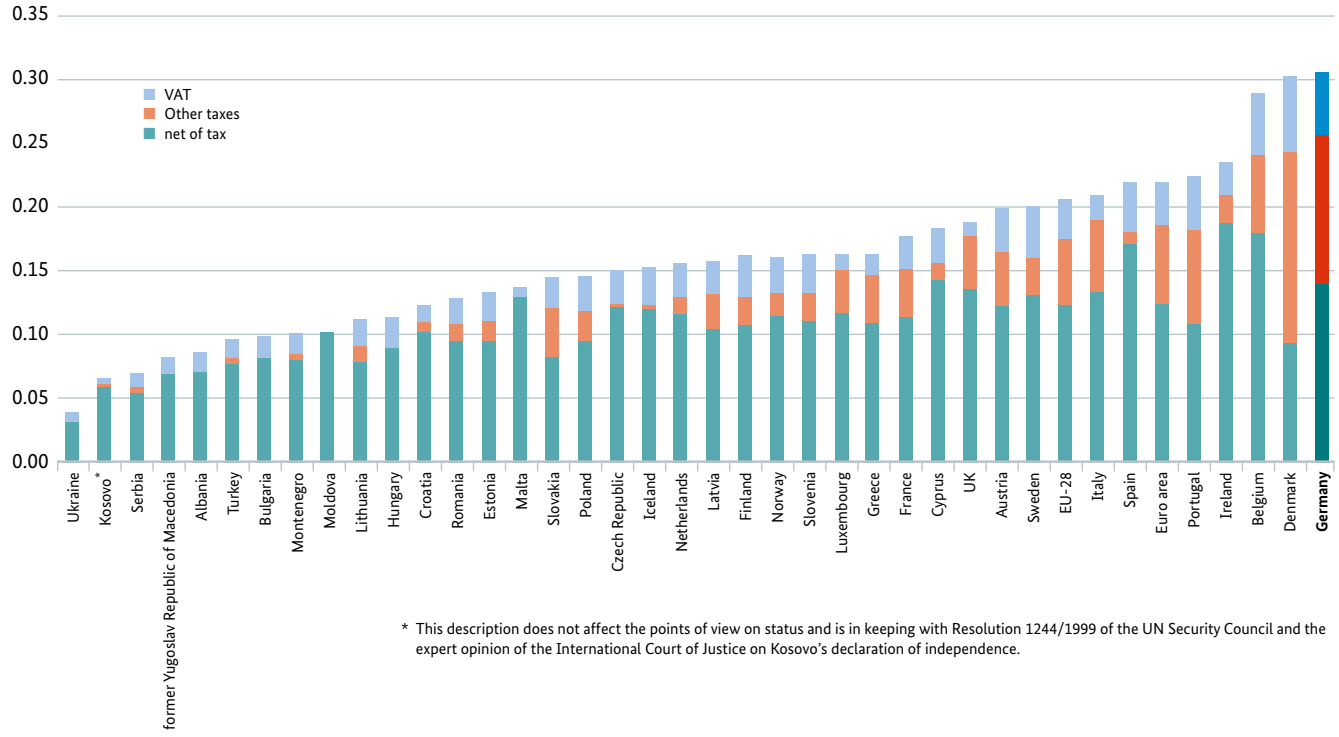
70 BDEW (2018): BDEW electricity price analysis May 2018. Domestic and industry.

amount of electricity they consume means that they do not benefit from the various reliefs for taxes, charges and surcharges, or only benefit from them to a limited extent. The comments on domestic electricity prices therefore also apply to industry, skilled crafts, trade and services.

Electricity prices for private households including taxes and charges average €0.20/kWh in the European Union. Electricity prices are highest in Denmark and Germany, although Germany has overtaken Denmark for the first time since the end of 2017 (around €0.30/kWh).

Figure 11: EU country comparison domestic electricity prices for the second half of 2017 incl. taxes and charges with an annual consumption of 2,500 to 5,000 kWh

in € per kWh

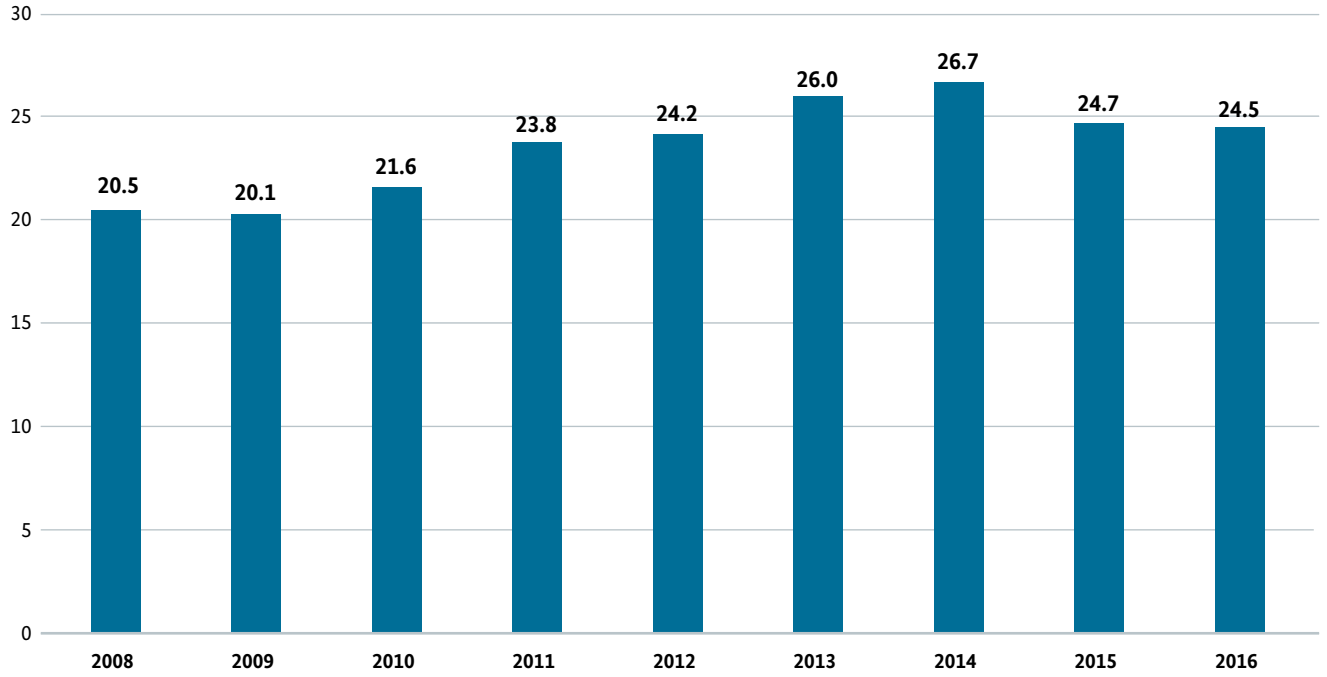


* This description does not affect the points of view on status and is in keeping with Resolution 1244/1999 of the UN Security Council and the expert opinion of the International Court of Justice on Kosovo's declaration of independence.

Source: Eurostat[71]

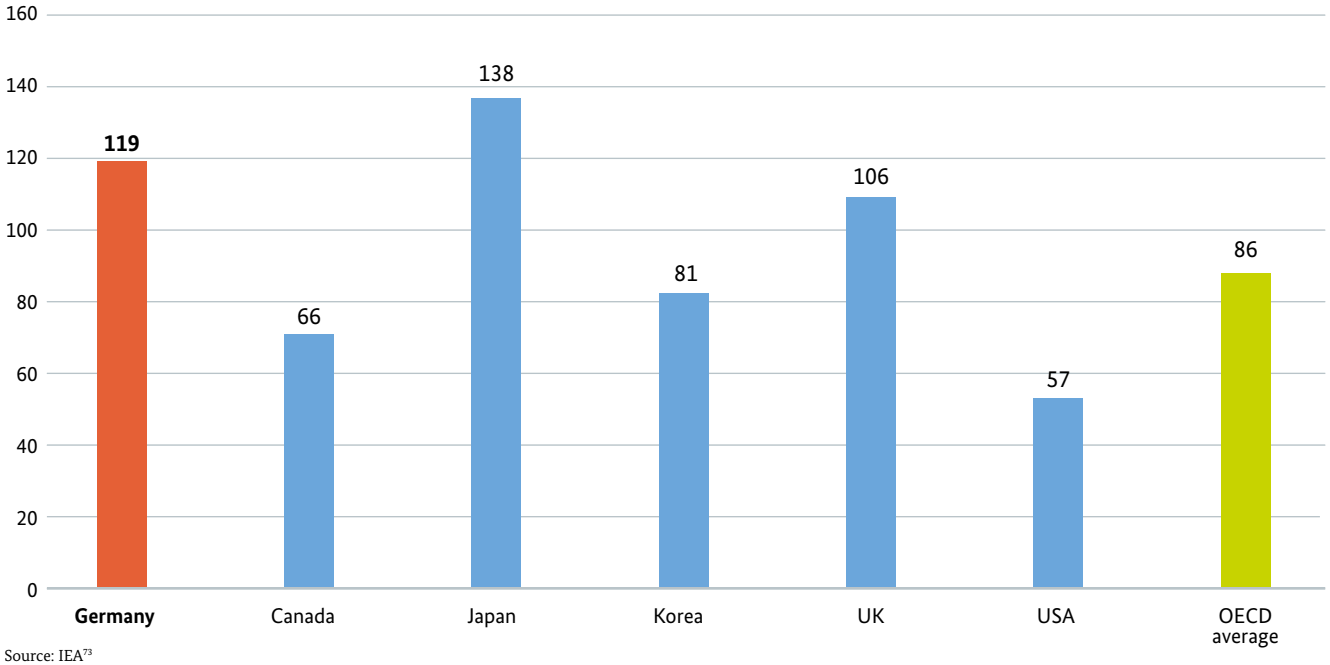
71 Eurostat: Preise Elektrizität für Haushaltskunde, ab 2007 – halbjährliche Daten (Online-Datencode nrg_pc_204) (Electricity prices for residential customers, from 2007 – half-yearly data (online data code nrg_pc_204).

Figure 12: Electricity costs for industry
in € bn.



Source: BMWi[72]

Figure 13: Average industry prices by OECD comparison, 2016
in €/MWh

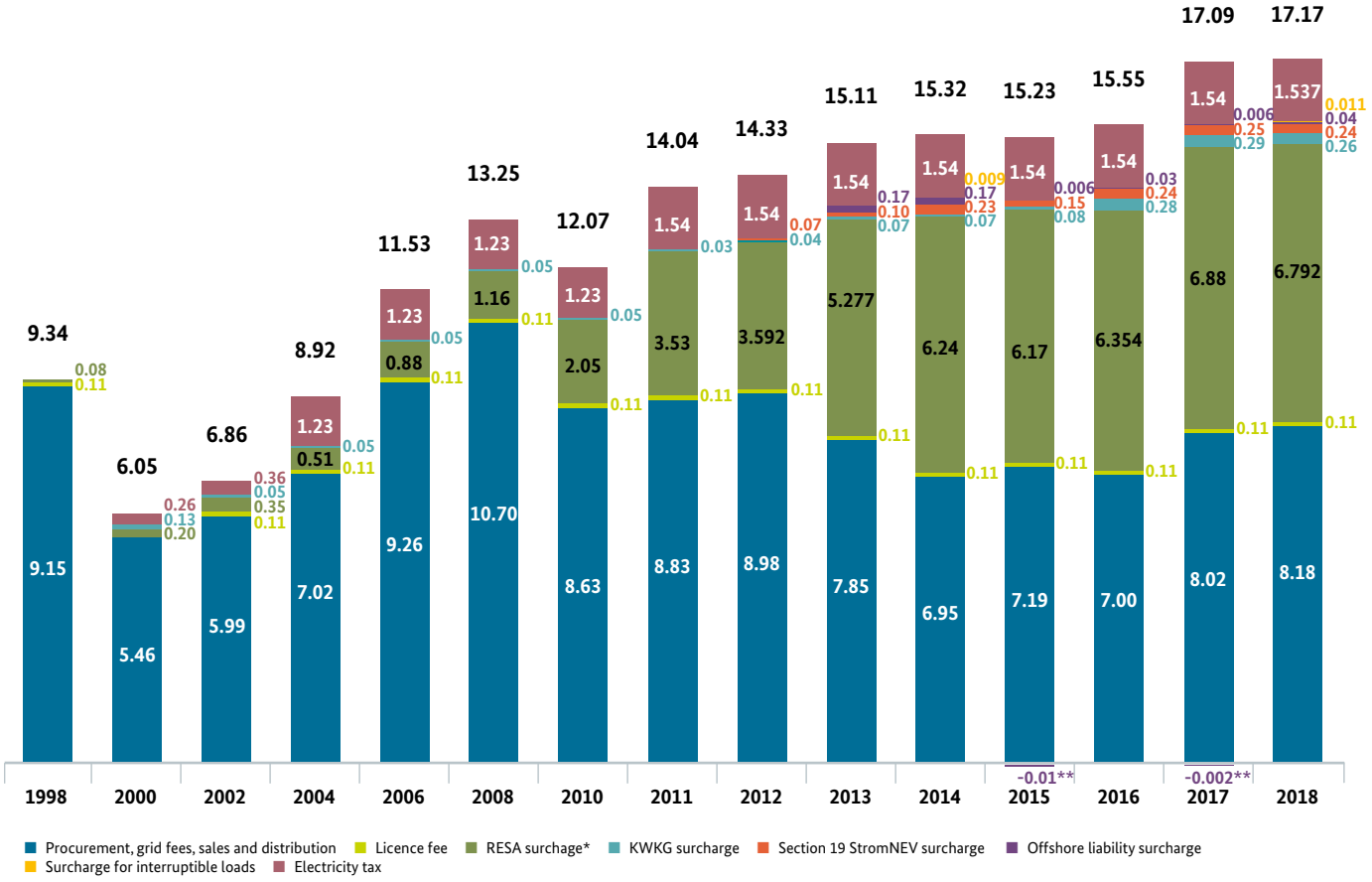


Source: IEA[73]

72 Own calculations based on BMWi (2018): 6. Monitoringbericht der Energiewende (Sixth monitoring report on the energy transition) (https://www.bundesnetzagentur.de/DE/Sachgebiete/ElektrizitaetundGas/Unternehmen_Institutionen/DatenaustauschundMonitoring/MonitoringEnergiederZukunft/monitoringenergiederzukunft-node.html).

73 Original figures in USD, average exchange rate from the ECB applied: 1 USD = €0.8435, source: own presentation based on IEA/OECD Energy Prices & Taxes 2018.

Figure 14: Electricity prices for SMBs (incl. electricity tax)
in ct/kWh
Annual consumption 160,000 to 20 million kWh (medium-voltage supply; reduction 100 kWh/1,600 h to 4,000 kWh/5,000 h)



*from 2010 application of AusgleichMechV **Offshore liability surcharge 2015/17 negative due to subsequent charging

Source: BDEW[74]

Industry

Electricity prices and electricity costs are an important cost factor for industry and therefore influence their competitiveness. German industry's total spending on electricity rose between 2010 and 2014 from around €22 billion to around €27 billion and then fell again by 2016 to around €25 billion per annum. However, due to the rise in electricity prices, electricity costs are likely to have risen again in 2017 and 2018 (see Figure 12).

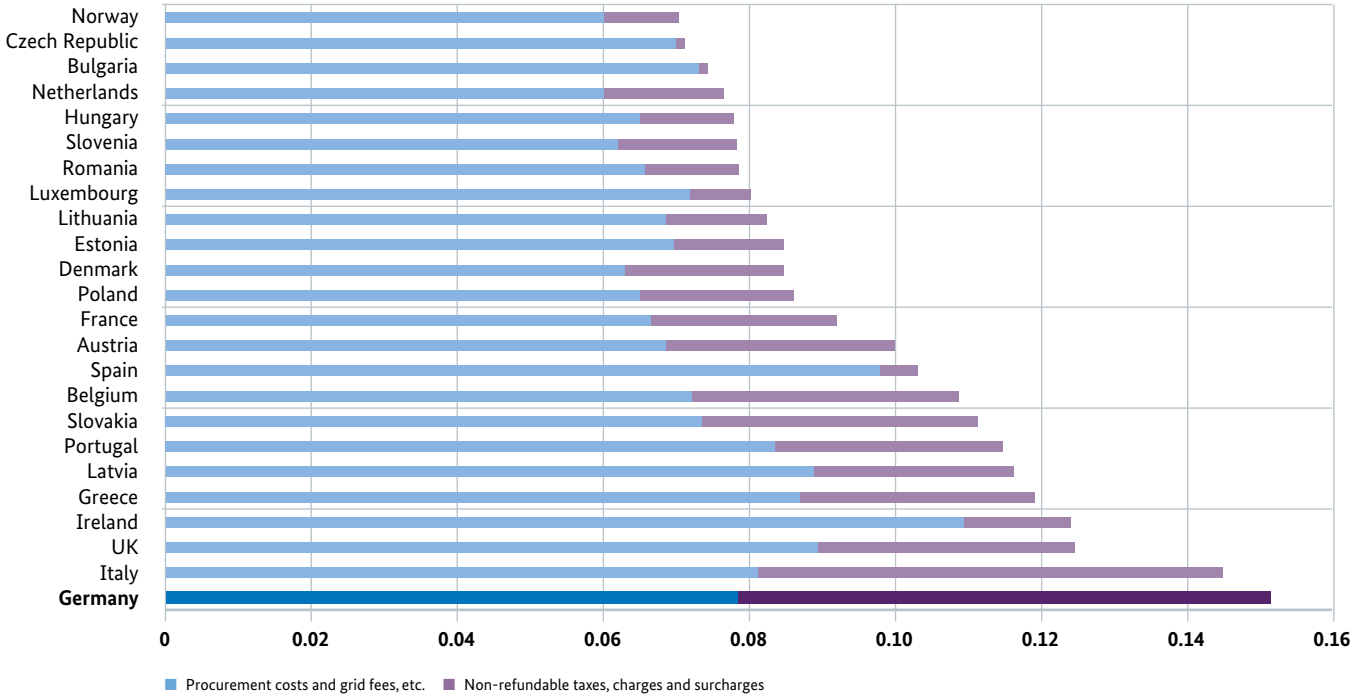
German companies are active around the world. Their products are in competition with other industrialised countries outside the EU and emerging, newly-industrialising countries. As shown in Figure 13, the average industrial electricity price in Germany is well above the OECD average. Compared with the US, it is more than twice as high in Germany.

The average electricity price for industrial consumers who do not cover their electricity requirements with their own power generation plants rose at the beginning of 2018 by around 84% compared with 1998 and by 184% compared with 2000 (figures are nominal in each case). The current average electricity price comprises around 52% of taxes, charges and surcharges and around 48% of electricity procurement, grid fees, sales and distribution. In contrast, charges are much higher for smaller companies, which generally do not enjoy as much relief.

74 BDEW (2018): BDEW-Strompreisanalyse Mai 2018. Haushalte und Industrie (BDEW electricity price analysis May 2018. Residential and industry).

Figure 15: EU country comparison, industrial electricity prices for the second half of 2017 incl. taxes and charges for an annual consumption of 500,000 to 2 million kWh

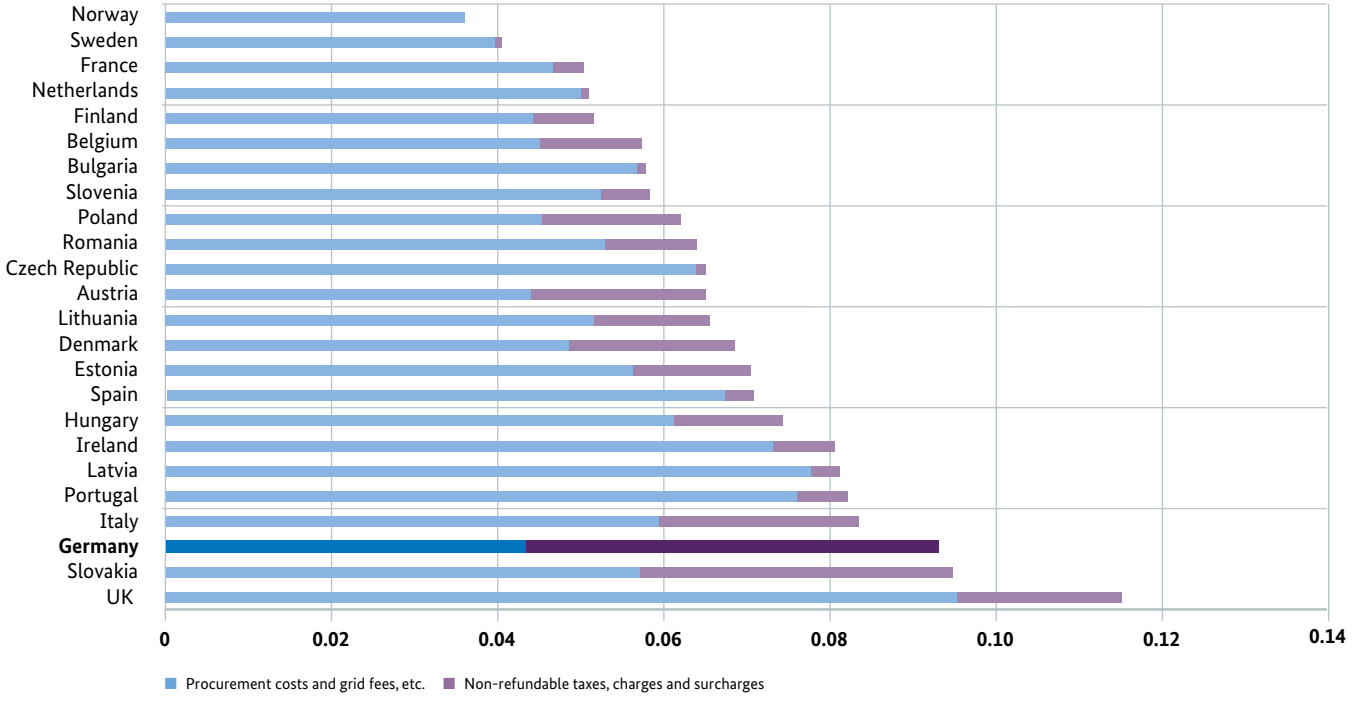
in €/kWh



Source: EUROSTAT[75], own research

Figure 16: EU country comparison, industrial electricity prices for the second half of 2017 incl. taxes and charges for an annual consumption from 70 to 150 million kWh

in €/kWh



Source: EUROSTAT[76], own research

75 Eurostat: Electricity prices for non-household customers, from 2007 – half-yearly data (online data code nrg_pc_205).

76 Eurostat: Electricity prices for non-household customers, from 2007 – half-yearly data (online data code nrg_pc_205).

German industrial electricity prices for companies that do not meet their electricity demand with their own power generation plants are among the highest compared with the EU as a whole. Excluding taxes and charges they would be placed roughly mid-table among EU countries. Nevertheless, the BDEW believes that only around 4% of industrial enterprises benefit from the special equalisation scheme under the Renewable Energy Sources Act (Erneuerbare-EnergienGesetz, EEG) to safeguard their international competitiveness, although these account for more than half of industrial electricity consumption.[77] 96% of industrial enterprises pay the full RESA surcharge.

The competitiveness of energy-intensive companies, in particular, depends to a large extent on electricity prices. Sectors that are considered to be particularly energy-intensive under the RESA's (Renewable Energy Sources Act) special equalisation scheme primarily include steel, chemicals and the non-ferrous metals glass, cement, chalk and paper. Companies requiring intense heat include the food sector and wood and paper production. Outside of industry there are other energy-intensive sectors, such as data centres.

Thanks to fees, surcharges and charges, the electricity price for (energy-intensive) industrial companies without relief (excluding refundable taxes) in Germany is among the highest in Europe (see above). In order to avoid distortion for industries that are competing internationally, reliefs are granted in Germany (and in other EU countries) such as the special equalisation scheme, for example.[78] The amount of relief granted depends to a large extent on the volume of electricity purchased and on the ratio between electricity costs and sales and value generated. Furthermore, 75% of the electricity price effects from emissions trading in energy-intensive industries will be smoothed out by electricity price compensation in 2019, although the compensation will decline over time. There are also regional differences between the Federal States due to differing grid fees.

In rural regions of northern and eastern Germany, in particular, there are higher electricity prices than the average in Germany, which represents a regional disadvantage for the companies based there.[79]

Energy-intensive companies that compete internationally also have the possibility to assign CO_2 certificates free of charge for the sectors with the highest risk of production being moved to countries outside the EU (so-called 'carbon leakage'). In Germany around 1,900 energy and industrial plants currently (in the third EUETS trading period from 2013 to 2020) participate in emissions trading (Europe-wide the figure is 12,000). Nevertheless, Germany enjoys location advantages such as proximity to customers/customer loyalty, a large degree of integration within the value chains, close integration with research and development and sectoral clusters, highly skilled workers and a secure energy supply. However, other countries are increasingly also in a position to offer all of these conditions, although currently at lower energy costs (for example, the US along with the boom in shale gas and shale oil). It is unclear how long these low energy costs will last. Long-term planning security is therefore hugely important for companies in order to guarantee the amortisation of investments and thus allow investments to happen. European law on government aid plays a decisive role in avoiding competitive distortion as Germany continues to assume a pioneering role in energy and climate policy.

77 Industry's net electricity demand was 249 TWh in 2017. This includes own consumption excluding the RESA surcharge in the amount of 69 TWh. With respect to net electricity demand excluding own consumption, the BesAR benefit in the amount of 102 TWh accounts for around 57%. Source: Fraunhofer ISI (2018): Mittelfristprognose zur deutschlandweiten Stromabgabe an Letztverbraucher für die Kalenderjahre (medium-term forecast of Germany-wide power supply to end consumers for calendar years) 2019 to 2023, Table 2, p. 30.

78 In regulating the reliefs applicable, and in particular the special equalisation scheme under Sections 63 et seq EEG 2014, the legislator is guided by thresholds that must be exceeded. Sectoral affiliation is taken into account (pursuant to Annex 4 EEG 2014), as well as annual electricity consumption and electricity intensity.

79 Following the NEMoG (Gesetz zur Modernisierung der Netzentgeltstruktur, Grid Remuneration Structure Modernisation Act), which took effect on 18.07.2017, from 2018 the transmission system is being incrementally harmonised across Germany and the privilege of avoiding grid fees is being phased out.

It is not only the amount of the energy costs that represents a burden for industrial value creation in Germany. Uncertainty around the future regulatory position, for instance with regard to the special equalisation scheme, also poses a challenge for Germany as a centre of industry and commerce.[80] Uncertainty is already reflected today in weak investing activity from energy-intensive industry in Germany, despite a high level of economic growth.[81]

3.2.4. Security of supply

Security of energy supply is a valuable asset. The continuous availability of energy and heat is the foundation on which the German economy is built. This also encompasses the secure supply of energy resources. It is important to note in this context that Germany also has a well-developed gas infrastructure. In its decision on the "coal penny" or "Kohlepfennig" (a subsidy that was applied to support the coal-mining industry) in 1994, the Federal Constitutional Court already demonstrably found that "the interest in the supply of energy [is] as common today as the interest in putting bread on one's table." Security of supply is embedded as a key goal in the appointment resolution of the Commission on "Growth, structural change and employment".

However, unlike the targets in relation to the development of renewable energy and the reduction of greenhouse gases, the objective of supply security has not been further qualified or even quantified.[82] In order to track the security of supply, the BMWi monitors the security of supply under Section 51 EnWG and provides a report under Section 63 EnWG based on probability-based analyses across all Federal States and according to European legal guidelines (common methodology).

The BMWi's monitoring report uses the term 'security of supply' to refer to sustainably and permanently meeting demand. Essentially this covers every step in the electricity supply system: electricity production, the availability of primary energy carriers for electricity production, the transportation of electricity, trading and sales and distribution.[83] Security of supply can be demonstrated using the criteria of supply reliability, system security and needs-oriented electricity production:[84]

- **Security of supply:** This relates to the question as to whether the end consumer remains connected to the grid or if the supply suffers an unplanned interruption – for example, due to weather events or accidents related to construction work. The operators of the distribution system must submit a report to the Federal Network Agency by 30 April each year in relation to the supply interruptions that occurred in the grid in the preceding year (Section 52 EnWG). From this information the Federal Network Agency calculates the average value of the supply interruptions for all end consumers, which is known as the SAIDI value (System Average Interruption Duration Index). However, this is not suitable for measuring the actual energy supply security or quality –

80 Gebr. Grünewald GmbH & Co. KG is a medium-sized, energy-intensive company in the paper industry. The company produces special types of paper for the European market. Its direct competitors produce in the Czech Republic, Austria and Sweden. In this competitive environment, Gebr. Grünewald GmbH & Co. KG needs internationally competitive energy prices. Additional costs of €10/MWh mean additional costs of €275,000 per annum for Gebr. Grünewald GmbH & Co. KG, which equates to the size of the family company's net income.
TRIMET Aluminium SE is an independent German aluminium manufacturer: In 1990 Europe still had 36 aluminium smelters. In 2018 there are now only 15. With a base electricity load supply that will predominantly turn to more expensive gas-fired power stations if coal-fired power generation is abruptly phased out, energy-intensive industrial production in Germany would no longer be competitive. Electricity is the largest cost item for aluminium production. Electricity costs amount to approximately 40% of total costs. An increase of 1 ct/kWh therefore means an increase in total production costs of around 10% compared with the costs in 2018, and this is against a uniform worldwide exchange price for the aluminium that is produced. For reference: TRIMET alone, at 6 TWh/a, requires more than one percent of German energy production – 1 ct/kWh thus equates to additional annual costs of €60 million.

81 IW (2017): Energiepolitische Unsicherheit verzögert Investitionen in Deutschland. IW policy paper 13/2017; Statistisches Bundesamt 2017; Energy-intensive sectors: Paper, chemicals, glass/ceramics and metal production and machining.

82 The German Federal Court of Auditors (Bundesrechnungshof) sharply criticised this in 2016: "The monitoring of the energy transition must be optimised with respect to the target architecture. The objectives of supply security and affordability must be substantiated, evaluated and quantified in just the same way as the already adequately-quantified goal of environmental sustainability" (German Federal Court of Auditors (2016): Report to the Budget Committee of the Federal German Parliament (Bundestag) under Section 88 (2) BHO on measures for implementing the energy transition by the Federal Ministry for Economic Affairs and Energy).

83 BMWi (2016): Monitoring report by the Federal Ministry for Economic Affairs and Energy under Section 51 EnWG on supply security in relation to the network-based supply of electricity.

84 Maurer, Christoph (2018): Versorgungssicherheit – Grundlagen (Security of Supply – Fundamentals). Presentation to the meeting of the Commission on Growth, Structural Change and Employment on 13 July 2018.

which is critical for industry in particular – because it only captures supply interruptions of more than three minutes.

- **System security:** In addition to network expansion, grid operators are also tasked with the secure operation of the electricity grids. In doing so, they ensure that the electricity that is procured on the market actually reaches the energy customers. Extended, general power outages – also known as blackouts – are usually system security problems.[85] In order to ensure system security, grid operators turn to system services. These include, in particular, the use of balancing capacity (frequency stability) and idle power (voltage stability) as well as the use of generating installations to restore the grid where major faults occur ('black start' capability). Furthermore, the grid operators are obliged to take certain measures in order to maintain the security of the power supply system (Section 13 EnWG). These include, in particular, so-called 'redispatch' and feed management measures: Where grid congestion is anticipated, the grid operators direct energy producers to reduce their plants' production. Reserve power stations are started up behind the bottleneck, in order to replace the reduced electricity production. Each year the Federal Network Agency decides the requirement for reserve power stations (Section 3 NetzResV). For instance, for winter 2018/2019 the requirement for reserve grid capacity is 6,600 MW. Where a power station operator intends to shut down a power plant, the operator is obliged to report this to the Federal Network Agency no less than 12 months in advance (Section 13 EnWG). If the Federal Network Agency categorises the power station as being systemically important following a request by a transmission system operator, it can block the shutdown. The power station is then transferred to the grid reserve (see Chapter 3.2.2).

- **Needs-oriented electricity production:** In addition to the stability of the electricity grids, a secure electricity supply requires that electricity customers can continuously meet their demand on the market. In a competitive system, economic supply security is typically safeguarded by companies doing everything they can in the interests of their own profitability to ensure that the population is supplied with the products they provide.[86] The German energy industry therefore leaves the construction of power stations and the development of grids to public (generally municipal) and private enterprise companies. There is an expectation, based on experience, that this is the most cost-effective way to achieve a high level of supply security. At a European level, needs-oriented electricity production on the market is monitored and assessed by the European Network of Transmission System Operators ENTSOE, and at regional level this is done by the Pentalateral Forum. In Germany, the Federal Ministry for Economic Affairs and Energy monitors supply security on an annual basis (Section 51 EnWG). In addition, a joint supply security report is prepared with the neighbouring countries in the European Union. The methods used at a European and national level are based on a probabilistic method taking a European perspective, which is continuously monitored. Supply security is evaluated there using a measurable, quantifiable criterion known as the LoLE (Loss of Load Expectation), which measures the expected hours each year during which the electricity supply on the market will be unable to fully meet the electricity demand. In Germany, during these hours the power stations in the capacity reserve will step in to cover the demand. As a general point, it must be noted for the calculation of the LoLE value that the static approach of the energy balance report (in simple terms: secured output less peak annual load > 0) has been superseded from 2018. The probabilistic calculation is based on various assumptions and ancillary conditions. These relate, among other things, to conventional available power station capacity abroad, as well as to grid expansion plans involving cross-border interconnector capacity, for instance. Since model results involve increasing uncertainty as the time horizon increases, they should be supplemented with appropriate sensitivity analyses and plausible bands for the model results. Descriptions of results would also be desirable for extreme situations such as 'dark lulls' or hot spells.

Supply security on the energy market is currently guaranteed to a very high level. The duration of interruptions in supply at the distribution system level has been at a consistently low level for many years. By international compari-

85 Maurer, Christoph (2018): Versorgungssicherheit – Grundlagen (Security of Supply – Fundamentals). Presentation to the meeting of the Commission on Growth, Structural Change and Employment on 13 July 2018.

86 Säcker, Franz Jürgen and Timmermann, Andreas (2018), in: Säcker, Franz Jürgen (Ed.), Berliner Kommentar zum Energierecht (Berlin commentary on energy law), 3rd Edition, Section 1 item 8.

son, Germany has one of the world's most secure electricity supply systems. The following precautions have also been taken to ensure that the electricity supply is secure: In addition to a reserve for regional risks to protect system security in the transmission systems (grid reserve), today the so-called 'contingent standby' is already ready to meet longer-term risks on the electricity market. The costs are borne by industry through grid usage fees and private households.

In order to meet the energy demand, a capacity reserve is also ready for any extreme, short-term events on the energy market.

Supply security must continue to be protected even as the energy transition continues with the phasing out of nuclear energy by the end of 2022 and the further expansion of renewable energy. This presents a challenge.[87] With respect to the dimension of system security, a particular question arises as to how the future provision of system services such as idle power can be arranged so that they are more independent of conventional power stations (system security).[88] In recent years, measures for maintaining system security such as redispatch have become more important. The volume of reductions and increases in the feed-in using redispatch measures in 2017 rose to around 18,000 GWh compared with about 11,000 GWh in 2016.[89] There are many different reasons here, such as production plant locations and volatile infeed as well as delays to the expansion of the grid. Overall bottleneck management costs (redispatch, infeed management, grid reserve) increased from €0.8 billion in 2016 to €1.4 billion in 2017.[90] The further expansion and optimisation of the electricity grids is therefore a prerequisite for ensuring that system security remains assured into the future. This includes, in particular, the planned commissioning of the extra-high voltage lines that are under construction and being planned.

The completion of the domestic European electricity market is the stated goal of the European Union. Supply security on the electricity market ("needs-oriented electricity production") must therefore be seen at a European level. The European Union's energy policy is also committed to security of energy supply. Pursuant to Art. 194 (1) lit. b AEUV, guaranteed security of supply is one of the objectives of the European Union's energy policy. However, the member states continue to bear the primary responsibility for ensuring security of supply. Germany is connected to its neighbours through cross-border interconnectors. The physical transmission of electricity is restricted by the transmission capacity of the power grids and the cross-border interconnectors. German electricity supply is provided in a European network and is integrated into the domestic European market (see Chapter 3.2.1).

The current market situation is still characterised by overcapacity throughout Europe.[91] The Commission on Growth, Structural Change and Employment is unanimous that national overcapacity will be largely depleted by the time the last nuclear power stations are shut down from 2023. At the same time, a decline in the secure output is expected in neighbouring countries, as the example of Belgium is clearly showing at the moment.[92] A study by the Joint Research Centre, the European Union's science and knowledge service, is examining the growth in the installed output of coal-fired power stations in the European Union. There will be a decline from 150 GW to 105 GW in the period from 2016 to 2025 and a further decline to 55 GW by 2030.[93] The electricity export balance aggregated over the year is also

87 See Kleinekorte, Klaus (2018): Presentation to the meeting of the Commission on Growth, Structural Change and Employment on 29 August 2018.

88 BTU Cottbus-Senftenberg (2018): Betrachtungen zur Mindesterzeugung von Braunkohlekraftwerken im Kontext des Netzbetriebes. Systemmehrwert durch mehr Flexibilität (Considerations of minimum generation by lignite-fired power stations in the context of system operation. Added systemic value from greater flexibility).

89 Half of the redispatch volume of 18 TWh comprises infeed reductions in northern and eastern Germany (including 60% lignite-fired power stations) and half of increases in infeed in southern Germany in particular (including 35% each for natural gas- and coal-fired power stations). Source: BNetzA (2018): Quartalsbericht zu Netz- und Systemsicherheitsmaßnahmen Gesamtjahr und Viertes Quartal 2017 (Quarterly report on grid and system security measures for the year as a whole, and the fourth quarter, of 2017).

90 Of this figure, €235 million related to redispatch, €373 million to infeed management and €286 million to the grid reserve in 2016. In 2017, €423 million related to redispatch, €610 million to infeed management and €415 million to the grid reserve (see Federal Network Agency 2019, "Grid and System Security", available at: https://www.bundesnetzagentur.de/DE/Sachgebiete/ElektrizitaetundGas/Unternehmen_Institutionen/Versorgungssicherheit/Netz_Systemsicherheit/Netz_Systemsicherheit_node.html).

91 Maurer, Christoph (2018): Monitoring der Versorgungssicherheit am Strommarkt – Analyse für 2020 bis 2030 im Auftrag des BMWi (Monitoring supply security on the energy market – analysis for 2020 to 2030 on behalf of the Federal Ministry for Economic Affairs and Energy).

92 Schroeder, Robert (2018): Bedarfsgerechte Stromeinspeisung (Needs-oriented energy infeed). Presentation to the meeting of the Commission on Growth, Structural Change and Employment on 29 August 2018.

93 BDEW (2018): Verfügbarkeit ausländischer Kraftwerkskapazitäten für die Versorgung in Deutschland (Availability of foreign power station capacity for supply in Germany).

insufficient to safeguard supply. This is all the truer the higher the share of fluctuating and supply-dependent energy carriers in the energy mix. In order to assess the security of supply, it is therefore more instructive to look at extreme situations. Electricity supply must therefore also be assured during extended periods when there is unusually little electricity from wind and sunshine, coinciding with a high level of demand due to the cold (known as 'cold lulls'). It must also be borne in mind here that peak load situations can also occur at the same time in the countries of Central and Western Europe. Weather-related effects (such as cold spells and drought) generally also occur in many European countries at the same time, due to their large scale.

The electricity market must send reliable investment signals in order to ensure that supply security on the electricity market remains guaranteed even after nuclear energy is phased out by the end of 2022. Planning security is required to provide this. This only exists if the market players can be confident that reliable political decisions will be made with sufficient time to implement them. Furthermore, within the European market, precautionary needs-based electricity production, for instance, must also be guaranteed at the national level. This is due to the fact, for example, that the national energy policies of other European member states can change and capacity growth in neighbouring European countries cannot be estimated with certainty. National measures must also be possible in order to minimise the resulting risks, at least on an interim basis. The German capacity reserve system is a response to the need for national coverage, without compromising the market.[94] Contingent standby provides another coverage instrument, in addition to the capacity reserve.

Security of supply for heat

The core climate policy objective of the Commission on Growth, Structural Change and Employment is the incremental reduction and phasing out of coal-fired power generation. A significant nu mber of the coal-fired power stations in Germany produce not just electricity, but also heat for local heat supply and industrial process heat. So there can be little doubt that a reduction in coal-fired power station capacity will have an impact not only on the supply of power but also on the supply of heat. This necessarily gives rise to different challenges with regard to the reduction of coupled and uncoupled coal-fired power station capacity, which must be differentiated.

Industrial heat

Coalfired CHP plants for mining and manufacturing industry contributed to the energy supplied to industry by supplying 15.3 TWh of process steam and heat in 2017. In the area of lignite, process steam is used in particular for lignite refinement. It must be remembered here that many CHP plants that supply industrial enterprises are counted as public supply plants, because they are operated by contractors. It is therefore not possible to clearly classify them.[95]

District heating

District heating grids are Germany's third key energy infrastructure, after gas and electricity grids. They supply heat to over 5.8 million households, particularly in urban areas.[96] For space heating supply in residential buildings the proportion of district heat has more than doubled in the last ten years. District heating does not only heat private households and residential buildings. Industry and commerce are also customers for district heat to a significant extent, for instance as process heat or for heating manufacturing plants.

The value of district heating grids from a climate policy perspective is that this infrastructure allows urban centres to be decarbonised much more easily. This is more and more true the more densely these areas are populated and the higher the density of apartments and heat. Experience has shown here that energy efficiency can only be improved through insulation by investing substantial expenditure (and even then only to a limited extent). The advantage of grid-bound heat supply is that heat that is increasingly produced using renewable energy or low-CO_2/CO_2-free energy carriers is very easy to distribute in these urban areas.

94 The power stations in the capacity reserve are outside the electricity market. They are only deployed if no market clearance can take place. In addition, they may not offer electricity on the market.

95 Falkenberg, Hanno et al. (2018): "Evaluierung der Kraft-Wärme-Kopplung. Analysen zur Entwicklung der Kraft-Wärme-Kopplung in einem Energiesystem mit hohem Anteil Erneuerbarer Energien" (Evaluation of CHP. Analyses of the development of CHP in an energy system with a high proportion of renewable energy). Prognos AG, Fraunhofer IFAM, Oeko-Institut, BHKW-Consult and Stiftung Umweltrecht, 15 August 2018.

96 BDEW Magazine "Zweitausend50", No. 2/2018.

At the same time, CHP/heating grid systems that are flexibly operated contribute to the integration of electricity from renewable energy into the energy system. Many CHP plants are operated in combination with heat accumulators and power-to-heat plants. This makes them extremely flexible and allows them to produce electricity independently of heating demand at times when wind power and photovoltaic plants are not available.

Powertoheat plants use the electricity from these renewable energy plants to generate heat when the electricity grids can no longer transport it away. This relieves the burden on electricity grids, prevents or delays the shutting down of renewable energy plants, and increases the proportion of renewable heat in district heat supply, thereby helping to mitigate climate change.

In many cities, existing coal-fired CHP power stations will be replaced by newer, lower-CO_2 stations by 2022 (for example in Kiel, Cottbus, Chemnitz, Frankfurt (Oder), Herne, Hürth). Coal currently accounts for more than one quarter of district heat production. On average, coal makes up 19% and lignite makes up 7%.

It should be noted here that the coal portion of district heat production varies sharply from one district heating grid to another. While coal-fired CHP stations are the primary producer in some cases, coal accounts for little or nothing of the production in other district heating grids. Due to the local nature of district heat supply described above, and the resulting local attachment of CHP plants, the rapid shutting down of coal-fired CHP could bring very significant challenges for heat supply. This is particularly the case if the coal-fired block-unit CHP plant is the primary producer in the district heating network. In many cases, an alternative, low-CO_2 solution will need to be found for the heat production. The secure supply of heat (district heat and process heat) must be fully guaranteed at all times.

This gives rise to two relevant spheres of activity: the development and continuation of support for combined heat and power, and realising the potential for “green district heat”.

3.2.5. Mining area plans

One feature of the lignite industry is the close geographical and economic relationship between power plant(s) and open-cast mine(s): Changes to power station operations have a direct impact on open-cast mining operations, and vice versa. Due to the high proportion of fixed costs in open-cast mining (which has around 80% fixed costs and 20% variable costs), lower coal support or electricity production volumes bring economic challenges for the distributed lignite system. This interplay must therefore be borne in mind in all decisions relating to reducing CO_2 in lignite-fired power generation.

Another feature of the lignite industry is the formation of provisions for the rehabilitation of areas that have been used for lignite mining. Provisions are formed on a statutory basis under the German Commercial Code (Handelsgesetzbuch). Provisions in lignite mining are formed as total obligations, distribution provisions and accumulation provisions and recognised in the balance sheet according to set discounting regulations, assumptions on specific inflation rates and increases in personnel costs.

The polluter-pays-principle general applies in mining. Where there is a premature shutdown, the balance sheet provisions show a deficit between the funds required at a nominally chosen time for land reclamation and the actual cash value that was available at an earlier date. The financial deficit here is the largest directly after the development phase and reduces as the working life of the open-cast mine increases, through to its phasing out, to a value of zero.

Mine-related provisions must be successively decreased in line with the actual growth of the open-cast mine and exercised/used up in due course, although reclamation and rehabilitation efforts, for instance for land or drainage systems and the relocation of infrastructure, are also performed as mining operations are ongoing.

Currently, the philosophy associated with the formation of provisions and the rolling system of (partial) rehabilitation even during the actual open-cast mine extraction phase assumes the full implementation and completion of the mining operation. The development, normal operation and completion of the mining project must take place as part of an orderly operation. A check is required in each individual case to see if the premature completion or shutting down of

an open-cast mine can ensure that mine operators fully meet their rehabilitation obligations by (monetarily) allocating the provisions that have formed up to that date.

Where an open-cast mine is closed, the discrepancy between the funding that is actually required for the rehabilitation and the available provisions is greater the sooner the mine is shut down after the development phase.

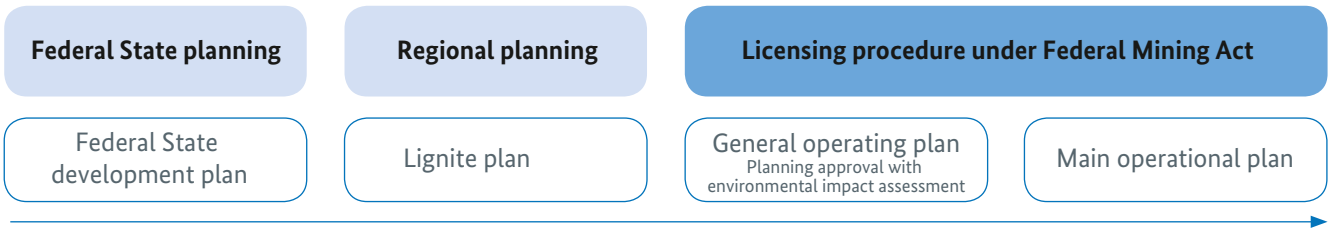
Spatial planning prerequisites must be met in order to operate a lignite mine (Federal State development plan, lignite plans). At the same time, open-cast mines are subject to a mining law licensing procedure under the Federal Mining Act (Bundesberggesetz, BBergG).

The open-cast lignite mines operated today are the result of a complex regulatory approval system consisting of decisions at regional level, lignite plans, framework plans and main operational plans. They are based on time-intensive coordination between various interests and an assessment of the impact of an open-cast mine based on the existing underlying legal framework. Given that companies in the lignite industry have no plans to develop new open-cast mines, mining area plans are as shown in Figure 17.

Mining law procedures govern whether, and with which potential restrictions, the delivery volumes covered by the lignite plans can actually be developed and extracted. The mining authorities of the following Federal States are responsible:

- Brandenburg: State Office for Mining, Geology and Raw Materials
- Saxony: Saxon Mining Office
- Saxony-Anhalt: State Office for Geology and Mining
- North Rhine-Westphalia: Arnsberg District Council
- Lower Saxony: State Office for Mining, Energy and Geology.

Figure 17: Overview of the approval stages for open-cast lignite mining



Open-cast lignite mining: Approval stages until development can begin

Source: "Renewable Energy Projects in Mining Regions" according to the Oeko-Institut 2017[97]

97 Oeko-Institut (2017): Die deutsche Braunkohlenwirtschaft. Historische Entwicklungen, Ressourcen, Technik, wirtschaftliche Strukturen und Umweltauswirkungen (The German lignite industry. Historic developments, resources, technology, economic structures and environmental impacts).

Rhineland mining area

There are three open-cast mines in the Rhineland mining area – Inden, Garzweiler and Hambach. The volumes delivered in 2017 were between 20 million tonnes (Inden) and 39 million tonnes (Hambach). Overall, the total annual delivery volume in the Rhineland mining area in recent years has fluctuated between 90 and 100 million tonnes.[98] While the open-cast mines of Garzweiler and Hambach supply the power stations of Neurath, Frimmersdorf and Niederaußem, the Inden open-cast mine supplies lignite to the Weisweiler power station. Through the successive transfer of a number of power stations to contingent standby (see Chapter 3.2.2) in the Rhineland mining area, by 2020 there will be a reduction in the annual lignite delivery volume and electricity production volume.

As regards the approval process under the relevant (regional) planning system and mining legislation for the three open-cast mines, the situation is as follows:

- **Regional decisions:** In the past, the regional North Rhine-Westphalian government reached decisions in 1987 (expansion of the Inden I open-cast mine with the addition of the adjoining Inden II open-cast mine) and 1991 (expansion of the Garzweiler I open-cast mine with the addition of the adjoining Garzweiler II open-cast mine). The last regional decision was passed in 2016. The regional government cited the significant changes to the underlying energy policy and energy industry conditions as the trigger for this. Specifically, in the case of Garzweiler II the previous regional decision and lignite plan from 1991 was reviewed. The Garzweiler open-cast mine was reduced with the removal of the Holzweiler site. This resulted in a reduction in the potential extraction volume of around 400 million tonnes. The extraction limits for the other two open-cast mines (Inden and Hambach) were unchanged.

- **Lignite plans:** Lignite plans have been prepared and approved for all three open-cast mines. Due to the reduction of the Garzweiler II open-cast mine, the Garzweiler II lignite plan has yet to be adjusted. The lignite committee of Cologne district council is responsible for this.

- **General operating plan and main operating plan approvals:** Clear main operating plan approval has been provided with respect to the extraction for all three open-cast mines. Legal proceedings are pending before Cologne administrative court and before the higher administrative court for the Federal State of North Rhine-Westphalia in relation to the current main operating plan approval for the Hambach open-cast mine for the period from 2018 to 2020 and in relation to the third general operating plan approval. Following a decision of the higher administrative court of 5 October 2018, under the scope of the current main operating plan the use of forested areas of Hambach Forest is current not allowed (as of 10 October 2018).

General operating plan approvals:

- **Inden open-cast mine:** Following the amendment request of 2012, approval granted for an unlimited period until coal has run out.

- **Garzweiler open-cast mine:** Approval fully granted from 1997 until the end of 2045 (but will need to be amended following changes to the lignite plan following the regional decision of 2016); the regional decision does not provide for any restriction in time for the Garzweiler open-cast mine, but rather only a reduction in area.

- **Hambach open-cast mine:** Approval of second general operating plan granted from 1995 to the end of 2020 (2014 saw the approval of the third general operating plan from 2020 to the end of 2030; the application and approval for the fourth general operating plan are still outstanding).

In Garzweiler, 1,600 resettlements are still underway (Keyenberg, Unterwestrich, Oberwestrich, Kuckum and Beverath). 600 resettlements are still underway at the Hambach open-cast mine (Manheim, Morschenich).

The open-cast mines are expected to run out of coal as follows:

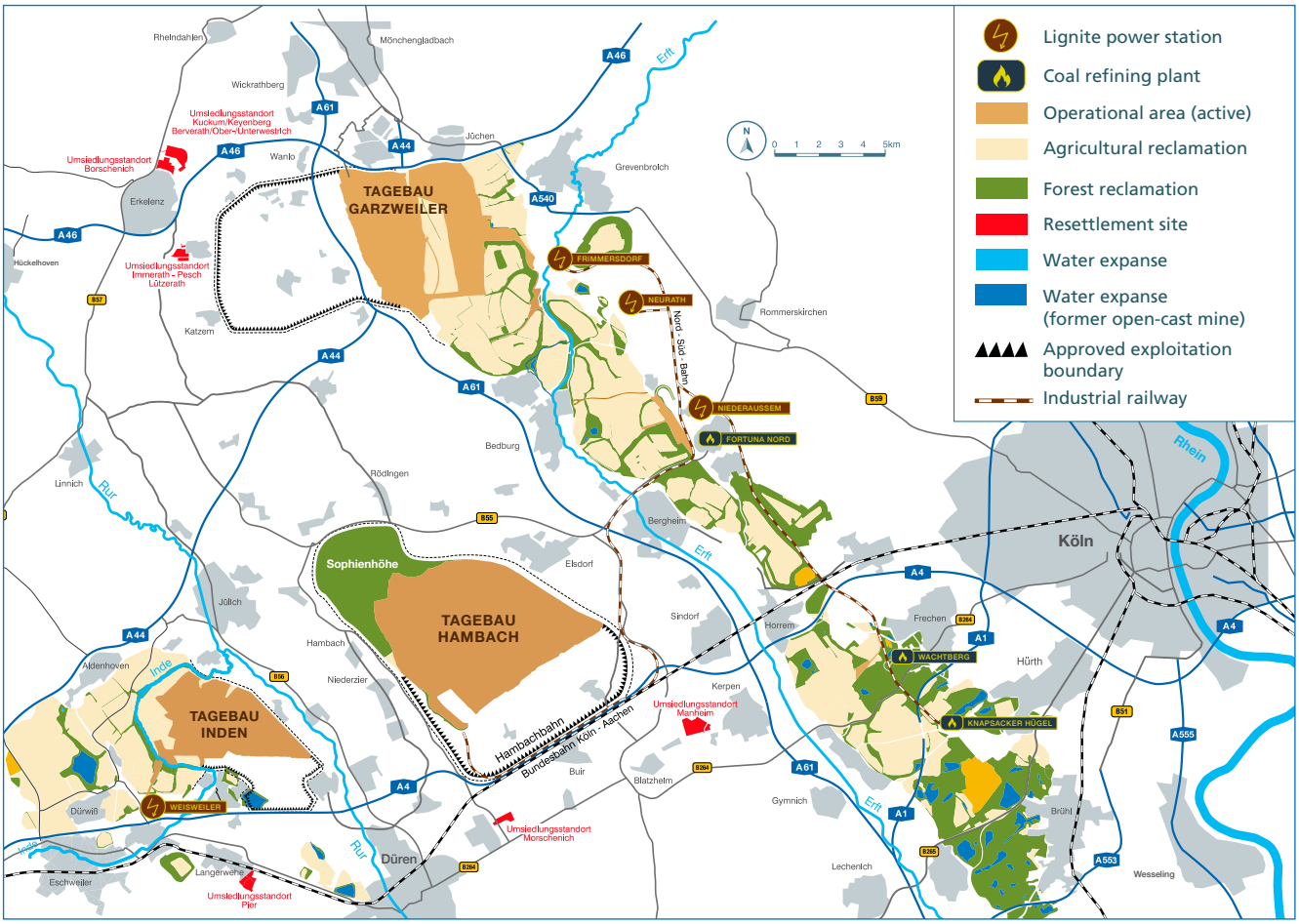
- Inden open-cast mine around 2030.

- Garzweiler and Hambach open-cast mines by the middle of this century.

- The regional decision in 2016 (see above) has reduced the exploitable lignite volume at the Garzweiler II open-cast mine by around 400 million tonnes to approximately 2.3 billion tonnes for the three open-cast mines combined.

98 Coal industry statistics (2018): Lignite output by mining area.

Figure 18: Rhineland mining area



Power stations	Output*
Frimmersdorf	600 MW
Neurath	4,200 MW
Niederaußem	3,400 MW
Weisweiler	1,800 MW **

Open-cast mine	Output	Reserve
Garzweiler	35–40 Mt/a	1.2 bn. t
Hambach	35–45 Mt/a	1.4 bn. t
Inden	20–25 Mt/a	0.3 bn. t

Refinement	Products
Fortuna	2.3 Mt
Frechen	2.2 Mt
Knapsacker-Hügel	0.7 Mt

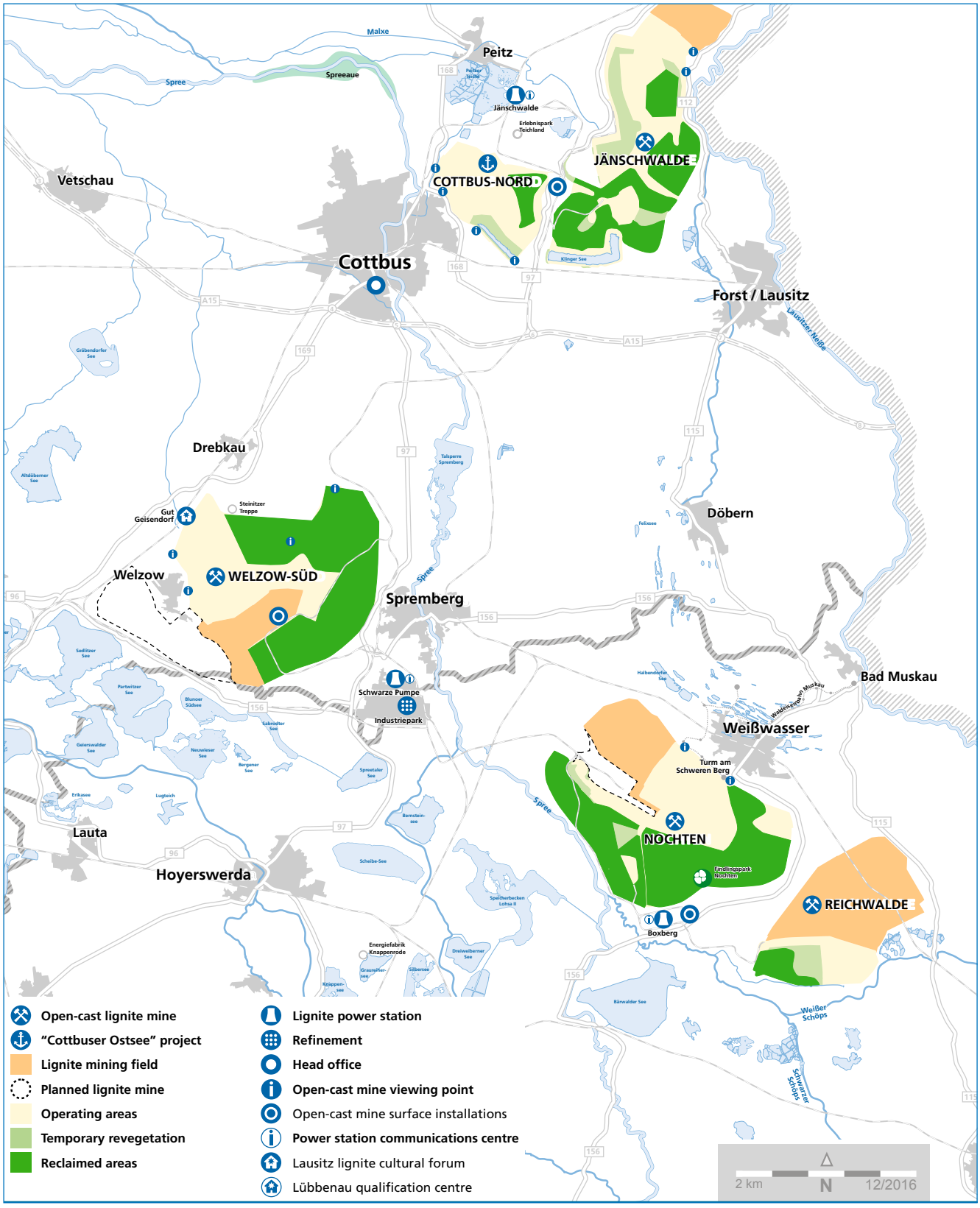
> power production of approx. 70–75 TWh/a (40% NRW or 13% D)

*rounded; **excluding VSG turbines

Source: DEBRIV/RWE Power[99]

99 DEBRIV (2018): Rhineland mining areas map. Version 08/2017. Note: The regional decision of 2016 is not yet included in the presentation.

Figure 19: Lausitz mining area



Source: DEBRIV[100]

100 DEBRIV (2018): Lausitz mining areas map. Version 08/2017.

Lausitz mining area

Lausitz Energie Bergbau AG (LEAG) operates four open-cast mines in the Lausitz mining area (see Figure 19). The Jänschwalde and WelzowSouth open-cast mines are located in the Brandenburg portion of the mining area, while the Nochten and Reichwalde open-cast mines are located in the Saxon portion. These open-cast mines primarily supply the Jänschwalde, Schwarze Pumpe and Boxberg power stations. The CottbusNorth open-cast mine was shut down at the end of 2015 and is currently being reclaimed.

In March 2017, LEAG introduced its mining area concept for Lausitz. With this company, the prerequisites were put in place in conjunction with the Federal States of Brandenburg and Saxony to allow planning for the region. It provides the foundation for LEAG's entrepreneurial activity with respect to the power stations and open-cast mines in Lausitz as well as the power station site of Lippendorf over the next three decades. The mining area concept is in the planning and approval process and is being implemented. The mining area concept provides for a total extraction volume of up to 1.2 billion tonnes, which represents a decrease on the previous planning from 2015 of 850 million tonnes. The individual extraction volumes planned are as follows:

Figure 20: Lignite volumes in the Lausitz mining area

Mining areas (all figures in millions of tonnes)	Original concept as of 01.01.2015	Mining area concept as of 01.01.2017	Reduction in extraction
Approved mining areas			
Jänschwalde	81.7	68	
Cottbus-North	1.8	-	
Welzow-South	286.5	254	
Nochten	279.1	223	
Reichwalde	332.1	331	
Continuation			
Welzow-South, subsection II	204	204 *	-160
Nochten, mining area 2	310	150 **	
Future areas			
Jänschwalde-North	250	-	-250
Spremberg-East	220	-	-220
Bagenz-East	220	-	-220
Total reduction in extraction following mining area concept			-850

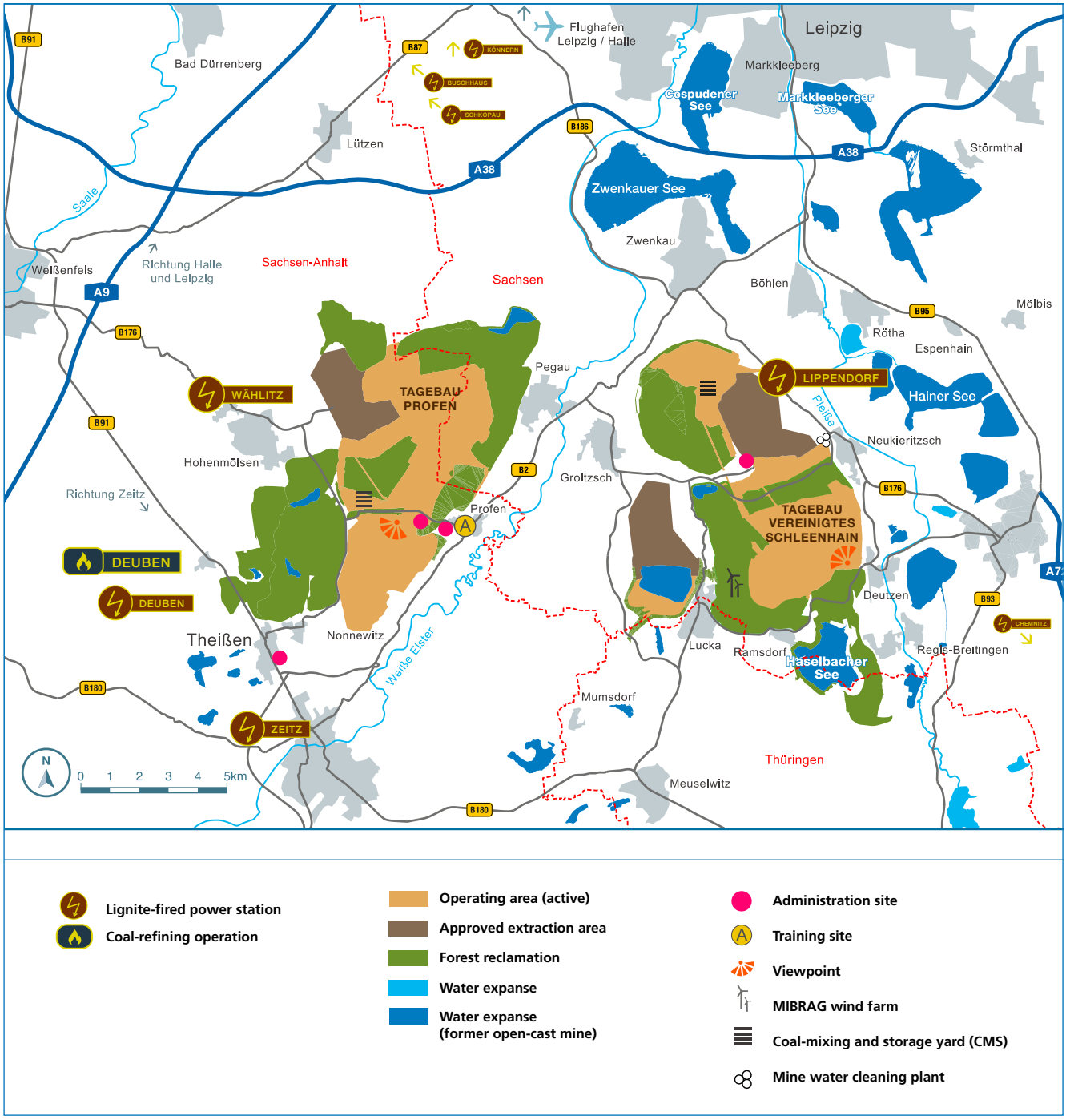
* LEAG will reach a decision for subsection II of the Welzow-South open-cast mine by no later than 2020.

** Mühlrose subfield

Source: LEAG[101]

101 LEAG (2018): Documents on the session of the Commission for Growth, Structural Change and Employment on 29 August 2018.

Figure 21: Central German mining area



Source: DEBRIV[102]

102 DEBRIV (2018): Revierkarte Mitteldeutschland (Central German mining area map). Status: 08/2017.

Mining areas that are already approved are still available in the Brandenburg portion of Lausitz in the Jänschwalde and Welzow-South open-cast mines. The Jänschwalde open-cast mine is expected to be wound up on schedule in 2023. The Jänschwalde power station will then be operated for a further period of ten years using coal from the south of the mining area. In line with the figure above, the future fields that had still been planned in 2015 (Bagenz-East, Spremberg-East, Jänschwalde-North open-cast mines) are now no longer to be exploited. LEAG will reach a decision for subsection II of the Welzow-South open-cast mine by no later than 2020.

The special field in Mühlrose is included in Nochten open-cast mine. Following the planned continuation of extraction area 1 in Nochten, the Mühlrose subfield (extraction area 2) will also be added. The Reichwalde open-cast mine is to be continued according to the approved plans. No general operating plan has been approved for subsection II of the Welzow-South open-cast mine (800 resettlements, for example in Proschim) and the special Mühlrose field in Nochten II open-cast mine (200 resettlements).

Central German mining area

The Central German mining area includes the Profen open-cast mine in Saxony-Anhalt and Saxony and United Schleenhain open-cast mine in Saxony. MIBRAG operates both open-cast mines.

The Profen open-cast mine primarily supplies the Schkopau power station (operated by Uniper Kraftwerke GmbH) as well as smaller industrial and combined heat and power stations. The Schleenhain open-cast mine supplies the Lippendorf power station (operated by LEAG) by means of a conveyor system. In addition, ROMONTA Bergwerks Holding AG, the world's largest producer of crude montan wax, operates its own Amsdorf open-cast mine.

The United Schleenhain open-cast mine consists of three subfields, the Schleenhain field, the Peres field and the Groitzscher Dreieck field. A total of 228 million tonnes of lignite is still available here (as of the end of 2017).[103] 10.6 million tonnes of coal was extracted in 2017.[104]

The lignite plan for the United Schleenhain open-cast mine, which has been binding since 1999, was declared null and void by the Saxon higher administrative court for formal reasons in November 2003. Work began to realign the Schleenhain lignite plan in December 2003. This has been binding since August 2011.

Both the regional development plan and the lignite plan seek to safeguard a full supply of raw lignite to the Lippendorf power station by around 2040. MIBRAG has also declared its intention to extract lignite from the United Schleenhain open-cast mine until the beginning of the 2040s.[105] In 2014 the first excavation material was moved in Peres, while in December 2016 MIBRAG delivered the first coal from Peres to Lippendorf power station.[106] As the last mining area, coal will be extracted in the Groitzscher Dreieck. No approved general operating plan is yet in place for the use of the localities of Obertitz and Pödelwitz.

Profen open-cast mine extends across the mining areas of ProfenSouth, Schwerzau and Domsen. The lignite reserve was around 124 million tonnes at the end of 2017,[107] while 7.8 million tonnes of coal was extracted there in 2017.[108] The Profen open-cast mine is connected to the public rail network.

The lignite plan for Profen open-cast mine was resolved in 2000 (Saxon portion of the open-cast mine), the subarea development programme (Saxony-Anhalt) in 1996. According to information from MIBRAG, Profen-South is expected to run out of coal by 2020.

103 Rendez, Helmar (2018): Perspektiven der deutschen Braunkohlenindustrie 2018 (Prospects for the German lignite industry 2018). Presentation at Lignite Day (Braunkohletag) 2018 Halle, p. 5. Available at https://braunkohle.de/index.php?article_id=98&fileName=perspektiven_der_deutschen_braunkohlenindustrie_2018.pdf.

104 Coal industry statistics (2018): Lignite extraction by open-cast mine.

105 "MIBRAG's goal is to exhaust the deposits under the subarea development plan (Saxony-Anhalt) or the lignite plan (Saxony) and the permitted general operating plans at the Profen open-cast mine by the mid-2030s and in the Schleenhain open-cast mine by the beginning of the 2040s" (MIBRAG (2018): Documents for the meeting of the Commission on Growth, Structural Change and Employment on 29 August 2018.

106 DEBRIV (2018): Mitteldeutsches Braunkohlerevier 1990 bis 2017 (Central German mining area 1990–2017). Available at https://braunkohle.de/182-0-Mitteldeutsches-Braunkohlenrevier-1990-2017.html

107 Rendez, Helmar (2018): Perspektiven der deutschen Braunkohlenindustrie 2018 (Prospects for the German lignite industry 2018). Presentation at Lignite Day (Braunkohlentag) 2018 Halle, p. 5. Available at https://braunkohle.de/index.php?article_id=98&fileName=perspektiven_der_deutschen_braunkohlenindustrie_2018.pdf.

108 Coal industry statistics (2018): Lignite extraction by open-cast mine.

The Schwerzau mining area was opened in 2004.[109] Currently and in the future, extraction at the Profen open-cast mine will focus on the Domsen field. MIBRAG's goal is to extract lignite at the Profen open-cast mine until the mid-2030s.[110]

Helmstedt mining area

The Helmstedt mining area with the former open-cast mines of Helmstedt/Wulfersdorf, Treue, Schöningen and Alversdorf are undergoing a mining rehabilitation phase. The last coal was extracted in the Helmstedt mining area in 2016 at the former Schöningen open-cast mine. Until 2020, the Buschhaus power station is in contingent standby, with coal being stockpiled at the site. If necessary it can also be procured from the Profen open-cast mine from the Central German mining area.

With regard to the approval process under (Federal State) planning and mining law for the open-cast mines, neither regional decisions nor lignite plans are in place.

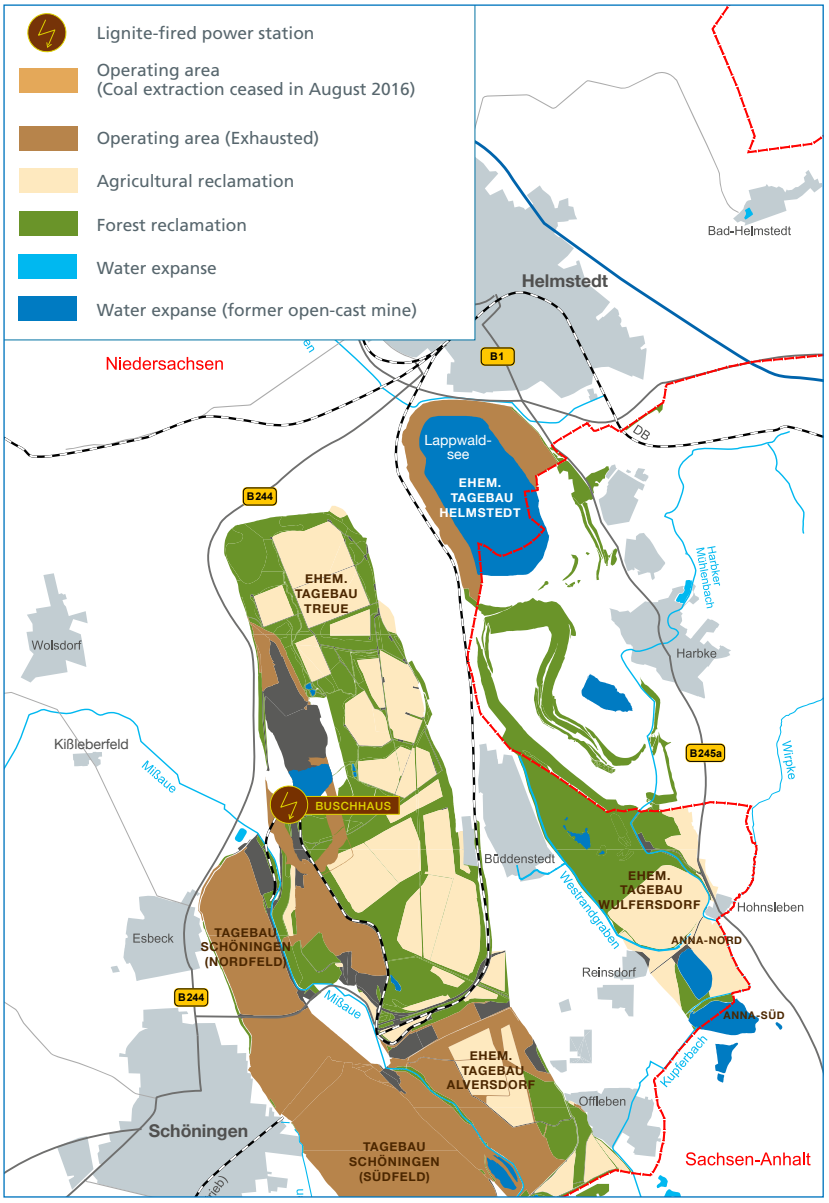
With regard to the general operating plan and main operating plan approvals, the situation is as follows:

The general operating plan for designing the surface after extraction for the open-cast mines of Treue, Alversdorf, Viktoria, Helmstedt and Schöningen governs the principles for rehabilitation/reclamation for the open-cast mines that had not then been restored with regard to the areas for agricultural and forestry reclamation, areas for nature conservation including habitat networks and areas for remaining stretches of water in the abandoned open-cast mine pits (Helmstedt/Wulfersdorf, Schöningen Baufeld South, if necessary slag sluicing for abandoned pits in the former Treue open-cast mine).

The final operating plans generally comprise a Part 1 (topographical design) and a Part 2 (surface drainage and landscape management provisions). For the Helmstedt mining area, the framework operating plan and its approval therefore resembles a "lignite plan" comparable to the Rhineland mining area and the mining areas in the eastern German Federal States.

For the former open-cast mines of Schöningen and Helmstedt/Wulfersdorf the final operating plans have yet to be presented and the mining planning approval process has still to be conducted for the residual bodies of water in the former open-cast mines of Helmstedt/Wulfersdorf and

Figure 22: Helmstedt mining area



Source: DEBRIV[111]

109 DDEBRIV (2018): Mitteldeutsches Braunkohlenrevier 1990 bis 2017 (Central German mining area 1990–2017). Available at https://braunkohle.de/182-0-Mitteldeutsches-Braunkohlenrevier-1990-2017.html.

110 MIBRAG (2018): Documents for the meeting of the Commission on Growth, Structural Change and Employment on 29 August 2018.

111 DEBRIV (2018): Helmstedt mining area map. As of: 08/2017.

Schöningen Baufeld South. Based on current planning, the rehabilitation of the Helmstedt mining area will produce the following end state:

Area	ha	%
Water	700	26
Agriculture	800	30
Forest/habitat	1,050	39
Other	150	5

3.3. Baseline for growth, employment and innovation potential

Germany is characterised by a stable overall economic baseline. As the Federal Ministry for Economic Affairs and Energy recently stated: "The German economy is in a constant and broadly based economic growth with a solid foundation in the domestic economy. Capacity is well utilised, employment is at record levels and consumer prices are stable."[112]

Since the end of the financial crisis, Germany has seen a period of economic recovery. Over the last few years, Germany has experienced constant and sustained economic growth, most recently noting a growth of 2.2% in 2017.[113]

But the global economic climate is currently slowing, partly due to the increasingly acute world-wide trade conflicts. This impairs the development of the German economy. According to the German Office of Statistics, growth in 2018 was only 1.5%.[114] The federal government has reduced its growth forecast for 2019 from 2.1% to 1.8%.[115]

Economic growth has also led to a positive development in the employment market. The unemployment rate for the whole of Germany has fallen over the last few years, and the average for 2017 was 5.7%.[116] At present (December 2018) it is 4.9%. In the light of the slow demographic development, the number of unfilled vacancies is growing in several industries and regions, usually in conjunction with a lack of qualified personnel.

This lack of skilled personnel is increasingly jeopardising the economic development.[117] Other problems faced by Germany as a business location include weak investments and time-consuming planning and approval procedures.

The importance of industry for growth and prosperity

Industry earns almost a quarter of Germany's gross domestic product – more than in most other countries. The industrial core is the starting point for the close links between manufacturers, suppliers and service providers and provides an important foundation for innovation, growth and employment in Germany. One reason why Germany emerged from the 2008 financial crisis in better shape than other countries was because it has a high level of industrialisation compared with other OECD states. Industry contributed 29.9% to the total economic output of Germany in 2017.[118]

A central factor for Germany as a location for industry is the existence of complete industrial value creation chains. At the heart of these value creation chains are the energy-intensive industries which produce the raw materials and commodities which are used in the subsequent manufacturing processes. They are faced with international competition, so they are especially dependent on a competitive, inexpensive and secure power supply.

Development of energy-intensive industry

In spite of the positive economic development, it must be pointed out that Germany is facing major challenges, at least in the energy-intensive industries, and that it is partly living on its historical reserves. The background to this development is that private investments are only slowly being

112 Autumn forecast of the Federal Government of October 2018.

113 Federal Ministry for Economic Affairs and Energy: Annual Economic Report 2018.

114 Press release by the Federal Office of Statistics of 15.01.2019, available under: https://www.destatis.de/DE/PresseService/Presse/Pressemitteilungen/2019/01/PD19_018_811.html.

115 Autumn forecast of the Federal Government, October 2018.

116 Federal Ministry for Economic Affairs and Energy: Annual Economic Report 2018.

117 German Chamber of Commerce and Industry (DIHK), economic survey, autumn of 2018.

118 Cf. also Federal Ministry for Economic Affairs and Energy (2016): Unsere Industrie: Intelligent. Innovativ. International. Zahlen für 2017 aktualisiert. (Our industry: Intelligent. Innovative. International. Updated figures for 2017).

made in Germany.[119] This is exemplified by the fact that net capital investments in the most energy-intensive industries – i.e. the gross capital investments minus depreciation – are merely at a nominal level. They have seen a distinctly negative trend in the last few years (2000 to 2014). These industries only saw positive net investments in 2000 and 2008.[120]

And structural change has already begun in the energy-intensive industries which manufacture basic materials and often represent the beginning of long industrial value creation chains. Measures must be adopted to counter gradual de-industrialisation. Further cost increases resulting from the closure of coal-fired power stations may accelerate this process.

The affected regions are often closely linked with the basic materials industry, so there is an increased risk of significant negative effects from structural changes if they are not able to sustain the existing value creation chains and the collaborative industry associations for energy and industry. As has been shown, the real net capital assets in all energy-intensive sectors (paper, chemicals, building materials, the sugar industry and metal manufacturing) have declined almost constantly over recent years. But the industry as a whole has seen a slight increase. The decline is all the more dramatic because the capitalised expenditure for research and development in each industry is also affected.[121]

Innovation potential

The largest share of the total expenditure for research and development in Germany is provided by industry.[122] This enables it to develop innovative technology and efficient processes, and it lays the foundations for value creation chains. Therefore, it also helps to solve environmental problems and to promote the sustainable use of resources. Because of their good market position and their all-round competence, German companies are ideally equipped to act as developers, suppliers and pioneering users of new and innovative technology such as combined heat and power, the circular economy, sustainable mobility, sustainable digitised value creation systems and Industrie 4.0. To achieve this, however, they need stable and predictable long-term framework conditions, especially reliable security for planning and investments.

Cooperation between business and science in the form of shared projects with universities, university research institutes and independent research institutes is particularly important. Funds invested in this field stimulate innovation and make a significant contribution to growth in the gross domestic product.[123]

Regional economic development

The positive overall economic development must not blind us to the major regional differences in economic growth. Since 2010, for example, growth in the federal states which contain lignite mining areas has usually been below the national average, and this makes structural change more difficult in the regions affected by the end of lignite and coal-fired power generation. In fact, economic growth in North Rhine-Westphalia has been below the German average in every single year since 2010.[124]

There are still significant regional differences in the economic development in Germany. Since 1990, all of the eastern German federal states have been part of an economic structural development process which aims to bring the region's economic performance up to the level in western Germany. In 2017, for example, the economic performance in eastern

119 Fratzscher Commission (2015): Stärkung von Investitionen in Deutschland (Strengthening investments in Germany).

120 Federal Office of Statistics (2017), energy-intensive industries: paper, chemicals, glass/ceramics, metal production and processing.

121 IW (2017): Energiepolitische Unsicherheit verzögert Investitionen in Deutschland (Uncertainty on energy policy delays investments in Germany). IW policy paper 13/2017.

122 Stifterverband (2016): Science statistics published by the business promotion association (Stifterverband) for research and development in the economy.

123 For example, cooperation between business companies and research institutes of the Fraunhofer Society leads to a growth of 21% in turnover and 11% in productivity. From a macro-economic perspective, every Euro invested in research contracts with the Fraunhofer Institutions leads to an increase of up to €18 in GDP. Cf. also Comin et al. (2018): Do Companies Benefit from Public Research Organizations? The Impact of the Fraunhofer Society in Germany; Study of the CIRCLE – Centre for Innovation, Research and Competences in the Learning Economy, University of Lund.

124 Cf. for example the total economic figures of the federal states (https://www.statistik-bw.de/VGRdL/). Lower Saxony (Helmstedt mining area) is an exception here. Its economic growth has usually been over the national average since 2010.

Germany was still only 73.2% of the western German level.[125] Other economic factors such as purchasing power, gross value creation, research and development activities in private businesses, export focus, company sizes and the wage level also indicate that there is still ground to be made up.[126]

The current Germany Report by Prognos AG confirms this trend and predicts that by 2045 the economic performance in the east will fall to two thirds of the average for the western German federal states – the same level as at the turn of the millennium.[127] The economic development of these regions is especially weak due to the unfavourable demographic development in the non-city states of eastern Germany and the relatively low private R&D activities.

And the coal and lignite areas are mainly in regions which have already seen often radical structural change processes in the past. Against the background of this situation, the Commission's work was therefore underpinned by the view that new structural changes and social and demographic upheaval for the people in all mining areas should be avoided at all costs, and that local value creation chains should be preserved.

3.4. Structural policy baseline

Economic structure in the mining areas and value creation

The economic performance of the affected regions is largely determined by the competitiveness of the whole of Germany as a business location. Structural policies can only be fully and successfully implemented in an environment that is conducive to growth.

The sectoral and industrial structures which are predominant today in the mining areas are the main factors which will determine how great the challenges of structural change will be. They also define economic opportunities which can arise from the strengths of each mining area.

The economic structure varies in the different mining areas. But one common factor is that the lignite industry plays an outstanding role in three of the four mining areas – the Lausitz, the Central German and the Rhineland mining areas.

Industrialisation tends to be less developed in these three mining areas than in the rest of Germany. The so-called intermediate goods in the Rhineland mining area (e.g. chemicals industry and other energy-intensive industries) are an exception.

In addition to the use of lignite for energy production, various branches of industry in the mining areas are currently dependent on using lignite-based material. This especially applies to the raw material supply for gypsum production. About 55% of today's gypsum raw materials are produced during the flue gas de-sulphurisation process in coal-fired power stations (FGD gypsum).[128]

In the service sector the mining areas each have different strengths and weaknesses. But a common element in all mining areas is that the more highly paid financial and insurance services, and services connected with information and communication, play a less important role.[129]

125 Federal Government (2018): Annual report of the Federal Government on the progress of German unity 2018.

126 The lack of large company headquarters has a direct effect on the inherent solvency of the local communities.

127 Prognos (2018).

128 Wagner, Thomas (2018): Gips-Rohstoffsicherung in Zeiten der Energiewende (Gypsum raw materials in the energy transition era). Background document for the Commission on Growth, Structural Change and Employment for its visit to the Lausitz mining area on 11 October 2018.

129 Cf. RWI Leibniz Institute for Economic Research 2018: Erarbeitung aktueller vergleichender Strukturdaten für die deutschen Braunkohleregionen (Development of current comparative structural data for the German lignite mining regions). Project report for the Federal Ministry for Economic Affairs and Energy. Hereinafter referred to as RWI 2018a.

Employment situation in the mining areas

The Commission on Growth, Structural Change and Employment has intensively and repeatedly studied the employment situation in the mining areas. The discussions have focused especially on unemployment, the availability of skilled personnel and the role of the lignite industry as a regional employer.

One positive element is that due to the good economic development over the last few years, and especially the reduction of the potential workforce in the eastern German mining areas due to ageing, unemployment has significantly declined in the lignite mining areas. However, the reduction in the potential workforce can also act as a hindrance to growth. Against this background, the unemployment rate alone is only of limited significance.

The lignite industry plays an outstanding role as an employer in the mining areas. In the Lausitz mining area, for example, the proportion of people employed in mining, energy and water management and the energy industry, which includes the lignite industry, is more than twice the national average. At present, there are about 20,000 direct employees in all four mining areas together.[130] Most of these employees have high qualifications. The salaries are significantly above average compared with other employees in the region and most other industries.

The proportion of persons directly employed in the lignite sector in relation to all employed persons who are subject to mandatory social insurance is approx. 2.0% in the Lausitz mining area, and 1.2% in the Rhineland mining area. In the two other mining areas the proportion was significantly lower, i.e. 0.3% (Central German mining area) and 0.1% (Helmstedt mining area).[131]

Due to the links with upstream industries, the consumer and investment goods industry and other purchasing power factors, the commission assumes that every direct job in the lignite industry leads to one other indirect or induced job in the mining area itself and one other job outside the local geographical area. Therefore, it must be assumed that there are about 60,000 jobs related to the lignite industry.

The skilled personnel situation in the mining areas is ambivalent. The number of employees in the mining areas who are in STEM careers, i.e. professions involving science, technology, engineering and mathematics, is mainly in line with the national average or somewhat higher.[132] One reason for this is the energy industry, with its relatively high proportion of engineers and scientists.

The commission is aware that many of the employees in STEM areas will retire from work in the next few years, especially in the Lausitz mining area and to some extent the Central German mining area. In the commission's consultations, companies in the lignite industry clearly stated that posts which become vacant in their companies must always be filled again to ensure that the company's operations can be maintained. Partly for this reason, the companies in the lignite industry make significant investments in vocational training. This means that they are an important anchor for young people looking for apprenticeships and vocational training in the mining areas, and that they play an important role in the provision of inter-company facilities in the dual vocational training system. Maintaining the supply of skilled and qualified workers in the region (existing staff, continued vocational training, training in new areas where appropriate) is a location advantage which should not be underestimated in the light of the lack of skilled personnel throughout Germany.

130 According to the latest figures published by the coal industry statistics organisation "Statistik der Kohlenwirtschaft e.V." exactly 20,751 people were employed in the lignite industry at the end of the first half of 2018. They included 991 apprentices. In addition, we must take into account the people employed by the "Lausitzer und Mitteldeutsche Bergbau-Verwaltungsgesellschaft mbH (LMBV)", whose focus is especially on recultivation work in the former lignite mining areas. Currently, about 730 employees and apprentices work for LMBV. Concerning the employment situation in the lignite industry, the commission heard the views of the lignite companies themselves and commissioned the RWI Leibniz Institute to prepare an assessment (in consultation with the four lignite companies LEAG, MIBRAG and RWE on 29 August 2018 and RWI 2018a). The figures determined by RWI were also based on information from the coal industry statistics organisation "Statistik der Kohlenwirtschaft e.V."

131 RWI 2018a.

132 The only exception here is the Central German mining area.

In its consultations, the commission observed that employment with mandatory social insurance has increased in all mining areas in the last few years and that new job opportunities have arisen outside the lignite industry. The growth in jobs has been especially strong in the service sector. But the number of employees in the mining areas is also rising in some manufacturing industries.

Contribution to tax revenue

A further important indicator of the structural baseline is the contribution of the lignite sector to public tax revenue. Here, the commission can draw on an independent scientific survey.[133]

The contribution of the lignite sector to the public income tax revenue confirms the fundamental findings on the regional economic importance of lignite. The proportion of the tax revenue from the lignite sector in the mining areas is about 0.7% (Central German mining area), 2.0% (Rhineland mining area) and 4.6% (Lausitz mining area). In addition to the amount which goes directly to the local communities (15%), the federal state share of the tax revenue (42.5%) must also be taken into account because the federal state budget also provides investment and subsidy funds for the region.

The commission noted that the figures for trade tax revenue showed different patterns in the various mining areas. The situation is particularly challenging in the Lausitz lignite mining area, because here the local communities are faced with significant demands for tax refunds from the former owner Vattenfall.

In the commission's view, the complicated tax revenue situation for some of the local communities requires special attention. And the limited potential to obtain subsidies if the local bodies are unable or not sufficiently able to provide their own co-financing contributions is already a risk factor for successful structural development.

Innovation potential of the mining areas

The Commission on Growth, Structural Change and Employment also considered the innovation potential of the mining areas. This is an important factor to stimulate the future economic development of a region. The innovation potential is normally estimated on the basis of indirect factors, e.g. the number of patent applications or the number of employees in research and development (R&D personnel).

As with many other indicators, here too there are significant differences between the mining areas. For example, according to the normal indicators, the Helmstedt mining area is significantly above the national average. The Rhineland mining area is slightly below it. But the innovation potential is particularly weak in the Lausitz mining area and the Central German mining area. Thus, the proportion of R&D personnel in relation to the total number of employees with mandatory social insurance in the Lausitz and the Central German mining areas is only about 0.33%. The national average here is approximately 1.32%. The average number of patent applications is also significantly lower in the eastern German mining areas than in the western German areas.

This is partly because research and development activities are mainly carried out in the corporate headquarters, and that they are hardly ever located in eastern Germany. The companies which were privatised after German reunification often decided for cost reasons not to have their own R&D departments, so they developed into mere "extended workbenches".[134] The few company headquarters in eastern Germany traditionally come from the (fossil) energy industry, energy-intensive industries and the optical industry. To increase innovation especially in eastern Germany, special consideration must be given to the indigenous potential, which must be supported with new subsidy mechanisms.

133 RWI 2018b.

134 Blum, Ulrich; Ludwig, Udo; Lang, Cornelia; Marek, Phillip (2011): Wirtschaftlicher Stand und Perspektiven für Ostdeutschland (Economic status and prospects for eastern Germany). Study on behalf of the Federal Ministry of the Interior. Halle Institute for Economic Research (IWH).

The number of business start-ups, which is a further indicator of innovation potential, also varies widely between the different mining areas. In the Rhineland mining area the number of start-ups per 10,000 employed persons is only slightly below the national average, and for hi-tech start-up in manufacturing industry or the service sector (e.g. new software developments) the gap even disappears completely. But in the Central German mining area, and especially in the Lausitz mining area, there are significantly fewer start-ups than in the rest of the Federal Republic. In a national comparison, the number of business start-ups is in the lowest quarter in four of the seven rural district and unaffiliated municipalities in the Lausitz mining area. In the Central German mining area this applies to the whole area with the exception of Leipzig.[135]

The commission sees several reasons for this. Especially in the Lausitz mining area, the small business structure of the local economy is a significant factor.[136] The relatively low concentration of universities and other public research institutes in the East compared with the western German mining areas could also be a reason. This would also fit in with the fact that where the conditions are right, even towns such as Görlitz in the Lausitz region have an above-average number of business start-ups. This also applies to Cottbus, which has a deep and broad range of research infrastructure at Brandenburg University of Technology (BTU Cottbus-Senftenberg).

Demographic development in the mining areas

On the basis of current trends, the demographic development up to 2035 in the two western German mining areas will be roughly the same as in Germany as a whole. But demographic change will have a greater effect on the Central German mining area, and especially the Lausitz mining area. Within the Central German mining area there will be a differentiated pattern of demographic change, with growing metropolitan cities (Leipzig and Halle) and continued decline in rural areas, even close to the cities, and especially in the areas around the open-cast mines and power stations. It must be expected that the number of people living in the two eastern German mining areas will shrink even more over the next two decades. At the same time, the average age of the population will rise. The commission assumes that by 2035, the proportion of people aged 60 or over in the Lausitz region will be about 45%. By comparison, the estimated proportion of this group in Germany as a whole is expected to be only about 36% in 2035.[137]

But the active working population are mainly in the 20 to 60 age range, so demographic change makes structural development more difficult in the Central German mining area, and especially in the Lausitz area. The commission therefore believes that it will be crucial to keep young people in the region, attract them to return to the area or encourage young people to move there from elsewhere. This requires an efficient education infrastructure with good apprenticeship and training opportunities and conditions, both in the dual vocational system and in academic disciplines, and attractive career prospects which must be identified or created in the mining areas.

The following elements are seen as critical effects of demographic change in areas with a rural character: ageing population, inadequate supply of everyday goods in smaller communities, imbalance in the availability of mobility, shops, culture and leisure facilities, insufficient allocation of new residential building land, over-capacity in basic infrastructure (water, sewage, heat), lack of opportunities for follow-on use of vacant buildings, danger of dying villages, loss of identity in social relationships, reduction to purely residential use, strong commuter structure, danger of population shrinkage and development sprawl.[138]

Location and settlement patterns in mining areas

In the opinion of the Commission on Growth, Structural Change and Employment, the location and the settlement pattern of a region are important conditions for its economic development. In thinly populated regions with a predominance of small business units, structural change is always a greater challenge than in regions with a more urban structure. There is a wide range of reasons for this: positive growth factors such as a connection to wider regional or national markets, a wide and varied pool of skilled person-

135 Cf. Institute for SME Research: Regionales Gründungsgeschehen auf Basis des NUI-Indikators (Regional start-up patterns on the basis of the start-up index). www.ifm-bonn.org.

136 Cf. the consultation with the business promotion agency Innovationsregion Lausitz GmbH on 18 September 2018.

137 Cf. also RWI 2018a.

138 https://www.indeland.de/assets/userfiles/Downloads/1-2015-03-23_Masterplan-indeland.pdf.

nel, networking with landmark companies and factors such as international links are less developed in such regions.

Here, the baselines in the mining areas are very different. For example, the two eastern German regions cover a wider area, are largely rural in character and mainly peripheral in their geographical location. By comparison, the Rhineland mining area and the Helmstedt mining area are strongly integrated with the surrounding major population centres:[139]

- **Lausitz mining area** (six administrative districts and the city of Cottbus): All administrative districts in the region, including the city of Cottbus as a higher-order urban centre, were classified as rural by the independent experts. The only area with urban connections is the northern part of the administrative district of Dahme-Spreewald, which benefits from its proximity to Berlin.

- **Rhineland mining area** (five administrative districts, municipal region of Aachen, city of Mönchengladbach): As in the other mining areas, the open-cast lignite mines here are situated in rural areas. But the surrounding administrative districts be are all classed as central and urban. The primary such areas are the municipal regions of Aachen and Mönchengladbach as higher-order urban centres in the region, and other higher-order urban centres in the Rhineland region such as Düsseldorf and Cologne are not far away.

- **Central German mining area** (seven administrative districts, cities of Leipzig and Halle): The Central German mining area mainly consists of rural administrative districts. But it includes the large city of Leipzig, and also Halle as another higher-order urban centre.

- **Helmstedt mining area** (two administrative districts, cities of Braunschweig/Brunswick and Wolfsburg): The Helmstedt mining area is the smallest of the four regions and is comparatively heterogeneous in its structure. The region is mainly municipal in character, but the administrative district of Helmstedt is classed as rural.[140] Wolfsburg and Braunschweig/Brunswick are the higher-order urban centres in the region.

Infrastructure in the mining areas (road and rail, digital infrastructure, energy infrastructure)

Supply-side construction and extension of the road and rail infrastructure, in conjunction with the associated mobility concepts (e.g. coordinated timetables, ecological forms of transport) is a fundamental precondition for successful structural development, especially in urban regions. The best possible accessibility within the mining areas (public transport), combined with transport routes from the mining areas to the surrounding major population centres (long-distance routes) are decisive factors to attract business enterprises and skilled personnel and to improve the general quality of life for people in the area. Better transport connections can enhance the attractiveness of a region, and connections with regional growth hubs can stimulate growth within the mining areas. A tailor-made integration of regions into transport networks could also enable these regions to be linked into regional and national value creation chains.[141]

The future is digital – in business and industry, in mobility, in the administration, in education and in private life. Therefore, the digital infrastructure is of central importance. The better its quality and efficiency, the greater are the opportunities for mining areas to benefit from the existing economic potential. Providing broadband connections in all areas is a significant location factor. Even after the completion of the present infrastructure projects there will still be areas which have at least 30 Mbit/second, but are not equipped for a gigabit network. Access to a high-performance digital infrastructure offers opportunities and development potential. Here, the expansion of broadband networks with glass fibre cables and the improvement of mobile phone networks will be crucial.

The mining areas, as the locations of open-cast mines and power stations, have an infrastructure which is designed for efficiency in the energy sector and which also offers a basis for the future development of modern energy production plants and energy technologies.[142]

139 For a overview cf. also RWI 2018a.

140 RWI 2018a, p. 163.

141 Cf., for example, the consultation with the independent expert Prof. Gerhard Untiedt on 18 September 2018.

142 IFOK and other project participants (2018): Erneuerbare Energien-Vorhaben in den Tagebauregionen (Renewable energy projects in open-cast mining regions). Project report for the Federal Ministry for Economic Affairs and Energy.

The locations with coal-fired power stations are particularly well equipped for the energy sector, partly because of the purpose-designed grid infrastructure. Moreover, power stations are operated by personnel who have a high level of competence in the operation of energy generating plants and processes. In fact, the necessary transformation of the power station infrastructure to reduce coal-fired power generation also offers opportunities. On the one hand, the regional potential and even some major elements of the existing power stations can still be used. On the other hand, energy transition technology can be used on a large scale for the first time. The regions can therefore take on a pioneering role. In addition to the structural policy significance, this could also act as a stimulus. Other locations and regions which will be affected by the transition in power generation in future could benefit from this trend, and it also offers an export potential for the German manufacturers of such technology.

People displaced by open-cast mining, local communities on the edge of open-cast mines

In all mining areas the Commission on Growth, Structural Change and Employment interviewed people from the open-cast mining areas who explained how they are affected. They include families who do not want to leave their home under any circumstances and families who have moved to newly created communities.

Open-cast mines are the largest artificial intervention in Germany's landscape. They force people to give up their homes and leave their houses, although they have often belonged to the family for centuries. This means that open-cast mines have a very drastic effect on the economic and social structure of the villages. Only part of the population moves to the designated relocation communities. Many farmers, craftsmen and shops leave the village community completely, often years before the final resettlement. Some local companies feel that their very existence is threatened by the impending resettlement scheme.

More than 45,000 people have been relocated in the Rhineland mining area, more than 50,000 in the Central German mining area and more than 25,000 in the Lausitz mining area. The resettlements in the Lausitz also create upheaval for the Sorbs and Wends, an ethnic group which strives to preserve its language, culture and identity. After 1990, the resettlements for mining purposes in the East of Germany were carried out on the basis of contracts under public law.

Local communities on the edges of open-cast mines suffer from the demolition of roads, paths and business connections to neighbouring communities. They experience direct impairments for many decades, for example due to the noise and dust from the mines, the loss of nearby facilities to relax in nature and the destruction of the landscape. This makes these communities less attractive for new people moving in or as a location for new business companies. The new lakes on the sites of the present large open-cast mines such as Garzweiler, Inden, Hambach, Nochten, United Schleenhain, Profen and Welzow-South will not be completed until well into the second half of this century.

Therefore, the commission sees it as a special goal to improve the conditions of life for local communities around open-cast mines. The development of fast Internet, easier designation of residential and industrial land, good transport connections and minimisation of the effects of the open-cast mining on these local communities are the tasks which the commission considers to be urgently necessary.

Cultural character of the mining areas

In addition to other regional factors, lignite mining has also had a deep cultural effect on the identity of the regions for decades. This is reflected in local clubs and associations, local customs and many other aspects of social life. Here, lignite mining companies provide donations and sponsoring to help to make the regions attractive for the local population.

Structural policy situation for power generation from hard coal

The Commission on Growth, Structural Change and Employment has also considered the current structural policy situation for coal-fired power station locations. Here, it based its work on a study compiled for the commission[143] which included an estimate of the contribution of the sec-

143 RWI 2018b.

tor to employment and value creation. The starting point was a consideration of the importance of the coal industry at the administrative district level. Throughout Germany, coal-fired power stations are located in 44 different administrative districts or unaffiliated municipalities.

According to the study, there are currently around 5,700 people working directly in the hard coal industry throughout Germany. All of these people are employed by power stations.[144] In the administrative districts which have coal-fired power stations, the average share of overall employment is 0.13%.

The situation is similar for the industry's contribution to value creation. The direct value created throughout Germany amounts to €958 million. This means that the value creation for each employee in a coal-fired power station is about €169 thousand. But here, we must also consider the value created by indirect or secondary employment. If this value is added, the authors of the report estimate that the total national value creation is about €1.9 billion. In the administrative districts which have coal-fired power stations, the average share of the coal industry in the overall value created locally is 0.17%.

With regard to the contribution to the tax revenue, the experts consulted by the commission were only able to make a very rough estimate. Therefore they worked on the assumption that the contributions of the coal industry to both income tax revenue and to trade and corporation tax revenue would roughly correspond to the contribution of the industry to value creation and employment in the locality. On this basis, the contribution of the administrative districts and unaffiliated municipalities to income tax revenue should be about €15 million, the contribution to trade tax revenue should be about €23 million.[145]

If these figures are examined in more detail, it is noticeable that in individual regions, the coal industry is only rarely as important for local value creation and employment as the lignite industry in the lignite mining areas.[146] To a large extent this can be explained by pointing out that the coal industry is far less concentrated in specific areas than the lignite industry (cf. also Chapter 5.1.5). But the role of the coal industry is especially important for regional value creation in relation to the interlinked supply and production chains in the industry (electricity and heat).

And there are some regions where the coal industry is of significant importance for the local economic structure. Therefore, Chapter 2.4 considers to what extent hard coal mining regions should be given access to the structural aid instruments proposed by the commission.

144 The last two locations for the extraction of hard coal – the Prosper- coal mine and Ibbenbüren coal mine – ceased their coal mining work at the end of 2018. This means that direct employment in the coal industry in future will only take place in coal-fired power generation. But in the lignite industry, to put it in simplified terms, there are direct employees in both power stations and in the open-cast mining sector.

145 Cf. also Chapter 3.4, especially the section "Contribution to tax revenue". The contribution to the federal state part of the income tax revenue has not been considered here.

146 Cf. Chapters 3.4 and 5.1.1 to 5.1.4. For example the proportion of employed persons who work directly in the lignite industry in the Lausitz mining area is about 2.0%, and in the Rhineland mining area it is still about 1.2%.

3.5. Statutory framework Structural policy

General constitutional rules on public finances and state aid

The provision of state aid to structurally weak regions in Germany is subject to special constitutional and legal conditions. The national government is fundamentally entitled to support structural transition under Articles 91a and 104b of the German Basic Law *(Grundgesetz)*. Under Article 91a of the Basic Law, the national government participates in the joint tasks "Improvement of the regional economic structure" (GRW) and "Improvement of agricultural structures and coastal protection" (GAK). "Improvement of the regional economic structure" (GRW) is the central instrument of national regional policy. The aim is to strengthen regional investment activities and thus create and safeguard permanent competitive jobs in the region. This enables structurally weak regions to be systematically activated instead of just subsidised.

In addition, under Article 104b of the Basic Law the national government is authorised to provide financial aid for particularly important investments by federal states, local communities or local community associations to balance the differences in economic performance within the country or to promote economic growth. But one condition for such financial aid is that the national government has the appropriate legislative competence for the way the funds are used. Financial aid from the national government for areas which are under the sole legislative competence of the federal states is generally not permissible.

State aid framework conditions within the European Union

For the purpose of the "Improvement of the regional economic structure" (GRW), the job market regions in Germany are differentiated in terms of their economic performance. The starting point for the promotion of the industrial economy in structurally weak regions is the definition of "assisted areas" in the EU regional guidelines for state aid.

Throughout Europe, the member states distinguish between A, C and D class assisted areas in which interventions to promote the economy are possible. Since 2014, Germany has no longer had any assisted areas in the highest eligibility category for state aid (A areas). In addition to the defined C category, the "Improvement of the regional economic structure" (GRW) introduced an additional assisted area category (D areas). The promotion of the industrial economy in these areas is subject to horizontal state aid requirements.

The following maximum aid rates currently apply in Germany:

Assisted area	Maximum state aid rate 1 January 2018 to 31 December 2020 (small, medium-sized and large enterprises)
Pre-defined and non pre-defined C assisted areas	30% – 20% – 10%
Pre-defined C assisted areas with border supplement (Areas adjacent to A assisted areas, the aid difference between these areas must not exceed 15%)	40% – 30% – 20%
D assisted areas	20% – 10% – up to €200,000

Special provisions apply to research and development projects and to investment aid for the local infrastructure.

Aid for research- and development projects:

Assisted area	Large enterprises	Medium-sized enterprises	Small enterprises
Basic research	100%	100%	100%
Industrial research[147]	65%	75%	80%
Experimental development[148]	40%	50%	60%
Feasibility studies	50%	60%	70%

147 The values apply subject to certain conditions, especially if it is a collaborative project (between a large enterprise and an SME or research institute). Fundamentally, the maximum aid rate for industrial research is 50%.

148 The values apply subject to certain conditions, especially if it is a collaborative project (between a large enterprise and an SME or research institute). Fundamentally, the maximum aid rate for experimental development is 25%.

Where investment aids are provided for local infrastructures, the amount of any aid must not be greater than the difference between the costs which are eligible for aid and the operating profit of the investment. The operating profit is deducted from the eligible costs either in advance on the basis of realistic projections or via a subsequent recovery mechanism.

The legal framework under competition law thus restricts the possible aid, depending on the status of the area.

The eastern German lignite mining areas in Germany (Lausitz and Central German mining areas) still count among the structurally weakest regions (C assisted areas) with the highest level of possible aid. The western German lignite mining regions (Rhineland and Helmstedt mining areas) mainly consist of areas that are not structurally weak as defined in the provisions of the joint task or the EU regional guidelines.[149] The administrative district of Helmstedt and the city of Mönchengladbach are the only areas classed as relatively weak (C assisted areas). Thus, the baselines for regional policy intervention to support the lignite mining regions vary, so the resulting intervention possibilities and levels of aid are also different.

The current aid programmes only run until the end of 2020. The European Commission has announced that it will extend the current aid provisions until the end of 2022. The future configuration of the aid provisions is not yet clear. It is still unclear what aid status the mining areas or individual industries will be assigned in future (energy-intensive industries, co-generating plants etc.). The federal government must take this into account in its discussions with European institutions.

In relation to the assistance area framework which is due to be redefined at the European level, the commission believes it necessary that the impending structural transition must be taken into account in advance for the coming state aid period.

149 The administrative district of Heinsberg and the municipal region of Aachen are defined as D areas.

4. Measures in the energy sector

According to the original decision to establish the Commission on Growth, Structural Change and Employment, its mandate includes the development of a plan of action with the following main focus areas:

- Measures on the contribution of the energy industry to close the gap and achieve the goal of a 40 per cent reduction in emissions as far as possible.

- Measures to reliably ensure the achievement of the 2030 goal for the energy sector, including a comprehensive impact assessment. The climate protection plan prescribes the goal of reducing emissions from the energy industry by 61 to 62% in 2030 compared with the values in 1990. For the contribution of coal-fired power generation, the commission is asked to suggest suitable measures to the energy industry to enable this sector goal to be achieved by 2030, and these measures are then to be integrated into the policy programme to implement the 2030 Climate Action Plan.

- In addition, a plan is to be created for the gradual reduction and phasing out of coal-fired power generation, including a completion date and the necessary accompanying measures for the legal, economic, social, renaturalisation and structural policy framework.

Climate protection must be implemented in all sectors in order to achieve an economically and ecologically efficient and coordinated reduction of greenhouse gas emissions. The energy sector plays a key role in achieving the goals of the 2050 Climate Action Plan because electricity will be increasingly used for heating, transport and industry in the course of the combined development of different sectors.

In the energy sector the commission recommends an ambitious and balanced set of measures which will significantly reduce CO_2 emissions from the energy industry and nevertheless guarantee a reliable supply of electricity and heat, ensure affordable electricity prices, especially including competitive pricing for industrial customers, and be implemented in a socially acceptable way. The measures will give planning certainty to market stakeholders, the regions, people living near open-cast mines and resettled persons, they will be take jobs into account and offer a fair solution for power station operators and electricity consumers. In conjunction with the measures to monitor the structural transition (cf. Chapter 5.3), the commission thus presents a balanced set of measures which combines economic development, social acceptability and climate protection.

In its recommendations in Chapter 4, the Commission on Growth, Structural Change and Employment assumes that the federal government will carry out the agreed measures and fulfil the requirements described in Chapter 3.2.2 to carry out the transformation of our energy system in full and within the designated time scale. It expects the federal government to carry out systematic and rapid management of the energy transition to enable these measures to be implemented.

The commission expects the federal government to ensure that later changes in the law, for example in environmental and planning law, do not jeopardise or undermine the results presented by the commission. This especially applies to the impending revision of the 13th and 17th Federal Immission Control Ordinance (BImschV) which is due in the implementation of EU law.

The measures and their implementation will be comprehensively reviewed by a panel of independent experts in 2023, 2026 and 2029 to determine their effects on the achievement of climate goals, the development of electricity prices, the reliability of the power supply, jobs, the structural policy goals, the implemented structural policy measures and the regional value creation. If appropriate, adjustments must be made (cf. Chapter 6).

The recommendations of the Commission on Growth, Structural Change and Employment must also be seen in the context of the Paris Convention. The cumulated greenhouse gas emissions are the decisive factor for the affect on the climate. With regard to the central measures, the commission distinguishes between three phases in accordance with the terms of the assignment. In this respect, the measures to reduce the gap towards the achievement of the 40 per cent goal, the measures to be taken by 2030 and the end date for coal-fired power generation are directly connected.

The Commission on Growth, Structural Change and Employment therefore recommends the following set of closely interlinked measures. The commission underlines that the individual measures are mutually dependent to provide an appropriate response to the expected consequences of the reduction and the termination of coal-fired power generation for climate protection, the reliability of supply, industry and end consumers, coal regions, employees in the industry, open-cast mining and remedial measures after open-cast mines are closed:

- **Climate protection measures**
  - Assured step by step reduction and termination of coal-fired power generation
  - Ensuring the expansion of renewable energy to 65% by 2030 in a way that fits in with the system and the market
  - Further development of and continued support for combined heat and power
  - Cancellation of CO_2 certificates in the European Emission Trading system
- **Measures for the energy market and electricity prices for industry, commercial users and private consumers**
  - Compensation for electricity consumers
  - Consolidation and continued development of ETS electricity price compensation
- **Measures to ensure reliability of supply**
  - Further development of reliability of supply monitoring
  - Examination of a systematic investment framework
  - Use of the existing reserve instruments to safeguard the electricity market
  - Further development of and continued support for combined heat and power
  - Faster approval procedures for new gas-fired power stations
  - Adequate replacement for closed coal-fired power stations from reserve grid capacity
- **Measures for grids, storage, sector coupling and innovation potential**
  - Modernisation and better use of electricity grids by optimisation, expansion and market activities
  - Revision of the system of prices, charges and surcharges in the energy sector
  - Examination of the introduction of CO_2-based pricing to steer the sectors, even outside the European Emission Trading system
- **Measures for value creation and jobs**
  - Socially responsible arrangements for the reduction and termination of coal-fired power generation
  - Development of the affected mining areas as energy regions equipped for the future
- **Measures to take open-cast mining and safe remedial treatment of closed open-cast mines into account**
  - Securing of funding for remediation

4.1. Protection of the climate

The development of greenhouse gas emissions depends on a number of different factors (cf. Chapter 3.1 and 3.2). The Commission on Growth, Structural Change and Employment assumes that CO_2 emissions from the energy industry will fall to about 280 million tonnes by 2020 as a result of the measures that have already been agreed (European Emission Trading, expansion of renewable energies, conversion from coal-fired to gas-fired co-generation, security standby supply etc.). On the basis of the studies that are available today, the commission also assumes that without additional measures, the energy industry is highly likely to fail to achieve its sectoral goals by 2030 (175 to 183 million tonnes of CO_2).

The Commission on Growth, Structural Change and Employment therefore suggests the implementation of the following measures:

Measure: Assured step by step reduction and termination of coal-fired power generation

To ensure legal certainty in the procedure and an effective impact on the climate policy situation, the commission recommends the closure of power station capacity by agreement with the relevant power station operators. In this process, the existing structural differences between the different mining regions and the associated significance for regional value creation must be taken into account. Every closure is subject to review by the Federal Network Agency under Section 13b of the Energy Act (EnWG).

As far as compensation is concerned, the existing structural differences between the lignite and coal-fired power stations in relation to CO_2 emissions, operating company structure, the relationship with mining operations and the associated number of affected jobs will be taken into account. Insofar as no mutual agreement is achieved, the commission recommends a regulatory solution with compensation payments in the framework of the legal requirements.

The necessary funding must be provided to finance the recommended measures.

No surcharge on electricity prices will be made.

The commission also recommends that no building approvals be issued for new coal-fired power stations. For power stations which are already built but which have not yet started operations, the commission recommends that a negotiated solution be found so that these power stations are not taken into operation.

Specifically, the Commission on Growth, Structural Change and Employment recommends the following implementation steps:

Period from 2018 to 2022

In the period from 2018 to 2022, lignite and coal-fired power stations are to be closed down step by step, or refitted under the Combined Heat and Power Act (KWKG), so that the total output of the power stations on the market in 2022 is reduced to about 15 GW of lignite and about 15 GW of hard coal. Compared with the end of 2017, this represents a reduction by almost 5 GW from lignite power stations and 7.7 GW from coal-fired power stations. In addition, the commission recommends conversion from coal to gas as far as possible within the grid reserve capacity (currently 2.3 GW). This

would therefore lead to a total reduction by at least 12.5 GW of coal-fired power station output in the market. These measures will provide a CO_2 reduction of at least 45% in the energy sector compared with 1990.

To implement this reduction, the commission recommends that the closures be mutually agreed with the operating enterprises on a contractual basis. This would include an agreement on compensation payments to the operators and provisions for socially responsible arrangements for the reduction and termination of coal-fired power generation, and would subsequently be fixed in law. It would cover power stations which are in operation, not yet in operation or still under construction. The instruments to calculate the amount of the compensation could be tender processes or provisions on the same principle as for security standby. If a tender process is selected, an exclusion of redundancies for operational reasons and unreasonable social and economic disadvantages for the affected employees would be a necessary requirement.

The commission deems it desirable that Hambach Forest be preserved. In addition, the commission asks the federal state governments to enter into a dialogue on resettlement with the affected persons in the locality in order to avoid social and economic hardship.

Period from 2023 to 2030

The Climate Action Plan 2050 envisages that by 2030 the energy industry should reduce greenhouse gas emissions by 61 to 62% compared with 1990, i.e. 175 to 183 million tonnes CO_2 equivalent. To achieve this, a significant reduction in the installed capacity of the coal-fired power stations in the market is necessary. In addition, lignite and coal-fired power stations need to be taken off the market, so that the capacity of the lignite and coal-fired power stations on the market in 2030 (without reserve capacity) is reduced to a maximum of 9 GW of lignite and 8 GW of coal. Compared with 2017 that represents a total reduction of 10.9 GW for lignite power stations and 14.7 GW for coal power stations. The reduction of greenhouse gas emissions in the period from 2023 to 2030 should be as constant as possible.

In 2025 there will be a substantial intermediate step in the reduction of emissions by 10 million tonnes of CO_2, which should be achieved by an innovation project as far as possible.

In the years 2023, 2026 and 2029 there will be an evaluation of the measures implemented up to this year in relation to reliability of supply, electricity prices, climate protection, the development of EU state aid law and structural development. This is also necessary for an adequate assessment of the consequences of the phase-out of nuclear power in 2022 and the closures that have been carried out up to that time.

For the implementation, the commission recommends voluntary measures such as a mutually agreed negotiated solution with the operators of the lignite mines and a voluntary close-down premium for the lignite capacity. The solution should include not only provisions for a socially compatible organisation of the phase out, but also a reasonable compensation payment scheme based on objective criteria[150] for the operators.

Based on these criteria, the compensation payment reduces over time, i.e. the later the power stations are closed down, the lower the compensation payment will be. This degression of payments does not apply to plants which are less than 25 years old at the time of closure. The compensation must be organised in a way that is permissible under the state aid rules. Plants for which the conversion from coal to low-emission fuels is mainly financed under the Combined Heat and Power Act (KWKG) will not receive any additional compensation payment.

For the closure of the lignite-fired power stations, the commission recommends that a mutual agreement on a contractual basis should be made with the operators. It should include an agreement on compensation payments to the operators and provisions for socially acceptable arrangements for the phase out of lignite, and it would then be fixed in law. To ensure the reliability of the supply and an orderly structural transition, this agreement should as far as possible include a constant reduction of the lignite capacity in the market.

150 One possibility would be to base the compensation payments on the formula for the security standby minus the costs of reserve capacity. The remuneration for the security standby consists of two components: the loss of contribution margins on the electricity market for four years and the costs of reserve capacity for four years. The contribution margins are calculated from the future base electricity prices minus the costs of CO_2 certificates, minus short-term fuel costs and minus variable operating costs (e.g. flue gas purification). For the security standby, the historical prices from 1 October 2014 to 30 September 2015 were used. In addition, the costs associated with open-cast mines must be taken into account if appropriate.

The commission assumes that a mutual agreement will be made for the whole of the planning up to 2030 in the course of negotiations with the operators of lignite-fired power stations.

If a mutual agreement with the operators of lignite capacity is not reached by 30 June 2020, the commission recommends that a regulatory solution be implemented with compensation payments in the framework of the legal requirements in accordance with the above reduction plan. This will ensure a planned development to safeguard the reliability of the supply.

In the area of coal-fired power stations, the federal government should ensure a constant reduction of capacity in the market as far as possible. This process should take into account both the current foreseeable reduction of coal power station capacity as defined in the Combined Heat and Power Act (KWKG) and the reliability of the supply. For the remaining capacity, a tender process should be carried out which offers a voluntary close-down premium for closures. The more attractive the relevant conditions under the Combined Heat and Power Act (KWKG), the greater the anticipated CO_2 savings will be, and the lower the proportion of the close-down premiums which must be borne by taxpayers.

If the tender process for the close-down premium is over-subscribed, the contract will be awarded according to a criterion based on the reduction in emissions. In any tender process, a necessary requirement is an exclusion of redundancies for operational reasons and any unreasonable social and economic disadvantages for the affected employees. If the reduction in coal capacity proceeds in line with the reduction plan as a result of market forces and without intervention, no tender processes are necessary for the affected years, or the close-down premium stipulated in the tender process is reduced to zero.

If a mutual agreement with the operators of the hard coal capacity is not reached in time, the commission recommends that a regulatory solution be implemented with compensation payments in the framework of the legal requirements in accordance with the above reduction plan. This will ensure a planned development to safeguard the reliability of the supply.

In the event of regulatory measures, a de-minimis arrangement should be provided for power stations with a capacity of less than 150 MW_{el} (e.g. industry power stations). These power stations should be given until 2030 for conversion from coal to gas. Conversion from coal to gas should be subsidised under appropriate provisions.

End date for coal-fired power generation

According to the present plans for the mining areas, the production of electricity from lignite is due to end in the late 2040s (cf. Chapter 3.2.5). The production of electricity from hard coal will largely depend on the technical service life of the installations and the development of CO_2 and fuel prices. The latest generation of coal-fired power stations will be 40 years old in the early 2050s.

According to the Climate Action Plan 2050, emissions of greenhouse gases are to be 70% lower in 2040 and 80 to 95% lower in 2050. In addition, emissions in the energy industry must also be reduced after 2030.

The commission recommends the end of 2038 as the **end date for coal-fired power generation**. If the requirements for energy, employment and the economy are met, the date may be brought forward to no earlier than 2035 in negotiations with the operators. This question will be reviewed in 2032 to decide whether this is possible (“opening clause”). This review will also cover the question of whether the assumptions for the end of coal-fired power generation as a whole are realistic.

The end date for coal-fired power generation will be comprehensively reviewed by a panel of independent experts in 2026 and 2029 to determine the effects on the achievement of climate goals, the development of electricity prices, the reliability of the power supply, jobs, the structural policy goals, the implemented structural policy measures and the regional value creation, and will be adjusted if appropriate (cf. Chapter 6). Any necessary intervention in property rights must also be taken into account in this connection.

Measure: Cancellation of CO_2 certificates in the context of European Emission Trading

It must be ensured that the national closure of lignite and coal-fired power stations is also sufficiently effective in the framework of the European Emission Trading system. Therefore the commission points out that under the current reform of European Emission Trading, from 2021 it will be possible for member states to delete emission certificates from their national auction budget to a defined extent as a result of power station closures which arise from additional national measures .[151] The commission recommends that this possibility should only be used up to the amount of the additionally reduced CO_2 quantity.

Measure: Ensuring the expansion of renewable energy to 65% by 2030 in a way that fits in with the system and the market

One of the central instruments to achieve the climate goals is the further expansion of renewable energy. To ensure that the 65% target that is defined in the coalition agreement can be achieved, reliable framework conditions for investments in renewable energy are necessary. The commission also recommends that the annual new-build volumes for renewable energy should be adjusted in the light of the 65% target up to 2030, and in particular that the lignite mining areas and the coal-fired power station locations should also be used for the expansion of renewable energy. By using innovative technology, the mining areas can become model regions for the energy transition.

Measure: Development and continuation of subsidies for combined heat and power

The closure of coal-fired power stations is also likely to affect power stations which make a relevant contribution to the production of heat and which also make a significant contribution to the reduction of emissions in other sectors. The reliable supply of heating (district heat and process heat) must be ensured. The extension and further development of the Combined Heat and Power Act (KWKG) play a central role in this respect. This measure also contributes significantly to the reduction of greenhouse gas emissions and plays a substantial role in ensuring the reliability of the supply (cf. Chapter 4.3).

As a consequence of the above climate protection measures, the CO_2 emissions from the energy industry will fall to a maximum of 175 to 183 million tonnes by 2030. The proposed measures thus ensure that the reductions in emissions will take place in addition to the reductions that are already expected. Under the terms of the commission's assignment, this means that the energy industry will provide a major contribution to the achievement of the 40% climate goal, and that the sectoral goal of the energy industry up to 2030 will be reliably achieved.

This takes into account that these closures will increase the capacity utilisation and thus the emissions from the remaining power stations (net reduction) and will change the cross-border exchange of power (cf. Chapter 3.2).

151 Even in the current trading period up to 2020, the purchase and subsequent deletion of certificates is already possible.

4.2. Energy market and electricity prices for industry, commercial users and private consumers

The Commission on Growth, Structural Change and Employment assumes that electricity market prices will rise in the coming years as a result of the probable increases in the price of fuel and CO_2 certificates. The proposed additional closures of coal power station capacity will reduce the supply and thus lead to further increases in the electricity market price. At the same time, the continued expansion of renewable energies will tend to reduce prices on the electricity market (cf. Chapter 3.2.2), although it may increase the system costs and the demand for subsidies.

Electricity prices in Germany are relatively high for both private households and business enterprises. Any additional increase in electricity prices will have a negative effect on electricity consumers, especially energy-intensive industries (cf. Chapter 3.2.3). Therefore the commission agrees that flanking measures are necessary to limit electricity prices in order to safeguard the competitiveness of energy-intensive industries. In addition, any extra cost burdens for commercial users and private consumers should be as small as possible.

Measure: Compensation for electricity consumers

Compensatory measures must be created to lessen the impact of electricity price increases resulting from the politically accelerated reduction and close-down of coal-fired power generation on businesses and private households. The commission therefore deems it necessary for a subsidy on grid transmission charges to be provided from 2023 for private and commercial electricity consumers, or some other measure with an equivalent effect, to minimise the price increase for electricity which will result from the faster reduction of coal-fired power generation. From today's perspective, the subsidy required to compensate for this increase is likely to be at least €2 billion per annum. The exact volume of this amount will be determined in the 2023 review. This subsidy must be fixed in the federal budget, and its status under the state aid rules must be secured. No additional surcharge or charge on the electricity price should be made.

The federal government should endeavour to develop an instrument which complies with the state aid rules and acts in addition to the above instruments to lessen the impact of price increases resulting from the politically accelerated reduction and closure of coal-fired power generation on energy-intensive companies which take electricity from the grid but do not benefit from a reduction of the grid access charges.

Measure: Consolidation and continued development of electricity price compensation

Against the background of the past increases and the anticipated future increases in CO_2 prices, the commission believes that a consolidation and continued development of the ETS electricity price compensation system for particularly energy-intensive enterprises is necessary. The federal government should ask the EU Commission to extend the electricity price compensation system to 2030, stabilise the level of aid provided and secure it permanently. The federal government should also take steps to ensure that the compensation amount is available as needed in the budget of the energy and climate fund.

4.3. Reliability of the supply

A secure provision of electricity and heating at the highest level is of major importance for Germany as an industrial location. This applies both to the sufficient availability of the installed power station capacity and to the security of the system.

The federal government must carry out the legally prescribed monitoring of the reliability of supply to ensure that the supply of electricity is reliably available at all times. This task of monitoring the reliability of the supply is an important instrument for short-term, medium-term and long-term measures to identify challenges to the reliability of supply at an early stage, and thus to act as an early warning system for possible dangers.

Measure: Further development of the monitoring system for the reliability of supply

To improve early recognition of risks to the reliability of the supply, the commission recommends that the current system to monitor the reliability of supply should be developed further.[152] This will significantly strengthen its information value as a robust estimate of the anticipated future power generation capacity. The further development should measure the reliability of the energy supply, including the quality of this supply, and should include a method to analyse the reliability of the energy supply in a risk-oriented, demand-based and continuous manner ("stress test"). The report which is already required under the applicable laws should therefore be extended to include an evaluation of economic viability for the construction of new power stations and storage capacities in order to identify any investment gap as early as possible, and it should also be able to predict the development of wholesale prices. In addition, a mandatory risk management element should be introduced to determine whether the energy supply is assured for the individual market participant even when there is a shortage of supply. This will include an analysis of the energy demand from industry, commerce, private consumers and the public sector. Consistent uniform standards should be developed, and supported by risk thresholds if appropriate. But this should not limit the investment freedom of the market participants.

The reliability of the supply should fundamentally be assured for the domestic energy market. The recommended measures for the end of coal-fired power generation are fundamentally designed to give planning certainty to the market participants and thus ensure that the necessary investments in new capacity – especially gas-fired power stations and storage capacity – are made in the framework of the *Energy-Only* market and the Combined Heat and Power Act (KWKG). If these investments are not made, or if the further development of the supply reliability monitoring system shows that the investments are not made in time, the commission recommends the following measure:

Measure: Examination of a systematic investment framework

If insufficient new power station capacities are under construction by 2023 to compensate for the politically decided closure of the lignite and coal-fired power stations, the commission recommends the examination of a systematic investment framework which would be able to provide the appropriate investment incentives in good time so that the reliability of supply is always assured. This may also be done for a limited regional area. To take the lead-in time for investments into account, the investment developments must be constantly monitored. Steps must be taken to ensure that there is no time divergence between the demand for power station capacity and the completion.

To provide additional security for the electricity market, an extensive instrument is available in the form of the capacity reserve (from 2019), the grid reserve and the security standby. Increasing these capacity reserves could be a means to allay fears about the consequences of an ambitious reduction in coal-fired power generation.

152 To monitor the reliability of the supply, the Federal Ministry for Economic Affairs and Energy will implement a supply reliability monitoring system under Section 51 of the Energy Act (EnWG). It will basically cover all stages of the electricity supply: the existing capacity for power generation, the availability of primary energy sources for power generation, transport of the electricity, trading and sale, cf. Chapter 3.2.4. .

Measure: Use of the existing reserve instruments to safeguard the electricity market

In the event of any risks which may arise in the reliability of the supply, the commission recommends that the existing reserve instruments be comprehensively used. Here, the size of the reserves can be extended to a limited extent if necessary. However, unlimited expansion, especially of the reserve capacity, would lead to market distortions. Therefore the commission recommends that the reserve capacity should be limited.

A large proportion of the coal-fired power stations in Germany generate not only electricity, but also heat for district heating. Combined heat and power production and its heating infrastructure therefore make an important contribution to maintaining the reliability of supply in the electricity and heating sector. This automatically leads to different challenges for the reduction of combined and dedicated coal power stations, which must be considered separately. Especially the local combination of the district heating grid and the supply of process heat means that any closing down of coal-based heat production will require parallel measures to replace this heat locally. Fundamentally, it must be taken into account that due to the expansion of fluctuating renewable energies, it will be increasingly necessary for combined power and heat plants to be operated more flexibly. In addition, in the last resort the climate goals need a conversion to CO_2-neutral heat production based on renewable energies.

Measure: Development and continuation of combined heat and power

The commission therefore recommends that adequate and long-term framework conditions should be created for combined power and heat plants. In future, combined power and heat plants should be developed into modern, flexible power and heat systems which include not only combined power and heat plants, but also storage capacity, district heat grids, heat pumps, power to heat systems and solar or geothermal plants. Therefore, even after 2022 and up to 2030, stable framework conditions for investments in modern power and heat systems should be created so that the power and heat sector can develop in line with the energy industry sectoral goal for 2030. In this context, the further conversion from coal to gas power and heat plants should be made more attractive by 2026, and innovations for compatibility with green gases should be subsidised. In addition, a regulatory framework should be created for subsidies for new heat networks or the adaptation of existing heat networks to the new requirements.

The locations of coal power stations already have a well-developed energy infrastructure, and preservation of this infrastructure should be supported. In this respect, the operators of coal-fired power stations should be offered a further incentive for conversion to less emission-intensive fuel types.

Measure: Faster approval procedures for new gas-fired power stations

The commission therefore recommends that measures to accelerate the approval processes for the construction of new gas-fired power stations should be examined, especially in existing coal power station locations.

A reduction in the coal capacity also creates challenges for the stability of the system. Up to now, coal power stations have especially made an important contribution to short-term capacity and the temporary reserve capacity (cf. Chapter 3.2.4). Grid stability and reliability are so important for the economy that a precautionary supply is an important principle. Moreover, system security in the electricity grids, as an element of the reliability of the supply, is also facing local and regional challenges. This means that even if there is sufficient reliable capacity available nationally (and taking the reliable capacity in neighbouring countries into account), regional problems may nevertheless arise for the reliability of the supply due to bottlenecks in the grid. System security, grid stability and black start capacity must be fully assured at all times.

Measure: Adequate replacement for closed-down coal-fired power stations from the grid reserve

To ensure that even coal-fired power stations which form part of the grid reserve can be closed down, the commission recommends that equivalent alternatives be created, especially gas turbines and storage capacity.

4.4. Grids, storage, sector coupling and innovation potential

A well-developed electricity grid is the backbone of an energy system that is increasingly based on the volatile provision of electricity from renewable energies. To ensure that the power supply remains reliable and affordable at all times, the German energy system is also dependent on modernisation and a better use of the electricity grids. To align power generation and consumption in a demand-based and consumption-oriented way, the transmission and distribution grids must therefore become "smarter". Especially at the distribution grid levels, a regional balance between generation and consumption and a greater use of local flexibility can relieve the burden on the overall system and optimise feed-in management.

Measure: Modernisation and better use of electricity grids by optimisation, expansion and market activities

The commission therefore recommends that the modernisation of transmission and distribution grids be systematically carried out. To ensure that an expansion of renewable energy to 65% by 2030 and a step by step reduction and termination of coal-fired power generation can be successfully implemented, other measures for optimised grid operation are needed. In addition to the necessary new grid sections and grid expansion, numerous smart solutions provide possible ways to use the existing grids more intelligently. Here, digitisation offers considerable potential. Moreover, the commission considers it necessary that the step by step reduction in coal-fired power generation and the associated measures should also be taken into account in long-term grid planning by the Federal Network Agency and in the national demand plans.

Storage capacity can provide the necessary time-based flexibility for the integration of renewable energies and provide a number of system services.

Even in the transition phase of the energy system it is already urgently necessary to realise the potential of the different storage technology systems. This requires incentives for research and testing, and especially an improved and robust statutory framework which will permit economically viable operation.

Sector coupling plays a crucial role in achieving the climate goals because it is only by using renewably generated electricity for heat, gas and fuel that all sectors can be de-carbonised. In addition, sector coupling helps to make the energy system more flexible when "power-to-X" systems are used as an additional potential for flexible demand control (demand-side management). At the same time e-mobility, power-to-heat and power-to-gas offer significant flexibility potential to react to the fluctuating feed-in of renewable electricity. Today's regulatory framework (especially in the area of taxes, charges, prices and surcharges) still hinders effective coupling of the sectors.

In addition, the production of hydrogen plays a central role in sector coupling. Hydrogen can also be linked with flexible combined power and heat. This strengthens the energy transition at the local level, increases flexibility and offers solutions for existing municipal and industrial structures. An integration of hydrogen production and flexible combined power and heat can lead to a further increase in the flexibility of combined power generation.

Another key technology for sector coupling is power-to-gas (P2G). It enables renewable electricity to be converted into an energy form which can be stored in the long term as renewable gas and can be distributed via the existing gas grid. The gas grid has considerable storage capacity, and in future it can increasingly receive, store and distribute renewable gases and distribute them to other sectors. At present, P2G plants mainly exist as pilot projects on a correspondingly small scale. In the medium term, they are thus still a topic for research and development with the aim of achieving economic effects of scale as quickly as possible. Apart from technical factors, regulatory learning is also important for sector coupling. Therefore, it is especially important to develop regional living labs to achieve further progress in the system integration of P2G plants. Even at the planning stage, however, the prospects for a transition from the pilot or research phase to the market play an important role in any investment decisions. The commission also suggests that market incentive mechanisms should be established for green hydrogen.

Measure: Revision of the system of taxes, charges, prices and surcharges in the energy sector

The commission recommends that the existing system of prices, charges and surcharges in the energy sector should be completely revised. The current system, which places an excessive burden on electricity compared with other energy sources, acts as a hindrance to sector coupling and the use of existing or new flexibility options such as power-to-gas, hydrogen and storage. To support sector coupling, the commission therefore also recommends a reduction in the tax on electricity. This – in conjunction with the proposed subsidy or transmission grid prices or equivalent measures – would bring down electricity prices.

Measure: Examination of the introduction of CO_2-based pricing to steer the sectors even outside the European Emission Trading system

The commission recommends that the introduction of a CO_2-based pricing system should be examined to steer the sectors even outside the ETS system. As a result of this, these sectors could be expected to make a greater contribution to climate protection in the future, and on the other hand it would be an incentive to use the flexibility potential of power-to-X plants. CO_2-based pricing should be designed in a socially responsible way.

4.5. Value creation and employment

In the three lignite mining areas – Lausitz mining area, Central German mining area and Rhineland mining area – the mining industry plays a central role. A premature closure of power station capacity and open-cast mines will speed up structural transition. The closure of hard coal power stations will also have a negative effect on regional employment and value creation.

The Commission on Growth, Structural Change and Employment lays great importance on ensuring that the measures to reduce CO_2 emissions are combined with the necessary structural measures so that they lead to successful structural developments.

Measure: Socially acceptable design of the reduction and termination of coal-fired power generation

The commission considers it essential to cushion the negative effects on employees. And it must be ensured that employees are not subjected to unreasonable social and economic disadvantages. In particular, the affected companies must be placed in a position that enables them to exclude redundancies for operational reasons.

Employees in open-cast mining and in lignite and coal-fired power stations must be given viable career prospects. Depending on the personal situation of the affected employees, binding collective agreements must be made between the two sides of the industry, e.g. to ensure placement in skilled jobs and compensation for lower wages, apprenticeships and further training, compensation for financial losses or for early retirement, assistance in obtaining adjustment benefit (APG), compensation for pension deductions or other early retirement factors.

To achieve this, sufficient finance must be available for the whole lignite and coal mining and power generating sector to ensure that all employees have a chance to find future-proof jobs with adequate remuneration and working conditions. These points must also feature in mutually agreed contractual provisions. The employee representative bodies and trade unions must be included in the relevant negotiations. The provisions must be fixed in collective agreements.

Measure: Development of the affected mining areas as energy regions equipped for the future

To ensure that the affected regions can continue as energy regions in the future, their technology competence and innovative capacity and the use of renewable energies, storage capacity and green hydrogen (power-to-gas) should be increasingly subsidised as future technologies in the affected regions. The same applies to the construction of new gas-fired power stations, especially heat extraction, in the existing power station locations. The energy sector could then continue to contribute to regional value creation. However, this requires the creation of appropriate regulatory conditions (cf. Chapter 4.4).

4.6. Consideration of open-cast mining and safe remedial treatment of closed open-cast mines

The effects of a reduction of power production in lignite-fired power station on the associated open-cast mines must be taken into account (cf. Chapter 3.2). The operators of open-cast lignite mines have extensive obligations to carry out remediation work in the mines after use.[153] In the process of the renaturation measures, extensive financial investments and personnel deployment will be needed for a long time in the mining areas.

The premature closure of lignite power stations involves a shortening of the previously planned service life, and possibly a reduction in the size of open-cast mines. The processes to adjust permits must use all possible ways to accelerate the procedure so that any standstill of the open-cast mines or the renaturation process is avoided and the operators have planning certainty throughout. This also means that new open-cast lignite mines for energy production should not be created in future.

In this respect, an accelerated termination of coal and lignite-fired power generation may lead to extra costs for the operators of open-cast lignite mines. If open-cast mines are significantly reduced in size, it is not certain that the reserve provisions to date will be sufficient for the financing of the whole renaturation process. In addition, the costs arise earlier so less interest can be accrued, and the necessary funds may need to be saved over shorter periods.

It must be checked how the cost structures are changed and what consequences this can have on the balance sheets of the companies if open-cast mines are closed earlier than was originally planned as a result of the phase out of coal. The commission suggests that in addition to the present annual financial statements, the operators should be required to provide transparency about the extent to which payments for closure and renaturation are not only covered for the future, but are available as liquid funds at the necessary time. In addition, a state body should be given a right to obtain information.

153 Section 55 (1) No. 7, No. 9 of the Federal Mining Act (BBergG); cf. also *von Mässenhausen*, in: Boldt/Weller/Kühne/von Mässenhausen, Federal Mining Act (BBergG), 2nd edition 2016, Section 55 marginal note 145.

Under the Federal Mining Act, the operating company must bear the post-mining costs of coal and lignite extraction. If compensations or close-down premiums are paid, the owners of the lignite companies must use these payments to cover the post-mining costs. To achieve this, in any permits for new operating plans under the Federal Mining Act, the federal states should make full use of the possibility of insolvency-proof guarantee amounts if there is no joint corporate liability scheme.

A binding agreement must be made to ensure that water management, especially for the river Spree, is assured in the event of a premature phase out of lignite mining. It must be ensured at all costs that the river Spree does not run dry, especially to safeguard tourism in the Spreewald.

5. Prospects for existing, new and future-proof jobs

5.1. Effects, structural policy impact and future visions for mining areas

Regional structural development means that new prospects must be developed for the regions on the basis of their strengths, and must then be implemented at an early stage by practical measures and with the involvement of the local participants. The accelerated reduction and termination of coal-fired power generation has major effects on the regions, so the increased joint efforts to promote structural development must begin immediately. Confidence in a promising structural transition will only arise where future-proof prospects and firm supporting measures are visible in practice.

One basic requirement for a successful structural transition is an independent, adaptable and verifiable regional development concept which covers the relevant mining area as a whole and its interactions with the surrounding region. Some regions have made more progress than others in the development of such concepts. The existing regional development concepts and specific suggested projects and measures can be found in the annexes to this report.

In the consultations in the mining areas, the commission gained a grass roots impression of the challenges which the regions are already facing and the effects which the premature termination of coal-fired power generation can have in the regions. In addition, the commission gathered information on the existing potential in the regions to face these challenges successfully and to benefit from the opportunities which arise from the structural transition.

Germany already has extensive experience of dealing with the structural transition in coal and lignite mining. The experience gained in the eastern German mining areas is especially characterised by the partial collapse of the lignite industry in the years after reunification. But western Germany also has experience of structural dislocation, and the effects are increasingly felt even today in the Ruhr district and Saarland.

The declared aim of the commission is therefore to learn from the experience of the past and to take early action to shape the structural development in a step-by-step and planned manner.

This is the only way to avoid structural dislocation in the regions. Although each region has a different baseline, the regions are not starting from scratch. Transition has already begun, and the lignite mining regions are already in the process of adapting actively to the time after lignite-fired power generation.

The regions have a range of potential strengths which must be harnessed. Many participants have ideas for their regions because they want to make them future-proof, economically strong, attractive and pleasant to live in. This existing potential is an important basis for success in facing the impending transition.

The following sections show the considerations for the future development in each of the mining areas.

5.1.1. Helmstedt mining area

In August 2016 open-cast lignite mining ended with the closure of Schöningen open-cast mine. Buschhaus power station was transferred to security standby status in 2016, but this will end in 2020. There are no other active lignite power stations or open-cast mines. Today there are about 150 direct employees and 300 indirect or induced employees within the mining area or outside the boundaries of the area as they are described here.[154]

The very rural Helmstedt mining area in the administrative district of Helmstedt is thinly populated and has an inadequate infrastructure for the supply of goods, mobility and communication systems. In its gross domestic product, the economic performance of the rural district today is about 50% of the national average. The higher-order urban centres in the region and the motor industry currently provide a stable basis for economic development. The challenges are to create new core growth and development centres and thus reduce the area's dependence on the large-scale industrial centres in places such as Braunschweig (Brunswick) and Wolfsburg.

154 Cf. the employment figures as deduced in Chapter 3.4.

But the increasing spread of digitisation in the workplace also creates new development opportunities for rural regions. And the comparatively high availability of land and open spaces offers an opportunity to create new commercial and industrial premises. As in the other lignite mining areas, the existing electricity grid infrastructure provides a locational advantage for the construction of new energy production systems and energy storage capacity.

The mining area recently founded the Helmstedt regional management board which aims to act as a central coordinating body for the design of structural transition. But the funding for the regional management board only runs until 2020.

5.1.2. Lausitz mining area

The Lausitz mining area is distinguished from the other mining areas in North Rhine-Westphalia and central Germany because here we can speak of a historically developed special importance of the lignite industry. An example can be seen in the economic structure of the rural district of Görlitz, where a total of €946 million or 16.2% of the gross value created in 2015 was earned in the energy sector. In the manufacturing sector (without construction), the energy industry earned almost half (48.6%) of the value created.[155] The figures are similar in the rural district of Spree-Neiße further north. There, the figures for the manufacturing industry amount to 68% of the total gross added value because of the importance of th emining and energy industry.[156]

In total, the lignite industry in the Lausitz mining area achieved a gross added value of slightly more than €1.2 billion in 2016 according to the calculations of the RWI economic research institute, i.e. around 4.3% of the total added value in the region.[157] The lignite company LEAG itself states that it creates an annual added value of about €1.4 billion in the Lausitz mining area.

In addition to the roughly 8,000 direct employees of LEAG in the mining and energy industry, it is reasonably estimated that there are about 500 other companies with approx. 16,000 employees which are directly or indirectly dependent on the lignite and energy industry as service providers and suppliers (with different degrees of dependence and different regional locations within and outside the mining area).[158] In this connection it is also important that various other large industrial employers in the region have been faced with great difficulties in the last few years.

Today, the lignite mining area is one of the most important industrial locations in the Lausitz region. This area aims to continue as a location for industry, and in this respect to become a modern, attractive and forward-looking economic region. Although the region has a number of small industrial, commercial and trade employers, the range of industrial production in the region – such as chemicals, power station components, rail vehicles, plastic and metal processing – could be considerably expanded.

The success of structural transition policies will therefore be measured by the extent to which the Lausitz can be strengthened as an industrial location: The goal is to harness the existing potential in a joint effort by the national government, the federal states of Brandenburg and Saxony, the local communities and administrative districts, employers, unions and civil society organisations in order to create an attractive and future-oriented economic region with new value creation chains. And the Lausitz also needs to become a European model region for structural transition.

This means that the obvious infrastructure deficits must be remedied, including the patchy digital infrastructure and the deficits in the transport infrastructure (road, rail and water). For the Lausitz, this especially applies to the urgently needed better connections to the surrounding metropolitan regions.[159] The lack of attractive mobility connections between rural areas and the metropolitan regions is currently the main obstacle for the recruitment of the urgently needed skilled personnel.

Young and active skilled personnel are necessary for a sustained economic development. Steps must therefore be taken in the Lausitz to counter the demographic development and the associated decline in the skilled personnel pool, because

155 Statistical Office of Saxony 2017.

156 Landesamt für Datenverarbeitung und Statistik Brandenburg (Brandenburg Office for Construction and Transport).

157 RWI 2018b.

158 Cf. the employment figures as deduced in Chapter 3.4.

159 Cf. also the considerations on the location, settlement structure and infrastructure in the mining areas in Chapter 3.4.

in future the competition for highly qualified skilled personnel will become more difficult throughout Germany. The highly qualified personnel from the lignite sector are therefore a valuable resource for the future structural development. In connection with the step-by-step reduction of lignite-fired power generation, it is especially important to safeguard and expanding the job market and systematically recruit new skilled personnel. The attractive apprenticeship and training facilities of the LEAG lignite company should be developed further at all costs. These historically developed apprenticeship and training structures can be utilised in the national competition for highly qualified skilled personnel, and the quality of the region as a whole must be increased by creating attractive social infrastructures and recreation facilities.

The development of the digital infrastructure to create a highly modern glass fibre network with gigabit capacity in the whole region is also an essential basic condition for economic development prospects and for competitive location conditions to attract new investors. The Lausitz mining area needs clear commitments from the national government so that the necessary long-term planning processes can begin without delay.

Increasing the innovation potential and competitiveness of the Lausitz plays a central role in the structural development process. Drawing on existing areas of competence and research profiles can unlock the potential for further technology-based spin-off companies. Improving the conditions for start-ups is an important factor here. The existing innovation system in the Lausitz should be expanded to create spill-over effects. Furthermore, non-university research institutes of the Max Planck Society, the Fraunhofer Society, the German Air and Space Travel Centre (DLR) and other research centres of the Helmholtz and Leibniz societies could be deliberately established in the Lausitz and linked with existing research institutes to harness the research and development potential.

In addition to the energy industry, other significant industries in the Lausitz mining area include nutrition, chemicals, paper, glass, gypsum, plastics, metal production and processing and the manufacture of metal products, especially in the lightweight construction sector. Other areas include mechanical engineering, vehicle construction, automotive parts and the manufacture of electric and optical products and equipment. Tourism is a recent addition (Görlitz, Lausitz lakes). And there are promising initiatives in the service sector, especially in logistics and mobility.

Taking into account the university cities of Dresden and Cottbus, the region has a well developed university and non-university research landscape, which is already excellent in some areas, with special development focus or development scope in the areas of energy, mobility, bioeconomy, resource efficiency, health care, culture, tourism and artificial intelligence.

The Lausitz mining area offers excellent basic resources to enable it to remain a strong energy region even under changing energy policy conditions. The energy-specific competence in the region offers the opportunity to support the transition of energy systems from the present centralised structures to the future largely decentralised structures, a trend which can be seen throughout Europe. And in the context of a cluster strategy, the existing economic and scientific structures can be linked with development trends which are appropriate for the region:

- **Lausitz Cluster Energy (LCE): remaining as an energy region**
  Drawing on the existing competence in energy technology and resource efficiency, the available research capacity, the infrastructure for electricity and gas and the pool of available sites, the Lausitz will use the trend towards de-carbonisation in the energy sector for the expansion of renewable energy, the industrial production of hydrogen, energy-efficient building renovation and energy-enhanced town and village conversion in order to establish new value creation chains, partly on an industrial scale. The power station locations in Boxberg, Jänschwalde and Spremberg will become new generation industrial estates with a focus on the use of renewable energies and their conversion to become energy sources for businesses with long-term availability.

- **Lausitz Cluster Mobility (LCM): a model region for ecological and modern mobility**
  Various forms of ecological mobility can be researched, tested and applied in the region. Significant potential is seen in storage technology and production, work on innovative propulsion technology, development and production of lightweight materials for road and rail transport, manufacture of high-tech materials as components for microelectronics and integrated traffic concepts.

- **Lausitz Cluster Bioeconomy and Resource Efficiency (LCBR): market leader in the economical use of fossil-based and limited resources and biogenic basic materials**
  Drawing on existing resources, networks and business enterprises (e.g. biosaxony, Silicon Saxony, BASF), there are many possible applications in the production of new basic materials for the pharmaceutical and chemicals industry, regenerative medicine, agriculture and food production, and also for the international demand for competence in dealing with post-mining landscapes.

- **Lausitz Cluster Health Care and Tourism (LCGT): best health care and individual recreation**
  Ensuring a high standard of health care is based on a close cooperation between in-patient and out-patient facilities, the Faculty of Medicine and University Clinic in Dresden and a collaborative association of regional hospitals. A central training facility for the growing demand for nursing staff is being created with the European Medical School. One main focus of the cluster will be research and innovations in connection with robotics and digitisation. The existing small business and craftsmanship structures in medical technology, material technology and special textiles offer significant potential. In addition, the range of tourist facilities can be systematically supplemented by facilities offering health and wellness programmes.

- **Lausitz Campus for Artificial Intelligence (LCKI): making the Lausitz into one of the European development locations for artificial intelligence**
  Artificial intelligence determines the dynamic development of the digital revolution. The creation of a special place for encounter between top researchers in computer science, engineering, mathematics, science, medicine and pharmacology and application-oriented researchers from the relevant departments in business companies will lead to synergies and transfers from basic research to practical applications. Here, there is also a link to the other clusters mentioned above. The Lausitz AI campus will initially be founded in an attractive location in the Lausitz by spin-offs from the Excellence University of Dresden and under the leadership of the university, and it will be extended and used together with the non-university research institutes in the region. The Smart System Hub Dresden also supports this development. The IT resources with high-performance network infrastructure and next generation high-performance computers are major prerequisites.

In the Lausitz, are numerous stakeholders are contributing to the development of the region. For successful control and steering of the structural transition, a joint organisation from the two federal states is needed (Saxony and Brandenburg), and the national government should also be involved. Municipal local authorities should also participate. With Innovation Region Lausitz GmbH (IRL) sponsored by Lausitz businesses, Economic Region Lausitz GmbH (WRL) sponsored by local communities, the Lausitz round table and many other initiatives, employers and unions, clubs and associations, the Lausitz already has a number of regional structures which can be drawn on in the course of the further structural development. For two years the IRL has supported companies in developing new products and entering new markets, thus helping them to become less dependent on orders from the lignite industry. With the support of joint subsidies of €7.3 million from the Federal Ministry for Economic Affairs and Energy, the Free State of Saxony and the federal state of Brandenburg, guiding principles are currently being developed in the Lausitz, and their results will be taken into account and integrated in the implementation of the results of the commission's work.[160]

5.1.3. Rhineland mining area

Historically, the supply of electricity and heating in the Rhineland lignite mining area led to the development of a number of industries in this region which would not be feasible without a supply of electricity, gas and heating. Even today, the industrial use of energy in the Rhineland mining area plays a significantly greater role than the regional and national average, which is why prosperity and employment in this area and the surrounding regions is especially dependent on a competitive supply of energy. The above-average proportion of energy-intensive industries makes a major contribution to the creation of value. The value creation in these industries amounts to €7.1 billion of the total turnover of €32 billion.

160 The Lausitz Future Workshop *(Zukunftswerkstatt Lausitz)* is a project of WRL. Together with experts, business companies, associations, scientists, trade unions and representatives of the civil society in the region, it aims to develop consistent guiding principles for the Lausitz by 2020. Cf. also: https://zw-lausitz.de/.

The number of employees in the lignite industry is estimated at about 9,000. There are a further 18,000 indirect or induced jobs within or outside the boundaries of the mining area as defined here.[161] In addition to energy-intensive industry with about 93,000 employees[162] there are also other branches of industry in the Rhineland mining area – as in the other mining areas – which are currently dependent on the use of lignite.

The gross added value in the lignite sector in the Rhineland mining area in 2016 was about €1.7 billion. This represented a share of approx 2.4% of the regional value creation.[163] RWE estimated its direct contribution to value creation in the Rhineland mining area at around €2.0 billion per year.

This shows that there are also major challenges in the Rhineland mining area. At the same time there are also good chances of a successful structural transition if the framework conditions are right and the level of the subsidies is sufficient.

The region has a number of location advantages compared with the other mining areas. The region itself has two higher-order urban centres in Aachen and Mönchengladbach. It is also fairly close to the metropolitan centres in the adjoining Rhineland (Bonn, Cologne, Leverkusen and Düsseldorf). The (energy) infrastructure and transport connections are good, although they must be adapted to the new challenges: For example, the infrastructure of the mining area itself must be comprehensively overhauled in the impending transformation process. Another advantage is that the region has a very good university and research structure. This includes RWTH Aachen University, Jülich research centre and several applied science universities, technical universities and other universities.[164]

The Rhineland mining area can also draw on its strong economic structure. In addition to the energy industry and energy-intensive industries, there are also business companies in the resource efficiency, mobility and logistics sectors. And there are initiatives in IT and agriculture.

The Rhineland mining area has already made progress in developing structures to accompany and support the structural transition process. A specialised institution has been created, the Rhineland Mining Area Future Agency, which acts as a central coordination platform in the mining area and is networked with the other regional stakeholders.

One special factor in the Rhineland mining area is the level of networking and the interdependence of the value creation chains. Close to the open-cast mines there is a mutually structured closely interlinked network of energy-intensive businesses and coal-related production lines. Therefore, especially in the Rhineland mining area the consequences of any energy policy decisions must also be evaluated in their direct effects on the value creation network structure.

The following starting points could favour the development of new value creation chains and future-proof jobs:[165]

- **Energy and industry:** The Rhineland mining area aims to establish itself as an energy region for the future and a model location in the future energy system. Possible specific measures include the creation of a regional energy management system, e.g. the Quirinus project of SME, and the establishment of a low-carbon technology campus for energy-intensive industry. And the Rhineland mining area is an important business location for RWE, many small and medium-size energy enterprises and energy-intensive industry, and it has a vibrant university and research infrastructure with international excellence in energy and production.

161 Cf. the employment figures as deduced in Chapter 3.4.

162 frontier economics (2018): Die Bedeutung des Wertschöpfungsfaktors Energie in den Regionen Aachen, Köln und Mittlerer Niederrhein (The importance of energy as a value creation factor in the Aachen, Cologne and middle lower Rhine region). Short study on behalf of the Chambers of Industry and Commerce IHK Aachen, IHK Cologne and IHK Middle Lower Rhine.

163 RWI 2018b.

164 Cf. also the analysis of the structural policy baseline in Chapter 3.4.

165 Cf. also Rhineland Mining Area Future Agency (2018): Eckpunkte eines Wirtschafts- und Strukturprogramms (Central elements of an economic and structural programme). Available under: http://rheinisches-revier.de/media/20180924_eckpunkte_strukturprogramm_rheinisches_zukunftsrevier.pdf.

- **Innovation and education:** The mining area aims to develop a trendsetting start-up culture ("Innovation Valley Rhineland"). Spin-offs from universities scientific institutions lead to new business start-ups in the mining area. This involves initiatives such as university extensions (e.g. Technical University of Cologne campus Rhine-Erft) and the creation of five innovation hubs and start-up centres in the Rhineland mining area (e.g. Brainergy Hub Jülich).

- **Region and infrastructure:** This includes the follow-on use of power station sites, the creation of model districts and the establishment of a multi-functional landscape park. A future-proof realignment of the Rhineland mining area also requires the development of a suitable transport infrastructure to develop the region and connect its development potential to the large population centres such as Cologne, Düsseldorf, Mönchengladbach and Aachen in the best possible way. New intelligent transport routes combined with innovative technology and drive systems (fast cycle paths, expansion of rail transport, new roads and bridges, closing of gaps in the infrastructure, expansion of climate-neutral mobility in rural areas, development of smart logistics centres, expansion of mobile charging stations and public transport etc.) can help to cover distances and create better connections between the high quality urban and rural areas in the region.

- **Resources and the agricultural and food business:** This heading brings together the development of a model region for closed material cycles and recycling, the establishment of new value creation systems in bioeconomy in cooperation with renowned research institutes (especially FZ Jülich) and business companies in the region, the development of a model region for digitisation in medicine as a way to ensure medical services in urban areas and innovative products for health services.

The Rhineland Mining Area Future Agency is responsible for the structural transition in the Rhineland mining area. The Future Agency must cooperate with the national government and the federal state to ensure that a development based on the strengths of the region is effectively stimulated. To achieve this it cooperates with all stakeholders in the region – local communities, businesses, employer, trade unions, associations and civil society. It is positive that a working group of civil organisations and interested individuals has formed in the Rhineland mining area to help in shaping the region with its concept "Rhineland mining area habitat – good for life and good for work".[166]

In addition, ways must be found to support suppliers from the SME and craft sector, especially in the development of their own future prospects. This includes adapting the vocational training facilities for staff to the new challenges and training them.

5.1.4. Central German mining area

The Central German mining area is characterised by its proximity to the increasingly strpmg science and business locations of Leipzig, Halle an der Saale, Merseburg, Magdeburg and Jena. But there is still a major contrast between the cities and the surrounding areas. The region has long been known as an area of change and innovation. In future, the aim is for the Central German mining area to be part of a region which is one of the leading metropolitan regions in central Europe, both in terms of its economic performance and its excellent academic institutions and its cultural riches and high quality of life. Especially in the areas of chemicals, energy, automotive/logistics and life science it will act as an innovation hub which develops answers to the major questions of the future by offering highly attractive conditions not only for traditional industry, but also for start-ups and creative ventures. But this development requires the necessary structural support measures and will take several decades.

- **Logistics and the automotive sector:** In the region around Leipzig, with the logistics hub of Leipzig/Halle, the mobility of the future is constantly in the focus of research, development and construction with leading international mobility companies such as BMW and Porsche and the automotive suppliers in the region. The existing value creation chains in the automotive and mobility sector are being expanded. That includes the development of new drive concepts (battery cells, hydrogen-based fuel cells etc.) – including biologistics – and

166 Structural transition coordination group (2018): Lebensraum Revier – gutes Leben und gute Arbeit. Revierperspektiven: Aus dem Revier – Für das Revier. Zivilgesellschaftliches Konzept 10/2018. (The mining area habitat – good for life, good for work. Mining area prospects. From the mining area – for the mining area. Civil society concept 10/2018). On-line: https://revierperspektiven-rheinland.de/wp-content/uploads/2019/01/Revierperspektiven-Rheinland_2019_01.pdf.

also the development of new transport, electric mobility and logistics concepts. Due to its central location, the Central German mining area offers ideal conditions for further expansion as a European logistics hub.

- **Digitisation, creativity, education and the smart region:** Central Germany will be one of the pioneers in the digitisation of industrial value creation chains. This will lead to the factories of the future where the fourth industrial revolution will take place in a rational manner with the focus on economy of resources, minimal energy consumption, an optimised CO_2 balance, digital and smart production solutions and SG connectivity. As a region specialising in knowledge, research, transfer and education, the Central German mining area is ideally suited to this task. With its highly traditional universities of Leipzig and Halle, Leipzig University of Applied Sciences, Merseburg University of Applied Sciences and the innovative Leipzig Graduate School of Management, there is a high level of potential that can be unlocked for the future. In addition, the University of Halle is planning to re establish its Technical Science faculty and a Structural Transition institute in collaboration with non-university research institutes and the city of Halle. In future, Leipzig and Halle will establish themselves as smart cities. The smart infrastructure hub of Leipzig and the smart systems hub of Dresden offer in-depth opportunities to develop new transport and electric mobility concepts. In the university city of Halle, the groundwork is being laid for self-driving and highly automated public transport.

  The interaction of research and development on the one hand and an efficient hospital environment and commercial enterprises on the other hand creates extra synergies for a high quality life science cluster which is proving to be especially powerful in the areas of e-Health, biotech and AI-based diagnostics.

  To create a vibrant media hub with a national and international reach, the existing structures in the media region of Halle-Leipzig are being strengthened to create an innovative and creative training and learning environment which provides media communicators of the future with practical and inter-disciplinary skills for the challenges in shaping the rapidly changing world of the media. Multi-functional centres will link culture, the creative economy, scientific communication and society and will further the creative development potential. Opportunities for education, qualifications, apprenticeship and further vocational training will create the basis for future high quality industrial jobs and support the concept of life-long learning by providing networked training courses, initiatives for digital teaching and learning methods and competence, especially in the medium-sized and smaller towns in the mining area.

- **Chemicals industry and energy sector:** The chemicals industry, like the food and sugar industry, is an indispensable branch of business in the Central German mining area which has close links with the energy industry. The power station locations in the region are structurally connected with the chemical industry and energy-intensive industries. There is a regional industrial symbiosis with an economical use of resources which requires a high standard of reliability in the energy supply. The process steam from the power stations is an integral part of the industrial symbiosis of the chemicals industry. The power stations in the region also use combined heat and power to provide reliable heating, e.g. in the higher-order urban centres of Leipzig and Halle and the surrounding municipalities. The structural transition in the Central German lignite region is a particularly strong challenge because of the parallel transformation of industry to use sustainable structures and the interlinked value creation systems. Innovation and digitisation are helping to create the energy systems of the future in the Central German mining area and to lay the groundwork for a sustainable energy region. The loss of inexpensive process steam and heat from lignite power generation will be compensated by developing and supporting alternative and inexpensive supply concepts for the companies. The development of new technologies with flexible uses should be promoted, and the creation of demonstration plants and even living labs should be encouraged. To this end, industrial clusters are being sustainably developed taking new scientific and technological knowledge into account, and a circular carbon economy is being established.

  The joint research and development by business and science must serve to advance the following areas: development of new technology for flexible uses which can be connected to the existing industrial legacy as a potential development for the future, development of demonstration plants for green hydrogen, use of lignite as a raw material, use of plastic waste for the chemical and petrochemical industry (GreenHydroChem living lab), technological systems to prove functionality in real applications (living labs), cooperation and harnessing of results between applied non-university research and university-

based research in the Central German mining area, promotion of innovative and sustainable technology and business models, for example by setting up specialised technology transfer and business start-up centres. The ongoing research in the bioeconomy cluster on the increased use of biomass as a raw material will be intensified.

- **Glass industry:** With the modern glass industry, the Central German mining area has an industry which has great future potential. To strengthen the economic focus of glass production with its values and expertise, it is important to support the founding of the Torgau Glass Campus – Professional School – for the glass, ceramics and building materials industry in the Central German mining area.

- **Innovation hub and pleasant home region:** The exodus from rural areas, population decline and demographic change are facing the Central German mining area with great challenges, so this region is predestined to play an active role in the creation of new technological solutions as a model or living lab region. The question of how we want to live in future must be explored both in a rural context and in terms of the relationship between urban centres and the surrounding areas.

  In the triangle around Zeitz, Naumburg and the Leipzig region, including Borna, there are plans to establish a German and European model area and living lab region in which new technologies, products and services for the life of tomorrow are developed and tested. A Zeitz Future Institute will be created as a place where the life of tomorrow can be re-imagined and developed. The Zeitz Future Institute aims to explore questions about how we want to live tomorrow, to consider possible solutions and to examine how the rural area can be better connected to urban centres. The central topic is examining highly complex IT systems as a basis for new technological products and services. The Institute provides the necessary scope to develop and test creative, unconventional and innovative concepts for life in the future. The needs of the people should be the main focus in the development of this smart region. The aim is to develop forward-looking solutions in areas such as health care, education, citizen-friendly administration, mobility, provision for basic needs and the better connections between town and country.

Promoting sustainable innovations and encouraging transfer to regional industry is especially important in the Central German mining area. Due to the almost complete absence of corporate headquarters, which is where research and development activities are often centralised, the R&D ratio in the Central German mining area is significantly below the national average. Systematic promotion will strengthen the endogenous innovative potential in the region. Pioneering ventures in the region include the research projects HYPOS and CarbonTrans, the work of the bioeconomy cluster, the Fraunhofer mining area network and the excellence and transfer centre for chemicals and biosystem technology. An inter-disciplinary institute for structural transition and biodiversity at the Martin Luther University of Halle-Wittenberg, which includes professors of Natural Science, Environmental Science, Technology, Law and Economics will provide scientific guidance and support for the impending structural changes.

The mining area will gain a high quality of life by providing interaction and networking between town and country, creating vibrant urban-type contexts and a versatile cultural landscape and post-mining region with a high environmental, residential and lifestyle quality which not only creates a pleasant area for economic growth and residential use, but also makes it attractive for tourism and local recreation. The varied cultural and tourist attractions combine traditional and modern features, open countryside and agriculture, enjoyment and health to give the region a reputation as an attractive residential and holiday location even beyond the boundaries of the mining area. History and an awareness of tradition are encouraged and create identification with the mining area. The creation and expansion of networked mobility options and attractive transport infrastructures aim to provide access to private residences, workplaces, culture, science, information and markets. Highly modern equipment and fittings in surgeries and hospitals and telemedicine services provide reliable health care. Up to date and flexible child care, school and educational facilities that meet modern international standards are important factors for young families. A permanent process of dialogue with the local population aims to support and enhance this development.

5.1.5. The Federal Republic as a whole

The step by step reduction and termination of coal-fired power generation also affects the energy industry outside the lignite mining areas. The locations of many hard coal power stations are also affected. At the end of 2017 there were 81 active power station blocks based on hard coal throughout Germany, with an output of 22.7 GW and about 5,700 employees.

Hard coal power stations are spread throughout the Federal Republic, but the main concentration is in the former Ruhr and Saar coalfields, in the coastal regions and along inland waterways which offer inexpensive transport options for imported coal. The majority of the power stations that are active today are older than 30 years, about a quarter (6,232 MW) started to operate in 2010 or later.

The large coal-fired combined power and heat stations which supply industry are situated especially in a number of chemicals complexes in North Rhine-Westphalia. They have a low electrical output. The coal-fired combined power and heat plants in industrial estates were built before 1990. So apart from climate policy considerations, there is also a technical need for modernisation.

The volume of German coal used in power stations fell from 45.8 million tonnes (1984) to 3.9 million tonnes (2017). In 2007 an agreement was made between the federal government, North Rhine-Westphalia, the Saarland, RAG AG and the mining, chemicals and energy trade union which stipulated that subsidies for the hard coal industry should be reduced and subsidised coal mining should be terminated in a socially responsible way by the end of 2018. In contrast with the lignite industry, which will continue to operate open-cast mines, employment in the coal industry in future will therefore only be in power stations. For the period from 2009 to 2019, the central government provided up to €13.9 billion to subsidise the sale of German coal for use in power stations, for steel production in blast furnaces and for the expenses of mining companies as a result of permanent closures. If the additional funds for adjustment benefits for redundant miners and long-term ecological costs are taken into account, the total cost of the orderly and socially responsible phase-out of coal mining for the period from 2009 to 2019 amounts to €21 billion.

Phasing out coal-fired power generation does not automatically lead to a closure of the locations. The consequences for the economic structure and the job market depend on the development in each individual site. It is possible to transfer existing coal-fired power stations to a security standby pool and thus preserve a significant proportion of the jobs for many years. Moreover, a site can be preserved by changing the fuel from coal to gas, although this would involve some loss of jobs in the power stations. In addition, there are various options for the post-mining use of coal locations in the energy industry because they already have good infrastructure and the relevant operating permits. Many of the locations are situated in central infrastructure hubs which offer access to electricity, heat and water supply grids and are well served by the transport infrastructure (harbours, railways, roads). Post-mining use could especially include applications for the supply of heating grids to serve surrounding buildings or for industrial purposes. And the infrastructure connections also offer the opportunity to establish storage capacity or facilities to provide system services in these locations. In addition, former power station sites could also be used for waste disposal, waste recycling or for the logistics associated with the recycling of materials.

The step by step reduction and termination of coal-fired power generation will also lead to difficult adjustment processes at the coal-fired power station sites. In this process, redundancies for operational reasons and unreasonable social hardship must be avoided. And the effects in individual cases must be considered. The commission has examined the structural policy baseline for the locations, and in Chapter 4 it developed different suggestions to provide the companies and local people the instruments that will enable them to actively shape the structural transition.

5.2. Principles for a structural development strategy

The premature exit from coal-fired power generation, which is motivated by climate policy considerations, has a major effect on the value creation structures of the German economy. This transition is most strongly felt at the regional level. It can only be economically viable and socially acceptable on the basis of successful regional development concepts.

A successful structural development needs not only opportunities and ideas, but also continuous active involvement of stakeholders in the regions. The commission is aware that not all ideas and projects will be a long-term success or safeguard value creation and good jobs in the regions. At the same time, new innovative topics arise over time which open up new prospects. The main concern is especially to enable the regions themselves to shape their structural development, for example by investments in infrastructure and education and by regulatory measures to provide scope for action.

Against this background, the commission recommends the following principles for a structural development strategy.

Goals

The structural policy goals are to create pleasant and attractive regions with a high level of economic dynamism, high quality jobs and innovative power which offer clear future prospects for the people in the location.

For the commission, however, it is not only decisive that the regions have new prospects, but that Germany as a whole is strengthened as a business location by harmonising climate protection, good jobs and business and thus contributing to the implementation of the guiding principle of sustainability. In relation to strengthening the economic performance and quality of life in Germany, it is an important element and a constitutional task to ensure that equal living conditions are created.

Equal living conditions require not only a strong economy, but also an efficient infrastructure for the supply of basic necessities in all regions. Suitable local solutions should be created to use synergies and integrate people fully in the transformation of the region. The closure of old value creation systems and the development of new systems must be carried out on a coordinated time scale. In the course of the structural development, it will also be necessary to consider the latest technology which in some cases is still only a possible option. The measures and projects mentioned in this report can only be the start of a development.

Additionality

The reduction and termination of coal-fired power generation triggered by additional political measures accelerates the structural transition in the mining areas and in coal-fired power generation and represents a special challenge. This challenge must be tackled in addition to the general structural assistance measures. A distinction must be made between structural development tasks, which can be countered with the existing subsidy programmes, and the new requirements which arise from the loss of jobs in the coal industry. This distinction from existing subsidy programmes is necessary in the light of the national goal of promoting rural areas and the fundamental overall goal of creating equal living conditions throughout the Federal Republic of Germany.

Support for mining areas must not only pursue the above goals, it must also be positively set apart from the general catching-up process that is still necessary almost everywhere in eastern Germany, and it must take the special situation of structurally weak urban districts in the Rhineland mining area into account. This distinction will avoid overlap and friction in relation to the subsidies for other structurally weak regions in Germany.

The continued remediation of open-cast mines dating from the former GDR in the Central German and Lausitz mining areas after 2022 must also be carried out in addition to the subsidies for the mining areas.

Time scale

Successful structural development requires reliable framework conditions and long-term monitoring. The central government, federal states, local communities and business enterprises must share the task of providing long-term support to the regions affected by the exit from coal-fired power generation. Especially the central government must therefore be willing to be a reliable long-term partner for the transformation of the mining areas, even long after the end of coal-fired power generation. In addition, the general con-

ditions and growth incentives must be supported by initial short-term measures. The accompanying subsidy programmes must also be designed to last several decades.

Effective control and coordination mechanisms and institutionalisation

An institutionalisation of the structural development process on the one hand and a strong integration of the federal states, local communities and local stakeholders on the other hand can harness local expertise and utilise the existing potential. This underlines the responsibility of the regions for their future-proof development. The national government must also be integrated into these structures.

Effective control and coordination mechanisms must be aligned with the existing instruments to support the structural development and must be interlinked with the new funding instruments. This is necessary to ensure that the different measures and initiatives from the different participants and subsidy funds can be dovetailed.

Numerous stakeholders and institutions are involved in monitoring the structural transition. Especially in the eastern German mining areas, there is a special need for coordination because the mining areas extend into two (Lausitz) or three federal states (Central German mining area).

The structural development process should therefore be institutionalised with a strong organisational structure, and the responsibilities should be clearly split between the national government, the federal states and the local communities. The coordinating tasks also include networking all stakeholders (involvement of employers, trade unions and civil society stakeholders) and monitoring the structural transition. To carry out these tasks effectively, they must be visibly based in the locality.

Private and municipal investments as the key

Here, the EU, the national government, the federal states and local communities must create a suitable framework for private investments. And the state must bear part of the political and financial responsibility for enabling key industrial businesses to locate in the regions.

The commission‘s goal is that the lost jobs with collective wage agreements and the apprenticeships for skilled personnel in the lignite industry and its suppliers should be compensated by new business investments. In this respect, it regards the commitment of private investors as crucial. It is aware that this needs effective incentives (e.g. investment and market launch incentives) and that the public sector and private business must enter into a strong partnership. The growth processes should fundamentally be tackled by a structural, sustainable and future-proof approach that is open for technology.

The national government should integrate its structural development strategy into an overall strategy for growing dynamism in investments. Although structural policy is important for the regions, it can only develop fully in an environment which is favourable for growth. The general framework for investments in such industrial jobs must therefore be business-friendly and conducive to investments. Alongside the provision of funding for the regions, this is the second necessary requirement for successful structural development. Businesses can only be encouraged to move to the region if the investment policy framework is internationally competitive.

Secure framework and regulatory requirements

The structural transition process must be safeguarded as far as possible, irrespective of short-term decision-making processes. The commission‘s recommendations aim to create a secure legal framework for future investments and for all stakeholders, both at the national and European level. For this purpose, an interstate agreement should be concluded between the central government and the federal states.

Structural policy activities need systematic control, reliability, legal certainty and planning certainty. The legal framework must ensure permanent certainty even beyond the legislative periods. To secure growth, structural change and employment in the mining areas, the commission‘s suggestions must be safeguarded for future generations by suitable legal agreements between the national government and the affected federal states and local communities.

Processes must be accelerated and existing instruments must be checked for effectiveness. The goal must be to harness these instruments even more effectively for the mining areas wherever possible, for example in structural policy, the provision of infrastructure and in the planning and approval procedures.

Finance

Structural development needs planning certainty in the form of a sufficient funding commitment which is valid for several years. In the current legislative period, the federal budget includes an extra €1.5 billion in priority funding for structural policies, but the commission sees this merely as a first step. In a second step a long-term structural development budget must be permanently defined. New financial instruments are needed, in addition to the existing instruments, which will bring together strategic investments in the lignite mining regions and secure their funding in the long term. Coal power station locations should receive structural aid from separate resources (cf. also the detailed considerations on finance in Chapter 5.4).

Projects which are subsidised with national government funds must comply with the internationally agreed *sustainable development goals* (SDGs),[167] to support sustainable developments in the long term. A particularly important element is promoting a CO_2-neutral economy.

This funding should not be limited to the "economic" structural transition, part of it should be earmarked to strengthen and develop civil society activities, the quality of life and soft location factors.

Possible compensation payments for energy suppliers resulting from the shorter active life of the power stations should not be paid from the structural incentive funds that are planned for the mining areas.

Accurate allocation of funds to the mining areas

The structural development strategy must be tailored to each mining area. The mining areas have different needs in relation to the various instruments. Special attention must be paid to the local communities near the edge of open-cast mines.

Projects and measures for structural development should always be based on transparent criteria, which are as quantifiable as possible, to secure the purpose of funds, quality, structural effectiveness and sustainability.

The selection of projects which are suitable to carry forward the structural development in the mining areas is made against the background of the evaluation standards in Chapter 2.4 and the following criteria:

- **Structural effectiveness and positive effect on jobs:** The contribution of the project to the structural development in the relevant mining area must take the direct and indirect effect on jobs into account as practically and verifiably as possible, and also the effect on value creation, enhanced competitiveness, expansion of competence and capacity, qualifications, recruitment and retention of skilled staff, cluster and innovation management, cost to benefit ratio and an estimate of the effects and potential involved in infrastructure projects etc.

- **Financial sustainability:** The financial stability of the project must be demonstrated, especially for institutional subsidies. In addition to the investment costs, the follow-on and operating costs should also be considered and appropriate concepts for permanent economic viability should be proved, with the aim that the projects should eventually be self-supporting.

- **Ecological and social sustainability:** The projects make contributions in the areas of economics – ecology – social goals. They relate to future topics and are in harmony with the development of an economy and society which is largely neutral in greenhouse gas output in the long term.

- **Contribution to the future, innovation content:** The contribution to future-related topics with their goals and conceptual content must be clear. This includes the model character of the project, its transferability and its suitability for any follow-on use which may be necessary.

167 A similar procedure is already planned in the award of public funds under Section 97 of the Restrictive Practices Act (GWB).

- **Regional significance and regional roots:** To demonstrate the importance of the project for the mining area and the wider region, the broader contribution and effects of the project in the region must be shown. The projects should be derived from the structural programme of the mining area if there is one.

- **Networking, cooperation, integration of the relevant civil society stakeholders:** The networking with and inclusion of relevant stakeholders and institutions within the region must be shown; projects should contribute to an increase in acceptance of the structural transition.

Monitoring and evaluation

The Commission on Growth, Structural Change and Employment considers it necessary that the implementation of the structural development strategies be supervised by a regular monitoring system, that the success of the measures be checked and that any necessary systematic adjustments be made (cf. Chapter 6).

5.3. Measures to monitor the structural transition

Measures for industry and SMEs

Sustainable structural transition in the regions can be successful if the existing resources of industry and the energy sector in the mining areas are used as development potential for the future and if the innovation and investment cycles of the existing industrial stakeholders are taken into account. The aim is to harness the regional industry clusters and operating competence, the skills of the highly trained personnel and the existing strengths in research and development in order to unlock technological innovation paths and facilitate a transformation to sustainable innovation regions.

To ensure a solid long-term economic structure, the needs of small and medium businesses and craft enterprises must be taken into account because they are crucial for an attractive and pleasant living and working environment for skilled personnel, and they are essential to provide a fundamental industrial basis. This must be appropriately considered in the development of the subsidy system. For all mining areas, support programmes should be developed with a special focus on the suppliers in the lignite industry so that they, too, are supported in the development of new fields of business and equipped to counter the shortage of skilled personnel in the crafts and trades.

The commission sees it as a special challenge to ensure that, in spite of the phasing out of the lignite industry, the regional and national value creation chains are preserved or developed and new value creation chains are established. To achieve sustainable success in the structural transition, major industrial investments will be needed to create new value creation chains because of the importance of the lignite industry in each of the regions. The commission is aware that large investments in the regions can only be successful if the regions are granted the necessary regulatory framework.

The structural framework for investments in jobs and apprenticeships must therefore be business-friendly and must contain investment incentives to ensure that the existing value creation networks in the regions (e.g. chemicals, paper, aluminium, steel, energy), which have up to now been closely linked with coal-fired power generation, will remain in the regions and make their own investments to promote regional development instead of questioning

whether they should remain in this location. The goal must therefore be to generate extra investments especially in these industries. Competitive electricity prices and a permanently reliable energy supply are therefore essential foundations for the industrial location.

To preserve the value creation chains for the gypsum industry, measures must be adopted to compensate for the phasing out of FGD gypsum by creating an additional environment-friendly way to extract natural gypsum.

To provide effective support for the structural transition in the lignite mining areas, a specific mixture of measures is necessary in each area which latches on to different points in the value creation chain and facilitates economic participation for different target groups. This also means that especially small business enterprises in the regions should be supported in the task of offering future-proof technology and services. Local craft and trade companies have a major influence on value creation and jobs in the regions and are important partners. As a climate policy objective, it is recommended that greater support should be given to meet the needs of local craft and trade companies and to establish a strategy to strengthen apprenticeships and vocational training for energy transition technologies and services, especially system solutions.

Regional development, infrastructure expansion and accelerated expansion

Regional development

For many decades, the large open-cast mines have acted as a barrier which has prevented any coherent development of the region and the creation of infrastructure networks. Spatial change in the mining areas needs to be supported by the national government and the federal states and designed so that a new location quality is created for residential use and for jobs. Structural transition offers the opportunity to develop post-mining landscapes which are resilient to climate change and have a high regional value creation.

The commission considers that the federal states and local communities have a special obligation to reserve sufficient land for new business premises in the regions in good time, to create mechanisms for accelerated planning and approval and to develop this land with all necessary and modern infrastructure services.

Infrastructure, economic and ecological synergies should be harnessed by a continued use and revitalisation of old industrial and power station sites. A revitalisation of coal power station sites for commercial, industrial or energy plants also provides considerable potential for new business locations.

Digital infrastructure

The commission considers that an important requirement for structural transition lies in overcoming structural weaknesses in the affected regions, especially in the infrastructure. Infrastructure policy is a central element of structural policy. Modern and efficient transport and digital infrastructure to develop and connect existing sites and the urgently needed new locations is now an important location factor for investment decisions - especially in view of the shortage of suitable land in the major population centres. The provision of solid prospects for the future in the mining areas requires not only transport connections for industrial and technology estates and scientific institutions, the whole of the region also needs a highly modern digital infrastructure network based on glass fibre cables and enhancement of the mobile phone networks. The goal must be to provide a gigabit-ready infrastructure everywhere. Where this cannot be achieved by market forces, the state must intervene and provide support. In areas which are already supplied with at least 30 Mbit/sec but do not have a gigabit-ready infrastructure, this requires an adjustment of the NGA definition by the EU Commission (defined threshold). Providing support for regional management of the mining areas could also encourage the creation of model regions with an extended gigabit-ready service.

The next mobile phone standard 5G will offer completely new applications compared with the present mobile phone standards. This means that technologies, devices and applications must be researched and developed. These opportunities must be carried into the mining areas. But this requires the necessary network coverage for testing, and incentives to set up business premises.

Digitisation is one of the central elements of the guiding principles and the vision development process in each mining area. The following points outline the practical measures suggested by the federal states with a lignite industry to accelerate the expansion of the digital infrastructure in the mining areas and thus to fulfil the necessary requirements for the implementation of the guiding principles.

- Especially the areas with a less developed digital infrastructure in the Rhineland mining area and the Lausitz should be designated as additional 5G model regions, thus equipping them to achieve digital progress by means of pilot projects even outside the major population centres.

- The Lausitz mining area offers promising starting points as a model region for 5G. Research, development and testing of new mobility applications on the Lausitzring or in the DEKRA vehicle inspection institute (self-driving vehicles) could be significantly supported. In the Rhineland mining area a 5G living lab could be set up (test centre for 5G applications). The applications must be linked with field tests in model local communities, for example for autonomous and highly automated self-driving trams (A-trams) or self-driving cars.

- The shortage of medical specialist doctors and qualified nursing staff, especially in rural regions, is increasing. Here there is potential for model projects to introduce e-health in rural regions (e.g. telemedicine services, patient-owned equipment for self-care, health portals).

Transport infrastructure

The Commission on Growth, Structural Change and Employment is convinced that an efficient transport infrastructure is a fundamental requirement for successful structural development. This would increase the attractiveness of the mining areas as a business location for new business premises and thus facilitate the development of new and innovative value creation chains. Improved connections to the nearby metropolitan regions and higher-order urban centres would bring the regions to life, make them pleasant to live in and open up new job opportunities for the local population.

To enable infrastructure projects in the four lignite mining areas to be implemented faster, additional infrastructure projects should be planned and assigned higher priority. It would also be conceivable to introduce a "mining area bonus" based on the slogan: "Priority for structural development areas". This could be used to give structural policy goals priority over the existing criteria.

There are also bottlenecks in the planning of infrastructure projects by the public sector. Therefore, the implementation of infrastructure projects in the mining areas should be used – partly as a model for other regions – to achieve faster planning by providing finance for external planning services. Here, even infrastructure projects should be included in the funding plans which are normally financed under the auspices of the federal states and local communities. Redefining the priorities of measures that are already planned would also be a sensible instrument. The legal implementation should pursue the goal of beginning the specific planning processes for the extension of the most important railway connections without delay during 2019.

Other possible measures include extending, supplementing and improving the existing transport links between the mining areas and centres that could promote development, e.g. by increasing the frequency of regional rail links and enhancing the existing connections to metropolitan cities. The commission points out that in addition to the extension of the transport infrastructure with national funds, it is also the responsibility of the federal states to place orders for the appropriate transport services.

From the perspective of the federal states, the following infrastructure projects are essential to provide effective impetus for structural development:

- Especially in the eastern German mining areas, good infrastructure connections to the urban centres of Berlin, Dresden, Leipzig, Jena, Chemnitz and Halle offer major opportunities because they increase the commuter potential – i.e. access to skilled personnel.

- The existing transport infrastructure in the Lausitz poses a special challenge. In addition to the stimulus which is necessary for the fundamental structural transition, people in the Lausitz need to feel the benefit of noticeable improvements in the short to medium term by electrification of the Dresden–Görlitz rail link, including the branch line to Kamenz, improvement/electrification of the Berlin–Cottbus–Görlitz route as a fast rail link, construction of a second track on the Cottbus–Lübbenau route, improvement of the Cottbus–Leipzig and Cottbus–Dresden rail links and electrification of the Cottbus–Forst link. This includes measures such as alterations to the station in Königs Wusterhausen, immediate electrification of the section between Görlitz and Niesky and from Görlitz to the German/Polish border to facilitate direct links from Wroclaw via Görlitz to Berlin and back, making Görlitz into a central point in an international railway route, adding direct morning and evening trains between Görlitz and Berlin and increasing the frequency of trains on the Dresden–Görlitz route and in the regional connections in the Lausitz.

Increasing the frequency of trains in the mining areas in general requires an increase in the regionalisation funds provided by the national government so that the existing infrastructure can be used more intensively. A measure that could be implemented in the short term would be to reorganise the "last miles", for example by model projects for the pre-ordered hire of electric scooters and e-bikes.

- Good and frequent connections to the Halle–Leipzig metropolitan region are important to increase the attractiveness of the Central German mining area. And progress must be made by facilitating more frequent trains (e.g. on the Chemnitz–Leipzig route), extending the S-Bahn urban railway network (e.g. by establishing a new S-Bahn route from Leipzig via Markranstädt to Naumburg/Merseburg and from Halle to Naumburg), long-term safeguarding of local passenger rail services (e.g. Zeitz–Weissenfels) to create additional development lines for public transport, and expanding the PlusBus and on-call bus system, especially in the evening and when shifts change at the local companies. The city tunnel in Leipzig should also contribute to improving local rail transport links. This requires an upgrade in the technical railway security systems in the tunnel. Electrification of the railway routes Leipzig–Zeitz–Gera, Leipzig–Bad Lausick–Geithain–Chemnitz and Zeitz–Weissenfels–Halle, construction of the connecting curve for the direct link from Merseburg to Leipzig and extension of the feeding routes (e.g. the route from Merseburg to Querfurt) would also improve the links between local and medium-sized municipalities in central Germany and the higher-order urban centres of Erfurt, Halle and Leipzig.

- Similarly, the connection from Delitzsch to Bitterfeld and Leipzig must be improved and the Leipzig–Grimma–Döbeln route must be strengthened. The use of alternative drive systems in local passenger rail services is a possible way to achieve further transport improvements in the region. A beneficial supporting measure for rail travel in the two eastern German mining areas would be the establishment and development of a German rail transport research centre at the Dresden branch of the Federal Railway Office, because this could be linked with the existing potential of the Technical University or the University of Applied Sciences in Dresden.

- Improvements in the road infrastructure, such as the eastern extension of the B6n from the B184 into Saxony, the enhancement of the B100 between Brehna and Bitterfeld and the improved connection of Zeitz chemical and industrial estate by linking the A38 with the A4 would create attractive conditions in the Central German mining area. For the southern part of the rural district of Görlitz, the potential arising from the border triangle location should be harnessed by building/completing the B178n and extending it northwards beyond the A4. Long-distance road connections via Weissenberg and Bautzen should be improved by widening the A4 motorway to six lanes.

- The structurally weak mining areas in central Germany and the Lausitz should be more closely connected and integrated into national logistics chains. The construction of a new east-west main road between the Central German and Lausitz mining areas would significantly improve the infrastructure framework for business companies moving into these regions. And the A13 motorway between Schönefeld and Spreewald motorway junction must be widened. The directly affected local communities in the Lausitz expect special support and subsidies.

- The great challenges for spatial development in the Rhineland mining area also lead to the possibility of an ambitious, dynamic and future-proof development of the region. In this context, both the local communities around open-cast mines and the communities affected by changed plans for formerly designated new mines need special support.

  An international building and technology exhibition should be held with the focus on the future of the Rhineland mining area which would bring together the development of the local communities as PLACES FOR THE FUTURE in a MOBILITY REGION OF THE FUTURE with the goal of taking trendsetting steps into an innovative and ecological future with a high quality of life. The exhibition should be implemented together with the people in the region, local communities and business companies in a participative and high quality process.

- A new Rhine-Erft campus is being built with the focus on regional development and infrastructure systems, infrastructure management and geo-informatics (transformation management) to support this development. For the MOBILITY REGION OF THE FUTURE, projects will be subsidised which serve to implement the mobility concept for the whole region and equally take into account the changing mobility needs for private trans-

port, new requirements for the transport infrastructure, climate protection and current trends in technology. The regional measures should be linked with support for innovations in universities and the world of business in order to develop new mobility concepts for roads, rail and air and to implement these solutions in practice. Such measures include Cologne as a digital node, setting up a network of mobility points in the Rhineland mining area, Kerpen mobility port and the project "Mobile Rhineland" which aims to boost the personnel and planning capacity for public transport in the Rhineland.

- Good infrastructure connections between the Rhineland mining area and the surrounding higher-order urban centres and measures to ease the pressure on these higher-order urban centres are important prerequisites for the success of this concept. The rail transport measures include the Rheinspange Wesseling bridge (with a cycle path), the Cologne Westspange link, the third track on the Cologne–Aachen rail link, extension of the S-Bahn urban railway Mönchengladbach–Cologne, the fast cross-border train link Eindhoven–Cologne, removal of the Mönchengladbach–Rheydt–Odenkirchen bottleneck, two track extension of the Kaldenkirchen–Dülken route, the fast rail link Venlo–Mönchengladbach–Neuss–Düsseldorf ("ROck project"), extension of the regional railway for an Erft S-Bahn, conversion of the RWE factory railway lines for goods transport, closing the gap between Linnich and Baal, connection of Jülich research centre to the rail system, the cross-border regional line Baesweiler/Aldenhoven-Siersdorf, the Regio tram Baesweiler–Würselen–Aachen, full extension and electrification of the single-track line Düren–Euskirchen and the Eifel railway link Cologne–Euskirchen.

- With the necessary transport links and other infrastructure development work, there is promising potential in the Helmstedt mining area for the gradual development of an industrial estate of about 250 hectares in an ideal location near the A2/A39 motorway intersection. This could create a model industrial estate for the future directly next to one of the central European transport routes.

- The single-track route between Weddel (Braunschweig/Brunswick) and Fallersleben (Wolfsburg) is to be extended to a two track route by 2023 under an existing building permit. Such a project could help to cushion the effects of the structural transition by improving commuter access to jobs in Wolfsburg. In view of the foreseeable dual track line on the Weddel loop, the extended public transport and the faster travel times as a result of a direct link from Helmstedt to Wolfsburg, an increased demand must be expected.

Supply infrastructure

In the opinion of the Commission on Growth, Structural Change and Employment, structural development also includes preserving the existing infrastructure. Demographic change in the lignite mining regions already poses major challenges for the municipal energy and water supply companies because of its effect on the maintenance of their infrastructure. The attractiveness of the regions for their residents must therefore also be safeguarded by providing an affordable, efficient and future-proof supply of heating.

The grid infrastructure in the mining areas, which is geared to the energy sector, and the expertise in this area that has developed over several decades, should also be available in future in the transition to an energy industry based on regenerative energy sources.

New value creation chains could be demonstrated with the appropriate living labs and thus contribute to a diversification of the industrial landscape (hydrogen production, fuel cells, battery storage, power-to-X, use of coal as a raw material). This could also be used for the further development of the existing locations of the chemicals industry (material and climate-neutral use of CO_2, synthetic gases from renewable energy). In addition, the existing potential of the energy and industrial regions should be used to link the transformation of industry and the energy system with the safeguarding and development of competence in the area of research, development and innovation. The lignite mining areas are especially suitable as model regions for innovative projects in the area of power-to-X. Linking hydrogen, network infrastructure and application-oriented research is a good example of this.

All mining areas have set themselves the goal of remaining as energy regions in the future. In this respect, the federal states have mentioned the following specific projects:

- The project ideas in the Lausitz mining area include the construction of a demonstration plant for hydrothermal gasification, a feasibility check for a rotation storage device including a possible pilot plant and the construction of a pilot plant for a "reference hydrogen power station" which can potentially render important system

services. These projects should be accompanied by the establishment of a Fraunhofer institute for energy infrastructure (partial institute at the Brandenburg University of Technology/BTU Cottbus-Senftenberg or at Zittau/Görlitz University of Applied Sciences) which would focus on energy infrastructure and energy grids. Fundamental questions and challenges related to the transformation of the energy system could then be specifically dealt with. To strengthen and develop the Lausitz as a region of energy, industry and innovation, measures which draw on and transform the industrial heritage of the mining areas should be supported by the national government.

- The Rhineland mining area, with its power station sites, its energy-intensive businesses which depend on a reliable energy supply and its innovation competence, is an ideal location for investments in the new product of "reliability of supply" which must now be defined as a consequence of the energy transition. Because the energy supply and energy-intensive industries are situated near each other, the Rhineland mining area can act as an energy region of the future which contributes to grid stability and the reliability of supply for Europe. Key projects include the heat storage power station Store-to-Power, the establishment of a new German Aerospace Institute, setting up and developing an intelligent regional energy management system, promotion of a battery cell production plant, setting up a Fraunhofer institute for geothermal energy and energy infrastructure (partial institute in North Rhine Westphalia for digital energy), a living lab for energy and raw material supply with reduced greenhouse gas emissions using green hydrogen and an Innovation Centre Düren.

- In the Central German mining area, the concepts for using the lignite mining regions for renewable energy envisage a direct follow-on use of parts of the post-mining landscape. The projects Amsdorf Energy Park and Profen Energy Park involve not only the construction of photovoltaic installations, storage units and wind turbines, but also reusable material centres (including phosphor recycling) and facilities for geothermal energy and geothermal heat in connection with greenhouses and short rotation plantations. The sector coupling projects with power-to-X technology can draw on existing regional activities on the subject of green hydrogen – the HYPOS project.

Infrastructure expansion and accelerated expansion

Plans which can only be implemented in several decades do not meet the requirements of structural transition in the mining regions. To encourage confidence in the development capability and future of the regions, an attractive framework should be created within five to seven years for relocating companies, skilled personnel and apprentices. Local, regional and national networks should be created and innovation-based developments should be promoted.

The overall goal of the measures described below is to accelerate investments in the infrastructure development significantly, but without calling into question the standards that have been achieved in areas such as environmental law. The commission also proposes that the measures to accelerate the planning and approval should on the one hand be limited to the mining areas themselves, and on the other hand limited in time to the duration of the structural subsidies.

For selected measures in the transport infrastructure, in addition to the Federal Traffic Infrastructure Plan 2030, it is recommended that a special provision be added to improve the transport infrastructure in German lignite mining regions which sets aside the conventional demand criteria and clearly emphasises the overriding public interest. Redefining the priorities of measures that are already planned is also a sensible instrument. The evaluation of the projects should have a clear structural policy focus and thus differ from the system criteria used in the Federal Traffic Infrastructure Plan 2030. A federal "structural law for the lignite mining regions" should therefore act as a needs-based law and thus define the urgent needs of the measures determined and the preferential implementation of such measures in a dedicated special funding programme.

In addition to the "Act on Speeding Up the Planning and Approval Procedures in the Transport Sector" which was debated by the German parliament and the Federal Council in November 2018 and passed on 8 November 2018; further measures to adjust the legal framework to speed up planning and approval in the lignite mining areas should be considered.

This includes checking, and if necessary implementing, the following measures:

- Legally defined reference dates for the relevant and operative factual and legal situation to evaluate the legality of official planning approval decisions;
- Legislative basis for early public participation;
- Inclusion of landmark transport projects in the lignite mining areas in a law concerning specific infrastructure projects (by analogy with the Act to Accelerate the Construction of the Leverkusen A1 Rhine Bridge). Such a law would need to contain an opening provision for measures which cannot yet be defined specifically enough, but nevertheless meet the reference criteria, because Section 17e of the Federal Trunk Roads Act currently limits the simplification of legal protection standards to projects which are listed in the Annex to the Act because they promote German unity, integrate new member states into the European Union, improve links with the hinterland of German seaports, serve to create other international connections or have a special function to remedy serious transport bottlenecks;
- Eliminate the requirement for railways (General Railway Act) and roads (various road traffic acts) which stipulates that secure funding must be proved as part of the planning approval procedure (by reference to the Air Transport Act where this is not required);
- A simple mechanism to ensure that a premature start to construction work does not disqualify a project for subsidies (e.g. if the project is listed in an official project list by a designated administrative unit);
- A mechanism to deviate from the requirements of the Federal Budgetary Principles Act in questions related to tender processes and procurement - unless European standards apply (e.g. for sectoral contracting entities).

Parallel to the above points in a federal law, it would be helpful to have an anticipatory regional planning procedure. It also seems sensible to stipulate that no percentage limitation of planning costs in relation to construction costs should apply.

Difficult assessment and balance of interest questions and issues such as species protection law or approval of exemptions are a challenge for local administrative bodies. Even the growing number of proposed projects can place extra time pressure on the administrative authorities. The commission therefore recommends that the relevant public authorities should be assigned sufficient staff to enable them to speed up administrative procedures and deal with applications quickly and carefully.

In addition, the federal states have made further suggestions to accelerate the extension of the infrastructure:

- Simplified examination and decisions under EU law if “protected species” are involved (negligibility if the population is not relevant enough).
- Under national procedural law, the right to pursue legal action should be linked to the obligation to cooperate in planning approval procedures, and the estoppel principle should be introduced in court proceedings. Anyone who knows reasons which would frustrate a planning project must present them without delay.
- For measures to meet urgent needs, the right to seek an injunction to halt building work should be excluded if it can be expected that the errors can be remedied in a supplementary planning approval procedure.
- If it is found that a planning approval decision is unlawful, it should be permissible to implement parts of the project which are not affected by the error.
- In addition, any court proceedings and time limits in planning approval procedures should be shortened – by analogy with the Act on Speeding Up the Planning and Approval Procedures in the Transport Sector in transport projects to promote German unity.
- Balance of interest guidelines should be issued, thus determining/restricting the scope for interpretation in planning law and subsequent court action (legal certainty).

Research institutes and innovation regions

The Commission on Growth, Structural Change and Employment is convinced that the research sector plays a central role in the economic development of the regions. It provides the basis for innovations and to harness the skilled personnel potential. In turn, innovation capacity is an important measure of the ability to create new value creation chains.

The commission advocates a strengthening of the research locations in mining areas, development of cooperation between neighbouring science and research institutes and close cooperation with science and business. The goal is to achieve a systematic transfer of knowledge and technology, leading to the development of new, flexible-use technologies which harness current trends and are characterised by their ability to interact with the existing industrial and energy-related core competence areas. Other positive stimuli could also be expected from a combination of establishing research institutes and living labs, accompanying social science research and other additional subsidy programmes.

The commission has explored and presented specific concepts to develop the mining areas into competitive innovation regions:

- The possibility of developing cluster strategies should be supported. In the Rhineland mining area, cluster structures have been established and used for the ENERGY REGION OF THE FUTURE, the MOBILITY REGION OF THE FUTURE, Rhineland Innovation Valley and the field of bioeconomy with the aim of achieving the best possible growth impetus over the next ten years from the cooperation between business and science. The participants should be equipped with innovation budgets so that they can implement the resulting initiatives.

- Due to the very low research and development (R&D) ratio in the eastern German mining areas[168], and in order to develop innovation potential, R&D tax incentives should be provided as a pilot project to support the personnel and assignment costs for research and development. In this connection, the promotion of social innovation should also be taken into account. It is worth considering whether the mining areas can be given special promotion conditions by increasing the subsidies, for example in areas such as industrial research and experimental development.

- In these regions, in addition to the support for R&D programmes, the option of systematically strengthening the existing public research infrastructure and establishing new research institutes should also be considered. Establishing or expanding public research institutes would also increase the potential for participation in R&D support programmes. Extending the research infrastructure at local universities and non-university research institutes would not only increase the innovation potential in the eastern German mining areas, it would also help to strengthen the medium-sized municipalities which can play an important anchor role in the economic and demographic development of thinly populated regions. This is necessary because of the significantly lower innovation potential of the Lausitz and the Central German mining area; especially in private businesses, the potential to initiate innovation processes and participate in subsidy programmes is limited.

- The extension of the public research infrastructure in the eastern German mining areas should be based on the existing, potential and innovative (technological) focus areas of the regional economy. This opens up the potential for cooperation between science and the regional economy and a transfer of new technological knowledge which can help to strengthen the competitiveness of the business enterprises in the mining areas.

- An extension of the research capacity should be linked with a similar extension of the facilities in the tertiary education sector. Such courses and facilities could then help to improve the attractiveness of the regions for young people who want to study in the tertiary sector. And these persons would then help to secure the regional potential of skilled personnel if they take up jobs in the local employment market after they have completed their studies. The likelihood that graduates will stay in the region is all the greater if they can gain work experience in the region during their studies and

168 Cf. also Chapter 3.4.

make contact with potential employers.[169] This could be encouraged by appropriate measures in the mining areas such as trainee placements for students.

Strengthening the existing research and transfer activities in key technologies

From the perspective of the federal states, a research and transfer campaign "Industrial centres of innovation" should be established to promote extensive cooperation networks consisting of industrial companies, digital start-ups, universities and research institutes.

- The "Innovation Centre for Modern Industry Brandenburg (IMI)" and the "SME 4.0 Competence Centre Cottbus" sponsored by the Federal Ministry for Economic Affairs and Energy are complementary research and transfer institutions at Brandenburg University of Technology (BTU Cottbus-Senftenberg) which have successfully supported digital transformation in SMEs in Brandenburg for several years. They link the technological aspects of digitisation with the change processes in the digitised world of work – actively supported by Chambers of Industry and Commerce, business associations and trade unions. Both institutions are well known in Brandenburg and beyond and could form the nucleus of a "Value Creation 4.0 Campus" in Cottbus which could attract other relevant institutions, business enterprises and start-ups. The project "Lausitz Innovative Learning Centre (ILL)", which opens up career prospects at different levels of education e.g. by providing key competence areas, should therefore be pursued further.

- Other existing approaches, such as the CASUS which is planned in Görlitz as an international centre (as part of the Helmholtz centre Dresden-Rossendorf) the Innovation Campus Görlitz for scientists of various disciplines to share in developing digital methods for system research, should also be encouraged and supported. This is expected to enhance international visibility in relevant future topics, to increase the attractiveness of the region for academic specialists and to promote the transfer of digital system research methods to industry.

- The integration of renewable energies into the sectors of electricity, heat, industry and transport is one of the most important tasks for the further implementation of the energy transition. The existing gas infrastructure and power-to-X technology (PtX) could provide the decisive key to the success of sector coupling and thus the achievement of the climate goals. Especially the conversion of renewable electricity into hydrogen, methane, chemical substitutes or renewable fuels can enable electricity to be stored for long periods via the existing gas and tank infrastructure, transported and used in various sectors.

- Starting from 2019, a research syndicate will collaborate with a living lab in the Lausitz mining area to carry out application-based research into storage technologies and power-to-X methods, and new findings will then be fed into academic teaching. The thematic content of this project overlaps to a large extent with the project HZwo INFRA in Görlitz. This combination of research and practical application offers great potential in this topic, which should continue to be supported because it offers a noticeable contribution to structural development in the Lausitz.

- In all university locations in the Lausitz, research into the use of the potential of (industrial) hydrogen-based energy production in connection with the energy infrastructure and the use of renewable energy should be systematically supported, and in fact there are specific plans to establish a relevant Fraunhofer institute at the Brandenburg University of Technology in Cottbus-Senftenberg. In Cottbus, it is planned to increase scientific excellence in the area of system engineering in Germany by establishing an institute of the German Aerospace Centre (DLR) with the focus on "Next Generation Turbo-Fans" .

- Drawing on the expertise of the Brandenburg University of Technology Cottbus and Zittau/Görlitz University of Applied Sciences, there are also plans to establish a German Aerospace Centre institute for low CO_2 industrial processes.

169 This is shown by an analysis of the migration patterns of graduates in Germany, cf. Homolkova, K.; Niebuhr, A; van Rienen, V. (2016): Arbeitsmarkteintritt der Studierenden der Fachhochschule Kiel. Analyse des Erwerbseintritts, der Mobilität und der frühen Erwerbsphase der Studierenden der Fachhochschule Kiel im Zeitraum 2005 bis 2014 (First jobs of students of Kiel University of Applied Sciences. Analysis of initial jobs, mobility and the early employment phase of students of Kiel University of Applied Sciences Kiel between 2005 and 2014). IAB-Regional Nord 07/2016, Nürnberg.

- In the Lausitz, mechanical engineering also offers opportunities for the future in lightweight construction and energy technology because these research topics are fundamental for sector coupling, heat and energy storage and efficiency. Zittau/Görlitz University of Applied Sciences with its Institute of Process Technology, Process Automation and Measuring Technology and the Fraunhofer Institute for Machine Tools and Forming Technology should also be developed further. In mechanical engineering there are also opportunities in research into optimised production techniques and procedures, e.g. by automation and robots, which can draw on existing automation competence in the lignite mining industry in the Lausitz. This field of research is also relevant to logistics technology.

- Moreover, the Lausitz offers major potential in the area of innovative land use. Here, the initiative proposed by the GFZ German Research Centre for Geosciences in Potsdam, together with six related institutes of the Leibniz Association and the Fraunhofer Society and numerous practical partners in the region to found an inter-disciplinary centre for land innovation at the BTU should be subsidised.

- The Rhineland ENERGY REGION OF THE FUTURE project provides impetus for research and development to transform the business models of the energy industry into the energy system of the future. This includes future locations such as deep geothermal energy at a former power station site, a CO_2-free energy supply system at the Campus Melaten, further development of the Solarcity Jülich and the creation of a Fraunhofer Institute department of digital energy.

- Both in the Rhineland mining area and throughout Germany, it must especially be taken into account how energy-intensive industry can remain competitive in spite of rising energy prices due to the energy transition. The high importance of energy costs for production leads to special energy efficiency. Further savings can often only be achieved by technological leaps. In the Rhineland mining area, the existing professors and institutions with a production-related competence should be more strongly involved in the development of transformation technologies and processes. The institutes on the Campus Melaten/Campus West at the RWTH Aachen should be supplemented by a new institute with a collaborative focus on “Low-Carbon Technologies”. In the Rhine district of Neuss, the Campus Changeneering with its focus on the metal, chemicals and health sectors will bring together research, science and business to work cooperatively on innovations in these areas, and also in cross-over disciplines with a special focus on digitisation, and to create premises and networking options for business founders, start-ups and freelancers.

- The universities and research institutes around the Rhineland mining area already have a proven level of excellence. The Brainergy Park Jülich can make a significant contribution to energy efficiency. The concentration of highly innovative businesses and research institutes will create a competence centre with a pioneering character which will act as an independent energy storage facility. To deal with the upcoming transformation task, the potential in the universities and research institutes must be more effectively harnessed for the development of the region. To this end, the universities and institutions of higher education in Aachen, Cologne and Düsseldorf and Jülich Research Centre, together with many other scientific institutions, should use their excellent research to enable start-up centres to provide stimulus for new businesses and spin-offs in the region. Such projects include the Excellence Start-up Centre plus, the creation of a blockchain institute and the establishment of a New Business Factory.

Raw material industries and the use of material

In this area, the federal states have made the following suggestions:

- The glass industry is a promising core element for a sustainable economic development in the Central German region. To be able to offer high quality apprenticeship and vocational training in the region in the field of glass/ceramics/construction materials, the establishment of a “Glass Campus Torgau” could make an important contribution as an outstanding academic vocational training centre for specialists in the glass industry. The aim is to consolidate and extend the technical glass industry in the Central German mining area as an industry which is important even outside the region.

- Lignite contains carbon, so it can also be used as a raw material for the chemicals and petrochemical industry. It will be possible to mine lignite in Germany for many years to come. Deciding to what extent this will be possible, and under what conditions, is a matter for further research.[170] One suitable approach which harnesses the existing potential in the Central German mining area would be the creation of a model project for the future use of lignite as a raw material by the Fraunhofer Institute. In central Germany there is already substantial and marketable use of material from lignite. Using the existing potential in the Lausitz mining area, it is possible to create a model project under the auspices of Freiberg University of Resources (TU Bergakademie Freiberg) to explore the use of lignite as a raw material for the production of synthetic fuel or in CO_2-neutral recycling.

- The chemicals industry and plastic manufacturing are innovative key industries in the Central German mining area, and in combination with the existing scientific expertise they play an active role in shaping the structural transition. In conjunction with the further development of the Fraunhofer Excellence Centre for Chemicals and Biosystem Technology for the Circular Carbon Economy, the integration of all regional stakeholders and the associated transfer activities, this process can provide further stimulus in the transformation process to make the Central German mining area into a region of innovation.

- Against the background of the monovalent incineration capacity which is being created in Lower Saxony, there is also a need for phosphor recovery plants. The ash material should preferably be reprocessed in the same federal state and used to recover phosphor. Here, the Helmstedt site offers a good starting point.

- In the Rhineland mining area, the local strengths in bioeconomy (e.g. BioSC 2.0), plant research, the use of lignite as a raw material (carbon initiative) and climate-neutral fuels should be developed and used in the economy.

Development of new business models for digitisation

The significant factor for the sustainable development and future viability of the regions is that companies not only react to the requirements of digitisation, but are also able to develop appropriate business models in the framework of digitisation. All forward-looking processes are based on the recording and use of large quantities of data. A business landscape that consists mainly of SMEs, like in the Lausitz, is faced with special challenges. In general, the individual companies are not able to invest in the hardware or in specialised personnel, e.g. data analysts. To solve this problem, service centres linked to Brandenburg University of Technology (BTU Cottbus-Senftenberg) must be established in the Lausitz mining area (data warehouses, data mining, data analysis) to support SMEs in the digitisation process. As a pilot project, an initial service centre should be established in Cottbus.

To utilise the existing potential in the Central German mining area, it would be sensible to set up a state-recognised private university which could start by offering Bachelor study programmes in electrical technology, computer science and business IT. This technical emphasis could also compensate for the technical deficits arising from the closure of the Telekom university in Leipzig. The German-American-Institute (DAI), which is also being newly founded, should ideally be linked with the private university.

Scientific monitoring of the structural transition and transformation

The commission points out that especially in the lignite mining regions, scientific (local) accompaniment and (local) monitoring of the structural transition should be established as an important topic in the academic scene. In this respect, the federal states have developed the following suggestions:

- In the Rhineland mining area, the establishment of a Max Planck Institute for transformation research should provide important stimulus.

170 Unpublished study by Prof. Dr. Armin Grunwald, Karlsruhe Institute of Technology (KIT).

- Setting up an inter-disciplinary centre for research into structural transition and biodiversity in the post-mining landscape at the Martin Luther University of Halle-Wittenberg can provide scientific monitoring of the structural transition and be accompanied by new impetus on the basis of scientific analysis.

- Establishment of the Saxon Institute for Energy and Transformation Research (SIET) at Zittau/Görlitz University of Applied Sciences based in the Lausitz mining area to generate ideas for the structural transition and to review the adopted strategies on a regular basis.

Experimentation clauses, living labs and regulatory measures

The Commission on Growth, Structural Change and Employment has recommended several times that the lignite mining areas should become innovation regions to develop solutions for structural transition.

There are various ways to do this. In the commission's opinion, a region can be regarded as an innovation region if the individual instruments interact in such a way that new and innovative value creation chains arise in the mining areas. Here, the commission especially recommends that experimentation clauses, living labs and regulatory measures should also be considered.

To achieve this development, the national government and the federal states should create scope in the existing legal provisions and legal framework which are in harmony with the existing standards in areas such as environmental, employment or collective bargaining law. The national government and the federal states must cooperate closely to identify and implement any appropriate exceptions. Measures must be adopted which will enable planning processes to be carried out faster in the mining areas, especially in relation to shorter approval procedures.

This can be ideally supplemented by living labs, an instrument which is also announced by the national government in its new seventh energy research programme to enable projects with a pioneering character for the energy transition to be started. It must be examined whether individual living labs can be set up under special regulatory conditions in the mining areas, as innovation regions for the future. Numerous studies indicate that power-to-gas will play an important role in creating greater flexibility in the power supply and that in future there will be considerable demand for the extension of power-to-gas plants, so the living labs in the structural transition regions should place special emphasis on this technology. Another main focus should also be placed on creating living labs in the area of "green district heat". The experience gained with the current Sinteg projects should also be taken up in the living labs.

Here, too, an intelligent combination of regulatory scope and supplementary financial support, e.g. via a fund, could make the mining areas into pioneers and innovation hubs for specific topics.

The reduction of bureaucracy and administrative tasks which are unnecessary, i.e. not objectively justified, should be used as an additional instrument to relieve unnecessary pressure on businesses. The protection of employees, consumers or the environment and the achievement of social goals or other goals which are in the public interest should not be subordinated to administrative or bureaucratic requirements.

To ensure that the structural development is in harmony with European law, the German government should also reach agreement with the EU on the following issues:

- German special assistance areas under Article 107 (3) letters a and c of the Treaty on the Working Procedures of the European Union (AEUV),

- An integrated realignment of the EU structural and research assistance system in newly declared special assistance areas (model regions) which goes beyond the logic of the various individual structural funds which apply today,

- Adjustment of EU state aid law for newly declared special assistance areas (model regions) and

- Adjustment of the state aid regimes so that even companies which are classed as SMEs in Germany can receive such aid. This should also apply to SMEs which are part of a larger company or are more than 25% under municipal ownership and therefore unable to claim any subsidies.

Establishment of public authorities and public facilities

The Commission on Growth, Structural Change and Employment considers it necessary for the national government and the federal states to make a voluntary commitment to take special steps to establish and extend public authorities or institutions in the mining areas in the next few years. Strengthening the presence of the public sector in the mining areas, especially by extending or relocating public authority offices in the mining areas, will underline the commitment of the national government and the federal states to the future of the mining areas. And the benefits of new jobs and effects on local purchasing power will support regional development. The commission considers it sensible and necessary that clear target numbers should be defined for the number of jobs in national and federal state public authorities which should be created in the lignite mining areas. For example, the creation of a total of up to 5,000 new jobs by the national government by 2028 would be fitting. The preparations for such steps should be made in this legislative period as far as possible.

Job guarantees for employees and apprentices

The end of coal-fired power generation in the Federal Republic of Germany is a task for the whole of society because the basic reasons for this decision from an ecological and economic perspective are justified by reference to the whole of society.

The terms of the assignment given to the Commission on Growth, Structural Change and Employment mainly involved creating practical prospects for new, future-proof jobs in the affected regions.

Jobs in the lignite and energy industry are mainly highly qualified jobs with collective wage agreements and mandatory social insurance. The prospects for new jobs, which should be subject to collective agreements as far as possible, must therefore fulfil comparable standards to avoid a structural collapse and to safeguard value creation in the regions. The commission's central concern is therefore to exclude redundancies for operational reasons and to create high quality and future-proof jobs which offer new career prospects especially for employees and apprentices in the coal and lignite industry. It is therefore decisive that the existing strengths and economic structures in the lignite mining areas and hard coal power station locations should be developed by suitable structural policy measures (investments in broadband expansion, transport infrastructure, research and education) to create new and competitive jobs specifically in the mining areas without any delay so that the reduction of coal-fired power generation can be continued.

With the active and preventive use of the job market instruments, it should at the same time be ensured that people in the mining areas are strengthened in their competence and that the establishment of new or start-up companies or research institutes is not hampered by a lack of skilled personnel. Close cooperation at the national and federal state level will ensure that the stakeholders pool their resources, find joint solutions for the mining areas, use existing instruments in a coordinated manner and if necessary design new and complementary resources. The starting point for these resources should be the investment concepts and mining area plans.

The primary goal should be to keep the qualified employees in good jobs or provide them with good new jobs, to create good apprenticeships for the young generation and to realise job opportunities. Employees[171] in lignite and coal-fired power stations and in open-cast mines need firm commitments from politicians that the necessary measures for the structural development will be directed towards the creation of new and competitive jobs and that the employees will receive the necessary support to enable them to maintain their job quality and income level in an appropriate manner. Redundancies for operational reasons will be excluded.

Depending on the personal situation of the affected employees, binding collective agreements must be made between the two sides of the industry, e.g. to ensure placement in skilled jobs and compensation for lower wages and provide apprenticeships and further training, compensation for financial losses or early retirement, assistance in obtaining adjustment benefit, compensation for pension deductions or other early retirement factors. This is necessary to ensure that all affected employees can use the opportunity of forward-looking jobs with adequate wages and working conditions.

171 Including the approx. 1,000 apprentices.

The employee representative bodies and trade unions must be involved in the negotiations and agreements on the closure of power station capacity and open-cast mines, and the agreed arrangements must be laid down in a collective agreement between both sides of the industry.

Planning certainty is not only necessary for the business companies, it is also of major importance for the employees and their personal life and career prospects. This means that a sufficient amount of time must lie between the closure decision and the date of the closure. This is important to give employees the opportunity to make any necessary adjustments in their life and career plans. This period is also necessary to give sufficient time to work out the associated collective agreements and to implement them in practice. It must therefore be ensured that lignite and coal-fired power stations and open-cast mines are only closed down after sufficient advance notice. This will also provide the necessary time for business investments combined with structural development measures which will create new jobs in the affected mining areas and power station locations.

Older employees in lignite mining will require special job guarantees from the political system, and sufficient national government funds must be earmarked to finance this. Where necessary, the legal options to claim early retirement must be used.

To cushion any transitions if necessary, arrangements must be developed with the national government and both sides of industry for an adjustment benefit for lignite (APG-B) for employees in the lignite industry. Similar to the phasing out of hard coal mining, this should be an industry-specific solution only for coal which cannot be transferred to other industries. This scheme should cover all employees of lignite companies, who would be eligible from the age of 58. The period of validity of the APG-B adjustment benefit should be adapted to the whole phase-out process for coal in Germany.

The legislative body needs to create the necessary legal, administrative and financial basis for the introduction of the APG-B adjustment benefits as quickly as possible, or to adapt the existing basis. It must be ensured that sufficient funds are available for the entire phase-out process to finance a socially responsible transition fpr tje employees. It must be checked, for example, whether a limit of the benefit period to five years, which currently applies in the hard coal industry, is also sufficient to cushion the necessary reduction in personnel in the lignite industry. The APG-B adjustment benefit can cover transitions up to the time when it is possible to claim premature old age pension with deductions. The resulting pension deductions must then be compensated.

A similar scheme is needed in coal-fired power generation.

Social protection of employees – over and above the introduction of an adjustment benefit – will require a number of collective agreements (e.g. placement in qualified jobs through recruitment, compensation for wage losses, apprenticeships and vocational training, cushioning of financial losses or early retirement, bridges into adjustment benefit, compensation for pension deductions). There is uncertainty about whether the affected businesses will be able to bear these costs in full for the total duration of the period. Therefore the trade unions must be included in the negotiations with the employers, and in addition to possible compensation for property, it is essential to plan a component for social compensation. If there is no negotiated solution, alternative solutions are needed so that businesses and public authorities can share in securing the social compensation.

The creation of new, well paid jobs by structural policy measures presupposes that sufficiently qualified skilled personnel are available. Education, training and vocational qualifications are therefore an important requirement for successful structural policy in the mining areas – especially in regions which are faced with a reduction in the pool of employable persons as a result of demographic change.

Against this background, a stronger integration of the policies for regional structure, qualifications and the job market in the mining areas could help to improve the framework conditions and thus the prospects for success of the structural policy assistance measures. The coordination of different political initiatives can also be used to increase the intensity of the assistance provided in the lignite mining regions by extending the opportunities to combine different subsidies.

And subsidised qualifications and vocational training can help to adapt the qualifications of the workforce in the mining areas to the changing vocational demands so that these employees are still able to work in industry and in the energy sector. The companies, especially the mine operators, should therefore cooperate with the Federal Employment Agency as early as possible to provide vocational

training and qualification courses for their personnel. The teaching of fundamental digitisation and STEM skills should play a special role.

Based on comprehensive monitoring of competence areas and qualification courses, the individual potential of employees in the mining areas can then be used by recruiting them into good and future-proof jobs and training courses.

Internal recruitment

Different phase-out processes in the mining areas could lead to job transfers between different locations within the same lignite companies, moves to different lignite companies or internal relocation within the company but outside the mining area. The potential for such "internal recruitment" exists if posts in certain locations become vacant due to retirement and appropriately qualified employees in other company locations lose their jobs as a result of the closure of open-cast mines. Mobility assistance can enable the affected employees to use their special qualifications as long as possible, and for the lignite companies this would reduce the cost of training other highly qualified workers or recruiting them temporarily. Such recruitment processes need internal points of contact in the companies and a central office in cooperation with the Federal Employment Agency, especially for external recruitment.

External recruitment

If internal recruitment within the mining industry is not possible, external recruitment in suitable branches of the job market is sensible. In this process, an earnings guarantee must be ensured for a certain period on the basis of appropriate agreements.

Further vocational training

In some cases, a change of jobs may involve the need to extend and adapt a person's existing skills and expertise. The Federal Employment Agency can use the extended assistance possibilities created by the Skills Development Opportunity Act (Qualifizierungschancengesetz) to subsidise participation in individually necessary and exactly targeted vocational training, and thus contribute to the preventive further training of employees.

And for young people, the apprenticeship and education system must be adapted and strengthened for the new requirements and new structural focus areas in order to offer attractive life and career prospects in the regions, and at the same time to meet the need of newly relocated or founded companies for skilled personnel.

There are currently about 1,000 apprentices in the lignite companies, and they must quickly be given permanent employment prospects, if necessary with interim extra qualification modules. And the school pupils in the mining areas who will earn their leaving certificates in the next few years and then look for apprenticeships need to be offered future prospects on the basis of promising initial jobs. To achieve this, new and attractive apprenticeships must be provided at the same level as before until the vocational training market in the mining areas has become balanced. The lignite industry in places such as the Lausitz also trains young people for other companies. The existing instructors and the technical apprenticeship infrastructure in the lignite companies should be continued by taking over the instructors and technical equipment in regional apprenticeship associations.

The existing expertise can then continue to be used to train skilled personnel in the region.

In the mainly rural mining areas, a model project should be created to determine the extent to which digitisation and new mobile phone standards (5G) can be used to teach vocational school content (here: specialised technical theory) in "digital classrooms" irrespective of the distance and the class size.

To meet the demand for skilled personnel in the energy industry, industrial companies in the regions and new companies which will move into the regions, a cooperation between all stakeholders is needed. This is essential to network the existing vocational education and training institutions and establish the necessary extra capacity which is needed to ensure that businesses can find the necessary highly trained personnel when they need them.

Successful and adaptable structures are available with the two initiatives "SCHOOL&INDUSTRY Germany" and "Create STEM Future". In cooperation with the Federal Employment Agency, career guidance for young people can take the structural transition and structural development in the mining areas into account and show new paths into interesting and high quality jobs. Another important goal is also to retain and train well-trained skilled personnel in the regions – and especially to equip them for the demands of digitisation and other technical and scientific areas.

Here, the Lausitz can draw on proven and tested formats such as support for collaborative training and advice on further vocational training by the Brandenburg Economic Development Office. The results of the cooperation between different stakeholders could take the form of new or larger collaborative inter-company vocational training initiatives or an intelligent combination of existing places of learning (upper school centres – inter-company apprenticeship and training institutions – business companies).

The Federal Employment Agency should be integrated at an early stage into the monitoring bodies responsible for structural transition so that they can contribute their job market expertise[172] concerning the future viability of careers and the existing and required competence and qualifications for staff. Transparency is necessary about the training and qualifications which can be provided in the mining areas and the need for action to adapt existing training programmes so that newly relocated companies, start-ups and research institutes are not hindered by a lack of skilled personnel.

Regional roots and participation of civil society

Structural development can only be successful together with the people who see the regions as part of their identity, their home, the place where their traditions and their future lie. The necessary steps should be organised or continued from within the regions to ensure that the people are actively involved in the processes of change. This not only applies to the economic framework, it also involves the attractiveness of the regions in their agricultural diversity, their cultural traditions, their quality of life and the provision of the necessities of life. An awareness of traditions and history should also be promoted by supporting regional initiatives. Systematic support programmes are necessary to activate civic and local involvement in the regions. In the Lausitz mining area this includes support for the language, culture and identity of the people of the Sorbs and Wends. Advice must be ensured for potential applicants for all assistance programmes.

It is of central importance that the existing regional stakeholders be brought together in their shared interest in the structural transition in each region, e.g. so that they can speak with one voice when applying for subsidies or act as a coherent point of contact for the national government and the EU. Specifically, the commission recommends support for systematic measures addressed to civil society, public involvement and social entrepreneurship so that the structural transition processes in the lignite mining regions can be strengthened as a grass roots movement. These measures should encourage small and medium-sized projects by civil organisations, public participation movements and social entrepreneurs in order to support social cohesion and the quality of life.

A successful long-term structural transition in the mining areas requires participation and acceptance on the part of the local population and civil society groups (clubs, initiatives etc.).[173] Social cohesion must be strengthened, especially in regions with a history of conflict. This, too, is an important requirement in order to create a successful framework for a viable long-term economic structural development.[174] The structural transition can only be a successful joint long-term venture if it activates and gains support from the people in the locality.[175]

Assistance programmes

The Commission on Growth, Structural Change and Employment commends the assistance programme "Mining Area Enterprise" *(Unternehmen Revier)* as a sensible approach and sees it as a suitable reference point for future assistance programmes. At the same time, the commission considers it necessary for the assistance structure in the mining areas to be made even more effective. All national government departments must review their assistance programmes to see how the assistance requirements, conditions and subsidy volumes must be adjusted to provide priority funds in the regions, and where greater flexibility is possible. However, the local communities will not be able to bear financial loads, or only to a minimal extent. Against this back-

172 The qualification profiles of the employees in the mining areas should be analysed, and extended where necessary, to develop profiles for new employment opportunities on the basis of outdated career profiles. To supplement this, the job market policy measures should be supported by an analysis of the structural transition in the mining areas up to now.

173 Cf. contribution by Prof. Dr. Ortwin Renn (IASS) at the plenary meeting of the commission on 18 September 2018.

174 Cf. contribution by Rev. Burkhard Behr (Protestant church of Berlin-Brandenburg - Silesian Upper Lausitz) on the commission's trip through the mining area on 11 October 2018.

175 Cf. contribution by Rev. Jens Sannig (Superintendent of the Diocese of Jülich) on the commission's trip to the Rhineland mining area on 23 October 2018 and the contribution by Mario Kilman (Domowina) on the commission's trip to the Lausitz mining area on 11 October 2018.

ground, in the mining areas it should be possible to reduce the co- payment which must be borne by local stakeholders where necessary, or to establish alternative forms of finance for the co-payments. The commission deems it necessary that the local communities must be supported by intelligent solutions to provide the necessary planning and administrative capacity.

Special attention must be given to the state aid rules issued by the European Union which define the scope for action of the member states. The Federal Government should take early action to advocate necessary changes in the state aid rules. In addition, the planned extensions to the existing protective mechanisms or new mechanisms should be subjected to a legal state aid review with sufficient advance notice.

If not all mining areas are classed as assisted areas under the scheme "Improvement of the regional economic structure" (GRW) in future, new assistance rules should be considered which could enable these areas to bring infrastructure and other projects into the subsidy scheme as special assistance areas.

The mining areas participate to very different extents in the existing assistance programmes. In particular, only a very small volume of funds from R&D programmes reaches the Lausitz mining area.[176] Therefore it should be reviewed whether an adjustment of the assistance conditions and a support infrastructure in the locality could improve the absorption capacity of the mining areas. Especially SMEs, which are the dominant element in the economic structure of the eastern German regions, can be faced with major obstacles when they apply for subsidies.

Possible support from the European Union

The Commission on Growth, Structural Change and Employment points out that it is necessary for the European Union to monitor and support the mining areas in the process of reducing and phasing out coal-fired power generation. The European Union offers its member states and regions a wide variety of support, advice and assistance instruments. They range from classical aid instruments (structure and investment funds and assistance programmes such as INTERREG and Horizon 2020) and specific competitions, calls and initiatives (e.g. the initiative for "Coal and Carbon-Intensive Regions") to the creation of the "Coal Platform" (Coal Regions in Transition Platform), which explicitly focuses on the strategic process of transition in coal regions..

The commission welcomes the fact that on 14 November 2018 the European Parliament, in relation to the current negotiations on the multi-year financial framework, demanded an allocation of €4.8 billion in special funds for a new "Fund for a Fair Energy Transition" as a reaction to the social, socio-economic and ecological effects of the structural transition in the European coal regions. It sees this as a promising approach and asks the Federal Government to support this project.

In practice there are numerous obstacles – including legal issues – which offer an extra challenge to the coal regions compared with other more competitive regions of Europe. Therefore, the existing support mechanisms must be supplemented by further practical simplifications in the procedure. The goal must be to assist businesses moving into the area and to create incentives for investments which pave the way for an innovative and forward-looking economic structure which meets the requirements of an increasingly digital society. To achieve this, the existing rules under European law must be examined to see how appropriate and adaptable they are. This especially applies to the state aid rules, but it is also relevant to the tax framework, depreciation and investment arrangements and the task of accelerating the planning and approval processes. The co-financing requirements must be adjusted to take the financial capabilities of the federal states and local communities into account. If necessary, it must be considered whether the national government could contribute to the co-financing requirements for the federal states and local communities. Preferential treatment in European support programmes must also be examined.

The EU, the national government and the federal states should engage in a joint structural development process which would especially create better subsidy conditions for investments by existing companies and the acquisition of new companies, which provide an identifiable added value for the region. Especially in the industry and energy sectors, the existing competence in the mining areas must be preserved and developed. At the same time, these sectors in the

176 Cf. the written answer by the Federal Government to the question about structural policy measures, session of 23 August 2018.

mining areas are currently dominated by a few large enterprises. In the context of the goal of diversification and the preservation and development of the existing competence, it must also be possible for these companies to receive support.

For the adjustment process to be successful, the regions affected by the reduction and phasing-out of coal-fired power generation need the necessary assistance instruments as quickly as possible. Especially for the establishment of large industrial location projects, it would be of great interest to apply principles that are similar to the IPCEI instrument[177]. In addition, the commission assumes that the Federal Government will appeal to the European Commission to create a coal conversion scheme for the affected mining areas.

5.4. Institutionalised structures

The Commission on Growth, Structural Change and Employment has studied structural policy baseline and the development potential in the mining areas in great detail. It has also carried out an in-depth examination of the available instruments to support the structural transition and developed recommendations for action that should be taken. The practical implementation requires a specific financial framework and process, and the large number of suggested actions need to be sensibly brought together in a general concept.

Structural development needs planning certainty and sufficient funding. The necessary funds must be made available to the affected mining areas for a period of several years.

A comprehensive legislative package to "strengthen growth, structural change and employment" in lignite mining areas and coal-fired power station locations will provide a binding framework, for example in the form of interstate agreements, accompanying laws and other instruments, which will define the measures to support structural transition and the associated funding:

- The €1.5 billion earmarked in the federal budget for the current legislative period should be used in an immediate structural policy action programme. The federal states should quickly agree with the national government on the specific measures which can be implemented by the end of 2021. In the implementation of the implement structural development strategies proposed by the regions, the first measures should preferably be subsidies from the current programmes of the various national budgets, which should be strengthened accordingly.

- To set a visible token, the commission also recommends that an initial investment incentive for the mining areas should be created in the period from 2019 to 2021 (immediate action program for business investments):

    - A short term investment allowance should be introduced for the lignite mining areas. The goal is to activate private investments - see also the commission's comments on private and municipal investments as a key to structural transition (cf. Chapter 5.2).

177 Important Projects of Common European Interest.

  - The annual funds earmarked for the programme "Mining Area Enterprise" (idea competitions in the mining areas) should be substantially increased.
  - The programme "WIR! – Change by Innovation in the Region" should be extended for the duration of the transition process, also applied to the Rhineland mining area and increased.

- The legislative package should include an Act on Administrative Measures to define the measures to be adopted by the national government or with the participation of the national government, especially for infrastructure development, business and innovation incentives and location support for public authorities and research institutes. The commission deems it necessary that the Federal Government should create an extra budget allocation of €1.3 billion per year for 20 years to finance individual projects from the national budget in the federal states affected by a premature phasing-out of coal-fired power generation. This Act on Administrative Measures should also be implemented in a ratified interstate agreement between the central government and the affected federal states and local communities. One model for such a legal construct could be the Bonn-Berlin Act. The provisions of the Act on Administrative Measures must ensure that the necessary flexibility in a structural development process over several decades is possible. The commission expects the Federal Government to present the key elements of such an Act on Administrative Measures after consultation with the affected federal states by 30 April 2019.

- In addition to the Act on Administrative Measures, the Federal Government should provide the federal states with national funds to secure the structural policy measures in the medium to long term, irrespective of the budget situation. The commission recommends that the federal states affected by a premature phase-out of coal-fired power generation should be provided with annual funds of €0.7 billion for a period of 20 years. Such a budget would create the ability to react flexibly to projects and requirements for structural assistance that are not foreseeable today.

- In addition, a special funding programme for the transport infrastructure should be created to improve the transport connections.

- And appropriate government funds must be earmarked for any necessary job market activities (cf. Chapter 5.3).

The Commission on Growth, Structural Change and Employment expects the national government and the federal states to agree on a ratio for the distribution of the funds. To take the timetable for the reduction and termination of coal-fired power generation and the different implementation periods of the measures in the mining areas into account, it should be possible for mining areas which need funds at an early stage to receive premature extra support from the structural assistance fund. This should be balanced out over time to avoid any distortion in the distribution ratio.

Because the federal states and local communities are so heavily affected, any co-financing requirement should be waived. And steps should be taken to ensure that any necessary co-finance for measures subsidised by the EU can be provided from central government funds.

The stakeholders in the affected regions will have a decisive impact on the structural development at the local level. This will require sponsoring institutions which are trusted by the affected parties, familiar with the local circumstances, can ensure an effective use of the funds and embody the political will to promote a successful structural development in order to create new opportunities for the regions. The sponsoring institutions should exist for the whole duration of the task, i.e. for decades.

In view of the fact that the mining areas have fundamentally different starting points to face the structural transition, the commission suggests that different instruments should be used as a framework for a positive structural development. The basic considerations are outlined here. The selection of the institutions and the details of their appointment must be reserved for the necessary negotiations between the central government and the federal states. In this process, the different regional needs must be taken into account.

A rapid creation of such an institution – except where it is already active in a mining area (e.g. the Rhineland mining area Future Agency) – is an expression of a forward-looking, sustainable structural policy for the mining areas and a crucial condition for a structural transition in the regions. Such an institution must also be present in the regions so that it is accepted by the local population. In the Central German and Lausitz mining areas, the commission recommends that the national government should cooperate with the affected federal states to establish a self-consuming and time-limited institution for "growth, structural change and employment". In the Helmstedt mining area, where lignite

mining has already ended, the commission recommends that provisions to finance structural measures should be agreed as part of the overall package.

The institution should be placed under a supervisory body in which the national government and the affected federal states and local communities are represented. To ensure the participation of the political powers, businesses, trade unions, science and civil society, local institutions such as mining area monitoring committees should be set up which include representatives and stakeholders from the affected mining areas, even across federal state borders. If appropriate, this can be based on existing institutions, or these institutions can be developed. The active participation of both sides of industry on a partnership basis places extra demands on the participants. Therefore, part of the finance should be provided to the employers and employee representatives for preparation, administration, monitoring, evaluation, information and oversight in the supervisory bodies. A model here could be the instrument for technical assistance in the EU structural fund.

It is crucial that these institutions should be able to start their work as soon as possible. Implementation must begin immediately, otherwise it will not be possible to fulfil the conditions for compensation for the climate policy decisions which have affected the dominant value creation and employment structures in the mining areas.

Such an institution will especially benefit the structural development in the mining regions in six areas:

1. Development, updating and implementation of a goal-oriented strategy for growth and employment in line with the strengths of each mining area,

2. Strengthening the innovation potential of the mining areas, advancement of research, development and vocational qualifications,

3. Investments in industry and small and medium-sized enterprises in the mining areas,

4. Extension of the infrastructure,

5. Regional development and quality of life in the mining areas, and

6. Civil society dialogue and participation in shaping the future in the mining areas.

These are significant starting points for the development of the mining areas which the commission has developed in its appraisal of the structural policy baseline (cf. Chapter 3.4) and in the measures to support and monitor the structural transition (cf. Chapter 5.3).

In accordance with the basic principles of a structural development strategy as defined by the commission (cf. Chapter 5.2), the funding must be provided in addition to the other existing subsidy programmes and measures. But it must be ensured that the subsidies from the existing assistance programmes are coordinated to achieve a synergy with the additional funds provided to support the structural transition. In particular, the Federal Government should check whether finance from the regional and structural funds of the European Union can be used in combination in the mining areas.

Public “mining area conferences” in all four mining areas could be a suitable way to ensure broad participation at the beginning of the process, to create networks among the stakeholders and to promote discourse about innovative approaches and projects to support the structural transition.

6. Monitoring, evaluation and amendment clauses

In Chapters 4 and 5, the Commission on Growth, Structural Change and Employment recommends a closely dovetailed package of measures. The commission underlines that the individual measures are mutually dependent to create new, future-proof prospects in the regions and provide an appropriate response to the expected consequences of the reduction and the termination of coal-fired power generation for climate protection, reliability of supply, industry and end consumers, employees, open-cast mining and remedial measures in a post-mining environment. To achieve this, the measures proposed by the commission must be implemented in a synchronised fashion and must achieve the intended effects.

The commission therefore recommends that the assumptions, the implementation of the package of measures and its effects should be comprehensively evaluated at regular intervals. This means that the intended effects of the measures should be recorded, and that their effects on the climate protection goals, reliability of supply, electricity costs, regional development and employment should be assessed. If it becomes apparent that the goals will not be achieved in individual areas, the commission recommends that systematic adjustments should initially be made in the affected areas.

For this purpose, the commission recommends the regular compilation of progress reports to document the implementation of each measure described in Chapters 4 and 5. To assess the effectiveness of the measures, the commission recommends that in good time before the first assessment date the Federal Government should develop criteria and associated indicators that can be used to evaluate the implementation of the measures in Chapters 4 and 5 and the effects according to the evaluation criteria in Chapter 2. The reports will be approved by the German Cabinet and presented to the German parliament and the Federal Council for discussion.

In addition, the Federal Government should nominate a panel of independent experts who will check and evaluate the progress reports. It should include experts in structural development, regional policies, employment, the energy sector, industry and climate protection and should be able to evaluate experience and insights drawn from all of the mining areas. In this respect, it is suggested that the expertise of the Commission on Growth, Structural Change and Employment should continue to be used. On the basis of the evaluation criteria in Chapter 2 and the measures defined in Chapters 4 and 5, the committee will decide on any need for action and make any relevant recommendations. The commission recommends the years 2023, 2026 and 2029 as the dates for regular reviews. An initial report on the implementation of the programme of immediate measures should be presented in 2023.

The reports by the Federal Government and the committee of experts should be published.

The Commission on Growth, Structural Change and Employment assumes that the necessary procedures for revised laws and legislative measures at the national and European level will be initiated before the end of 2019. It deems it necessary that the following criteria and measures as described in Chapters 4 and 5 will have been implemented by the defined review dates in 2023, 2026 and 2029, and that their intended effects up to that time will have developed according to the evaluation criteria defined in Chapter 2.

If the evaluations in 2023, 2026 and 2029 show that the following criteria and measures have not been fulfilled, the necessary adjustments must be made to the measures described in Chapters 4 and 5. Here, the Federal Government should take the appropriate steps as quickly as possible. The following criteria and measures are relevant in this connection:

Structural development, value creation and employment

- Identifiable and sufficient establishment of new jobs and new value creation in the regions to achieve equivalent replacement for the decrease in jobs and value creation resulting from the reduction and phase-out of coal-fired power generation (in 2023, with further appraisal in 2026 and 2029);

- Enactment and implementation of a comprehensive legislative package to “strengthen growth, structural change and employment” (in 2023), consisting of: An immediate action structural policy programme and an immediate action programme for entrepreneurial investments;

- A legislative package to define the measures to be adopted by the national government or with the participation of the national government, especially for infrastructure development, business and innovation incentives and location support for public authorities and research institutes;

- Establishment of a financial possibility to secure short-term and long-term structural policy measures, and an immediate action financial programme for the transport infrastructure.
- Establishment of sponsoring institutions for structural development (in 2023);
- Initial investment projects in industrial developments should have been applied for or implemented, and advanced planning and initial implementation of transport and digital-infrastructure projects should be apparent (in 2023, with further appraisal in 2026 and 2029);
- Initial new location projects for public authorities and other public facilities should have been started (in 2023);
- Creation of customised programmes for the mining areas to promote joint research and development by science and business, and initial location projects for research institutes (in 2023);
- Creation of participative bodies to ensure that employers, employee representatives, business and civil society stakeholders in the locality are institutionally involved in approvals for subsidy projects and the distribution of funds (in 2023);
- Socially responsible arrangements for the phase-out of coal-fired power generation, i.e. social safeguarding of employees by appropriate legal provisions, collective agreements and financial safeguards (in 2023);
- Specific progress in the development of the affected mining areas as future-proof energy regions by creating the appropriate regulatory framework conditions (in 2023, with further appraisal in 2026 and 2029).

Protection of the climate

- Reduction of coal-fired power generation in accordance with the measures described in Chapter 4 (in 2023, with further appraisal in 2026 and 2029);
- Cancellation of CO_2 up to the maximum value of the extra CO_2 volume saved (in 2023, with further appraisal in 2026 and 2029);
- Reform of the Renewable Energy Act and the Combined Heat and Power Act (KWKG) to create a reliable framework for investments in renewable energies in compliance with the 65% target by 2030 and the further development of and continued support for combined heat and power by an extension of the Combined Heat and Power Act (KWKG) up to 2030 (in 2023).

Energy market and electricity prices for industry, commercial users and private consumers

- Electricity price compensation for indirect costs in the European Emission Trading system should be extended to 2030 and stabilised (in 2023);
- A subsidy for the transmission grid prices, or an equivalent measure to cushion the increase in electricity prices resulting from the faster phasing out of coal-fired power generation, should be fixed in the federal budget and approved under the state aid rules (in 2023).

Reliability of supply

- Reliable energy supply of the necessary quality and sufficient volume for the demand at all times (in 2023, with further appraisal in 2026 and 2029);
- Reform of the Electricity Market Act to develop the monitoring system for the reliability of supply (in 2023);
- Examination of a systematic investment framework if there is not sufficient new power station capacity under construction by 2023 to compensate for the resolved closure of the lignite and coal-fired power stations (in 2023);
- Use of the existing reserve instruments to safeguard the electricity market (in 2023, with further appraisal in 2026 and 2029);
- Examination of measures to accelerate approval processes for the construction of new gas-fired power stations, especially in existing coal-fired power station locations (in 2023);

- Substantial progress in the extension and optimisation of transmission grids (in 2023, with further appraisal in 2026 and 2029);
- The Federal Requirement Plan Act must have been updated in relation to the 65% extension target for renewable energies (in 2023, with further appraisal in 2026 and 2029);
- Adequate replacement for closed coal-fired power stations from the grid reserve (in 2023, with further appraisal in 2026 and 2029).

Grids, storage, sector coupling and innovation potential

- Adequate progress with the modernisation of the transmission and distribution grids in compliance with the extension of renewable energies (in 2023, with further appraisal in 2026 and 2029);
- Revision of the system of taxes, charges, prices and surcharges in the energy sector (in 2023, with further appraisal in 2026 and 2029);
- Examination of the introduction of CO_2-based pricing to steer the sectors apart from the European Emission Trading system (in 2023).

Consideration of open-cast mining and safe remedial treatment of closed open-cast mines

- Utilisation of the possibility of insolvency-proof guarantees by the federal states when new operating plans are approved if there is no joint corporate liability (in 2023, with further appraisal in 2026 and 2029).

Annex 1
Appointment resolution

Appointment of the Commission on Growth, Structural Change and Employment

It is the policy of the Federal Government to support the establishment of full employment and living conditions that are equivalent throughout Germany. In order to achieve this, the structural change taking place in many areas must be supported in an active and comprehensive manner such as to strengthen growth and employment, particularly in the regions affected.

The Federal Government is committed to the climate change targets over the period to 2050 agreed at national and European level and in the framework of the Paris Agreement. The Climate Action Plan adopted by the Federal Government in 2016 describes the path toward an extensive greenhouse gas neutral economy and society in Germany by the middle of the century. In particular, the Climate Action Plan sets out specific reduction targets for individual sectors (energy, industry, buildings, transport and agriculture) by 2030. We will take appropriate measures to ensure that these are met in a manner that maintains the triangle of objectives consisting of security of supply, environmental sustainability and economic efficiency.

In implementing the Climate Action Plan structural change will accelerate in many regions and economic sectors, in particular in the energy production sector. The accompanying changes must not be solely at the expense of the regions producing coal-fired power. Instead, they must create opportunities for sustainable economic growth coupled with quality employment. We wish to harness these opportunities, thus avoiding structural breaks and constraints on international competitiveness.

For that reason the Federal Government is appointing a Commission on Growth, Structural Change and Employment which is asked to develop specific proposals by the end of this year. Its tasks shall include in particular the development of an action programme with the following priorities:

1. Establishment of a concrete perspective for new future-proof jobs in the regions affected through cooperation between the federal authorities, the Länder, municipalities and economic actors (for example, in the areas of transport infrastructures, development of skilled labour and entrepreneurship, location of research institutions and long-term structural development).

2. Development of a mix of policy instruments which bring together economic development, structural change, social acceptability, social cohesion and action on climate change and, at the same time, establish perspectives for sustainable energy-producing regions in the framework of the energy transition.

3. This also includes necessary investments in the regions and economic sectors affected by structural change for which existing federal and EU support instruments will be deployed in the regions affected on an effective, targeted and priority basis and for which, in addition, a structural change fund, comprising primarily federal resources, will be deployed.

4. Measures to ensure that the energy sector is on a reliable course to reach the 2030 target, including a comprehensive impact assessment. The target established by the Climate Action Plan is for the energy sector to reduce emissions by 61 to 62% by 2030 compared with 1990 levels. For the contribution resulting from coal-fired power generation, the Commission should propose appropriate measures for the energy sector to meet the 2030 target for inclusion in the programme of measures to reach the 2030 targets in implementation of the Climate Action Plan.

5. In addition, a plan for the step-by-step reduction and termination of coal-fired power generation, including an end date and the necessary legal, economic, social, renaturation and structural policy support measures.

6. Also measures to be taken by the energy industry as a contribution towards minimising the undershoot on the 40% reduction target. The Federal Government will publish an updated estimate of the anticipated undershoot as part of the Climate Action Report 2017.

The following persons are appointed as members of the Commission on Growth, Structural Change and Employment:

Chairpersons

Matthias Platzeck
Ronald Pofalla
Professor Barbara Praetorius
Stanislaw Tillich

Members

Professor Jutta Allmendinger
Antje Grothus
Gerda Hasselfeldt
Christine Herntier
Martin Kaiser
Steffen Kampeter
Stefan Kapferer
Professor Dieter Kempf
Stefan Körzell
Michael Kreuzberg
Dr Felix Matthes
Claudia Nemat
Professor Kai Niebert
Professor Annekatrin Niebuhr
Reiner Priggen
Katherina Reiche
Gunda Röstel
Andreas Scheidt
Professor Hans Joachim Schellnhuber
Dr Eric Schweitzer
Michael Vassiliadis
Professor Ralf Wehrspohn
Hubert Weiger
Hannelore Wodtke

The following three members of the German Bundestag are appointed as persons having the right to speak but without the right to vote:

Andreas G. Lämmel
Dr Andreas Lenz
Dr Matthias Miersch

The Commission on Growth, Structural Change and Employment shall record the results of its work in written reports to the committee of state secretaries. The Commission on Growth, Structural Change and Employment shall present its written recommendations for measures concerning the social and structural policy development of the lignite regions and their financial security by the end of October 2018. It shall present its written recommendations for measures to be taken by the energy industry as a contribution towards minimising the undershoot in reaching the 40% reduction target by 2020 in advance of the 24th United Nations Climate Change Conference, which will take place from 3 to 14 December. The final report shall be submitted to the Federal Government at the end of 2018. The Federal Government will publish the Commission's reports. Members of the Commission shall receive an expenses allowance.

The Federal Government will provide comprehensive support for the work of the Commission. The Commission will be supported by a committee of state secretaries composed of representatives from the Federal Ministry for Economic Affairs and Energy, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, the Federal Ministry of the Interior, the Federal Ministry of Labour and Social Affairs and, in addition, from the Federal Ministry of Finance, the Federal Ministry of Food and Agriculture, the Federal Ministry of Transport and Digital Infrastructure and the Federal Ministry of Education and Research. Other ministries concerned with issues of structural development will be called to the sittings as required. In parallel with the deliberations of the Commission, there will be regular communication between the Minister-Presidents of the Länder concerned and the Federal Ministers of the steering group. The heads of the State Chancelleries of the Länder concerned will also be involved in the steering group on a regular basis. To provide organisational support, a coordination office for the Commission will be established in the Federal Ministry for Economic Affairs, which will carry out secretariat functions. Representatives of the steering group ministries comprising the Federal Ministry for Economic Affairs, the Federal Ministry for the Environment, the Federal Ministry of the Interior and the Federal Ministry of Labour and Social Affairs and of the Länder Brandenburg, Lower Saxony, North Rhine-Westphalia, Saarland, Saxony and Saxony-Anhalt shall attend the meetings of the Commission, representatives of the Federal Chancellery shall have guest status.

Annex 2

Schedule of sittings for the Commission on Growth, Structural Change and Employment

26 June 2018 – BMWi*	**First plenary sitting of the Commission on Growth, Structural Change and Employment**
13 July 2018 – BMWi	**Second plenary sitting of the Commission on Growth, Structural Change and Employment**
16 July 2018 – BMWi	**First sitting of the Working Group: Energy Industry and Climate Targets**
19 July 2018 – BMWi	**First sitting of the Working Group: Economic Development and Jobs in the Regions**
23 August 2018 – BMWi	**Third plenary sitting of the Commission on Growth, Structural Change and Employment**
29 August 2018 – BMWi	**Fourth plenary sitting of the Commission on Growth, Structural Change and Employment**
18 September 2018 – BMWi	**Fifth plenary sitting of the Commission on Growth, Structural Change and Employment**
24 September 2018 – Central German mining area	**First site visit: Central German mining area**
11 October 2018 – Lausitz mining area	**Second site visit: Lausitz mining area**
12 October 2018 – BMWi	**Sixth plenary sitting of the Commission on Growth, Structural Change and Employment**
24 October 2018 – Rhineland mining area	**Third site visit: Rhineland mining area**
25 October 2018 – BMWi	**Seventh plenary sitting of the Commission on Growth, Structural Change and Employment**
15/16 November 2018 – BMWi	**Eighth plenary sitting of the Commission on Growth, Structural Change and Employment**
26 November 2018 – BMWi	**Ninth plenary sitting of the Commission on Growth, Structural Change and Employment**
25 January 2019 – BMWi	**Tenth plenary sitting of the Commission on Growth, Structural Change and Employment**

* BMWi = Bundesministerium für Wirtschaft und Energie = Federal Ministry for Economic Affairs and Energy.

Annex 3

Experts consulted

13 July 2018	**Second plenary sitting of the Commission on Growth, Structural Change and Employment** **Structural policy fundamentals** Core data on the lignite mining areas • Dr Jochen Dehio and Dr Torsten Schmidt, Leibniz Institute for Economic Research (RWI) Socio-economic components and structural change • Rüdiger Siebers, former member of the group works council at Vattenfall Europe Mining AG **Climate policy and energy industry fundamentals** International, European and national climate policy framework • Professor Edenhofer, Potsdam Institute for Climate Impact Research Facts and figures on the coal industry • Dr Michael Ritzau, BET Electricity market and security of supply: an introduction • Dr Frank Sensfuß, Fraunhofer Institute for Systems and Innovation Research • Dr Christoph Maurer, Consentec
23 August 2018	**Third plenary sitting of the Commission on Growth, Structural Change and Employment** **Climate targets and implications for the coal industry** • Dr Philipp Gerbert/Dr Jens Burchardt, Boston Consulting Group • Professor Georg Erdmann, Technische Universität Berlin • Professor Andreas Löschel, Westfälische Wilhelms-Universität Münster
29 August 2018	**Fourth plenary sitting of the Commission on Growth, Structural Change and Employment** **Consultation of lignite companies, in particular on jobs and value creation in energy production** • Dr Markus Krebber, Chief Financial Officer, RWE • Dr Armin Eichholz, Board Chairman, MIBRAG • Helmar Rendez, Board Chairman, LEAG **Security of supply** • Urban Rid, Head of Department for Energy Policy – Electricity and Grids, Federal Ministry for Economic Affairs and Energy • Jochen Homann, President of the Federal Network Agency • Robert Schroeder, Head of the System Development Division, European Network of Transmission System Operators for Electricity • Dr Klaus Kleinekorte, Amprion, Managing Director • Boris Schucht, 50Hertz, Board Chairman • Professor Klaus-Dieter Borchardt, Director Internal Energy Market, Directorate-General for Energy, European Commission

18 September2018	**Fifth plenary sitting of the Commission on Growth, Structural Change and Employment** **Instruments and effects on energy prices** • Professor Wolfgang Lucht, Humboldt Universität zu Berlin and German Advisory Council on the Environment • Dr Patrick Graichen, Director, Agora Energiewende • Dr Lindenberger, Institute of Energy Economics • Dr Martin Iffert, Board Chairman, TRIMET Aluminium SE **Illustrative approaches for new forms of regional value creation** • Professor Ortwin Renn, Scientific Director, Institute for Advanced Sustainability Studies (IASS), Potsdam, and Dr Jeremias Herberg, Research Associate, IASS • Professor Gerhard Untiedt, TU Clausthal and GEFRA-Gesellschaft für Finanz- und Regionalanalysen, Münster • Andreas Feicht, Chairman of the Executive Board, WSW Wuppertaler Stadtwerke GmbH and WSW mobil GmbH • Professor Hans Rüdiger Lange, Managing Director, Innovationsregion Lausitz GmbH
24 September 2018 **Central German mining area**	**First site visit: Central German mining area** • Volker Jahr, Chairman of the works council, MIBRAG AG Zeitz • Chris Döhring, Managing Director, GETEC green energy AG • Ralf Irmert, Managing Director, Trinseo Deutschland GmbH, Schkopau Works • Rena Eichhardt, Managing Director, Romonta Bergwerke Holding AG • Götz Ulrich, District Commissioner, Burgenlandkreis, and Henry Graichen, District Commissioner, Leipzig District • Professor Andreas Berkner, Head of the Planning Board, Regional Planning Association Leipzig-West Saxony • Jens Hausner, Spokesperson for the citizens' action group: Pro Pödelwitz • The Hildebrandt family from Groitzsch
11 October 2018 **Lausitz mining area**	**Second site visit: Lausitz mining area** **Venue: Weißwasser** • Michael Stein, Managing Director, KSC Anlagenbau • Katrin Bartsch, Chair of the Executive Board, Stadtwerke Weißwasser GmbH, Director of the Wirtschaftsinitiative Lausitz e.V. • Marco Bedrich, youth representative at LEAG, member of the trade union IG BCE • Nancy Nadebor, Nadebor Firmengruppen **Representatives from the region (venue: Großräschen)** • Burkhard Behr, pastor in the evangelische Kirche Berlin-Brandenburg – schlesische Oberlausitz • Marko Klimann, Chairman of the Economic Committee of the Domowina • Winfried Böhmer, spokesperson for Aktionsbündnis Klare Spree e. V. • René Schuster, Federal Chairperson, Grüne Liga • Thomas Wagner, manager of the Spremberg works, Knauf Deutsche Gipswerke KG

11 October 2018 Lausitz mining area	**Lausitz economic region (venue: Großräschen)** • Bernd Lange, District Commissioner, Görlitz District • Siegurd Heinze, District Commissioner, Oberspreewald-Lausitz District **Locations for science and research (venue: Großräschen)** • Professor Christiane Hipp, Vice-President for Research, BTU Cottbus-Senftenberg • Professor Tobias Zschunke, Prorector for Research, FH Görlitz-Zittau • Dr Peter Wirth, Project Director, Leibniz Institute of Ecological Urban and Regional Development **Lausitzrunde (representatives of the Lausitz, venue: Großräschen)** • Fred Mahro, Mayor of Guben • Manfred Heine, Mayor of the municipality of Spreetal and Chairman of the Zweckverband Lausitzer Seenland Sachsen
24 October 2018 **Rhineland mining area**	**Third site visit: Rhineland mining area** **Industry and energy in times of change** • Michael F. Bayer, Chief Executive Officer, Aachen Chamber of Industry and Commerce • State Secretary Christoph Dammermann, Chairman of the Supervisory Board, Zukunftsagentur Rheinisches Revier GmbH • Joachim Rumstadt, Chairman of the Executive Board, STEAG GmbH • Eckhardt Rümmler, Chief Operating Officer, Uniper SE • Dr Christopher Grünewald, Managing Director, Gebr. Grünewald GmbH & Co. KG • Dr Pao-Yu Oei, Head of the Junior Research Group CoalExit, Faculty of Economics and Management, Technische Universität Berlin • Professor Johann-Christian Pielow, Managing Director of the Institute for Mining and Energy Law, Ruhr-Universität Bochum **After lignite** • Pastor Jens Sannig, Dean of the evangelische Kirchenkreis Jülich • Professor Bernhard Hoffschmidt, Director of the Institute for Solar Research, German Aerospace Center (DLR) • Professor Harald Bolt, member of the Board of Directors, Forschungszentrum Jülich • Sebastian Pönsgen, Managing Director, PRIOGO AG • Dirk Jansen, Head of Environment and Conservation Policy, BUND NRW e.V. • Norbert Winzen, Keyenberg

Annex 4

Site visits programme – Commission on Growth, Structural Change and Employment

24 September 2018 **09:30 to 16:30**	**Visit to the Central German mining area** **Sitting held in the Stadthaus Halle (Salle)**	
	Chair of the sitting:	Ronald Pofalla
	9:30 – 10:00	**Welcome addresses** Dr Bernd Wiegand, Major of Halle (Saale) Dr Reiner Haseloff, Minister-President of Saxony-Anhalt
	10:00 – 12:30	**Short presentations and questions to the experts** See Annex 3 for the list of experts
	12:30 – 14.30	**Lunch break in the Stadthaus**
	13:30 – 14:30	**Closed sitting of the Commission (members only)**
	14:30 – 16:25	**Plenary sitting of the Commission** Organisational matters Discussion of the conclusions resulting from the morning session Discussion of the draft structure of the report
	16:25 – 16:30	Summary and farewell
11 October 2018 **10:40 to 16:30**	**Visit to the Lausitz mining area** **Sitting held at different venues in the mining area**	
	Morning sitting: Afternoon sitting: Chair of the sitting:	TELUX Saal, Weißwasser SeeHotel, Großräschen Professor Barbara Praetorius
	10:40 – 11:00	**Welcome addresses** Torsten Pötzsch, Major of Weißwasser Michael Kretschmer, Minister-President of the Free State of Saxony Dr Dietmar Woidke, Minister-President of Brandenburg
	11:00 – 12:10	**Short presentations and questions to the experts** See Annex 3 for the list of experts heard at the Weißwasser venue
	12:10 – 13:30	**Coach transfer to SeeHotel Großräschen** with commentary provided by: Dr-Ing Klaus Freytag, Commissioner of Land Brandenburg for the Lausitz
	13:30 – 14:00	**Welcome addresses delivered outdoors at** Thomas Zenker, Major of Großräschen Greetings from Minister-Presidents Dr Dietmar Woidke (Brandenburg) and Michael Kretschmer (Saxony)
	14:00 – 14:40	**Lunch break in the SeeHotel**
	14:40 – 16:20	**Short presentations and questions to the experts** See Annex 3 for the list of experts heard at the Großräschen venue
	16:20 – 16:25	**Organisational matters**
	16:25 – 16:30	**Summary and farewell**

24 October 2018 **10:00 to 15:30**	**Visit to the Rhineland mining area** **Sitting in the Council Chamber of the Rhein-Erft District in Bergheim**	
	Chair of the sitting:	Matthias Platzeck
	10:00 – 10:20	**Welcome addresses** Michael Kreuzberg, District Commissioner, Rhein-Erft District Armin Laschet, Minister-President of North Rhine-Westphalia
	10:20 – 11:30	**Industry and energy in times of change** Short presentations and questions to the experts as listed in Annex 3
	11:30 – 13:00	**Tour of the Rhineland mining area** with commentary provided by Dr Reimar Molitor, Managing Director, Region Köln/Bonn e. V.
	13:00 – 13:45	**Lunch in the Council Chamber**
	13:45 – 15:15	**„After lignite“** Short presentations and questions to the experts
	15:15 – 15:30	**Organisational matters and farewell**

Annex 5

Voting result and separate opinions

The Commission on Growth, Structural Change and Employment adopted the final report at its sitting on 25 January 2019 by an overwhelming majority with 27 out of 28 votes in favour. The following pages set out the separate opinions submitted by members of the Commission.

Separate opinion

by Commission members Dr Felix Matthes, Professor Barbara Praetorius, Gunda Röstel, Professor Kai Niebert, Reiner Priggen and Professor Hans Joachim Schellnhuber

We accept in full the final report of the Commission on Growth, Structural Change and Employment adopted by an extremely large majority of Commission members as we consider the establishment of a societal consensus for the future development of coal-fired power following a predictable and steady path to be vitally important both on societal and on energy, climate and economic policy grounds. We consider the compromise reached, despite weaknesses in the climate policy ambitions, to be acceptable having regard to the different interests involved, in other words, climate action, the regions, the workforce, energy consumers and the energy industry. This applies both to the different objectives and strategies and to the energy, environmental, regional, economic and financial policy instruments and projects. We also consider the relative frequency of interim reviews, involving the possibility to make adjustments, an important element of the essentially consensus-based model proposed by the Commission for the phasing out of coal-fired power in Germany.

However, in implementing the consensus-based road map for the phasing out of coal-fired power in Germany, above all the political instruments and projects will require repeated adjustment to take account of actual circumstances, in particular in the context of the reviews proposed for 2023, 2026, 2029 and 2032. In our view, whenever additional or amended climate policy measures are needed going beyond the closure of power stations on a negotiated basis or on regulatory grounds, close consideration should always be given also to the introduction of a minimum CO_2 price for the electricity sector in the framework of the EU Emissions Trading Scheme (EU ETS).

It is possible and highly desirable to establish a minimum CO_2 price of that kind for the electricity sector on the basis of joint European efforts, above all in cooperation with the neighbouring countries to which Germany is particularly closely linked as part of the regional electricity market for central and western Europe (above all: France, Germany, Netherlands, Luxembourg, Austria and Denmark). The minimum CO_2 price for the electricity sector needs to rise consistently over time, above all, in order to curb the uncertainties that may result from the anticipated medium-term price volatility in the market for emission allowances under the EU ETS.

A more predictable price for CO_2 may facilitate the opening up of a wider range of emission reduction options. These are, in addition to increased incentives for the closure of power stations, above all, a CO_2-efficient operation of all power generation facilities and improved economic viability of generation options based on renewables and of measures to increase efficiency in electrical usage. It establishes much greater planning certainty for investment and disinvestment. It can significantly improve the climate effects of the coal phase out through the closure of power stations by dampening the rebound effects, both domestically and abroad, since the CO_2 price is a critical factor in determining which power stations replace the production lost through the closure of coal-fired power stations. And not least, a predictable CO_2 price allows for an additional and equally predictable compensation of electricity costs for industries that are particularly electricity intensive and leads to revenue that can be used to support and supplement the transformation process in the energy sector.

Separate opinion

submitted by Commission members Martin Kaiser, Professor Kai Niebert, Professor Hubert Weiger and Antje Grothus before the final vote on the Commission report was taken

The undersigned Commission members accept the compromise ultimately reached by the Commission on the phase out of coal-fired power in order to overcome Germany's climate policy standstill of recent years. The outcome means in the short term the steady shutdown in 2019, 2020, 2021 and 2022 of over a quarter of the coal-fired power station capacity installed.

At the outset of their work for the Commission, the undersigned members set down that the establishment of a phase out pathway that is viable in climate terms would be a guiding principle of their participation. We wish to record that in our assessment neither the planned phase out date of 2038 nor the vague pathway for the period to 2030 suffices for an appropriate contribution to climate action by the energy sector. Correspondingly, we cannot accept either of these elements.

Both the vague pathway after 2023 and the overdue phase out date hinder the energy sector's achievement of a cumulative CO_2 reduction over the coming years that is compatible with the Paris Agreement. On the contrary, the CO_2 emissions accumulating in the atmosphere are far too great for Germany to be capable of delivering its contribution to limit global warming to a maximum of 2 degrees, let alone 1.5 degrees. In this respect, the Commission has missed a major opportunity to combine ambitious climate action with future-proof regional and economic development.

A clear description of the steady phase out pathway from 2023 to 2029 is urgently needed. The Federal Government can and must establish the pathway at a later date in accordance with the steady process of shutdown specified in the Commission report.

In delivering this minority opinion, we are voting against the absence of further specific yearly steps for the period 2023 to 2030 and we are committed to ensuring that this gap is filled at a later date. In addition, the overdue phase out date is not acceptable to us on climate policy grounds. Climate protection requires a phase out by 2030.

Despite this separate opinion rejecting the two points mentioned, we accept the overall outcome as, first, a clear start for the phase out for the period to 2022, involving a specific mandate on the Federal Government to take action to shut down coal-fired power stations in the years 2019 to 2022, and the preservation of the Hambach Forest has been negotiated. Second, within a few years, the planned structural measures and the planned expansion of renewable energy will change the debate.

Separate opinion

by Commission member Antje Grothus on use of lignite in the production of other substances

The Commission report recommends in several places the use of lignite in the production of other substances (in other words, its chemical conversion).[01]

The social and economic disadvantages experienced by the individuals affected in the regions and the land damage that results from lignite mining are wholly disproportionate to that technology. For that reason, the use of lignite in the production of other substances cannot be a reason for continuing to mine lignite or to justify its mining on the basis that its use in industrial production is necessary. I reject the idea of further research to develop new options for the use of lignite and funded by the public purse as a waste of money.

The situation is aggravated by the fact that, compared with the current resource base of oil, gas and renewable biomaterials, the CO_2 emissions that result from the use of lignite in industrial production are at least twice as high. It is also impossible for products manufactured from lignite to be CO_2 neutral.[02]

Further explanations

It is proposed that in place of burning lignite it should be used in the production of fuels and chemicals as was the case in the past. Today, in Germany, it is used in industrial production only to a very limited extent for products with special applications in the manufacturing of montan wax or activated carbon.

The option of using lignite in the manufacturing of chemical products aside from special applications, as suggested by the Commission report, constitutes a dead end, however, from the perspective of climate change and efficiency. The chemical composition of lignite means that the quantity of chemical products such as fuels and plastics that a tonne of lignite produces is much smaller than can be achieved with a tonne of natural gas or oil. That is why the emissions of the greenhouse gas CO_2 are correspondingly higher. One tonne of lignite always produces the same quantity of CO_2 whether it is burned or gasified and used in the manufacturing of products.

In addition, it is impossible for the manufactured products to be CO_2 neutral as their chemical carbon skeleton remains that of lignite. If lignite is burned directly, it is fully converted to CO_2 (and ash). If it is gasified, although initially only a smaller quantity of CO_2 is released, the rest is formed later when the manufactured products reach the end of their life. In the case of fuels that occurs immediately on combustion and in the case of plastics and other chemicals when they are no longer needed and disposed of, e.g. in an incinerator.

Where renewable hydrogen manufactured using green electricity is used, coal reserves can be exploited more efficiently in such processes. However, the greater product yield comes at considerable cost. Extremely large quantities of renewable energy must be supplied such that, as a consequence of using green electricity, a proportion of the coal reserve is no longer needed for hydrogen production but can be turned into a product. Given the urgent need to decarbonise fossil-based power and heat production and mobility over the coming decades, energy quantities of that kind are hardly likely to be available.

Instead, steps should be taken to start manufacturing base substances or chemical products that build on those using primarily the carbon dioxide that results necessarily from existing processes and that cannot be avoided and in the future can only be reduced. Examples of facilities involving such processes are biogas plants, sewage treatment plants, breweries, lime kilns, brick factories and cement works For an organic chemistry that is sustainable, use can also be made of residues from renewable biomaterials and waste products that cannot be sensibly reused elsewhere, and potentially also atmospheric CO_2.

01 On pages 80, 90 and 95.

02 Deutscher Bundestag – 18th legislative period – Printed paper 18/8506.

Separate opinion

by Commission member Antje Grothus on the wording used for Hambach Forest and villages/resettlement

I accept the compromise ultimately reached by the Commission on the phase out of coal-fired power generation as the agreed 3.1 GW reduction in North Rhine-Westphalia in the Rhineland mining area will quickly lead to a reduction in CO_2 emissions and a major scaling back of opencast mining and as a result further villages can be saved from devastation.

The wording "in addition the Commission requests the Länder governments to engage in a dialogue on resettlement with those in the communities affected in order to avoid social and economic hardship" is, however, inadequate, from my position, as that wording does not stress with sufficient urgency that the Länder governments must carry out that dialogue with the aim of avoiding resettlement and devastation.

In accordance with the appointment resolution, living conditions that are equivalent should be established throughout Germany. Having regard to the wording used in the introduction of the Commission report[001] (new perspectives should be established for municipalities affected by opencast mining, ensuring that the benefits and burdens are fairly distributed / social cohesion should be strengthened particularly in the regions characterised by conflict / our proposals are intended also to strike a fair balance / the regions and the people who live there are right to expect solidarity from society and the political system), the Commission loses its credibility when it continues to allow for people to be driven from their homes and forcibly resettled in the name of lignite-fired power generation.

Resettlements are not and never were socially acceptable.[002, 003]

Consequently, the termination of coal-fired power generation can only be described as taking a socially acceptable form if it not only guarantees the social protection of workers, firmly incorporated in law, collective agreements and corresponding financial provisions, but also stops the destruction of further settlements and the forced displacement of people from their homes and better protects the municipalities on the edge of opencast mining areas.

The notion of social acceptability cannot be reduced simply to the dimension of jobs and financial security. Rather, it encompasses, as a whole, solutions that are socially just, positive effects on health and well-being, a good quality of life and, ultimately, also peaceful conflict resolution.

It is to be greatly welcomed that the Commission has clearly stated that Hambach Forest should be preserved. However, there is an absence of a clear follow-up statement that the measures proposed must result in the avoidance at all cost of further devastation to settlements still inhabited and to Hambach Forest in the course of opencast mining operations. That is central if a contribution is to be made to bringing peace to the regions and to achieving social acceptability within the meaning set out above.

In addition I wish to place on record the following:

In relation to my request to replace the term "desirable" in the sentence "The Commission considers it desirable that Hambach Forest is preserved" with the term "necessary", it was assured to me in the plenary sitting, on the part of the chair, that it was irrelevant whether the wording "desirable", "necessary" or "should be" was used in that sentence.

001 Introduction and page 101 of the Commission Report.

002 https://www.erkelenz.de/dokumente/rat-und-verwaltung/top-themen/positionspapier-umsiedler-tagebaurandbewohner.pdf?cid=3yf.

003 Gutachten zur Beurteilung der Sozialverträglichkeit von Umsiedlungen im Rheinischen Braunkohlenrevier (Expert opinion on the social acceptability of resettlements in the Rhineland lignite mining region), ILS-Schriften 48, https://www.landtag.nrw.de/portal/WWW/dokumentenarchiv/Dokument/MMV10-2737.pdf.

Annex 6 and 7

Translation still in preparation