

Expert Commission on the “Energy of the Future“ Monitoring Process

# Statement on the Second Progress Report of the Federal Government for 2017

Berlin · Münster · Stuttgart, May 2019

- Prof. Dr. Andreas Löschel (Chair)
- Prof. Dr. Georg Erdmann
- Prof. Dr. Frithjof Staiß
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## Summary

**ENERGY OF THE FUTURE** 

Commission on the Monitoring Process

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## Foreword

This statement by the Expert Commission on the “Energy of the Future“ monitoring process evaluates the Federal Government’s Second Progress Report on the energy transition for the period under review, 2017 (this simultaneously corresponds to the Seventh Monitoring Report). The monitoring process is intended to review progress towards reaching the Federal Government’s Energy Concept objectives from September 2010 “for an environmentally sound, reliable and affordable energy supply“ and evaluate the implementation status of the relevant measures, in order to readjust these where required. To this end, the Federal Government appointed an independent expert commission in October 2011 consisting of four energy scientists. These scientists are tasked with evaluating and commenting on the monitoring reports and progress reports that are published by the government ministries every year and every three years respectively. The monitoring reports focus on providing a fact-based overview of the German energy transition (“*Energiewende*“). Meanwhile the progress reports include more wide-ranging analysis and may also propose measures to overcome obstacles in the way of achieving the set objectives.

The Second Progress report on the energy transition and the corresponding statement have been published outside the originally planned cycle (Bundestag printed paper 18/6781). According to this cycle, the Second Progress Report (including the Sixth Monitoring Report) would have been submitted to the Federal Cabinet by 15 December 2017 and the seventh monitoring report by 15 December 2018. However, the negotiations that took place in autumn 2017 to form a coalition were unusually time-consuming and thus also delayed the monitoring process. Since a progress report should not only document the current status of implementing the energy transition, but also propose a vision for further development and, if necessary, far-reaching measures, the Federal Government decided to first publish a Sixth Monitoring Report (without a progress report) and only present the Progress Report (including the Seventh Monitoring Report) in the current cycle.

This Expert Commission statement chiefly refers to the draft Second Progress Report, which was made available by the Federal Ministry for Economic Affairs and Energy (BMWi) on 16 April 2019 - before internal coordination between the ministries. As far as time limits allowed, changes to the progress report were also taken into account in the context of the interministerial coordination. The statistics in the statement (inter alia in the energy transition traffic light chart) reflect the data as of 06 May 2019.

As part of the monitoring process, meetings were held (December 2018 and January 2019) with representatives from the Federal Ministry for Economic Affairs and Energy, the Federal Network Agency (BNetzA) and the Federal Environmental Agency (UBA). These meetings focused in particular on the climate and energy-related objectives for 2030 and also on the questions from the Expert Commission. The discussions this year were bolstered by the generous provision of up-to-date studies and information compiled on behalf of the Federal Government. Mention should be made of the discussions and results produced under the National Energy and Climate Plans, the National Action Plan on Energy Efficiency (NAPE) monitoring and the projects “Makroökonomische Wirkungen und Verteilungsfragen der Energiewende“ (Macroeconomic effects and distributive aspects of the energy transition), “Evaluierung des Energieeffizienzfonds“ (Evaluation of the Energy Efficiency Fund) and “Aktualisierung der Zielarchitekturstudie“ (Update of the target architecture study). In August 2018, the Chair of the Expert Commission was invited to attend the "Growth, Employment, Structural Change" commission as an expert and to a consultation in November 2018 of the Economic and Energy Affairs Committee of the German Bundestag. Our thanks go to all of our dialogue partners, especially our contacts from the ministries and federal authorities, for their constructive cooperation.

## Expert Commission on the “Energy of the Future“ Monitoring Process

The questions and issues raised during the monitoring process are addressed in this statement. Particular focus is given to an energy price reform (see the relevant chapter), in which the prompt and revenue-neutral replacement of charges on electricity by a CO<sub>2</sub>-related surcharge on fossil fuels is proposed. The aim of this proposal is to create incentives for climate-friendly investment in sector coupling, storage and flexibility options and new electricity applications, all of which are now vital steps to reduce greenhouse gas emissions. Looking ahead at the future, the Expert Commission also devotes a separate chapter each to the subjects “Outlook to 2030” and the “Outlook beyond 2030”, which are intended, among other things, to stimulate discussion on the continuation of the Federal Government’s Energy Concept for 2030 and possible long-term development paths. The present statement also highlights the question of public acceptance: this has been included in the subchapters "Monitoring public acceptance of the energy transition" and "Approaches to removing obstacles to reform". In relation to the latter subchapter, special thanks are due to Prof. Dr. Friedrich Heinemann of the Centre for European Economic Research (ZEW), who shared his expertise on the political economy of reforms in a joint workshop with the Expert Commission (January 2019).

The present statement could not have been prepared by the Expert Commission without the superb commitment shown by its scientific team. For this reason, we wish to extend our sincere thanks to Oliver Kaltenecker and Laura Klockebusch from the University of Münster, Lars Dittmar, Lisa Marina Koch, David Schröder and Dr. Fernando Oster from the Energy Systems Department of the TU Berlin, Maïke Schmidt and Anna-Lena Fuchs from the Center for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW), Stuttgart, and Eike Karola Velten and Amely Gundlach from the Ecologic Institute, Berlin.

Any errors or omissions in this statement are the sole responsibility of the undersigned.

Berlin, Münster, Stuttgart, 6 June 2019

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## Summary of the statement

### Statement on the Second Progress Report of the Federal Government

#### Status of the energy transition

1. With the Energy Concept of September 2010 and the phase-out of nuclear power of August 2011, the Federal Government has adopted an energy policy with a long-term strategy. To document the implementation of the Energy Concept and the progress made, the Federal Government publishes a fact-based monitoring report every year and a progress report every three years comprising an in-depth analysis of developments and measures, as well as an outlook for the future. Since 2011, the Federal Government has been advised in this process by an independent commission of four energy experts. The Expert Commission on the "Energy of the Future" monitoring process submits annual statements on progress in the energy transition. These are attached to the reports of the Federal Government and forwarded to the Federal Cabinet and the Bundestag.

2. This Expert Commission statement chiefly refers to the draft Second Progress Report, which was made available by the Federal Ministry for Economic Affairs and Energy (BMWi) on 16 April 2019 - before internal coordination between the ministries. As far as time limits allowed, changes to the progress report were also taken into account in the context of the interministerial coordination. The statistics in the statement (inter alia in the energy transition traffic light chart) reflect the data as of 06 May 2019. The Second Progress Report would have been a good opportunity to give substance to the coalition agreement from the spring of 2018 and the Federal Government's climate protection plan with a view to the energy transition - also during the preparation of the National Energy and Climate Plan (NECP) for the European Commission. Unlike monitoring reports, progress reports are intended not only to describe the implementation status of essential measures, but also to evaluate and, if necessary, investigate causes and obstacles in the event of undesirable developments. Progress reports are thus expected to propose measures or processes based on such measures in order to eliminate obstacles and achieve the defined goals. (Chapter 1 in BMWi, 2019f). In the view of the Expert Commission, this progress report is more like a monitoring report. The subchapters "Outlook" and "Conclusions" added to the end of the relevant main chapters do not provide convincing proposals, given the expected failures to reach targets in key areas of the energy transition. Specific relevant measures (bundles), as laid out in the First Progress Report from 2014, the National Energy Efficiency Action Plan or the Climate Action Programme 2020, are not on the horizon. The Progress Report falls short in this respect if a timely course is to be set for a successful energy transition, especially for the target year 2030. Against this backdrop, the Expert Commission has devoted a separate chapter in the present statement to the outlook to 2030 (see Chapter 3)

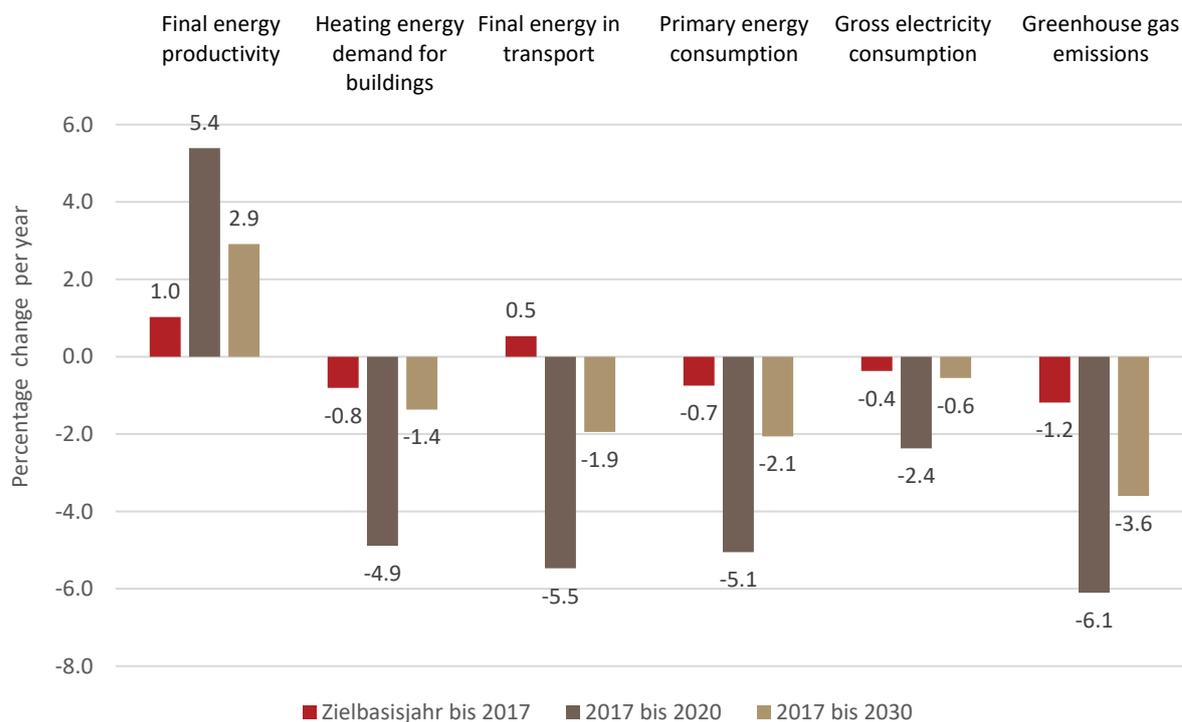
3. Irrespective of this, the Expert Commission welcomes the fact that the Federal Government, in its Second Progress Report, has addressed important recommendations put forward in the Commission's previous statement on the Sixth Monitoring Report (EWK, 2018). This includes the topic "Acceptance of the energy transition" (blue boxes in various chapters (BMWi, 2019f) and in this statement, especially in Chapter 1). The Federal Government has also responded to the proposals of the Expert Commission on the reform of fees, taxes and charges on energy (see Chapter 10 in EWK, 2018). In this context, the Second Progress Report refers to the Expert Commission's preferred instrument for the energy transition: general pricing of carbon dioxide emissions (see blue box in Chapter 3.2 in BMWi, 2019f). These and other issues raised during the monitoring process are addressed in this statement. There is a particular focus on an "energy price reform" (see chapter 12), which proposes the revenue-neutral replacement of charges on electricity by a CO<sub>2</sub>-related surcharge on fossil fuels within the near future. The aim of this proposal is to create incentives for climate-friendly investment in sector coupling, storage technology, flexibility options and new electricity applications, all of which are now vital steps to reduce greenhouse gas emissions (GHG emissions). Looking ahead at the future, the Expert Commission also

devotes a separate chapter each to the subjects "Outlook to 2030" and the "Outlook beyond 2030", which are intended, among other things, to stimulate discussion on the continuation of the Federal Government's Energy Concept for 2030 and possible long-term development paths. The present statement also highlights the question of public acceptance: this has been included in Chapter 1.4 "Monitoring public acceptance of the energy transition" and Chapter 1.3 "Approaches to removing obstacles to reform".

4. As in previous years, the Expert Commission revealed a mixed picture in its closer analysis of the progress made by the energy transition to date. Its negative assessment in relation to achieving GHG targets, improving energy efficiency and, in this context, saving energy, especially in the transport, building and primary energy sectors, is virtually unchanged compared to previous comments. For example, the annual average decrease in GHG emissions from 1990 to 2017 was only 1.2 % or only 27.5 % in total. To reach the 2020 target (- 40% compared to the 1990 level), the emissions would need to be reduced by 6.1% per annum over the remaining three-year period. Similar ratios between the objectives and the changes achieved so far are reflected in the final energy productivity: according to the Energy Concept, this should have increased by 2.1% per annum as of 2008, but the increase from 2008 to 2017 was only 1%; achieving the 2020 target would now require an annual increase of 5.4%. The situation in the transport sector looks especially bleak: Annual average energy consumption increased by 0.5% between 2005 and 2017. It would need to be reduced by 5.5% per annum from 2017 to 2020 to reach the target 10% lower consumption by 2020 compared to 2005. There is a similar shortfall in the development of building heat demand as well as primary energy and gross electricity consumption (cf. Figure Z-1). Measured against the objectives pursued by the Federal Government, considerably more action needs to be taken in these areas. The Expert Commission's views are echoed by the Federal Government's evaluations. However, the Commission would have liked to see the Federal Government drawing appropriate conclusions from their evaluations and proposing specific measures to reach the target path.

5. The Expert Commission recognises that at least the expansion of renewable energy is still on the right path. This has been driven in particular by the vibrant development of renewables-based electricity generation. For the Expert Commission, this proves that a substantial number of the Energy Concept objectives could be achieved, given the will to implement large-scale measures (such as the Renewable Energy Sources Act (EEG)). An energy price reform should be considered first and foremost as a next step in advancing the energy transition. The reform of fees, taxes and charges on energy is a difficult but necessary task. Ultimately, the energy price system requires clearer goals in order to keep down the costs of achieving the climate protection targets. Electricity prices also need to be streamlined to exploit the potential of sectoral coupling. The energy price reform can be financed by implementing largely uniform pricing of CO<sub>2</sub> emissions (cf. Chapter 12).

**Figure Z-1: Changes needed now and in the future to achieve specific energy transition targets**



Source: In-house, based on AGEb (2018a); BDEW (2019b); Destatis (2019g)

**Energy transition: traffic light symbols**

6. As in previous reports, the Expert Commission uses a traffic light in its assessment of the state of the energy transition. This format provides an authoritative presentation using seven lead indicators and various supplementary indicators. The traffic light colours indicate whether target achievement by 2020 - or by 2022 in the case of the nuclear phase-out - is likely (green) or unlikely (red). The colour amber identifies that attainment of a particular target cannot currently be guaranteed. The following Table Z-1 contains an overview of all indicators, while Table Z-2 contains a detailed analysis of each indicator.

7. The overall picture reveals "red" traffic lights in the areas of climate protection and energy efficiency. In the case of energy efficiency, the same applies to the three indicators of reducing primary energy consumption and final energy consumption in the transport sector and to increasing final energy productivity. The targeted reduction of heating energy demand in the building sector does not yet appear to have been ensured. There are clear green lights in relation to the phase-out of nuclear power and expansion of renewable energy. In the case of the latter, this evaluation refers mainly to the increase in the share of renewables in gross final energy consumption and gross electricity consumption. However, progress towards the objective of increasing the share of renewables in transport is given a negative evaluation, while the objective of increasing the share of renewables in heat consumption is considered uncertain.

8. The Expert Commission has identified uncertainties in relation to achieving the objectives in the areas of affordability, security of supply and acceptance. However, this does not apply to all of the indicators associated with these areas. For example, the Expert Commission considers the three indicators for final consumer expenditure (electricity, heat services and road transport) to be in the green light range, while the development of electricity unit costs in industry and household energy costs are rated less favourably.

9. In terms of security of supply, outages are still rare, but there are significant shortfalls in the development of electricity grids. The critical grid situations can still be remedied by cost-intensive system services such as congestion management measures. However, in the absence of a more resolute approach to grid expansion, the German government is endangering the objectives of developing renewable power generation plants and risks facing supply-critical situations in the future.

10. A straightforward evaluation of public acceptance is not available. While there is a clear general agreement on the energy transition's objectives, barely any agreement exists with regard to implementing the energy transition and the personal impact of energy transition measures. The assessment of the implementation of the energy transition is more negative since the last statement.

11. When comparing the Expert Commission assessments with those of the Federal Government, it can be noted that the Federal Government rates the reduction of GHG emissions in particular much more positively than the Expert Commission ("red" traffic light). Otherwise, the assessments of the Federal Government and the Expert Commission are relatively closely aligned for the remaining quantitative goals of the energy transition. The Federal Government assigns five points to the areas of increasing the share of renewables in gross final energy consumption (target: 18% by 2020) and increasing the share of renewables in gross electricity consumption (target: at least 35% by 2020), while the Expert Commission also considers it likely that the targets in these areas will be achieved ("green"). In terms of reducing primary energy consumption (target: reduction by 20% compared to the period 2008 to 2020), increasing final energy productivity (target: increase by 2.1% per year from 2008-2050) and increasing the share of renewables in the transport sector (target: 10% in 2020), the Expert Commission considers it unlikely that the targets will be achieved ("red"). The Federal Government is of the same view, assigning only one or two points to these areas. Meanwhile, the assessment of the reduction of heating energy demand in the building sector lies somewhere in the middle (target: reduction of heating energy demand by 20% compared to the period 2008 to 2020). The Federal Government awards three points to this objective, while the Expert Commission assigns it the "yellow" traffic light.

**Table Z-1: Summary assessment of the Expert Commission on the status of the energy transition in terms of attaining the 2020/2022 targets**

Dimension	Indicator	
Climate protection	Reduction in greenhouse gas emissions (lead indicator or headline target)	●
Phase-out of nuclear power	Operational nuclear power plants (lead indicator or headline target)	●
Renewable energy	Increase in share of renewables in gross final energy consumption (lead indicator)	●
	Increase in share of renewables in gross electricity consumption	●
	Increase in share of renewables in heat consumption	●
	Increase in share of renewables in transport	●
Energy efficiency	Reduction in primary energy consumption (lead indicator)	●
	Final energy productivity	●
	Reduction in heating energy demand in building sector	●
	Reduction in final energy consumption in transport	●
Security of supply	Expansion of transmission grids (lead indicator)	●
	Congestion management measures	●
	System Average Interruption Duration Index – SAIDI electricity and SAIDI gas	●
Affordability	End-user spending on electricity in terms of GDP (lead indicator)	●
	End-user spending on heating services	●
	End-user spending on road transport	●
	Industrial electricity unit costs by international comparison	●
	Residential energy costs	●
Public acceptance	General approval of the energy transition goals (lead indicator)	●
	Approval of the implementation of the energy transition	●
	Approval based on personal impact	●
Target attainment: ● Likely ● Not certain ● Unlikely		

Source: In-house

**Table Z-2: Detailed analysis of individual indicators**

Climate protection	<p>Reduction in greenhouse gas emissions (lead indicator or headline target) <span style="float: right;">●</span></p>	
	<p><u>Metric:</u> Total greenhouse gas emissions [megatonnes (Mt) of CO<sub>2</sub> equivalents]  <u>Target:</u> Reduction of at least 40 % in greenhouse gas emissions compared to the period from 1990 to 2020 / 55 % to 2030 [Energy Concept 2010] and reduction of 14 % compared to the period from 2005 to 2020 / 38 % to 2030 in the Non-EU-ETS sectors [EU Effort Sharing Decision 2009; EU Climate Action Regulation 2018]  <u>Evaluation criteria:</u> Prediction intervals and expert assessment  <u>Status quo 2017:</u> 907 megatonnes of CO<sub>2</sub> equivalents</p>	
Phase-out of nuclear power	<p>Operational nuclear power plants (lead indicator or headline target) <span style="float: right;">●</span></p>	
	<p><u>Metric:</u> Number of operational nuclear power plants [number of plants]  <u>Target:</u> Shutdown no later than 31.12.2017: 7 plants; 31.12.2019: 6 plants; 31.12.2021: 3 plants; 31.12.2022: 0 plants [13th Act Amending the Nuclear Energy Act (13. AtGÄndG) 2011]  <u>Evaluation criteria:</u> Expert assessment  <u>Status quo May 2019:</u> 7 plants</p>	
Renewable Energy	<p>Increase in share of renewables in gross final energy consumption (lead indicator) <span style="float: right;">●</span></p>	
	<p><u>Metric:</u> Share of renewables in final energy consumption incl. self-consumption for electricity and heat generation, as well as transport and grid losses (gross final energy consumption) [%]  <u>Target:</u> Increase in the share of renewables in gross final energy consumption to 18 % by 2020 and 30 % by 2030 [Energy Concept 2010]  <u>Evaluation criteria:</u> Prediction intervals and expert assessment  <u>Status quo 2018:</u> 16.7 %.  <u>Note:</u> The green traffic light symbol requires over-achievement of the “Increase in share of renewables in gross final energy consumption”.</p>	
	<p>Increase in share of renewables in gross electricity consumption <span style="float: right;">●</span></p>	
<p><u>Metric:</u> Share of renewables in gross electricity generation including balance of electricity traded with other countries (“gross electricity consumption”) [%]  <u>Target:</u> Increase in the share of renewables in gross electricity consumption to at least 35 % by 2020 and at least 50 % by 2030 [Energy Concept 2010]  <u>Evaluation criteria:</u> Prediction intervals and expert assessment  <u>Status quo 2018:</u> 37.8 %</p>		

Continuation

Renewable energy	<p>Increase in share of renewables in heat consumption <span style="float: right;">●</span></p> <p><u>Metric:</u> Share of renewables in final energy consumption for space heating, hot water, process heat, air conditioning and process cooling [%]  <u>Target:</u> Increase the share of renewables in heat consumption to 14 % by 2020 [Act on the Promotion of Renewable Energy in the Heating Sector (EEWärmeG) 2008]  <u>Evaluation criteria:</u> Prediction intervals and expert assessment  <u>Status quo 2018:</u> 13.9 %  <u>Note:</u> Amber traffic light symbol, since there was a drop of 0.9 percent in the period 2012-2017.</p>	
	<p>Increase in share of renewables in transport <span style="float: right;">●</span></p> <p><u>Metric:</u> Share of renewables in final energy consumption in the transport sector [%]  <u>Target:</u> Increase the share of renewables in the transport sector to 10 % by 2020 [EU Directive 2009/28/EC]  <u>Evaluation criteria:</u> Prediction intervals and expert assessment  <u>Status quo 2018:</u> 5.6 %</p>	
Energy efficiency	<p>Reduction in primary energy consumption (lead indicator) <span style="float: right;">●</span></p> <p><u>Metric:</u> Primary energy consumption [petajoules]  <u>Target:</u> Reduction of 20 % in primary energy consumption compared to the period 2008 to 2020 [Energy Concept 2010]  <u>Evaluation criteria:</u> Prediction intervals and expert assessment  <u>Status quo 2017:</u> 13,594 PJ</p>	
	<p>Final energy productivity <span style="float: right;">●</span></p> <p><u>Metric:</u> Average final energy productivity per annum in the period 2008 to the current period under review defined as real GDP divided by final energy consumption [EUR / gigajoules]  <u>Target:</u> Average final energy productivity of 2.1 % per annum in the period 2008-2050 [Energy Concept 2010]  <u>Evaluation criteria:</u> Prediction intervals and expert assessment  <u>Status quo 2017:</u> EUR 314 / gigajoule</p>	

Continuation

Energy efficiency	<p><b>Reduction in heating energy demand in building sector</b> <span style="float: right;">●</span></p> <p><u>Metric:</u> Final energy consumption for space heating, hot water, air conditioning and lighting in industry, the craft, trade and service sector and households [petajoules]  <u>Target:</u> Reduction of 20 % in heating energy demand in building sector between 2008 and 2020 [Energy Concept 2010]  <u>Evaluation criteria:</u> Prediction intervals and expert assessment  <u>Status quo 2017:</u> 3.351 petajoules (temperature-adjusted)</p>	
	<p><b>Reduction in final energy consumption in transport</b> <span style="float: right;">●</span></p> <p><u>Metric:</u> Final energy consumption in transport sector [petajoules]  <u>Target:</u> Reduction of 10 % in final energy consumption in transport sector between 2005 and 2020 [Energy Concept 2010]  <u>Evaluation criteria:</u> Prediction intervals and expert assessment  <u>Status quo 2017:</u> 2,755 petajoules</p>	
Security of supply	<p><b>Expansion of transmission grids (lead indicator)</b> <span style="float: right;">●</span></p> <p><u>Metric:</u> Discrepancy between planned and actual figure in transmission grid expansion (EnLAG and BBPIG projects) [km]  <u>Message:</u> The discrepancy is a measure of the grid-based security of supply, with increasing discrepancies indicating a (future) risk to security of supply.  <u>Evaluation criteria:</u> Expert assessment  <u>Status quo 2018:</u> Discrepancy 2,400 kilometres (1,050 kilometres completed, original planned value 3,450 kilometres)  <u>Note:</u> The red traffic light symbol reflects the assessment of continued future delays.</p>	
	<p><b>Congestion management measures</b> <span style="float: right;">●</span></p> <p><u>Metric:</u> Total of feed-in reductions in conventional and renewable generation capacity required to eliminate grid congestion [GWh per annum]  <u>Message:</u> The inadequacy of the grid infrastructure is reflected in the required feed-in reduction.  <u>Evaluation criteria:</u> Expert assessment  <u>Status quo 2017:</u> 15,700 GWh per annum</p>	
	<p><b>System Average Interruption Duration Index – SAIDI electricity and SAIDI gas</b> <span style="float: right;">●</span></p> <p><u>Metric:</u> Average electricity or gas supply outage per year and customer [minutes]  <u>Message:</u> SAIDI electricity is an indicator of electricity supply security and SAIDI gas is an indicator of gas supply security; SAIDI electricity and SAIDI gas disregard scheduled interruptions and interruptions due to force majeure; SAIDI electricity only measures outages that are longer than 3 minutes, while SAIDI gas measures all interruptions to gas supply.  <u>Evaluation criteria:</u> Expert assessment  <u>Status quo 2017:</u> 15.1 minutes for electricity and 1.0 minutes for gas</p>	

Continuation

Affordability	<p>End-user spending on electricity in terms of GDP (lead indicator) <span style="float: right;">●</span></p> <p><u>Affordability metrics:</u></p> <ul style="list-style-type: none"> <li>(Aggregated) end-user spending on electricity (or on heat services and fuel for road transport) divided by GDP [%]</li> <li>Electricity unit costs for industry defined as cost of electricity divided by value added [%]</li> </ul> <p><u>Message:</u> The indicators measure the burden of energy costs.</p> <p><u>Evaluation criteria:</u> Expert assessment</p> <p><u>Status quo 2017:</u> 2.1 % (end-user spending on electricity in terms of GDP)</p>		<p>— End-user spending on electricity in terms of GDP</p>
	<p>End-user spending on heating services <span style="float: right;">●</span></p> <p>— End-user spending on heating services in terms of GDP</p>	<p>End-user spending on road transport <span style="float: right;">●</span></p> <p>— End-user spending on road transport in terms of GDP</p>	<p>Industrial electricity unit costs by international <span style="float: right;">●</span></p> <p>— Electricity unit costs in Germany — Electricity unit costs in the EU</p>
	<p>Residential energy costs <span style="float: right;">●</span></p> <p><u>Metric:</u> Spending on energy by private households (excluding vehicle fuel) as a share of their overall consumer spending [%]</p> <p><u>Message:</u> The indicators shows the burden of energy costs borne by households and draws attention to potential social consequences of the energy transition; the burden of energy costs on low-income households is compared with the burden on average households.</p> <p><u>Evaluation criteria:</u> Expert assessment</p> <p><u>Status quo 2017:</u> 8.1 % (low-income households) and 5.7 % (average household)</p>		<p>— Monthly household income less than EUR 900 — Average household</p>
	<p>General approval of the energy transition goals (lead indicator) <span style="float: right;">●</span></p> <p><u>Metric:</u> Share of the population in favour of or opposed to the energy transition with regard to:</p> <ul style="list-style-type: none"> <li>general targets</li> <li>implementation</li> <li>personal impact [percent]</li> </ul> <p><u>Message:</u> The indicator is a measure of public acceptance of the energy transition and reflects societal support for the collaborative project.</p> <p><u>Evaluation criteria:</u> Expert assessment on the basis of the Social Sustainability Barometer</p>		
Public acceptance	<p>Approval of the implementation of the energy transition <span style="float: right;">●</span></p>		
	<p>Approval based on personal impact <span style="float: right;">●</span></p>		

12. According to the German Meteorological Service (2018), 2018 was “a big year in climate change”. The record summer starkly highlighted the potential effects of climate change that could become more common in Germany and large parts of Europe in future. The summer heat, which also inspired 2018’s official word of the year “Heißzeit“ (GfdS, 2018), had significant negative consequences for the energy industry and other areas of the economy. In some cases, coal, gas and nuclear power plants were obliged to reduce their output. This is a clear example of the type of possible implications that outages which are not statistically independent of each other can have for security of supply. The direct damage caused to German agriculture alone amounted to several billion euros. Estimates of the economic consequences of climate change suggest that, with a rise in global average temperature of 2.5 ° C, for example, global gross domestic product will drop by 1.3%. A drop of 0.2 % is estimated for the EU. In this context, the Expert Commission reiterates its recommendation from previous years to significantly increase efforts to reduce GHG emissions and also adapt to the effects of climate change. The necessary measures are also useful in the national interest (alone) and should successively include a carbon pricing adjustment to take account of damage caused by climate change.

13. This year, the Expert Commission is concentrating more intensely on analysing obstacles to reform that stand in the way of a successful energy transition, while outlining approaches on how to overcome these. An essential step in this regard is the establishment or regaining of confidence in politics and energy transition policymaking, in order to address citizens’ perception (documented by many surveys) of a divide between political promises and the realities of the energy transition. One starting point is to set up positive examples to act as role models. Specifically, the Expert Commission recommends the establishment of a “Citizens’ Forum on the Energy Transition”. There are a number of other ways to improve public acceptance, for example, by providing more targeted information and communication services, enshrining the fairness principle, creating a clear policy vision and obtaining a positive overview of risks and benefits.

14. Rigorous monitoring of the public’s acceptance of the energy transition is becoming increasingly important. Waning public support for many energy transition projects makes it difficult, for example, to expand the renewable electricity supply and thus achieve the objectives in the respective outlooks for 2030 and 2050. An extensive acceptance survey which is conducted on a regular basis is provided by the “Social Sustainability Barometer of the German Energiewende”. At the more general level of the energy transition targets, the barometer still shows high approval ratings. However, implementation of the energy transition is increasingly viewed critically by the population. This applies in particular in the case of negative personal impact, whether actual or subjective. Countermeasures are required to address these concerns. The Expert Commission offers some guidance in this statement.

15. Acceptance of the energy transition and the political enforceability of measures also depend on the associated economic distribution effects. The energy transition in the electricity sector to date has undoubtedly placed a greater burden on lower-income households. There are distribution effects in the industrial sector, for example, through the relief schemes offered to energy-intensive companies in respect of energy-related fees and charges. For this reason, much greater analysis of future energy transition measures with regard to their distribution effects is required. The revenue-neutral energy price reform proposed by the Expert Commission (see Chapter 12) can at least partially reduce undesirable effects.

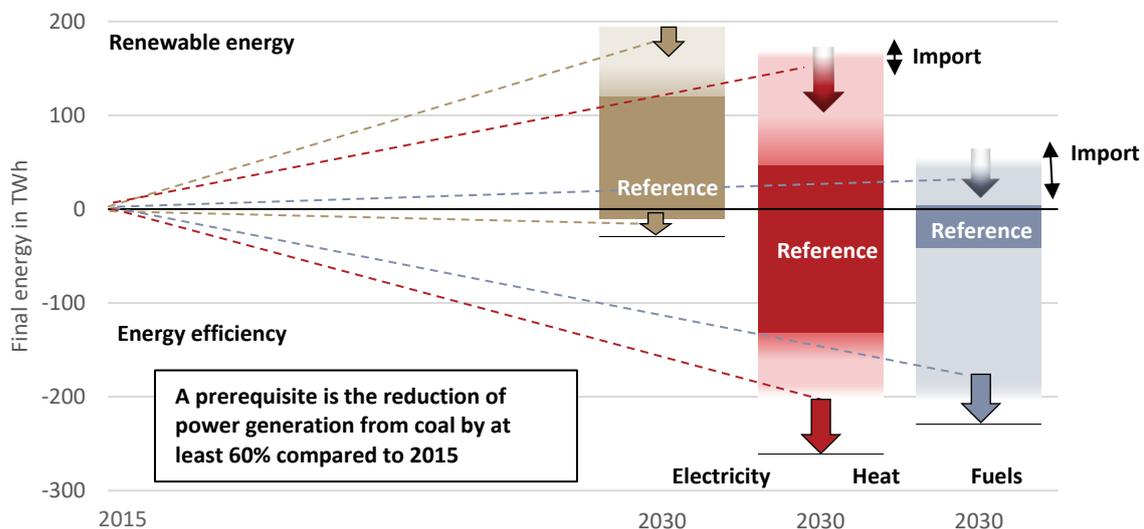
## Outlook to 2030

16. Once the phase-out of nuclear energy is complete, the climate protection target will become the sole overarching quantitative goal of the Energy Concept from 2023. Greenhouse gas reduction must be accelerated significantly over the next decade. In relation to the reporting year 2017, a reduction of at least 55% compared to 1990 would require the same progress to be made in the next 13 years as that achieved in the past 27 years, which included the reunification effect.

17. The Expert Commission hopes to stimulate discussion on the continuation of the Federal Government's Energy Concept for 2030 by elaborating guidelines for a quantitative set of targets that is conceivable. This does not yet exist, but appears to be required in the context of the EU Climate Action Regulation. According to this regulation, failures to meet national targets for climate protection in the transport and heating sectors can result in high fines.

18. Due to the large number of market participants and limiting conditions, achieving high efficiency gains in the short term is likely to be more difficult than expanding the supply of energy from renewable sources. The Expert Commission also recommends considering increased imports of renewable (electricity-based) gaseous or liquid fuels (such as methane produced from renewables or the feed-in of hydrogen into the natural gas grid). Importing renewable energy sources is an additional option to the domestic substitution of fossil fuels. However, in many cases, this is probably only to be considered as a second-best solution. The necessary change in final energy consumption through energy efficiency and renewables up to the year 2030, including the import of renewable fuels, is shown in Figure Z-2. This figure highlights in particular the assessment of flexibility (arrows) and the reference development according to the Federal Government's National Energy and Climate Plan (NECP) in the action areas electricity, heat and fuels.

**Figure Z-2: Necessary change in final energy consumption through energy efficiency and renewable energy to the year 2030, including the import of renewable fuels, assessment of flexibility (arrows) and the reference development in the NECP**



Grouped by action areas Electricity, Heat and Fuels. The use of (renewable) electricity in transport (electric mobility) and to supply heat (heat pumps, power-to-heat) is shown under Electricity.

Source: In-house estimate based on Prognos *et al.* (n.a.); BMWi (2019c); Öko-Institut *et al.* (2019). The use of fuels in industrial thermal power plants for heat generation has not been reported, so has been included based on in-house estimates.

19. As one of several variants, the following targets can be extrapolated to further pursue the Energy Concept to 2030 - provided that GHG emissions are reduced by at least 55% compared to 1990:

- Power generation using coal should be reduced by at least 60%.
- In the non-ETS sector, the EU Climate Change Regulation target of -38% compared to 2005 should be added.
- The 2020 target of an 18% share of renewable energy in gross final energy consumption should be raised to at least 32% in line with the EU target.
- The target for renewable electricity generation should at least match the 65% share of gross electricity consumption envisaged in the Federal Government's coalition agreement.
- The 2020 target of a 14% share of renewable energy in final energy consumption for heat should be updated and raised to 30-35%.
- The EU's 2020 target of increasing the share of renewable energy sources in the transport sector's final energy consumption by 10% should be raised to 20%. The possibility of multiple crediting for certain energy sources should be eliminated in this case.
- The 2020 target for reducing primary energy consumption should be maintained in the region of 30% compared to the base year 2008. It should also be supplemented by a reduction in final energy consumption of around 20% compared to 2008.
- Despite the plethora of new electricity applications that are increasingly available, savings in "traditional" electricity consumption should help to avoid an increase in electricity consumption. The existing target (2020) of reducing gross electricity consumption by 10% compared to the base year 2008 should be retained for 2030.
- The 2020 target for reducing the demand for heating energy (or final energy consumption) for buildings compared to the baseline year 2008 should in future refer to the total final energy consumption for heat (including process heat) and arrive at between 20-25% for 2030 (without electricity use for heat).
- The 2020 target of a reduction of 10% in final energy consumption in the transport sector compared to the base year 2005 should be updated and increased to 25%.

The Expert Commission recommends that the Federal Government takes these considerations into account as the Energy Concept moves into its next phase.

### **Outlook beyond 2030**

20. For Germany, a national climate protection target that complies with the "2°C target" would mean reducing greenhouse gases by 95% compared to 1990. To this end, a reduction of approx. 25 Mt of CO<sub>2</sub> per year between 2018 and 2030 and again between 2030 and 2050 would be required. By comparison, emissions were reduced by around 10 Mt of CO<sub>2</sub> annually between 2010 and 2018.

21. For a renewable electricity system dominated by photovoltaic and wind power, the legislature will need to create conditions for the necessary expansion corridors and grid expansion, as well as for flexibility options such as demand side management or storage. The Federal Government's Progress Report barely mentions the role of natural gas, despite the importance of this source of energy and thus does not disclose a coherent strategy for the future use of gaseous (renewable) energy sources.

22. An adjustment to the ambition level from at least -80% to -95% is primarily achieved in these scenarios by more comprehensive use of synthetic (electricity-based) renewable fuels. Furthermore, new methods for avoiding process emissions are needed in industry, for example, by using green hydrogen for steel production.

Carbon capture and utilization (CCU) technologies will also be a necessary addition from the current perspective. For 2050, the energy transition scenarios analysed also identify the great potential and necessity of sector coupling technologies in order to achieve the climate protection targets (cf. Table Z-3). It may not be possible to achieve very extensive defossilisation solely with the direct use of energy from renewable sources or in connection with Power-to-X technologies. The Expert Commission therefore recommends that attention should be given to a broader portfolio. In the building and agricultural sectors, the Federal Government should also consider options that are rarely discussed, such as innovative thermal insulation or methane-inhibiting feed additives.

**Table Z-3: Selected sector coupling technologies in 2050**

Feature	BCG/Prognos – REF	BCG/Prognos – 80 %	BCG/Prognos – 95 %	ewi – REV 95 %	ewi – EV 95 %	frontier economics – S&S 95 %	frontier economics – S&GG 95 %
Heat pumps [Million units]	4	14	16	13	6	17	7
Electric cars and electric LCVs [Million units]	14+1	26+2	33+2	33+2	33+2	No exact data	
HGV overhead power line [km]	0	4,000	8,000	No exact data			
Synthetic fuels [TWh]	0	0	268	170-177	188-207	467 (PtL)	622 (PtL and green gas)
Synthetic fuels and combustibles [TWh]	0	0	383	448	634	No exact data ( <i>et al.</i> 100 % import of PtL for air travel and shipping)	
Import of synthetic fuels [TWh]	0	0	340	402	585		

Source: In-house, based on BCG/Prognos (2018), ewi (2017) and frontier economics *et al.* (2017)

23. The Federal Government's Progress Report rightly stresses the importance of energy research as a "key function for a successful energy transition". For this reason, the Expert Commission recommends that future reports include a more comprehensive evaluation of the effects of the innovation system on the energy transition (and possibly vice versa) and the associated consequences for the economy. Private sector spending, which is about ten times higher than government spending on research and development, should also be considered. The Progress Report also rightly points out that one of the purposes of public funding for research is to support innovation within the German economy.

24. The Expert Commission welcomes the promotion of systemic research, including social dimensions, as well as the support of technology transfer into practice by means of living laboratories. However, the lack of any political decision to date on reforming energy prices leaves the market outlook largely open for many applications (see also Chapter 12 on energy price reform). There is therefore a risk that living laboratories will fail to get off the ground and the potential for innovation will be lost. All Power-to-X technologies, for which industry requires a market outlook, are highly relevant in this context. While other countries have already implemented highly dedicated strategies in this area, development in Germany is currently stagnating at demonstration project level. The Expert Commission recommends more intensive analysis of Germany's competitive position in this field in

terms of international innovation, as well as other relevant technological fields (such as digitisation) of the energy transition.

## **Greenhouse gas emissions**

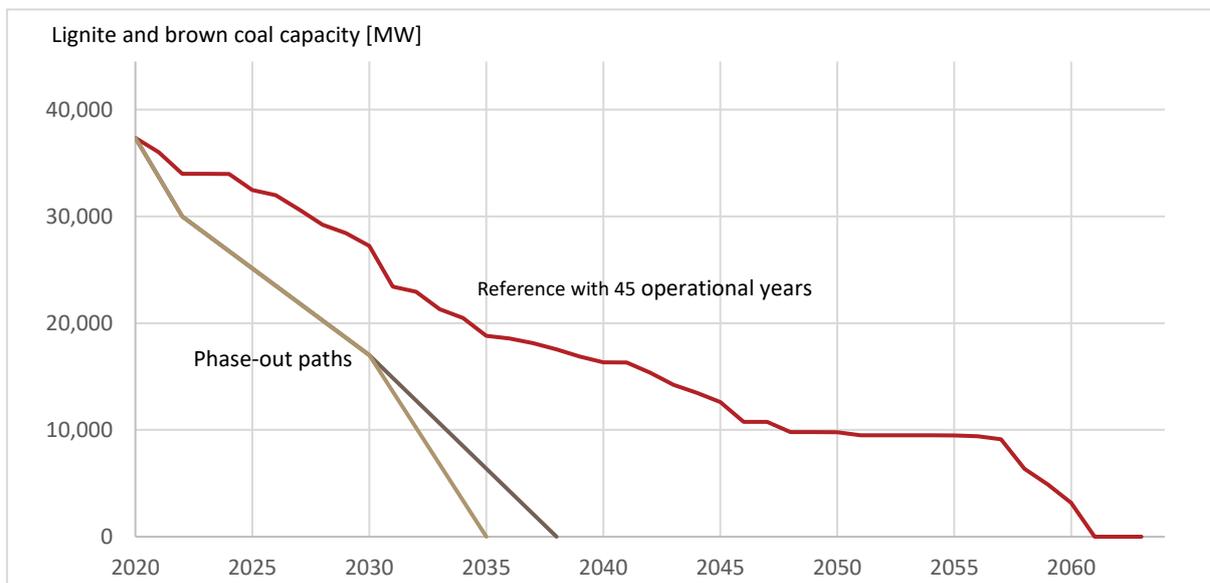
25. The development of GHG emissions is still off course. Even the slight decline of 0.5% in emissions in 2017 and the substantial reduction of 4.5% in 2018 according to initial estimates did little to change this. For years, the Expert Commission has warned of the risk of missing the 2020 target by a substantial margin. The Federal Government has since recognised this risk and noted a need for significant action. At the same time, it wants to make every effort to ensure the 2030 target of –55 % is reached.

26. The Expert Commission expressly welcomes the Federal Government's intention to align its climate protection policy with the ambitious goals of the Paris Climate Agreement. However, the success of this intention in both the medium and longer term will depend on a fundamental reorientation of energy and climate protection policy. This requires a review of the existing almost incalculable range of small-scale measures as well as the appropriate dimensioning of measures. All sectors are affected, not least the transport and building sector. In the Expert Commission's view, the Federal Government should therefore prioritise a comprehensive energy price reform.

27. The Second Progress Report is generally lacking on specific new measures and guidance on how to implement these. This applies not least to the implementation of the recommendations of the "Growth, Structural Change, Employment" Commission (more commonly called the "coal commission"). Notwithstanding some critical comments on these recommendations, the emission target for 2030 cannot be achieved without the proposed decommissioning of coal-fired power plants, together with an increase in the share of renewables to at least 65% of electricity consumption. The Expert Commission considers that the measures to be taken require a legal definition. The present draft of a climate protection law provides a basis for this.

28. The "Growth, Structural Change, Employment" Commission presented its final report at the end of January (KWSB, 2019). Among other things, the report contains recommendations on the German phase-out of coal and lignite power generation (cf. Figure Z-3). The reference development also shown in Figure Z-3 assumes a 45-year standard operating lifetime for hard coal and lignite power plants. This value is slightly below the historically observable operating lifetimes of 48 years on average. However, it is plausible due to the assumption that most coal-fired power plants are kept on standby for a few years at the request of the Federal Network Agency in order to safeguard security of supply. In the case of the politically instigated decommissioning of plants to the year 2030, an operating lifetime reduction of up to 10 years is required. The capacity to be decommissioned from 2030 is expected to reduce the operating lifetime by up to 25 years, which would affect in particular the relatively new power plants today with a total capacity of about 10 gigawatts (GW). This decommissioning will undoubtedly result in compensation claims by, for example, the power plant operators against the state to attract. The Expert Commission recommends that the Federal Government should immediately investigate whether the still comparatively new power plant units could be made industrially usable by suitable modifications after their use as coal-fired power plants comes to an end. In this regard, it calls for the establishment of appropriate R & D projects.

**Figure Z-3: Pathways for coal phase-out: Reference development and phase-out recommendations of the “Coal Commission”**



Source: In-house, based on BNetzA (2019c) and KWSB (2019)

29. The Expert Commission overall rates highly the fact that despite the very heterogeneous interests represented in the Coal Commission, it managed to submit a joint result. However, it is not in a position to comment here on all of the issues addressed by the Coal Commission, especially as it remains to be seen to what extent the Coal Commission's recommendations will be implemented by the German government. However, the Expert Commission would like to highlight some critical aspects regarding the implementation strategies proposed by the Coal Commission. This includes, for example, the impression that the Coal Commission's compromises closely comply with the expectations of political-economic theory: that is, that negotiations in the political sphere are often concluded at the expense of third parties (in this case at the expense of taxpayers).

30. In principle, the Expert Commission welcomes the Coal Commission's recommendation to carry out a monitoring and evaluation process (cf. Chapter 6 therein). It also agrees with the call for an "independent panel of experts". However, the Expert Commission has serious reservations about the suggestion that "the expertise of the Growth, Structural change and Employment Commission should continue to be leveraged" in this connection. This is especially true if the suggestion is understood as meaning that members of the coal commission should also become members of the proposed monitoring commission. Such a development would be a core contradiction to an effective and good governance structure. The Federal Government should therefore not take up this particular suggestion.

31. Climate action measures in the transport and building sectors must be aligned with the EU objectives for non-ETS sectors. Emissions in these sectors have exceeded the corresponding target path since 2016. Germany will therefore have to buy emission allowances from other EU countries until 2020 in order to fulfil its obligation under the Effort Sharing Decision. Depending on the assumed allowance price and the development of emissions, the expected annual costs will be approximately 30 to 500 million euros for the period 2018-2020. For the 2021-2030 follow-up period, the deviation from the target path is expected to be significantly greater if further measures are not taken. A reduction of 1% in emissions per year would result in a cumulative deficit of 684 million allowances; in the ambitious scenario including additional measures from the Projections Report of the Federal Government, the deficit would still amount to 176 million allowances. Depending on the projected

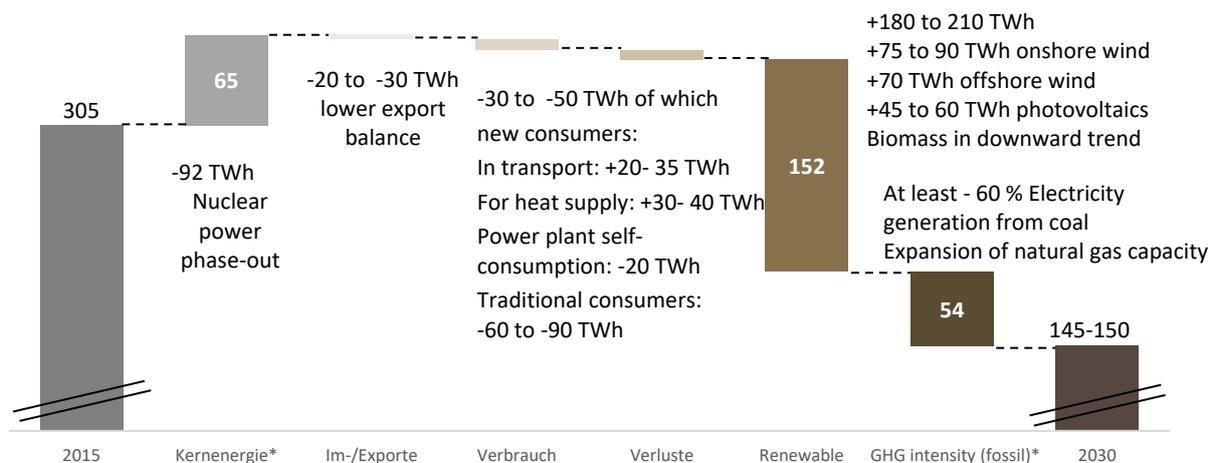
emissions and the assumed allowance price (up to 100 euros), Germany could incur costs in the order of zero to 9 billion euros annually.

32. Finally, the Expert Commission points out that energy-related emissions in industry increased by more than 17.5% in the period from 2005 to 2017, even more than in the transport sector (+ 4.2%). For this reason, the Expert Commission also sees a clear need for action in industry - beyond the scope of emissions trading - with regard to future emissions targets.

### Renewables-based electricity generation

33. The expansion of renewable energy remains generally on track. In 2017 and 2018, the proportion of gross final energy consumption covered by renewables rose again by 15.9 % and 16.7 % respectively. The reason for this was the dynamic expansion of renewables-based electricity generation, primarily in onshore wind energy use. For example, the Federal Government's minimum target of covering a 35% share of electricity consumption for 2020 with renewables was exceeded with 36% in 2017, while the share achieved in 2018 was almost 38%. The expansion of renewables-based electricity generation as a replacement for fossil-based power generation is also the biggest contributor to reducing CO<sub>2</sub> emissions from electricity generation by 2030. This is made clear in Figure Z-4, which quantifies the key factors influencing the CO<sub>2</sub> emissions from electricity generation from the Expert Commission's perspective.

**Figure Z-4: Development and impact of the key influencing factors on electricity generation emissions in 2030 compared to 2015 in Mt of CO<sub>2</sub>**



\* Since nuclear power generation is free of emissions, the discontinuation of nuclear power will increase emissions compared to 2015. The reduction in electricity generation from coal goes hand in hand with the expansion of natural gas capacity, which now covers parts of electricity generation. This generation of electricity has significantly lower specific CO<sub>2</sub> emissions due to higher efficiencies and the much lower emission factor of natural gas compared to coal. The GHG intensity of fossil power generation is thus reduced, contributing to lower emissions.

Figure illustrates the orders of magnitude.

Source: In-house estimate, based on AGEBA (2018b), Agora (2018d), Öko-Institut and ifeu (2018), NEP 2030 (2019a), UBA (2019a), Öko-Institut (2019), Öko-Institut *et al.* (2019).

34. The 2020 target set by the EU for Germany of 18% share of gross final energy consumption from renewable sources seems achievable, but can by no means be regarded as guaranteed because the momentum behind renewables-based electricity generation is waning. For example, the tenders for onshore wind energy are repeatedly undersubscribed and the number of approved sites indicates that no improvement is expected in the near future. Since compensation under the current regime is neither possible within the electricity sector using

other technologies, nor expected from the heating or transport sectors, it will be necessary to take additional measures to achieve the target.

35. Crucial decisions will also need to be taken in good time for 2030. These will be necessary, for example, if the increase to 65% in the share of electricity consumption from renewable sources, which is anchored in the coalition agreement, is to be implemented. The Expert Commission is deeply worried that the Progress Report did not include the 65% target as an explicit target for 2030, but only mentions it in Table 2.1 (target table) as a footnote referring to the coalition agreement. If investments in renewable energy fail to materialise outside the EEG, an adjustment of the corridors for expanding capacity within the EEG is essential. The 65% target will require an annual gross increase in capacity of around 4 to 4.5 gigawatts (GW) for photovoltaics and about 4 GW for onshore wind turbines. In addition, the capacity of offshore wind energy would need to be increased by up to 5 GW. The necessary investments are only made in a stable economic environment. This must therefore be defined as quickly as possible. Abolishing the existing 52 GW ceiling for photovoltaics would be a first step.

36. Another important factor is the issue of space availability. Transparent, proactive and balanced spatial planning will be required to achieve the 65% target. The Expert Commission therefore considers it misguided to abolish the favourable treatment of undeveloped outskirts because this would eliminate any obligation to continue to "give substantial space to wind energy". The primary objective must therefore be to have more robust and legally secure concentration zone planning in the future. In the field of photovoltaic systems, it can be assumed that at least some of the additional capacity will need to be provided by ground-mounted installations. There is therefore a need for action with regard to permissible delimited areas if the expansion is to be implemented cost-effectively.

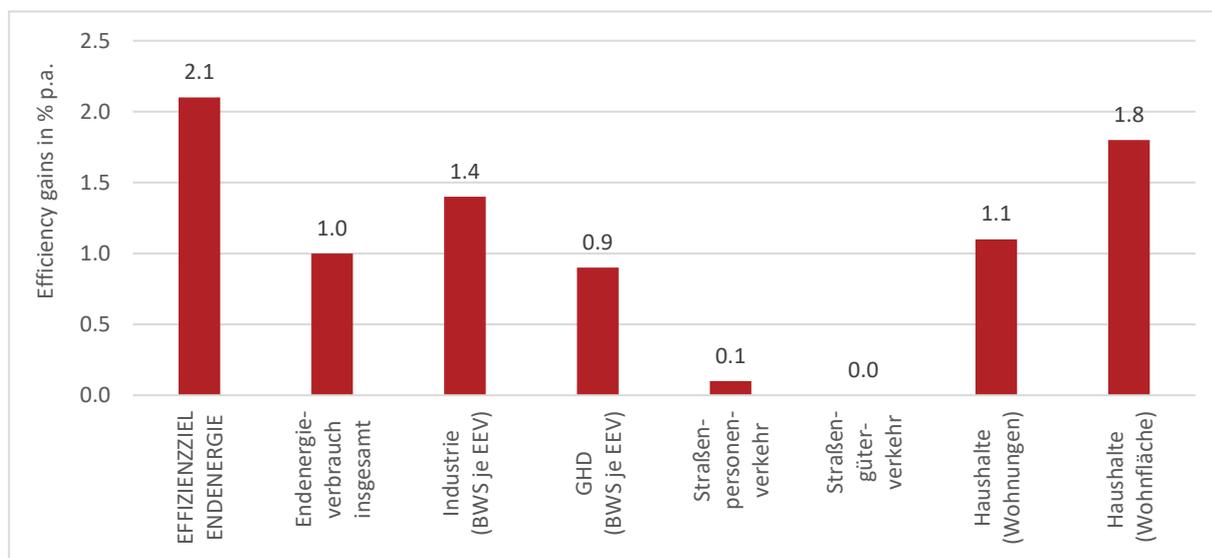
37. However, the increasing number of ever larger facilities is associated with conflicts of interest and use. This applies in particular to the use of onshore wind energy. Challenging expansion targets can only be achieved if the affected residents and communities are better integrated and engaged in the energy transition. Participatory models used to date such as the tenants' electricity model or community wind farms have not so far achieved an adequate degree of success. The development of other options in this area should be explored.

38. The Expert Commission has closely followed the dynamic developments on the market for Power Purchase Agreements (PPAs) and advises the Federal Government to use the requirements of the European Renewable Energy Directive as an opportunity to examine the effects of this type of marketing model on expansion goals and costs, under the EEG, for example. As part of this process, a review should also be carried out as to whether and under what conditions funding would also be possible in Germany for the transfer of guarantees of origin for new installations and whether this transfer would be beneficial for expansion.

## **Energy efficiency**

39. Both the Federal Government's monitoring reports and comments from the Expert Commission to date have repeatedly lamented the lack of progress on energy end-use efficiency and called for more incentives. The present Second Progress Report echoes this pattern. There is a clear failure to reach the targeted increase in final energy productivity by an annual average of 2.1% (cf. Figure Z-5). On average, final energy productivity only increased by approximately 1% between 2008 and 2017; in 2017, it even fell by 0.9% compared to the previous year. Nevertheless, there are signs that things may noticeably improved for the first time in 2018.

**Figure Z-5: Development of energy efficiency in specific final energy consumption sectors from target base year 2008 to 2017**



Sources: In-house, based on AGEb (2018a), Destatis (2019g) and BMVI (2018).

40. The target can no longer be achieved by 2020. To reach the target path by 2030, the increase in final energy productivity would have to be multiplied approximately by a factor of three. An increase of this magnitude would require a significant reduction in final energy consumption, which, in the Expert Commission's view, is barely feasible with the measures implemented so far. To date, a slight decline in final energy consumption has only been observable in private households. It is virtually stagnant in the industrial sector and trending upwards in trade, commerce and services, most especially in transport.

41. In transport, this is mainly due to increasing traffic volumes and the structural changes in the vehicle fleet. These developments could not be offset by the improvements in energy efficiency. If traffic volumes continue to increase in future, as assumed by the Federal Transport Infrastructure Plan, energy efficiency will need to be drastically boosted in order to achieve a genuine reduction in energy consumption and lower GHG emissions. In the Expert Commission's opinion, policymakers will need to decide whether to continue to focus primarily on efficiency and fuel substitution or also target traffic-reducing measures (see also Chapter 8).

42. The necessary increase in energy efficiency would also require a review of the National Action Plan on Energy Efficiency Plan (NAPE), which had an extremely limited impact according to the Second Progress Report. In the view of the Expert Commission, the forthcoming revision of the National Energy and Climate Plan should take the opportunity to launch larger funding programmes. This includes not only direct investment grants, but also extensive tax relief for energy-saving and climate-friendly investments.

## Buildings

43. The energy saving target for the building sector will most likely be missed by 2020, especially since the final energy demand of buildings grew in 2016 and 2017. In residential buildings and in the craft, trade and service sector, the reductions in final energy demand achieved since 2008 for space heating, hot water preparation, and also for process heating and cooling in the service sector, are not in line with the target. From 2008 to 2017, for example, the final energy demand of buildings fell on average by only 0.7% per annum (original values) or 0.8% per annum (adjusted). To achieve the target, the reduction would have to be multiplied fivefold to 5% per year. Reaching the 2020 target is thus no longer realistic.

44. The development of the share of renewables in final energy consumption for heating and cooling is inadequate, although at first glance it appears to be on the target path: with a share of 13.4% in 2017 and 13.9% in 2018, the target of 14% in 2020 seems formally achievable. However, since changes in the calculation system were not accompanied by adjustments to the targets, the reported shares are not comparable to the original target anymore. According to an initial estimate, the target should have been raised to 18-20%. This creates a clear discrepancy of 4-6% points.

45. The Energy Efficiency Strategy for Buildings is not sufficiently ambitious by comparison to the energy savings targets of the Federal Government's Energy Concept, but does set a good framework for achieving targets by 2030. However, it lacks an appropriate package of measures to shift progress towards the targets. In the Expert Commission's view, the target values from Figure Z-6 should be sought for overall demand for heating energy (including industrial process heat). These values strike a balance between a focus on efficiency and a focus on renewable energy.

**Figure Z-6: Development and impact of the key influencing factors on emissions produced by heat supply in industry, private households, and the craft, trade and service sector in 2030 compared to 2015 in Mt of CO<sub>2</sub>**

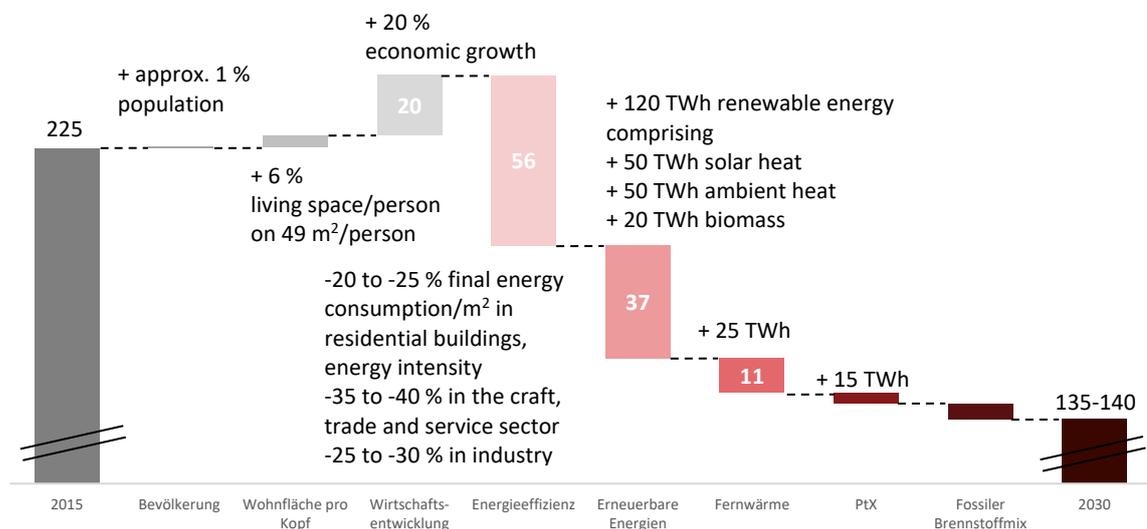


Figure illustrates the orders of magnitude. Including process heat in industry.

Source: In-house estimate based on Prognos *et al.* (unpublished), BMWi (2015), Agora (2017), BCG and Prognos (2018), dena (2018), Öko-Institut *et al.* (2019).

46. The measures implemented in the period under review to increase energy efficiency and the share of renewable energy in the building sector are basically limited to promotion, information and research programmes as well as to a change in the verification of compliance with legal standards. A tightening of the regulatory law in the context of the Buildings Energy Act (GEG) was abandoned, while the previously announced tax deductibility of energy-related renovations has yet to be implemented. In addition, the heavy capacity utilisation of the construction industry makes modernisation of the building stock more difficult.

47. For some of the existing measures, the Progress Report specifies the final energy savings achieved in individual years. However, the calculation basis for these figures makes these difficult to interpret. There is also a dearth of information on the extent to which these measures are either complementary or overlapping. The Expert Commission recommends that a comprehensible presentation be provided of the assumptions for the individual evaluations.

48. The Progress Report does not mention any further measures in the building sector, but refers to an internal process for drafting up a new efficiency strategy. There is no doubt that new measures are urgently needed to move forward with the energy-efficient refurbishment of buildings. However, this task must be made more attractive to both building owners and tenants. The Expert Commission also recommends the introduction of cross-sectoral pricing of CO<sub>2</sub> emissions in order to improve the framework conditions for energy-efficient technologies and the supply of renewable energy (see chapter Energy prices).

## Transport

49. Despite the objectives formulated in the Federal Government's Energy Concept from 2010, no reduction of energy consumption or of greenhouse gases in the transport sector has been achieved. On the contrary: Final energy consumption in the transport sector rose by 2.4 % in 2017 compared to the previous year. This is the fifth successive rise. However, according to the 2050 Climate Action Plan, the transport sector should cut its emissions to 98 Mt of CO<sub>2</sub> equivalents by the year 2030. Compared to emissions of 168 Mt of CO<sub>2</sub> equivalents in 2017, emissions therefore need to be reduced by 70 Mt of CO<sub>2</sub> equivalents or approx. 42 %.

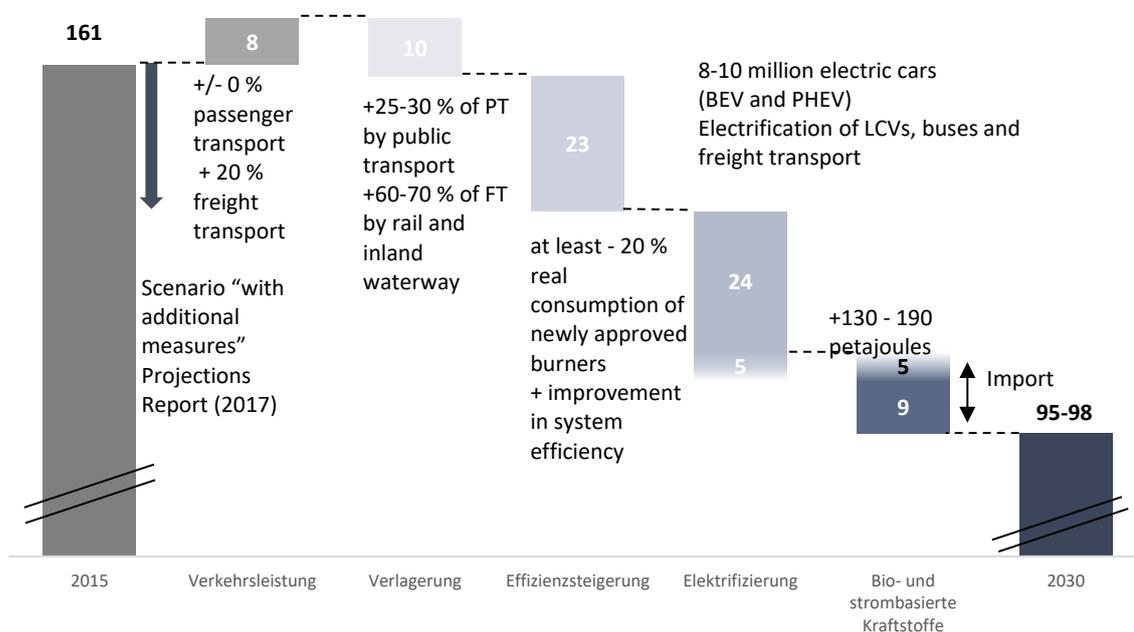
50. The coalition agreement states that German transport policy is bound by the Climate Action Plan 2050 and the Paris Climate Agreement. Nevertheless, concrete plans for implementation are still pending. All of the signs to date in fact suggest that the 2020 energy transition targets for transport will not even be achieved by 2030.

51. The National Platform on the Future of Mobility, in its interim report published by the working group "Transport and climate change" in March 2019, identifies many possibilities for a more climate-friendly transport sector. It also provides guidance on appropriate instruments for realising, or at least coming close to, the 2030 targets. However, this achievement would require the measures to be implemented immediately. The Expert Commission considers the proposals to offer a good basis for a climate-friendly transport policy. However, further measures would also have to be implemented. These include, for example, the introduction of access charges for specific urban areas. This type of "city toll" could lower emissions and reduce the volume of traffic, while also internalising other negative externalities such as traffic jams, noise and air pollutants. In this way, the economic costs of vehicle use would be borne by transport users.

52. With the continuation of the CO<sub>2</sub> fleet limits for passenger cars and light commercial vehicles and their introduction for heavy commercial vehicles (trucks and buses), the European framework for new vehicles is now set for 2030. The EU requirements can be met by increasing efficiency and using electric drives. However, further efforts will be needed to reduce and shift traffic to more climate-friendly modes of transport. The take-up of electric drives will depend significantly on expansion of the charging infrastructure. This is not simply a question of improving the public charging infrastructure, but also about reducing any legal obstacles to the installation of charging devices in the private sector as quickly as possible.

53. The use of CO<sub>2</sub>-neutral, electricity-based liquid or gaseous fuels (eFuels) can also contribute to climate protection. Although the use of electricity-based fuels, compared to direct electrification, is associated with high conversion losses and currently high costs, this use should be considered, especially for some heavy goods traffic and rail transport and, in the absence of foreseeable alternatives, also for aviation and shipping. From today's standpoint, the import of renewable fuels can mainly be assumed in this case. The Expert Commission recommends that the Federal Government define, within the near future, a roadmap for electricity-based fuels, while also drafting clear rules for their market launch. One possible option for achieving the 2030 targets for the transport sector is shown in Figure Z-7.

**Figure Z-7: Development and impact of the key influencing factors <sup>1</sup>on transport sector emissions in 2030 compared to 2015 in Mt of CO<sub>2</sub>**



Abbreviations: PT: Passenger Transport, FT: Freight Transport, BEV: Battery Electric Vehicle, PHEV: Plugin Hybrid Electric Vehicle. Figure illustrates the orders of magnitude.

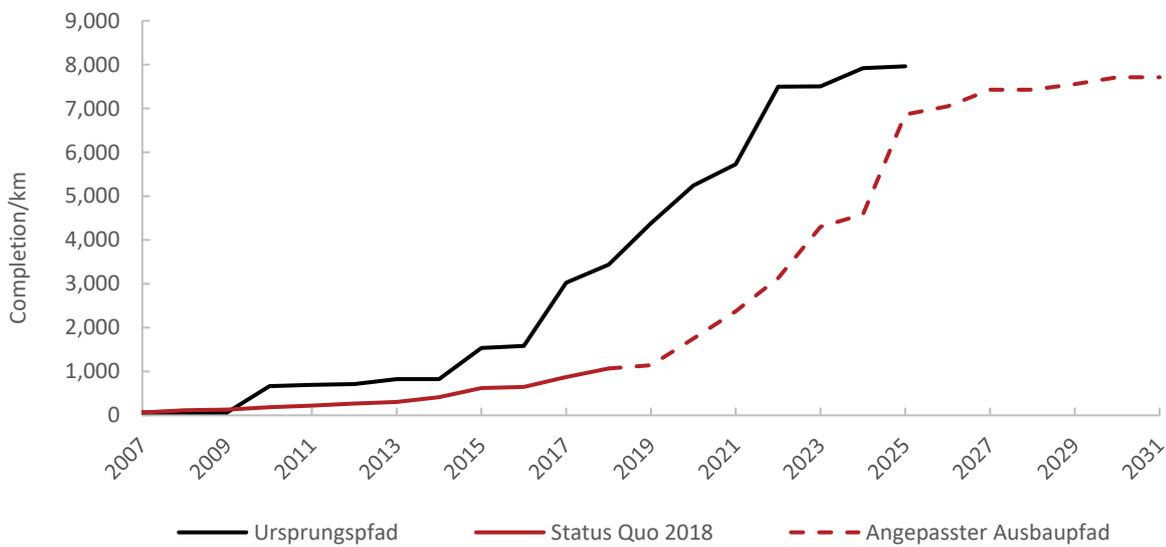
Source: In-house estimate based on BMUB (2017), dena (2018), BCG and Prognos (2019), NPM (2019), Öko-Institut *et al.* (2019) and other studies.

## Electricity grids

54. The Power Grid Expansion Act (EnLAG) of 2009 and the Federal Requirements Plan Act (BBPIG) of 2013 give a basis to the most important grid expansion projects for a functioning power transmission system (cf. Figure Z-8). Despite greater investment in the transmission system infrastructure and the increased commitment of the Federal Ministry for Economic Affairs and Energy, expansion of the grid continues to fall short of the legal requirements and the corresponding expansion projects. In the Expert Commission's view, the Progress Report does not adequately recognise the extent of the delay. By the end of 2018, routes amounting to 1,050 kilometres of the originally intended 3,450 kilometres specified in the EnLAG and BBPIG plans for this date had been completed. The completion dates are further postponed with each additional reporting year.

<sup>1</sup> In contrast to the procedure in the field of electricity and heat, there was no breakdown of components according to Öko-Institut and ifeu (2018) in the transport sector due to a lack of information from studies and overlapping of influencing factors (efficiency and electrification), but rather an estimation of the GHG reduction based on BCG and Prognos (2019), NPM (2019).

**Figure Z-8: Original path and adjusted expansion path for grid expansion according to EnLAG and BBPIG (as at December 2018)**



Sources: In-house, based on dena (2010), BNetzA (2012, 2019f), BNetzA/BKartA (2014b, 2015).

55. The grid operator calculations in the grid development plans for 2030 already indicate that it will not be possible to increase the renewables target to 65% and significantly reduce coal capacity without additional HVDC expansion, thus incurring considerably higher costs. The grid operator scenarios are also based on the adoption of new market and grid-based flexibility. At present, it is not foreseeable whether this flexibility can be realised on time and to the required extent. Enormous efforts are required in this area. The Expert Commission also believes that a fundamental reorganisation of electricity-related charges and a reform of the grid fee system are vital.

56. The amended EU Regulation on the Internal Market for Electricity requires member states to make at least 70% of net transmission capacity available for cross-border European trading from 2020 onwards. The German transmission network is currently far off this value. If Germany's internal grid congestion cannot be remedied by 2025 through a catalogue of measures, the European Commission may use its enforcement powers and require the splitting up of Germany's uniform bidding zone. The Expert Commission calls on the Federal Government to take the European Commission's intentions seriously and, if necessary, to prepare future division of the bidding zone.

57. The delays in transmission grid expansion are also reflected in the renewed increase in congestion management - even above the level reached by the previous record year of 2015. Almost every fortieth kilowatt hour of gross electricity production is now offset by a kilowatt-hour of generation capacity that been curtailed. In 2017, the curtailed energy volumes from renewable energy producers accounted for almost 3% of electricity fed into the grid under the EEG. There was also significant curtailment of offshore installations, for the first time. Further offshore expansion is likely to aggravate this problem. Electricity customers are asked to pay by the grid operators or via the EEG surcharge for curtailed electricity without being able to draw the electricity they have paid for.

58. According to the Progress Report, distribution networks are also expected to experience new challenges and increased investment. The reasons for this are the increasing feed-in from renewable energy producers in the distribution network and electromobility. The Federal Government does not mention specific figures here. However, a Progress Report would normally be expected to contain estimates of technical feasibility and

associated costs. To prevent any further undermining of the acceptance of grid expansion in the transmission and distribution network, the Federal Government should present realistic implementation timeframes and cost estimates for the next ten years as soon as possible.

### **Security of supply for electricity**

59. With the energy-only market, the responsibility for security of supply lies essentially with the balance responsible parties. However, according to the Expert Commission, this decentralised market design can only function within a form of balancing group management that is open to incentives. If balancing group commitments can be met with appropriate penalties for misconduct, appropriate pricing of flexibility options is possible, thus creating security of supply in the long term. In the past, the Expert Commission has repeatedly warned that the balancing group mechanism in its current form does not offer sufficient incentives. Last year, a mixed price procedure was introduced for tenders on the balancing energy markets. However, the new procedure has proven to be a step in the wrong direction, since balancing group deviations have tended to increase since it was introduced. The Expert Commission recommends providing stronger incentives for balancing group commitments, for example by taking account of the reserve costs for balancing capacity in the balancing energy price.

60. The proportion of generation capacity outside the actual electricity market continues to rise steadily. In addition to the recently increased grid reserve, the security standby and the capacity reserve, the grid operators are planning to provide 900 MW of battery storage capacity in their latest grid development plan under the heading “grid booster pilot plants”. This will fund a further significant share of generation capacity outside the electricity market through grid charges. However, this fundamentally contradicts the requirements of the European internal market in electricity in relation to the unbundling of electricity generation and grid operation.

61. With the new SMARD platform, the Federal Network Agency is helping to boost data availability and data transparency in the energy market. In particular, the availability of data under the far-reaching licence CC BY 4.0 is to be welcomed. At the same time, the Expert Commission advises on the content-related and technical development of the platform in order to enable sustainable business models, sound political recommendations and appropriate research.

62. The Federal Government has yet to define a security of supply standard, although this was part of the requirements under state aid approval of the reserve capacity. Germany has promised to apply a security of supply standard when sizing the capacity reserve for the first delivery period. In this context, it should be noted that the report on monitoring security of supply has still not been published in accordance with Section 63 of the Energy Industry Act (EnWG). According to the Energy Industry Act, this report should have been published in July 2018. The Expert Commission believes that the Federal Government is thus creating an “evaluation vacuum”, which leads to speculation and uncertainty. It therefore recommends filling this vacuum as quickly as possible.

63. The current security of supply analyses of the European Network of Transmission System Operators for Electricity (ENTSO-E), in a scenario for 2025, examine the impact of greater scaling back of fossil fuel generation capacity in Europe. For Germany, this scenario roughly corresponds to the coal commission recommendations for phasing out coal. According to the ENTSO-E report, Germany has a loss of load expectation (LOLE) of 3.3 hours per year, which roughly corresponds to the targeted security of supply level in France. With the planned capacity reserve, which was not included in the ENTSO-E calculations, implementing the recommendations of the coal commission seem feasible in the medium term without causing disruption to the electricity market (cf. Table Z-4). However, the analyses also show that a German coal phase-out will affect the security of supply in neighbouring countries, in particular Belgium and France. The Expert Commission therefore recommends planning the coal phase-out in close consultation with the neighbouring countries.

**Table Z-4: Selected figures on security of supply for the “Penta Region” countries**

	Security standard [h/a]	MAF (2018)			Reduction of conv. capacity in low-carbon scenario [GW]
		Base case		Low carbon	
		2020	2025	2025	
		Loss of Load Expectation [h/a]			
<b>Belgium</b>	3*	0.1	2.0	12.3	0.0
<b>France</b>	3	2.0	2.1	6.1	0.0
<b>Austria</b>		0.0	0.0	0.7	0.6
<b>Switzerland</b>		0.0	0.0	0.9	0.0
<b>Germany</b>		0.0	0.0	3.3	8.3
<b>The Netherlands</b>	4	0.0	0.2	5.2	1.1
<b>Lignite</b>		16.6	11.4	n/a	
<b>Hard coal</b>		23.2	20.9	n/a	
<b>Total</b>		39.9	32.3	24.0	9.9

\* 3 h/a LOLE and 95 percentile <20 h

Source: In-house calculations based on MAF (2018)

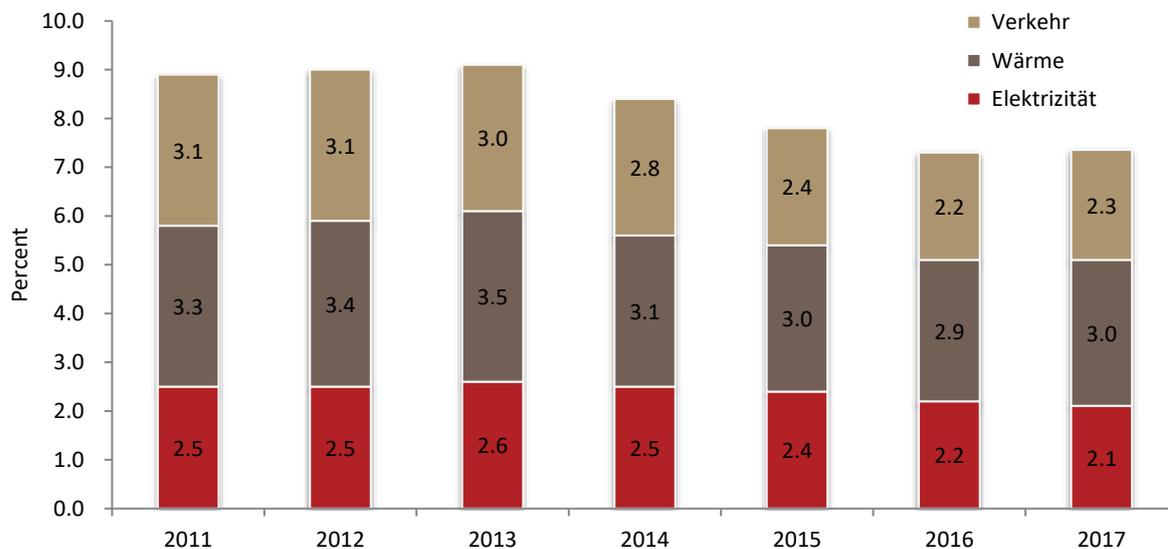
## Energy prices and energy costs

64. The share of end-user spending on electricity in terms of GDP has declined steadily since 2013. In the reporting year 2017, the proportion was 2.1%, the lowest level since 2010. The Energy Commission’s energy transition traffic light symbol is therefore green in this area.

65. Spending on heating services grew by 10% in 2017 to approximately 98 billion euros. The higher expenditure is mainly due to slightly higher prices and spending on energy efficiency. In terms of GDP, the relative burden of costs increased from 2016 to 2017 from 2.9 % to 3.0 %. This corresponds roughly to the levels in 2014 and 2015. Once again, the Expert Commission points out the dubious validity of the results presented here on spending on heat services, due to vague data. This applies in particular to the data situation with regard to the additional costs of energy efficiency measures. The Expert Commission therefore recommends that the Federal Government determine the additional costs for energy efficiency measures on the basis of annual sales figures for the key efficiency technologies. In a initial provisional overview, the Expert Commission has identified 10 core technologies. These include insulation for house exteriors and basement ceilings, glazing, solar heat and heat pumps.

66. In 2017, final consumers in the road transport sector spent about 5 billion euros more compared to the previous year. As in previous years, the causes are due to exogenous factors, especially an increased oil price. Measured in terms of gross domestic product, the relative cost burden is 2.3%, or 0.1 percentage points above the previous year’s level. Given the uncertainty about how policymakers will respond to the pressure to take action in the transport sector, it is difficult to predict developments in the future. Figure Z-9 shows end-user spending on electricity, heating services and road transport in terms of GDP.

**Figure Z-9: Share of end-user spending in terms of GDP**



Source: See Chapter 11

## Energy price reform

67. In the interests of achieving a political feasible solution, the Expert Commission recommends that charges on electricity be replaced in a revenue-neutral manner by a CO<sub>2</sub>-related surcharge on fossil fuels within the near future. One possible model for the energy price reform would be to eliminate the EEG and CHP surcharge (valued at 24.4 and 1.3 billion euros in 2017) with refinancing through a CO<sub>2</sub>-related tax surcharge on fossil fuels. In this way, the CO<sub>2</sub> prices already paid under the European Emissions Trading Scheme (ETS) could be deducted (if the ETS price is below the national CO<sub>2</sub> surcharge). A financial volume of approximately two times 25 billion euros at present, or 50 billion euros, would be shifted annually and would undoubtedly have a major impact on the development of the energy transition and GHG emissions.

68. A CO<sub>2</sub> price of around 50 euros/t CO<sub>2</sub> would guarantee refinancing given the electricity price and assumed reduction in volumes and taking into account the prices already paid under the emissions trading scheme and the financial consequences of replacing the special compensation scheme, which would presumably be required. In addition, this CO<sub>2</sub> price would fall into the range of different estimates for climate damage (see Chapter 1).

69. Calculations by the Expert Commission and other authors show that while distributional effects in private households do not preclude reform, they should be taken into account. An assumed CO<sub>2</sub> price of 50 euros/t CO<sub>2</sub> (with simultaneous reduction of electricity price) would result in an additional burden of about 90 Euro per year for the average household or 2.8% in relation to energy costs or 0.2% in relation to net income (cf. Table Z-5). In non-energy-intensive industries, these prices would have minor effects and would even reduce the burden in some cases. Nevertheless, policymakers would still need to concern themselves with individual cases of hardship. This applies in particular to the requirements of certain households (commuters living in unrenovated housing) and the export-oriented industry. With regard to the industry discount in the case of the EEG surcharge, public acceptance of this could be facilitated if the discount were to be financed in future by the federal budget rather than by higher energy tax surcharges on non-beneficiary market participants.

70. The energy price reform can be introduced gradually. The CO<sub>2</sub> tax surcharges should be reviewed at regular intervals and adjusted in line with the climate goals. The proposal establishes CO<sub>2</sub> pricing as the preferred

lead instrument of the energy transition. It is also not opposed to expansion of EU emissions trading at a later stage.

71. This energy price reform creates incentives for climate-friendly investment in sector coupling, storage technology, flexibility options and new electricity applications, all of which are now vital steps to reduce GHG emissions. It would reduce the competitiveness of fossil fuels, increase the opportunities for renewable energy and create prospects for new business models that are not reliant on government subsidies and detailed regulations, which have often been erratic in the past. An income-neutral reform would revive the stalled energy transition, without exposing the state budget or energy consumers to a higher overall financial burden.

The Expert Commission has supplemented its proposal with considerations on securing public acceptance and on the precise structuring of energy price reform (see also Chapter 1). An effective communication strategy that draws on proven examples, creates trust and involves stakeholders will play a key role in this reform. The overall process of energy price reform must be evaluated and developed on an ongoing basis.

**Table Z-5: Households: Effect of a CO<sub>2</sub> price of 50 euros/t CO<sub>2</sub> with a simultaneous reduction in the price of electricity (calculations as a proportion of net income)**

Electricity	Transport		Heat					
			Gas heating			Oil heating		
			Low demand for heating energy	Average household	High demand for heat	Low demand for heating energy	Average household	High demand for heat
			Share of net income [percent]					
3-person household and over	Petrol car	Occasional road users	-0.2	-0.1	0.1	-0.1	-0.1	0.2
		Average road users	-0.1	0.0	0.2	0.0	0.0	0.3
		Frequent road users	0.3	0.4	0.5	0.4	0.4	0.7
	Diesel car	Occasional road users	-0.2	-0.1	0.1	-0.1	-0.1	0.2
		Average road users	-0.1	0.0	0.2	0.0	0.0	0.3
		Frequent road users	0.3	0.4	0.6	0.4	0.4	0.7
Average household	Petrol car	Occasional road users	0.0	0.1	0.4	0.1	0.2	0.6
		Average road users	0.1	0.2	0.5	0.2	0.3	0.8
		Frequent road users	0.8	0.9	1.2	0.9	1.0	1.4
	Diesel car	Occasional road users	0.0	0.1	0.4	0.1	0.2	0.6
		Average road users	0.1	0.2	0.5	0.3	0.3	0.8
		Frequent road users	0.8	0.9	1.2	0.9	1.0	1.4
Single-person household	Petrol car	Occasional road users	0.2	0.4	0.9	0.4	0.6	1.3
		Average road users	0.5	0.6	1.2	0.7	0.8	1.5
		Frequent road users	1.5	1.7	2.2	1.7	1.9	2.6
	Diesel car	Occasional road users	0.2	0.4	0.9	0.5	0.6	1.3
		Average road users	0.5	0.7	1.2	0.7	0.9	1.5
		Frequent road users	1.6	1.8	2.3	1.8	1.9	2.6

Source: In-house, based on ADAC (2019), AGEb (2019b), BDEW (2019a), BMWi (2019d), Destatis (2019f, 2019e, 2019b), Heizspiegel (2019), KBA (2019b), UBA (2019a, 2019c).





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