Expert Commission on the Energy of the Future Monitoring Process

Statement on the Fifth Monitoring Report of the Federal Government for 2015

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- Prof. Dr Georg Erdmann
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Summary

ENERGY OF THE FUTURE

Commission on the Monitoring Process

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Summary of statement

Statement on the Fifth Monitoring Report of the Federal Government

1. In this document, the expert commission on the Energy of the Future monitoring process will provide a scientific analysis and assessment of the Federal Government's Fifth Monitoring Report for 2015. The statement pertains to the draft report as at the end of November 2016. Even after the implementation of the Federal Government's 10-Point Energy Agenda, much still needs to be done to meet the energy transition targets. The intention of the expert commission with this position paper is to help make this next phase of the energy transition a success. In eight chapters, it will look at eight fields of action where major decisions will need to be made on the future course of energy policy and has defined **programmatic guidelines** for this:

- ensuring the credibility of the energy transition (see Chapter 1),
- shaping the future course of climate protection (see Chapter 2),
- rethinking energy efficiency (see Chapter 3),
- taking a broader view of transport (see Chapter 4),
- upgrading the strategy for renewable power generation (see Chapter 5),
- making the electricity infrastructure fit for the future (see Chapter 6),
- ensuring that energy delivers value for money (see Chapter 7),
- harnessing the potential of digitalisation (see Chapter 8).

Ensuring the credibility of the energy transition

2. For the most part, the Federal Government's Fifth Monitoring Report provides a general factual account of the progress made in implementing the energy transition up to 2015. The expert commission addresses this in its summary review, but it also assesses the reported facts applying the yardstick of target attainment for 2020. In this connection, it also examines the probability of possible target shortfalls and considers the influence of exogenous factors on developments in various areas to date. There are evident **significant disparities in target attainment** between the largely favourable assessments of renewables on the one hand and the unsatisfactory developments in energy consumption and efficiency on the other (on this, see the comments in Chapter 1 of the full version of the expert commission statement).

3. On the supply side, the **expansion of renewables** is the crucial factor for fossil fuel substitution. Renewable energies are supposed to meet at least 35% of gross electricity consumption by 2020. From the present perspective, this target is likely to be met, as renewable power production in 2015 already accounted for 31.5% of total gross electricity consumption. The target of raising the renewables share in gross final energy consumption to 18% by 2020 can in all probability be met. Electricity generation plays a major role here, but the supply of thermal renewable energies will also make a significant contribution to this. The picture is different for the renewables ratio in the transport sector. There is little likelihood of meeting the 10% target for 2020, particularly as the ratio has even declined tangibly in recent years to a mere 5.2% (see Chapter 5).

4. Prospects are far less promising on the demand side, where the aim is to reduce primary and final energy consumption in individual sectors through energy savings and higher energy productivity. The Federal Government, for example, is looking to raise **final energy productivity** on annual average by 2.1% from 2008 to

2050. Germany is, however, still a long way from meeting this target: On average from 2008 (baseline year for the productivity target) to 2015, final energy productivity has only risen by about 1.3% (measured against the baseline figures) or even as little as roughly 1.1% (based on temperature-adjusted figures). To be able to return to the target path by 2020, the annual rate would have to be increased respectively by a factor of 2.4 or 3.2 on 2015 (to 3.2% or 3.5% annually), which is quite unlikely at the moment, even considering the policy measures that have now been taken. Final energy consumption trends in the individual sectors, for example, would tend to confirm this expectation.

5. A firm component of the Federal Government's set of targets is a 10% **reduction of gross electricity consumption** by 2020 based on 2008. Unlike in the past, when it largely rose on a regular basis, gross electricity consumption as a suitable yardstick for this has been on a slight downward trend since the financial market crisis and was 3.8% lower in 2015 than in 2008. This amounts to an annual average rate of minus 0.6%. To attain the target for 2020, it would have to decline in comparison with 2015 by 6.4% or 1.3% a year, i.e. about twice as fast from 2008 to 2015. This would call for additional activities at the least. The expert commission acknowledges that, as pointed out in the Fifth Monitoring Report, for the Federal Government "*considerable additional efforts will also be essential here to meet the targets set in the Energy Concept by 2020*" (Chapter 4 in BMWi, 2016).

6. **Final energy demand in buildings**, which comprises space heating and cooling, water heating and also electricity consumption for fixed lighting in non-residential buildings, declined by 9.9% (adjusted) or 11.2% (baseline figures) from 2008 to 2015. Meeting the reduction target for 2020 would then require a further decline of 11.3% or 9.9%. Looking at the adjusted figures, target attainment is not yet assured.

7. As a substantial target shortfall can be expected in **final energy consumption in the transport sector**, no particular contribution can be made to achieve the requisite reduction of total final energy consumption by 2020. The aim in the transport sector is to curb energy consumption by 10% between 2005 and 2020. In fact, though, consumption in 2015 was even higher than in 2005 (+1.2%). Trends in this period were largely driven by the steep rise in the volume of passenger and freight transport by 8.2% and 12.1% respectively, which could only be offset in part by the reduction in specific energy consumption figures. There have been no significant discernible changes in either transport behaviour or policy to date. In the view of the expert commission, energy policy in the transport sector is still a long way from attaining the target for 2020, as is also the assessment of the Federal Government itself (see Chapter 6 in BMWi, 2016).

8. Considering these outlined trends in the sectors of final energy consumption, there are reasons to doubt whether the target of a 20% reduction in **primary energy consumption** by 2020 compared with 2008 can be met. So far at least, primary energy consumption in this period to date has only declined by 7.6% and temperature-adjusted by a mere 6.3%. For the next five-year period, target attainment would imply a higher annual average reduction rate by a factor of 2.6 or 3.4 than in the seven-year period from 2008 to 2015. Even accounting for the measures taken so far, this does not appear feasible in the time left.

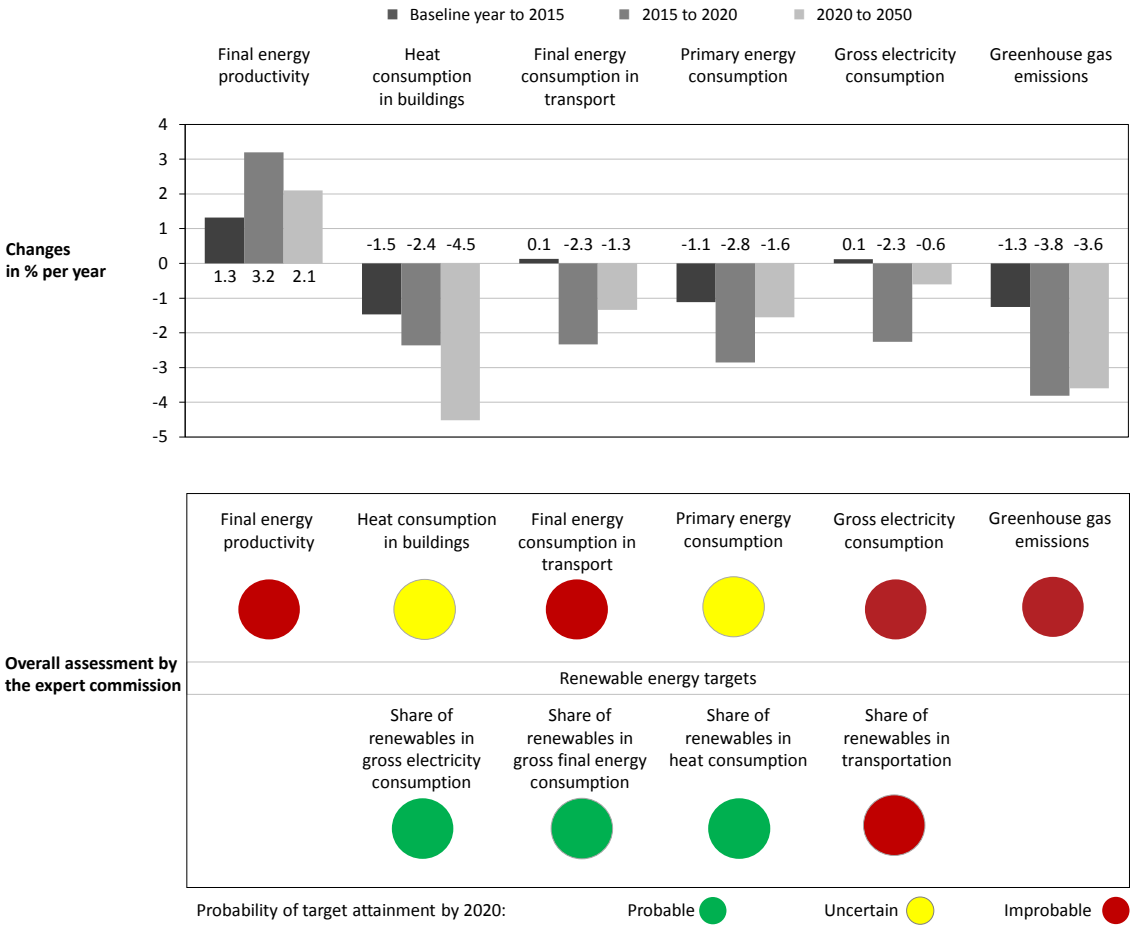
9. Based on this review, the expert commission has come to the conclusion that attaining the key policy target in the Federal Government's Energy Concept of reducing **greenhouse gas emissions** by 40% between 1990 and 2020 is also very unlikely. In its Monitoring Report, the Federal Government rightly emphasises that emissions have already been substantially reduced between 1990 and 2015 by approx. 27%. The Report, however, pays too little attention to the virtual stagnation of greenhouse gas emissions in the last seven years, i.e. since 2009. The only way to close the gap to the target for 2020 (749 million t of CO_2 equivalent) would be to reduce emissions by an annual average of almost 32 million t of CO_2 equivalent or 3.8%. Considering the anticipated stagnation of emissions at the previous year's level for 2016, greenhouse gas emissions would have to be reduced by as much as almost 40 million t of CO_2 equivalent a year in the four years from 2017 to 2020. Com-

pared with past figures, the pace of emission abatement would have to roughly triple in comparison with the period from 1990 to 2015 (-1.3% a year) and compared with the period between 2005 and 2015 it would even entail a fourfold increase. From the present standpoint, we cannot see how the Federal Government intends to achieve this. In the view of the expert commission, the scale of emissions to be reduced by 2020 should not, however, be underestimated for the attainment of the long-term climate change mitigation targets.

10. To assess developments, the Federal Government has since last year applied a system in its Monitoring Report that allocates points to measure the percentage deviation from the linear trend towards the target for 2020. Besides making a subjective assessment of the effectiveness of recently implemented measures and exogenous trends, the expert commission bases its evaluation on a more advanced methodology than the points system in the Monitoring Report, that of possible prediction intervals. The main findings of the **expert commission review** on the quantitative energy transition targets are presented in Figure 1. The (traffic light) colour markings show how probable or improbable full target attainment is for 2020. If it is assessed as probable, it is marked green and red if it is estimated to be improbable. Yellow indicates borderline cases. Accordingly, three renewable energy targets will probably be met. The attainment of the targets for reducing primary energy consumption and for heating requirements in buildings appears uncertain. The other energy transition targets for energy productivity, final energy consumption, the renewables ratio in transport and also greenhouse gas emissions are unlikely to be met.

11. The expert commission also acknowledges that **exogenous factors of influence**, i.e. outside the scope of influence of the Federal Government, hamper target attainment. Besides demographic changes, these include above all the sharp drop in international energy prices that continues to act as a disincentive for investing in higher efficiency and limit the effectiveness of the measures taken. Added to this are changes in price relations at the expense of lower-emission energy sources. The expert commission again recommends that the Federal Government commissions a study on the quantitative effects of these and other exogenous factors of influence. This should also take into consideration that the successful implementation of the decisions taken at the Paris Climate Change Conference will also bring the international energy markets under heavy price pressure in the medium and long term. Of equal importance in the view of the expert commission is also an investigation into the impacts of endogenous, i.e. internal, factors that could stand in the way of accomplishing the energy transition.

Figure 1: Assessment of target attainment by the expert commission



Source: Authors' own chart

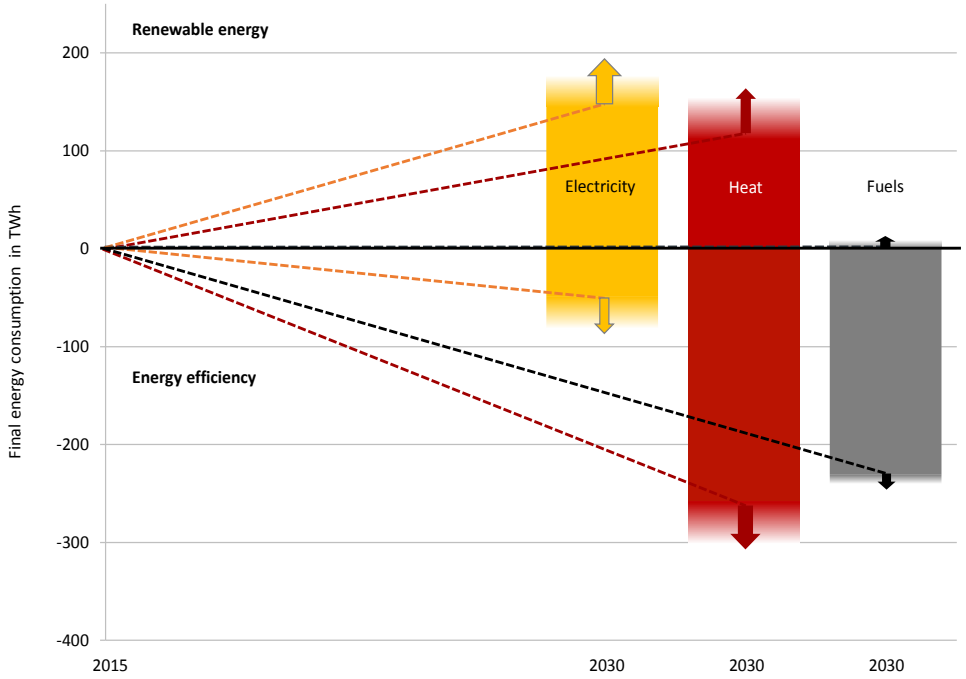
Shaping the future course of climate protection

12. The Federal Government has set itself the target of lowering **greenhouse gas emissions** by at least 55% between 1990 and 2030. The Climate Action Plan 2050 for the first time subdivides this target by sectors. The expert commission welcomes this closer specification but notes that this division lacks a proper explanation. The decision to roughly halve emissions in the power sector and to reduce them by a third in transport over the next 15 years has far-reaching repercussions and will require broad acceptance (see Chapter 2).

13. The Climate Action Plan 2050 contains no tangible energy-related targets for 2030 to draw on for **updating and completing the set of targets in the Federal Government's Energy Concept**. The expert commission would like to provide some reference figures as a contribution to the forthcoming debate on the coherent revision of the Energy Concept. It is generally apparent that the energy-efficiency and renewables targets will have to be met concurrently for the most part to achieve the climate change mitigation target for 2030 and pave the way for attaining the longer-term targets and also because there is very limited scope for offsetting target shortfalls in individual areas by surpassing them in others. Based on developments to date, this is particularly the case for reducing final energy consumption in transport. Figure 2 shows the changes possible in final

energy consumption through energy-efficiency measures and renewables expansion up to 2030 compared with 2015 with estimated flexibilities.

Figure 2: Change in final energy consumption up to 2030 compared with 2015



Source: Authors' own estimates based on data from the Institute for Applied Ecology/Fraunhofer ISI (2015), BMUB (2016) and additional studies

14. From this, we can infer several conceivable **variants for 2030** and deduce the following targets, premised on a reduction in electricity generation from coal of at least 50%:

- Retaining the target for the share of renewables in gross final energy consumption at 30%, while raising the target share in gross electricity consumption to 60%, as well as introducing a target share in final energy consumption for heating of 30% and a target share for renewables in final energy consumption in transport of 12%.
- Curbing gross electricity consumption (including new electricity applications) by 10% and final energy consumption for heating, including process heat (without electricity input), by 30% compared with the base year 2008, as well as reducing final energy consumption in transport compared with the baseline year 2005 by 35%.

15. Additional measures will be needed to meet the 2030 and 2050 targets, respectively, which can be implemented at national or European level. The package of measures for target attainment in Germany currently consists of many small-scale regulations and incentive systems on the one hand and exemptions from obligations on the other - not least due to special interests. With the growing need for action on target conformity, there is a risk that due to this diversity and its complex effects and interactions no adequate solution can be found. A streamlined and comprehensive steering mechanism would, however, be useful for reasons of efficiency and controllability. The expert commission therefore proposes general **carbon pricing as a guiding policy tool** to set out a stable, long-term framework for transforming the energy system. This will require comple-

mentary elements to address other market imperfections besides greenhouse gas emissions, such as in the building or transport sectors or in renewable energy, for example.

16. The European level would be the preferred point of intervention, especially emissions trading as the common and economically most sensible climate protection instrument, to find the most cost-effective ways of reducing greenhouse gas emissions. The expert commission recommends that the Federal Government advocate a reinforcement of emissions trading by adjusting the European abatement target, expanding the sectoral focus and introducing a price corridor. Considering the requisite policy and negotiation procedures and the foreseeable opposition, a European solution would, however, seem most unlikely. If, as expected, this does not succeed, additional national measures will be required to meet the German climate change mitigation targets. Since 2013, a number of other states taking part in European emissions trading have opted for **additional national mechanisms**.

17. As far as possible, the national measures should apply to all sectors and technologies. General carbon pricing will ensure this and afford the opportunity to amalgamate levies under the Renewable Energy Sources Act (approx. EUR 22.9 billion) and the Combined Heat and Power Act (approx. EUR 1.2 billion), electricity taxes (approx. EUR 6.6 billion) and possibly other energy taxes, levies, etc. in one instrument and prospectively largely replace them. This could also obviate the need to maintain the climate reserve for lignite-fired power stations. Inclusive carbon pricing would not therefore primarily entail an additional burden, but would in fact amount to a reduction in costs thanks to extensive efficiency gains. In exchange, the present complex funding mechanisms or instruments should be examined and abolished, unless they are warranted to remedy market frictions beyond the climate change problem. Thus, the instruments to be done away with would first of all have to be set off against the carbon price. This **systemic shift would secure the long-term sustainability of the transition** to a carbon-neutral economy, as it would minimise the burden on companies and households in the process. There are many other reasons in favour of this policy realignment. For example, the current promotion of renewable energy sources is incompatible with the important and correct idea of sector coupling, because more electricity is supposed to be integrated into the overall system (to avoid fossil fuels in the heating sector or transport sector), while at the same time the promotion of renewables in the electricity sector via the levying system ultimately raises the price of electricity, making it less attractive than fossil fuels. Carbon pricing would also be advantageous from a distribution standpoint as the income could be used accordingly.

18. Where German carbon pricing exceeds prices in European emissions trading, measures would have to be taken to ensure that German emission reductions are not countervailed by the use of the certificates then available elsewhere. The expert commission therefore again proposes flanking national target attainment with the **purchase and retirement of emissions allowances** by the Federal Government. Under the specifications of European emissions trading, the Federal Government could interpret the attainment of the national CO_2 target in a flexible way and meet its targets by purchasing and retiring emissions allowances equivalent to CO_2 target deviation. This would abate greenhouse gas emissions, as this measure would reduce the permissible emissions in Europe. But in this case the CO_2 target would have to be interpreted and defined at European level and not confined to German territory. At a carbon price of currently EUR 7 per t, for example, the annual cost for 50 million tonnes of CO_2 would amount to no more than EUR 350 million. Greater flexibility in meeting the target would also make economic sense. The best solution would be more stringent emissions trading; a concerted retirement of emission rights with EU partners coordinated by the EU Commission would, however, still be preferable to an inefficient national target attainment with a multitude of overlapping and in part mutually countervailing measures. At least this way, the most cost-effective measures would be carried out in Germany and several cheap abatement options abroad would be used.

19. The long-term **2050 climate change mitigation targets** affect the interim target for 2030. So far, the Federal Government left open how to specify the gap between the reduction of greenhouse gas emissions by 80% to 95% for 2050 based on 1990. It is, however, committed to carbon neutrality, also without discussing this in greater detail. The expert commission therefore recommends a precise specification of the long-term targets and an intensive discussion on the distribution of available emissions budgets over time. Instead of having to meet specific annual targets with pinpoint accuracy, they could then be steered more flexibly via these budgets. This approach can only function, however, if emission reductions are not continually deferred in the hope of being able to make them at short notice at the end of the timeframe. The expert commission suggests that the Federal Government give serious consideration to this kind of target definition, accounting for the above proviso.

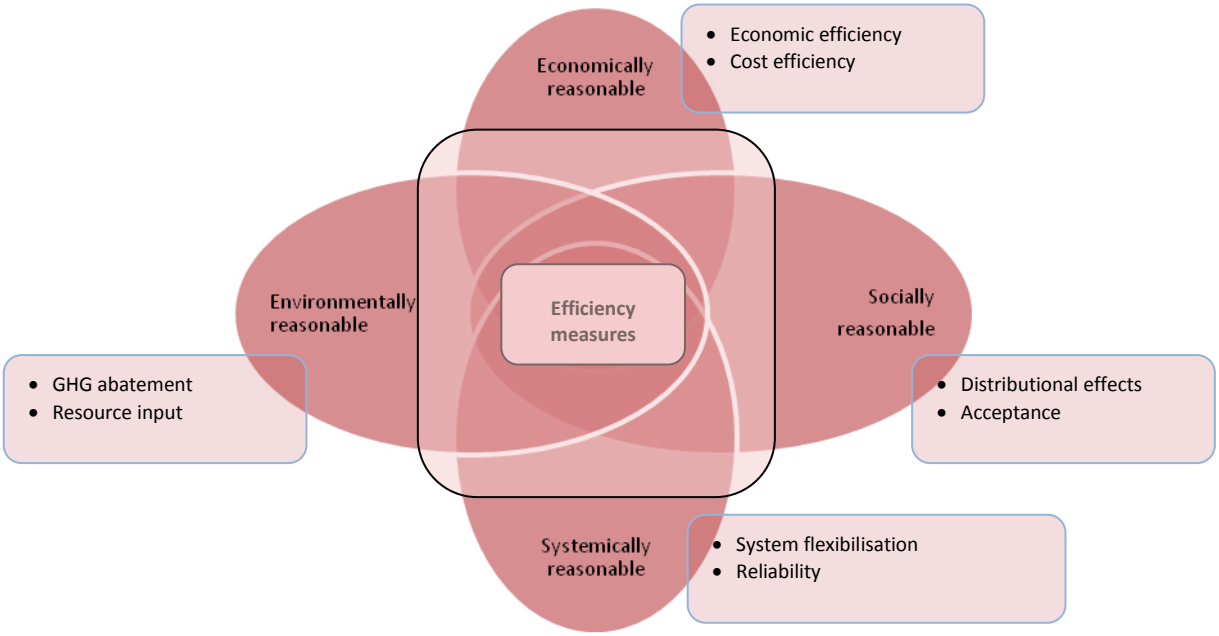
Rethinking energy efficiency

20. As the Federal Government's Monitoring Report shows, **major efforts** are still needed to achieve the targets in energy efficiency. However, from the expert commission's point of view the assessment is too optimistic in all areas. The Monitoring Report should have pointed out more clearly that the attainment of the key target for reducing primary energy consumption, for example, is not assured and that for raising final energy productivity is improbable. Although the Federal Government has taken a number of measures, under the National Action Plan on Energy Efficiency (NAPE), for instance, the resultant reductions in consumption are insufficient (see Chapter 3).

21. The **description of measures** in the Monitoring Report is insufficient in the assessment of the expert commission. Major measures, especially in the building sector are not mentioned, such as the Energy Conservation Regulation (EnEV) and the Renewable Energies Heat Act (EEWärmeG). The Report (almost) only lists funding programmes, in some cases without defining the target group or citing the anticipated or actual outcomes or the efficiency of funding allocation. This is why in its last statement the expert commission had already framed 10 guidelines for an effective energy-efficiency monitoring and hopes that the Federal Government will take account of these in its next Monitoring Report.

22. With Efficiency First, the Federal Government is looking to introduce a new 'basic principle', which, however, remains very abstract in the Monitoring Report, so that the expert commission cannot come to a tangible assessment. Whereas it generally welcomes the high priority that needs to be attached to efficiency, the principle cannot be construed as attaching overall precedence to this issue , but rather as a 'motto' that must nevertheless take account of diverse aspects. Not all technically feasible measures, legal provisions and funding options for raising efficiency can be assessed as expedient. In the opinion of the expert commission, economic, environmental, social and systemic criteria need to be applied for a comprehensive evaluation (see Figure 3). It therefore advocates **Think Efficiency instead of Efficiency First** as a better approach. Applying this as a basic principle means that the Federal Government should also appraise and amend the legal framework for the energy system to remove constraints and find ways to improve the efficient generation, distribution and use of energy.

Figure 3: Think Efficiency: high priority but also appraisal to criteria



Source: Authors' own chart

23. In **buildings**, which consume as much as a third of end-use energy, target attainment by 2020 is not assured when we take temperature-adjusted figures into account. The Strategy for Energy-Efficient Buildings sets out a long-term framework for achieving carbon-neutrality in existing buildings by 2050, with the two scenarios of high efficiency and a high renewables ratio as parameters. To be able to meet the targets in the Climate Action Plan, however, the reduction of final energy demand in buildings must be in the order of magnitude of the efficiency scenario. The Energy Conservation Regulation and especially the KfW funding programmes should be aligned as quickly as possible with the long-term target. The aim should also be to converge EnEV and EEWärmeG as well as the KfW funding programmes and MAP.

Taking a broader view of transport

24. The development of **final energy consumption** in transport in recent years indicates that there is no longer any realistic prospect of meeting the target for 2020. The Projection Report only predicts the attainment of the 2020 target by 2030. With the present measures in the transport sector, the foreseeable savings in energy end-use compared with the status quo are therefore very limited. Target scenarios point the way to more substantial cuts in final energy consumption and greenhouse gas emissions in transport, also with a view towards 2050. These are, however, based on assumptions about transport policy measures that are tantamount to a fundamental policy shift compared with the current situation rather than 'further efforts' – a phrase that is frequently used in the Monitoring Report of the government (see Chapter 4).

25. The Climate Action Plan 2050 sets an ambitious interim target for **CO_2 emissions in transport** for 2030. The current European proposal for setting binding national annual targets for greenhouse gas abatement in the period from 2021 to 2030 (Effort Sharing Regulation) includes an ambitious target for non-ETS emission reductions in Germany. The transport sector as one of the main sources for non-ETS emissions will play a key role to reach this goal. If the Federal Government is seriously concerned with complying with the Effort Sharing Regulation proposal, it should take urgent measures to implement the above-cited policy shift in transport.

26. The **transport sector** has, however, diverse **adverse impacts** that go beyond CO_2 emissions. Pollutant emissions and noise pollution incur high costs for health care and impair the quality of life in conurbations; land used for transport infrastructure limits the scope for alternative forms of use and splits up natural habitats. Traffic congestion incurs high economic costs. Furthermore, road transport still causes a high number of accidents and there has been a renewed rise in fatalities.

27. A comprehensive approach to addressing the problems in transport, a so-called transport transition, should aim at alleviating all the adverse impacts. Specific fields of action can be used to address these: the use of alternative drives and fuels, efficiency improvements in conventionally motorised transport, switching to more efficient and lower-emission transport modes and avoiding motorised transport. Table 1 correlates the **adverse impacts of transport and the countervailing fields of action available**. It shows that switching to alternative drives and fuels alone cannot address all transport externalities. Land use and traffic congestion costs in particular could only be curtailed to a limited extent with such a one-sided approach. Improving the efficiency of conventional drives cannot make a contribution here, either. In all probability, vehicles would also continue to generate a high level of noise pollution in future as well. Moreover, it is questionable whether efficiency improvements would bring about environmental benefits, as at least parts of these are usually offset by rebound effects. Switching transport to more efficient/lower-emission modes would, however, address all externalities. It would also lower the number of road accidents and fatalities as this field of action also entails a reduction in car traffic, where most of these externalities arise. Policymakers must harness the full potential of all these different fields of action when planning reforms in the transport sector to counter all its adverse impacts.

Table 1: Correlation of adverse impacts with fields of action

	Use of alternative fuels and drives	Efficiency improvements in conventionally motorised transport	Switching transport to more efficient/lower-emission modes	Avoiding motorised transport
Energy consumption	(X)	(X)	X	X
Greenhouse gas emissions	X	(X)	X	X
Pollutant emissions	X	(X)	X	X
Noise pollution	(X)		X	X
Land use			X	X
Congestion costs			X	X
Accidents and fatalities			X	X

X Correlations with direct impact.
(X) Correlations that do not apply for all possible implementation options or are mitigated by rebound effects.

Source: Authors' own chart

28. Besides specific policy measures for individual fields of action, **overarching pricing instruments** should set incentives for mitigating the adverse impacts of transport, for example in the form of taxing external effects based on the specific economic damage (Pigovian tax). The expert commission therefore gives some suggestions for an economically reasonable pricing in road transport:

- The approach adopted should take all externalities into account. Many different internalisation measures are currently implemented in Germany, i.e. there is no single, ideal approach for internalisation. The four-page long info box in the Federal Government's Monitoring Report also reveals the broad diversity of

initiatives, ranging from fuel economy labels for cars to round tables to the Federal Transport Infrastructure Plan.

- The heavy-goods vehicles toll in Germany can be seen as a form of Pigovian tax, but due to the narrow collection base and the rigid pricing the instrument is not designed in the best way. The usage price under the toll should be charged as far as possible for the entire transport infrastructure and to all users. This is the only way to internalise all externalities and prevent circumventions to the detriment of the general welfare. Keeping to rigid prices also hampers the efficient use of transport infrastructure. Instead, different prices should be charged by time and region. The new information technologies in particular can make toll charges far more responsive to actual traffic volume (in real time). This is one of the opportunities digitalisation (see Chapter 8) affords for the energy transition in transport.
- Because they account for various pollutant classes, the current heavy-goods vehicle toll and motor vehicle tax already contain an environmental component. As a matter of general principle, however, the economic policy instrument adopted for environmental externalities should be geared to the damage caused and only as an alternative to the volume of emissions or kilometres driven. Only then will the price of transport from A to B reflect the resultant damage to climate and the local environment. An instrument that largely disregards this, such as the motor vehicle tax graduated by pollutant classes, is not helpful in this respect.

Finally, the instruments should be incorporated into a joint system, also for the sake of simplicity and transparency of regulations. Unresolved distributional issues need to be taken into account here.

29. The expert commission recommends that the Federal Government upgrade the Mobility and Fuel Strategy into an **integrated long-term strategy across transport modes** with clear time horizons and quantitative targets. These are also necessary so that market participants can take them as a frame of reference for the intentions of the Federal Government.

Upgrading the strategy for renewable power generation

30. The **expansion of renewable energy sources** is making good progress. Electricity generation in particular grew at a rapid pace again last year, reaching a ratio of 31.6% to gross power consumption. The increase of 4.3% year-on-year is attributable above all to the rapid growth in electricity generation from onshore and offshore windpower. The minimum target of 35% for 2020 will therefore be met in all probability. The renewables ratio to final energy consumption for heating also improved, but with considerably less momentum. Despite slower expansion rates in solar thermal power and thermal pumps, 13.2% has now been achieved (target for 2020: 14%). At 5.2%, the only sector where renewables have not kept to the target path is transport. As a whole, electricity generation and heat supply have contributed to a favourable overall picture for the renewables ratio to gross final energy consumption, which rose to 14.9% in 2015. The 18% target set by the EU for 2020 therefore also appears to be attainable (see Chapter 5).

31. With EEG 2017, the Federal Government has switched from a system of price to quantity control. The aim is to keep to a target corridor of 40% to 45% for the ratio to gross power consumption in 2025. The expert commission, however, takes **a critical view of the way quantity control has been organised** in several respects:

- In EEG 2017, the expansion paths for electrical power capacity have been converted from a net to a gross assessment. As no verifiable findings are as yet available on the anticipated decommissioning of existing facilities after the expiry of the EEG duration of compensation, it should be possible to set the tendering volumes in a flexible way to guarantee target attainment even in the event of failure in individual areas (in and outside of the auctioning system).

- Limiting the expansion of onshore windpower does not raise cost effectiveness, as this is currently the cheapest option, particularly considering that the wind generators connected to the grid as of 2017 can still be expected to contribute to electricity production in 2040. Reducing the quantity for the expansion of onshore windpower can raise cost efficiency in the event of grid congestion, but this should be priced more accurately through appropriate grid charges, adjusted by region and period, for example (see Chapter 6.3).
- In the estimation of the expert commission, EEG 2017 marks a step towards more competition in the respective generating technology, because the shift to auctioning ensures a market-based compensation, but competition is confined to the respective generating segment in the tendering phase. The system of guaranteed minimum compensation remains unchanged so that the facility operators bear no market risks. The expert commission welcomes the underlying intention to cut costs, but a greater incentive for market transformation would be needed. Facility operators should be induced to bear market risks. In combination with carbon pricing and the related higher wholesale electricity prices, for example, this would be a means to do away with funding for renewable electricity generation.

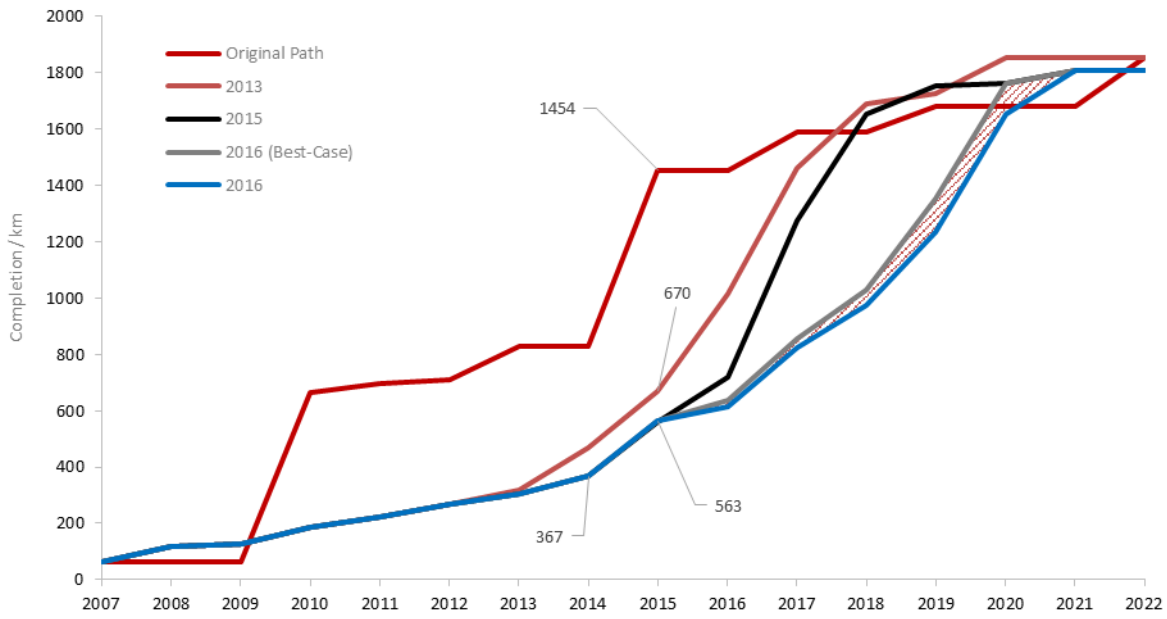
32. In sector coupling, the Fifth Monitoring Report concentrates on **coupling the electricity and heating sectors**. The predominant criterion here is technical efficiency, while less importance is attached to others, such as economic feasibility and the requisite stable framework. The expert commission would like to have seen a more multifaceted treatment of the topic and more details on the short-term, medium-term and longer-term significance of the various paths for sector coupling. For example, technologies for sector coupling can only operate economically if the kWh price of the electricity input is considerably less than that for the fossil energy sources to be replaced. As the energy transition is currently predominantly financed by kWh-priced electricity components, it is not economically viable. This problem could, for example, be addressed by carbon pricing or a dynamisation by period or region and shifting grid charges to higher demand charges (see Chapter 2 and Chapter 6).

Making the electricity infrastructure fit for the future

33. In its Monitoring Report, the Federal Government takes up the policy discussion on progress in and **costs for electricity infrastructure**. It specifies the investment and expansion needs in transmission and distribution grids and views these as essential for a successful energy transition. The expert commission agrees with this assessment and welcomes the additional transparency afforded by monitoring the Federal Requirement Plan Act (see Chapter 6).

34. In its Monitoring Report, the Federal Government sees the need for 'rapid' **grid expansion** (see Chapter 10 in BMWi, 2016). This is indeed lagging a long way behind the plans and completion forecasts have had to be repeatedly revised, as illustrated in Figure 4. It shows five curves, with the 'original path' depicting the time frame envisaged in 2009. The other curves represent the annual updates of the target paths, where 2016 has been supplemented by a best-case scenario. At the end of 2015, 563 km were actually completed, over 100 km less than still forecast in the previous year and almost 900 km less than originally planned. The new forecasts are based on the reports from the EnLAG monitoring process (BnetzA, 2016). The expert commission is also of the view that the Priority of Underground Cabling Act described in the Monitoring Report will expedite grid expansion in the long term, but planning procedures must first be recommenced, which will cause further delays.

Figure 4: Original path and gradually revised target paths for grid expansion according to EnLAG



Source: Authors' own chart based on BNetzA/BKartA (2010, 2014, 2015) and BNetzA (2016f)

35. The costs for **system services** rose sharply year-on-year in 2015 to EUR 1.6 billion and were largely attributable to interventions for eliminating grid congestion. The specific costs for remedying these bottlenecks, such as redispatch, feed-in management and interruptible loads, differ greatly and should be compared for optimising costs and assessed for their systemic relevance.

36. Further thought should also be given to **upgrading the regulations on grid charges**, because they currently take hardly any account of congestion. Introducing variable grid charges by area and period for output feeders and also for new input feeders would set more precise incentives for grid utilisation and provide an administrative solution for grid pricing geared to shortages that approximates a market-based approach. A demand-based feed-in component could be made contingent on maximum annual output.

37. In its Monitoring Report, the Federal Government provides meagre information on **electricity supply security**, particularly considering the extraordinary pace of developments in monitoring and planning supply security in the European electricity industry in the last five years, a current example being the discussion on closer cross-border cooperation on this issue. The expert commission welcomes efforts towards closer regional cooperation for improving supply security in the electricity sector. According to various studies, supply security in Germany does not appear to be critical in the years ahead. There is, however, greater cause for concern from an international perspective, in the so-called Pentalateral Energy Forum (PLEF) region that groups Germany, Austria, France, Benelux and Switzerland, where shortages in France could result in a regional supply crisis. The expert commission therefore recommends that the Federal Government consider the attendant risks for supply security in Germany.

Ensuring that energy delivers value for money

38. In its Monitoring Report, the Federal Government deals with price trends for various energy sources and their effects on households, trade and industry. The expert commission concurs with the government's view that **exogenous developments on the commodities markets** in particular have **reduced costs** in all sectors (see Chapter 7).

39. In this reporting year, the expert commission continues to apply the **national energy account indicator** (see Chapter 7.2). Unlike sectoral electricity prices, this indicator is relatively impartial to distribution issues. The time series for the national energy account and its main components are shown in Table 2.

40. An initial analysis reveals that **expenditure has declined compared with the previous year by about EUR 0.9 billion**. A major influence on this development have been corrective adjustments to the excessive offshore levy charged in previous years under Section 17f of EnWG. These cost reductions are, however, only likely to be temporary. Both the offshore levy and other levies or expense items will probably rise in the next few years, also including expenditure on heat/power cogenerators funded under the Combined Heat and Power Act. Grid charges have stabilised for 2015, but this is hardly likely to continue in the coming years. The reduction in revenue ceilings at distribution grid level in 2015 are largely offset by rising transmission grid costs in the same year. Further cost increases are foreseeable for transmission grids in the next few years due to redispatch and feed-in management measures, the maintenance of various reserves (grid reserves under Section 13d of EnWG, capacity reserves under Section 13e EnWG, standby backup facilities under Section 13g of EnWG and grid stabilisation precautions under Section 13k of EnWG), underground cabling and grid expansion in general. Higher charges can also be expected for distribution grids in the coming years (E-Bridge/IAEW/Offis 2014). It is not possible at present to estimate how far the equity yield rates recently reduced by the Federal Network Agency will mitigate these increases.

Table 2: Aggregate end-user expenditure for electricity

	2010	2011	2012	2013	2014	2015*
	EUR billion					
Total expenditure [1]	**60.9**	**63.6**	**64.3**	**71.0**	**70.3**	**69.4**
Government induced elements	**17.2**	**23.0**	**23.3**	**30.0**	**32.3**	**31.3**
Of which						
Electricity taxes [2]	6.4	7.2	7.0	7.0	6.6	6.6
Concession fees [3]	2.1	2.2	2.1	2.1	2.0	2.0
EEG surcharge (EEG differential costs) [4]	8.3	13.4	14.0	19.8	22.3	22.0
KWK-G [5]	0.4	0.2	0.3	0.4	0.5	0.6
Levies (Sections 17f, 18 ENWG) [6]	-	-	-	0.7	0.8	0.0
Government regulated elements	**16.9**	**17.6**	**19.0**	**21.2**	**21.4**	**21.4**
Of which						
Transmission grid charges [7]	2.2	2.2	2.6	3.0	3.1	3.5
Distribution grid charges [8]	14.7	15.4	16.4	18.2	18.3	17.9
Market-driven elements	**26.8**	**23.1**	**22.0**	**19.8**	**16.6**	**16.8**
Of which						
Market value EEG electricity [9]	3.5	4.4	4.8	4.2	4.1	4.7
Generation and sales [10]	23.3	18.6	17.2	15.6	12.5	12.0

*Partly provisional

Source and key: see Chapter 7

41. Finally, the table shows that the **market-based expenditure elements**, the core of Electricity Market 2.0, have remained at a low level. The trend of declining revenue in conventional generation continues. The expert commission would like to point out again here that this situation is unsustainable (see EWK 2012, 2014a, 2014b). In the medium to long term, prices must rise on wholesale electricity markets to enable the necessary conventional power stations to survive economically. This would entail a lower EEG levy, but rising wholesale electricity prices overall will ultimately lead to higher end-user expenditure. The extensive write-downs by the power station operators indicate how unsustainable this situation is (see Chapter 7).

42. The **ratio of end-user expenditure for electricity to (nominal) gross domestic product** declined slightly from 2.4% in 2014 to 2.3% in 2015. In absolute terms also, there was a drop in expenditure by almost EUR 1 billion in 2015. The expert commission also attributes this development to the EEG reform in 2014, which has slowed down the cost uptrend in the electricity sector. It considers this stabilisation of total expenditure to be only temporary, however. Further cost increases are foreseeable for the EEG levy, but also in particular for power grids. The indicator applied by the Federal Government - the total of wholesale electricity prices and the EEG levy - is not helpful for assessing cost trends for the energy transition in the electricity sector.

43. The large amount of **impairments on conventional generation assets** in Germany and Europe due to the price drop on wholesale markets also indicate that end consumers are currently not paying the full costs for electricity supply. If non-volatile generating capacity is necessary for continuous security of supply, this situation can only be of limited duration. End-user expenditure can therefore be expected to rise in the medium term.

44. Measured against gross domestic product, **the share of end-user expenditure in transport** declined noticeably from 2.8% in 2014 to 2.4% in 2015. Additional costs in the transport sector due to the energy transition are still of no significance. According to the estimates of the expert commission, **end-user expenditure for heating services** remained almost unchanged on the previous year at a relative ratio of 3.0% to gross domestic product. The decline in fuel expenditure due to the international price trend was offset by the increase in spending on energy-efficiency measures.

45. The statement of the expert commission is also concerned with the **unit costs of energy in German enterprises** by international standards. Average unit costs of energy in the manufacturing sector remain below the European average. As Figure 5 also shows, the energy cost burden has diminished, especially due to the fall in fossil fuel prices for all energy sources, except electricity. The unit costs of electricity are, however, of particular interest in the context of the energy transition, as energy policy exerts a major influence on them. Costs in Germany rose as compared with the European average in the period from 2008 to 2015 (see Figure 6). Whereas the unit costs of electricity for manufacturing firms have risen in Germany since 2011 by approx. 5% on average, they have declined by approx. 2% in Europe. In the German manufacturing sector in 2015, unit costs of electricity only kept below the EU28 level in metal manufacturing and metalworking and motor-vehicle manufacturing. Where (German) sectors depend heavily on electric power and less on fossil fuels, they have not therefore benefited from the price drop in fossil fuels. The financial scope for these companies is even more limited, despite low fossil fuel prices.

Figure 5: Index (2011=100) of real unit energy costs by energy source in the German manufacturing industry

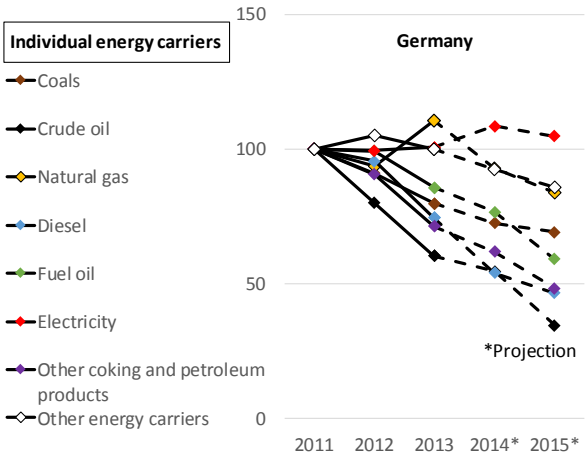
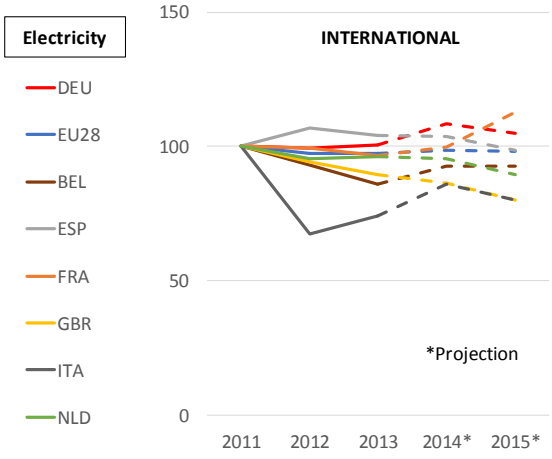


Figure 6: Index (2011=100) of real unit electricity costs in Germany, EU28 and selected EU countries



Source: Authors' own calculations

46. In the view of the expert commission, **charging government induced and regulated electricity price components** largely based on the kWh price places a constraint on flexibilities on the consumer side and sector coupling. This is particularly important for grid charges and the EEG surcharge. For sector coupling technologies to be competitive, financing must be based on incentives. In the opinion of the expert commission, the present trend of promoting individual technologies through specific exemptions in the levying system jeopardises the future acceptance of the energy transition.

Harnessing the potential of digitalisation

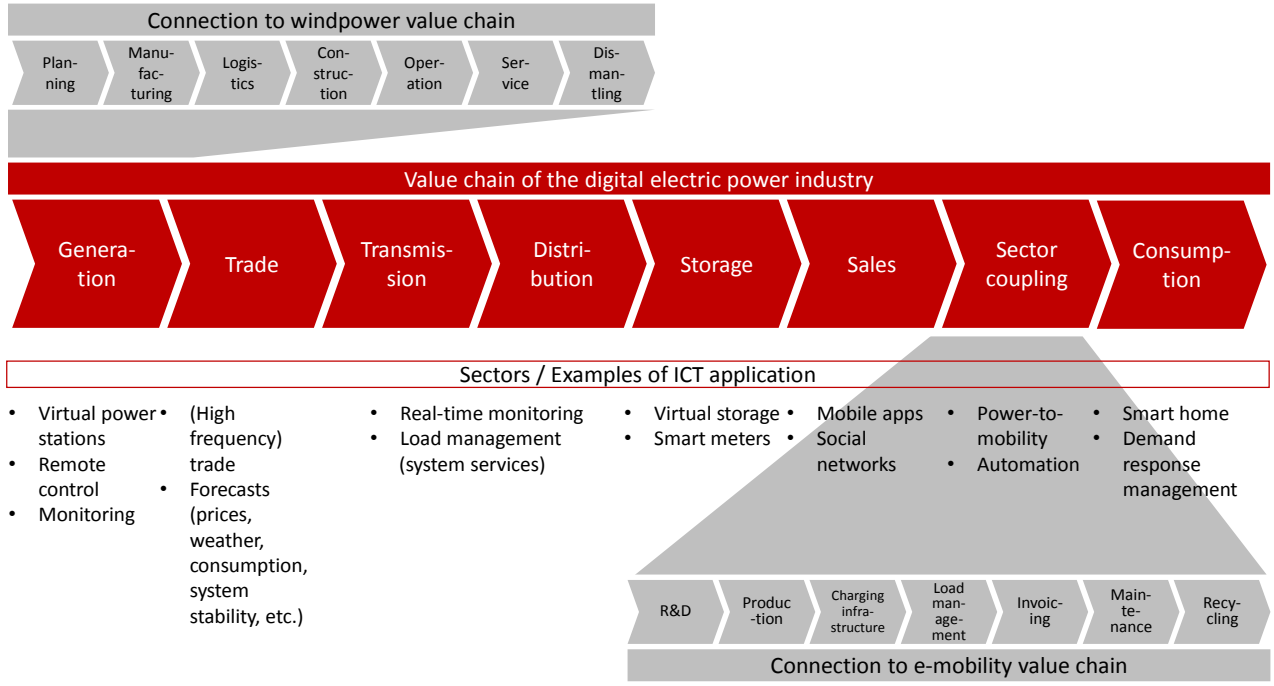
47. Digitalisation is a key issue for the future. The global transformation through information and communications technologies (ICT) is so significant that digitalisation has been dubbed the fourth industrial revolution. It will be particularly crucial for the future of the energy industry. The expert commission has concluded that Germany's success in the energy transition and climate protection will also depend on **how quickly the requisite infrastructure for digitalisation can be expanded in the years ahead** and how far the attendant risks can be kept under credible control (see Chapter 8).

48. In the course of energy market deregulation and due to the decentral approach of the energy transition, there has been a large increase in the number of actors. Functional and information chains that used to be located in one company in the past are often distributed today over several participants. Some new market roles have also emerged. Digitalisation will accelerate this development. The distribution over many actors calls for clearly demarcated interfaces among them. Not enough of these have been put into place so far. As in data protection, efficient and effective regulations must be introduced, also for **developing and accessing new data-based business models**. These include customer-friendly approaches, such as setting load-dependent and time-dependent rates, the deployment and management of virtual power stations or smart home and energy-efficient applications on a broad scale as well as corporate initiatives, such as the data-supported rationalisation and servicing of generating installations and grid infrastructure.

49. In the assessment of the expert commission, digitalisation has the potential on the electricity market to flexibilise energy supply and demand and alleviate peak loads. This can be expected to bring substantial economic advantages. For the young digital electricity sector, the expert commission **proposes a monitoring system for start-ups** that can be put to permanent use in the monitoring process.

50. Owing to the special **significance of digitalisation for value added**, this chapter will first impart a basic understanding of value chains in the electricity market and their digitalisation. Links in the digital electricity value chain (generation, trade, transmission, distribution, storage, sales, sector coupling and consumption) are supported by ICT and embedded in a network of upstream and downstream chains (see Figure 7). Based on this, the expert commission proposes a metric for assessing the status of digitalisation and value-added contributions for the electricity market overall and for each link in the value chain.

Figure 7: Value chain of the digital electric power industry and two examples of upstream and downstream value chains



Source: Authors' own chart

Summary of recommendations

51. From the current perspective, the attainment of the central targets of the Federal Government's Energy Concept for 2020 is improbable. In this year's statement, the expert commission makes a number of **recommendations** to the Federal Government for maintaining the credibility of the energy transition. To set out a stable and long-term framework for transforming the energy system, general carbon pricing should be introduced as a guiding policy instrument. The set of targets in the Energy Concept for 2030 must also be updated and completed to plan climate protection measures. In this connection, efficiency needs rethinking (consistent 'Think Efficiency' approach). Instead of taking a narrow view of the transport sector, problems need to be addressed as whole as part of a transport transition. The strategy for renewable power generation must be upgraded to set a better incentive for market transformation. The electricity infrastructure plays a key role in the energy transition and must be made fit for the future through speedy grid expansion and the further development of grid pricing. In all these efforts, attention should be paid to ensuring that energy delivers value for money, because end-user expenditure can be expected to rise in the medium term. Besides the risks, the energy transition also affords great opportunities, through digitalisation, for example. In the view of the expert commission, Germany's success in the energy transition and climate protection will also depend on making the most of these.

52. The expert commission has also submitted various proposals in recent years for improving energy transition monitoring with the aim of developing a consistent set of indicators to keep track of and assess the package of policy objectives, measures and impacts of the energy transition as a guideline for action. Some proposals have been adopted by the Federal Government, while others have not yet been addressed. We therefore suggest that particular consideration be given to the **following recommendations from previous statements**:

- revision of the points system for target attainment (see Chapter 1 in EWK, 2015; see Chapter 1),
- development of lead indicators (see Chapter 1 in EWK, 2014a),
- evidence-based evaluation of measures, with a particular distinction between endogenous and exogenous developments (see Chapter 3 in EWK, 2014b; see Chapter 1),
- extension of analyses for the time horizon up to 2030, accounting for various scenarios (see Chapter 10 in EWK, 2015; see Chapter 2),
- possibility of retiring emission allowances (see Chapter 4 in EWK, 2014b; see Chapter 2),
- application of the guidelines for effective energy efficiency monitoring (see Chapter in EWK, 2015; see Chapter 3), including collecting statistics and conducting surveys on different aspects of energy efficiency,
- suitable institutionalisation of NAPE monitoring (see Chapter 5 in EWK, 2015),
- scientific analyses of rebound effects in passenger transport (see Chapter 6 in EWK, 2015; see Chapter 4),
- in-depth investigation of the scope for sector coupling (see Chapter 2 in EWK, 2015; see Chapter 5),
- upgrading indicators for supply security (see Chapter 7 in EWK 2015 and Chapter 6 in EWK, 2014a; see Chapter 6),
- improved power balancing for electricity supply (see Chapter 6 in EWK, 2012 and Chapter 6 in EWK, 2014a; see Chapter 6),
- improvements in grid expansion and pricing (see Chapter 7 in EWK, 2015; see Chapter 6),
- application of the national energy account (see Chapter 7 in EWK, 2012, Chapter 7 in EWK, 2014a, Chapter 11 in EWK, 2014b and Chapter 8 in EWK 2015; see Chapter 7),
- taking greater account of unit energy costs, including indirect unit costs, and also in particular international comparisons of direct unit energy costs (see Chapter 8 in EWK, 2015 and Chapter 11 in EWK, 2014b; see Chapter 7),

- examination of macroeconomic impacts (see Chapter 12 in EWK, 2014b and Chapter 9 in EWK, 2015),
- taking greater account of distribution conflicts (see Chapter 7 in EWK, 2014a and Chapter 9 in EWK, 2015; see Chapter 7),
- development of a comprehensive set of innovation indicators (see Chapter 10 in EWK, 2014b),
- accounting for indicators on environmental impacts (see Chapter 5 in EWK, 2012 and Chapter 5 in EWK, 2014a),
- taking account of the acceptance of the energy transition (see Chapter 13 in EWK, 2014b).

The expert commission will be glad to assist in a constructive dialogue with the Federal Government on these issues.