Expert commission on the "Energy of the future" monitoring process

Statement on the first progress report by the German government for 2013

Berlin · Münster · Stuttgart, November 2014

- Prof. Dr. Andreas Löschel (chair)
- Prof. Dr. Georg Erdmann
- Prof. Dr. Frithjof Staiß
- Dr. Hans-Joachim Ziesing

Summary

ENERGY OF THE FUTURE
Commission on the monitoring process

Prof. Dr. Andreas Löschel (chair)
Prof. Dr. Georg Erdmann
Prof. Dr. Frithjof Staiß
Dr. Hans-Joachim Ziesing

Expert commission:

Prof. Dr. Andreas Löschel (chair)

University of Münster
Am Stadtgraben 9, 48143 Münster
E-Mail: loeschel@uni-muenster.de
Tel. +49 251-83-23022

Prof. Dr. Georg Erdmann

Berlin University of Technology,
Dept. for Energy Systems
Einsteinufer 25 (TA8), 10587 Berlin
E-Mail georg.erdmann@tu-berlin.de
Tel. +49 30-314-24656
Fax +49 30-314-26908

Prof. Dr. Frithjof Staiß

Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW)
Industriestr. 6, 70565 Stuttgart
E-Mail frithjof.staiss@zsw-bw.de
Tel. +49 711-7870-210
Fax +49 711-7870-100

Dr. Hans-Joachim Ziesing

Working Group on Energy Balances (AGEB)
Mohrenstraße 58, 10117 Berlin
E-Mail hziesing@t-online.de
Tel. +49 30-8913987

This statement is also based on the expert and commited work of our resarch associates:

Centre for European Economic Research (ZEW)

Robert Germeshausen
Philipp Massier

Berlin University of Technology, Department of Energy Systems

Lars Dittmar
Fernando Oster

Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW)

Maike Schmidt

Ecologic Institut

Eike Karola Velten

Summary of the Expert Commission's Statement

Preliminary remarks

The present document is the Expert Commission's Statement on the Federal Government's first Progress Report and the annual Monitoring Report. In contrast to the purely fact-based and retrospective Monitoring Reports, the 2014 Progress Report aims to perform a longer-range assessment of future developments and a more in-depth analysis of the cause-and-effect relationships between the measures currently being implemented as well as those necessary in future to achieve the defined objectives.

The 2014 Progress Report is supplemented by the Climate Action Programme 2020, the National Action Plan on Energy Efficiency (NAPE) and the Green Paper on the electricity market of the future. Furthermore, in late November a plan was being discussed in the media according to which the operators of coal-fired power plants were to be obliged to reduce emissions.

The Expert Commission welcomes the initiatives adopted by the Federal Government to avert the otherwise foreseeable failure to achieve the climate change mitigation target for 2020. The instruments envisaged appear broadly suitable, but they are not adequately described and quantified, so that it was not possible to assess them within the scope of our present Statement on the Progress Report. We therefore recommend the Federal Government to concretise the proposed measures and their intended effects in a timely manner, because this is likely to be crucial to the credible implementation of the ongoing energy transition process. The Expert Commission is ready and willing to provide specialist support in this respect.

The Expert Commission bases its Statement essentially on the Federal Government's draft of the Progress Report dated 12 November 2014. This is the version prepared for interministerial co-ordination. For time reasons, too, later revisions of and additions to the Progress Report could not be commented on in greater detail. This also applies to the statements made in the National Action Plan on Energy Efficiency (NAPE) and to the Climate Action Programme 2020.

Hence our assessments and options for action were formulated without the final version of the Government's 2014 Progress Report, identifying the

proposed further instruments. However, the Expert Commission would have needed precisely these concrete proposals and intentions on the part of the Federal Government to be able to deliver a definitive commentary. In this respect the governance of the monitoring process in the time structure as currently practised is leading nowhere. We therefore suggest solving these problems in collaboration with the Federal Government.

The monitoring-process as an element of the energy transition

In line with our remit, our report refrains from making any predictive statements that would involve the use of models and from performing its own evaluation of any measures. We do, however, examine the probable effects of the energy and environmental policy decisions already taken or planned in terms of their prospects of target achievement. The evaluations of individual measures and the scenario analyses underlying the Progress Report are also subject to closer scrutiny.

The 2014 Progress Report traces how certain indicators have developed in the past and outlines how they are likely to develop in the coming years. The areas in which developments are lagging behind the roadmaps for achieving the objectives are clearly stated. In this context, the magnitude of the shortfall is quantified. On that basis, measures that should be adopted to close the gaps are identified and analysed. A more critical examination of the reasons for the shortfalls would have been helpful at this point. In particular, the analysis of the effects of the measures already implemented and their contribution to achieving the objectives in many cases remains unclear in the 2014 Progress Report: which developments are attributable to the measures associated with the energy transition, which interactions have taken place, and how could these instruments be refined? This applies in particular to the action areas of climate change mitigation and energy efficiency. In the opinion of the Expert Commission, the Progress Report remains unsatisfactory in this regard and would benefit from addressing the manifoldly documented potentials for falling short of targets.

Hierarchy of targets

In its last two Statements, the Expert Commission suggested that the targets and objectives of the energy transition should be prioritized in a hierarchical structure.

The Expert Commission believes that the German Government's Energy Concept is defined by two superordinate objectives: lowering greenhouse gas emissions and the phase-out of nuclear power by 2022. These superordinate objectives are backed up by a number of sub-targets and implemented by means of political measures. The sub-targets and measures can and should be flexibly adaptable to the extent necessary and possible without compromising the attainment of the superordinate objectives.

The energy-policy triangle of economic viability, environmental compatibility and security of supply constitutes the conceptual yardsticks for appraising the sub-targets and measures. If the monitoring-process reveals unreasonably high economic, social or ecological burdens, the sub-targets and measures should be modified accordingly. However, the superordinate objectives of reducing greenhouse gas emissions and phasing out nuclear power remain unchanged.

The Expert Commission welcomes the fact that the Federal Government has in principle adopted our recommendation of prioritizing the targets into a hierarchy. The 2014 Progress Report structures the goals of the energy transition according to four levels: 1. political objectives, 2. core objectives, 3. steering goals and 4. individual measures. However, this hierarchy differs from our recommendations in one crucial aspect, as "climate targets, phase-out of nuclear power, competitiveness, security of supply" are given equal priority and are meant to form the political framework for the transformation of the energy supply system. The climate protection targets are quantified – e.g. 40 % less greenhouse gas emissions by 2020 – as is the phase-out of nuclear power by 2022. By contrast, there are no quantitative indicators for the goals of "competitiveness" and "security of supply." The Expert Commission has proposed indicators for both of these targets, but there is no threshold as of which it would be possible to speak of targets having been met or missed. In our view, this would not make sense anyway, as it could potentially over-define the system and consequently make it unachievable.

In the opinion of the Expert Commission, mixing quantitative and qualitative targets harbours the risk of a non-transparent trade-off process at the level of these political objectives leading to an implicit revision of the climate change mitigation and nuclear phase-out targets. The Federal Government is, of course, free to revise its targets, but because of the pivotal importance of these targets, any such revision should be explicit. The Government needs to be aware of the far-reaching implications of any such decision.

Greenhouse gas emissions reduction target at risk

In the draft of the 2014 Progress Report, the Federal Government upholds the targets set for 2020, especially that of reducing greenhouse gas emissions by 40 % compared to 1990. However, the Progress Report points out very clearly that precisely the greenhouse gas emissions target will be widely missed unless further actions are taken. The target shortfall is due – at least in part – to the lack of action at the time of the decision in 2011 to phase out nuclear power concerning compensation measures for the associated increase in CO_2 emissions.

The proposals for further actions set out in the draft of the Progress Report are in principle expedient, but in many cases no attempt has been made to quantify their results. In the opinion of the Expert Commission, the drafts of the 2014 Progress Report, the National Action Plan on Energy Efficiency (NAPE) and the Green Paper on the electricity market presented to us are not yet mature enough to fully compensate for the target deficits expected by the year 2020.

Admittedly, achieving the targets defined in the Energy Concept is indeed an exceptionally complex and extremely ambitious task. To meet those targets, the debate should address the following areas:

- measures outside of the emissions trading system,
- strengthening the emissions trading scheme,
- measures in the electricity sector,
- withdrawal of emission rights,
- introduction of a national CO_2 tax.

Use of model-based analyses in the monitoring-process

For the 2014 Progress Report the Federal Government draws upon model-based studies to extrapolate trends in the energy sector up to 2020 and beyond. These in turn are used to draw conclusions as to whether and to what extent the objectives of the energy transition are likely to be achieved. The table below compares the various calculations on target achievement. It is based on the 2014 Energy Reference Forecast, the Ongoing Measures Scenario (2012) from the Climate Protection Scenario 2050 and a linear extrapolation of current trends. The assessments reveal which of the energy transition targets set for 2020 will probably be missed. In this context the Expert Commission would like to suggest that the Federal Government should now also turn its attention to the medium-term targets for the period up to 2030.

Table: Target achievement in the reference trend up to 2020

Greenhouse gas emissions	**2011**	**2012**	**2013**	**2020**	**2030**	**2040**	**2050**
Greenhouse gas emissions (vs. 1990)	**-26.4 %**	**-24.7 %**	**-22.6 %**	**-40 %**	**-55%**	**-70%**	**-80% to -95%**
Reference Forecast				-36 %	-43%	-54%	-65%
Ongoing Measures Scenario (2012)				-35 %	-45%	-52%	-56%
Linear extrapolation				-30 %	-	-	-
Renewable energies	2011	2012	2013	2020	2030	2040	2050
Share in gross electricity consumption	**20.4%**	**23.5%**	**25.3%**	**≥ 35%**	**≥ 50%**	**≥ 65%**	**≥ 80%**
Reference Forecast				41%	52%	54%	64%
Ongoing Measures Scenario (2012)				37%	54%	61%	65%
Share in gross final energy consumption	**11.5%**	**12.4%**	**12.0%**	**18%**	**30%**	**45%**	**60%**
Reference Forecast				22%	29%	33%	39%
Ongoing Measures Scenario (2012)				18%	22%	26%	28%

Efficiency	**2011**	**2012**	**2013**	**2020**	**2030**	**2040**	**2050**
Primary energy consumption (vs. 2008)	**-5.4%**	**-4.3%**	**-4.0%**	**-20%**	**-**	**-**	**-50%**
Reference Forecast				-18%	-27%	-35%	-42%
Ongoing Measures Scenario (2012)				-10%	-	-	-29%
Linear extrapolation				-9%	-	-	-
Energy productivity final energy consumption p.a.	**1.7% (2008-2011)**	**1.1% (2008-2012)**	**0.26% (2008-2013)**	**-**	**-**	**-**	**2.1% (2008-2050)**
Reference Forecast				1.9% (2008-2020)	-	-	1.9% (2008-2050)
Ongoing Measures Scenario (2012)				1.2%	1.4%	1.4%	1.4%
Linear extrapolation				0.25%	-	-	-
Gross electricity consumption (vs. 2008)	**-1.8%**	**-1.9%**	**-3.3%**	**-10%**	**-**	**-**	**-25%**
Reference Forecast				-7%	-10%	-12%	-10%
Ongoing Measures Scenario (2012)				-2%	-	-	0%
Linear extrapolation				-7%	-	-	-
Transport sector	2011	2012	2013	2020	2030	2040	2050
Final energy consumption (vs. 2005)	**-0.7%**	**-0.6%**	**+1%**	**-10%**	**-**	**-**	**-40%**
Reference Forecast				-7%	-	-	-26%
Ongoing Measures Scenario (2012)				-9%	-	-	-29%
Linear extrapolation				+2%	-	-	-

In the context of this year's analyses the Expert Commission is taking a closer look at the methodology used for model analyses as reflected in the mentioned studies. The background for this is the Energy Reference Forecast, which the authors refer to as a "forecast of probable developments." However, this forecast is not a typical "business-as-usual" scenario but rather a prognosis based on an assumption of further measures about which no concrete details are given. In the opinion of the Expert Commission, a scenario predicting probable developments should also be accompanied by a scenario that dispenses with assuming future measures and focuses on establishing the framework for actions that may need to be taken.

Given the impending situation, the 2014 Progress Report should have also dealt in more detail with the reasons for the predicted target shortfalls. In actual fact, the Progress Report points out a number of exogenous developments that are detrimental to the energy transition (coal prices, CO_2 prices, etc.) but fails to note that some endogenous developments (e.g. rebound effects, delays in extending and expanding the transmission grid, the consequences of closing down nuclear power plants, etc.) are probably also to blame for the apparent target shortfalls. It would be advisable to take suitable steps (for instance using the models applied in devising the energy transition in the first place) to study and retrospectively quantify the influence of the exogenous compared to the endogenous factors. That would provide a basis for assessing the extent to which domestic developments and insufficiently effective courses of action are behind the evident deficits.

There is obviously a need for further methodological sophistication in the use of model-based analyses for the purposes of the monitoring process. To be able to take advantage of the heterogeneous modeling landscape available in the energy sector in Germany for the process of monitoring the energy transition and especially for elaborating the Progress Report, the Expert Commission suggests further institutionalizing the provision of model-based advice. In any case, an expert advisory panel should be set up to assist in the preparation of model analyses through regular discussions with the analysts.

Evaluation of existing measures

The Federal Government's annual reports are intended to facilitate a comparison of the current situation (actual status) with the goals defined for the energy transition (target status). Indicators play an important role in this context, because they compress data in order to present information in a compact and easily understandable form. However, indicators allow no conclusions to be drawn as to the efficacy and efficiency of the individual measures adopted. That would require a study of the specific measures based on empirical evidence. Only with the aid of such an evidence-based analysis can potential future target shortfalls and risks be identified. Such risks include inadequate effectiveness, unexpectedly high cost or unwanted side effects of the measures taken. In the context of the Progress Report, the key measures of the energy transition should be regularly analysed along these lines.

The Expert Commission thus recommends use of different analysis methods. In its Statement on the Progress Report, it sets out the essential methodological requirements and distinguishes a number of methods. These range from a simple description of the individual measures accompanied by a minimum of quantitative data, via descriptive statistical analyses and correlation analyses, to more recently developed methods of evaluation research for identifying cause-and-effects relationships.

The Expert Commission examines three approaches by way of example, assessing the effects of the electricity consumption tax, the ordinance governing interruptible loads for industry (AbLaV), and the Renewable Energy Sources Act (EEG). The first two of these measures appear to have made no major contribution to achieving the targets. By contrast, the site-specific promotion of wind-powered installations is effective, and even without major efficiency losses.

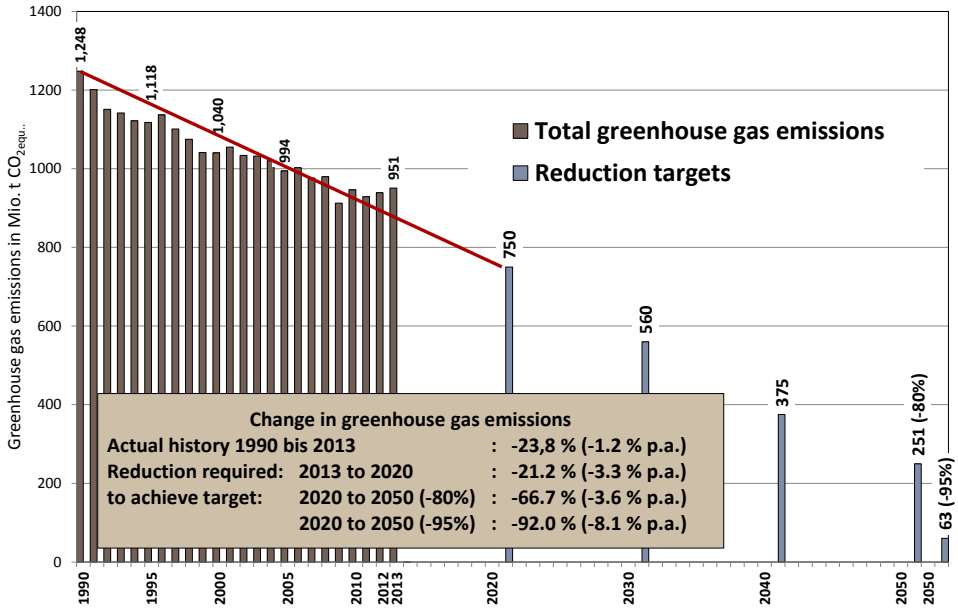
Greenhouse gas emissions

The Expert Commission welcomes the Federal Government's open admission that greenhouse gas emissions can be reduced by only 33 to 34 % instead of the intended 40 % by 2020 using existing measures. This shortfall has been clearly apparent in the ongoing trend ever since 2010 (see Figure).

According to the Progress Report, there is significant potential for reducing emissions in all sectors. The relevant areas for action are also adequately described. However, the Expert Commission misses information on the concrete measures to be adopted and how they are intended to help meet the targets. In the light of the impending gap in the achievement of the reduction target, high priority must, in the Expert Commission's opinion, be given to implementing suitable countermeasures. The Commission is, however, aware that this poses an extremely complex challenge to the Government.

The statement in the Progress Report that the Federal Government has decided on further measures for achieving the 2020 target in the Climate Action Programme 2020 is difficult to appraise on the basis of the draft version dated 12 November 2014. This adequately differentiates and specifies only the measures targeting largely non-energy-related greenhouse gas emissions. It is likewise not possible to appraise the Federal Government's statement that the target of reducing greenhouse gas emissions by at least 40 % can be met, if it fails to name a concrete figure for the further reductions to be achieved by the additional measures. This gives reason to assume that some activities are still in planning whose success is yet uncertain.

Figure: History of greenhouse gas emissions



From the technical perspective, greater exploitation of renewable energy sources and accelerating improvements in energy efficiency are decisive measures to close the gap. However, the Expert Commission shares the opinion that it will not be easy to achieve the intended emissions reduction in the short period up to 2020 only by improving final energy productivity and further expanding the use of renewable energy.

In that respect, the Expert Commission can comprehend that the potentials being able to be tapped in the short term actually lie in the electricity sector. Regarding the numerous applications for permission to shut down power plants by power utility companies, the Federal Network Agency could preferentially issue permits to close down highly polluting installations, as long as that would not involve a threat to the security of supply.

According to a plan under discussion at the end of November to introduce statutory regulations to oblige the operators of coal-fired power plants to reduce emissions by a further 22 mn t CO_2, the Federal Government would like to deploy a further instrument for closing the identified overall emissions target gap of at least 62.5 mn t CO_2. The Expert Commission is acquainted with

this plan only from contradictory media reports, which also formulate doubts for instance as to its admissibility under European law. Without knowing further details of the Government's intentions, the Expert Commission is unable to make any comments. However, it should be noted that, according to the findings of the 2014 Progress Report, the emissions target gap could be significantly wider than 62.5 mn t CO_2, so achieving the –40 % target would still not be certain.

The Expert Commission also points out that nearly all power generating installations in Germany are subject to the EU emissions trading scheme. Although closing down installations in Germany would, according to the territoriality principle, ease the national emissions balance, a real climate protection effect is hardly to be expected. The German Government should therefore check to what extent it can and would be allowed to buy up and withdraw EU emission rights to compensate the national emissions reductions achieved by shutting down power plants. It should likewise give consideration to the other options for reducing emissions outlined in Chapter 1 of the Statement.

Energy consumption and energy efficiency

In the opinion of the Expert Commission, energy efficiency is not being given the priority that has explicitly been postulated in the 2013 Coalition Agreement. Trends in the area of energy efficiency to date suggest that most of the targets are going to be missed by a more or less wide margin. This applies in particular to the target of reducing primary energy consumption by 20 % by 2020 and to the intended improvement in final energy productivity by on average 2.1 % per year. Also the Federal Government is anticipating a distinct target shortfall when it says that primary energy consumption will drop not by 20 % but only by 7.2 to 10.1 % by 2020 compared to 2008. To still be able to achieve the target, the pace of consumption reduction would need to be dramatically accelerated. This would require a further cutback of at least 1,400 PJ in primary energy consumption.

The draft of the Progress Report at the same time emphasizes that the energy efficiency measures adopted since October 2012 are expected to lead to a further reduction in energy consumption by around 43 PJ (equivalent to about 2.5 mn t CO_2) by 2020. The measures in question are especially the stricter

requirements of the amended Energy Saving Ordinance (EnEV 2013), the increase in funding for the KfW Building Rehabilitation Programme by 300 mn euros to currently 1.8 bn euros per year, and the introduction of programmes for promoting energy efficiency in industry.

According to the Progress Report, the measures envisaged for the final energy sectors in the National Action Plan on Energy Efficiency (NAPE) are intended to save a further 390 to 460 PJ in primary energy input. This is evidently not enough to close the target gap. The Expert Commission does not understand how the government can identify a major gap towards meeting its energy efficiency target and at the same time propose measures capable of covering barely a third of this gap. The Expert Commission would have expected some indication of how the remaining gap is to be tackled.

The table below provides an overview distinguishing the various targets and trends. In the case of power consumption, the target shortfall is around 15 bn kWh or just on 3 %. By contrast, the trend in final energy productivity appears particularly problematic. Extrapolation of the current trend would yield an increase of only around 7 % in all by 2020, whereas an increase of 28 % would be needed to achieve the target. The results for the transport sector are hardly better.

Table: Trends and targets in the field of energy efficiency

		Primary energy consumption*	Gross electricity consumption	Final energy productivity*	Building-related energy consumption*	Final energy consumption in traffic
		PJ	bn kWh	mn €/TJ	PJ	PJ
Target reference year	Units	14,409	618	282	3,671	2,586
2013		13,765	598	290	3,464	2,612
Target baseline year up to 2013	Average change in %	-0.9	-0.7	0.6	-1.2	0.2
2013 to target year 2020		-2.6	-1.1	3.5	-2.3	-1.6
2013	% change vs. target reference year	-4.5	-3.2	2.8	-5.6	1.0
Trend up to 2020		-10.4	-7.6	7.0	-13.0	2.4
	Units	12,911	571	302	3194	2,649
Target for 2020	%	-20	-10	28	-20	-10
	Units	11,527	556	362	2937	2,328
Target shortfall		-1,384	-15	-60	-257	-322
*) Adjusted values						

Against this background the Expert Commission concludes that considerable further efforts are needed. The broad range of potential target shortfalls has consequences for political decision-making. The scope of the actions required covers nearly all areas. Progress must not falter due to lack of available technical potentials. However, the effort to be invested beyond reaping the "low hanging fruits" should not be under-estimated nor should the willingness of the stakeholders to make the necessary investment be over-estimated.

The Expert Commission is not winking at the fact that the scale and the intensity of the actions needed could exceed the Government's and the general public's capacity to resolve the problems involved. Possibly, many of the necessary measures may not gain societal acceptance, with the result that their implementation could be hampered or even prevented entirely. In this context, too, the Expert Commission calls to mind the comparatively short time remaining before 2020. New measures will hardly be able to develop their full potential by then. In particular, stimulating large-scale investments often takes a long time, especially if the statutory basis has yet to be

established. Investments in energy-saving refurbishment of older buildings are particularly time-critical.

Energy-saving refurbishment of buildings and energy-efficient construction

Fortunately, the Federal Government has formulated a clear definition of the terms "heat requirement" and "primary energy requirement." For the purposes of quantifying the 2050 target, the primary energy requirement is now defined via the Energy Saving Ordinance (EnEV). That means that the renewable energy sources implicitly function as an efficiency-enhancing measure – thus making the energy efficiency target less ambitious. For the sake of clarity, therefore, the term "non-renewable primary energy requirement" should be used.

The heat demand is to drop by 20 % by 2020 compared to 2008. By 2050 the non-renewable primary energy requirement is to be reduced by 80 % (compared to 2008). This equates to a largely climate-neutral building stock. These targets will not be met if the current trend is allowed to continue unchanged. It would be necessary to double the average annual reduction in the final energy requirement for heating purposes from about 1 % (period 2008–2013) to 2 % (2013–2020). The same applies to the average annual reduction in the non-renewable primary energy requirement up to 2050.

The additional measures envisaged in the National Action Plan on Energy Efficiency (NAPE) will most likely not be enough to close the gap to the 2020 target. An appraisal of the ongoing and new measures taking into account deadweight and rebound effects, as well as interaction with other instruments is also lacking. This would be helpful so as to be able to better assess the actual effects and so suitably tailor the measures.

In the Expert Commission's opinion, a target shortfall is less tragic if further credible efforts are promptly made that hold promise of a longer-term effect. These could be for example stricter energy-saving requirements for new buildings and refurbishments and efforts to improve implementation. Assistance for energy-saving refurbishments should be geared to the long-term perspective up to 2050 and aim to achieve deep refurbishments (at least KfW building energy efficiency standard 70).

Transport

The Federal Government has to admit that it reckons with a reduction of the energy consumption in the transport sector of 11 % only by 2030, which implies that the target for 2020 would be missed. The Climate Action Programme 2020 assumes (all going to plan) a reduction of around 10 mn t in transport-related CO_2 emissions by 2020; however, the associated measures are only rudimentarily outlined. Besides, that would be only around 6 % less CO_2 emissions than in the target baseline year 2005.

Forecasts for the development of transport-related energy consumption have been elaborated in the context of the academic support provided for the Ministry of Economic Affairs. The Government should heed the recommendations given there and in comparable studies (for instance in the Policy Scenarios VI).

In the opinion of the Expert Commission, the energy transition cannot succeed without a significant contribution from the transport sector, especially since this sector relies almost entirely on fossil fuels. This should have been reflected in the debate about the additional measures required.

Renewable energy sources

The Federal Government has set relative targets for the expansion of the renewable energy sources. Whether they can be achieved thus also depends on how the baseline parameters develop. If the energy efficiency targets of the Energy Concept are achieved, it can be assumed that all the expansion targets for the renewables can likewise be met. The increase in the supply of energy from renewable sources required for this is about 90 TWh compared to 2013, bringing it up to well on 400 TWh. An extrapolation of the current efficiency trend, however, suggests that a further 50 TWh will need to be mobilized, which makes achieving the target much more ambitious.

The instruments available are in principle suitable for this purpose but need to be better tailored to meet the requirements and focused more on achieving the targets. This applies to the expansion corridors provided for in the amended Renewable Energy Sources Act, to stabilizing the development of photovoltaics and the use of biomass, and to the successful design and implementation of the planned competitive tendering models.

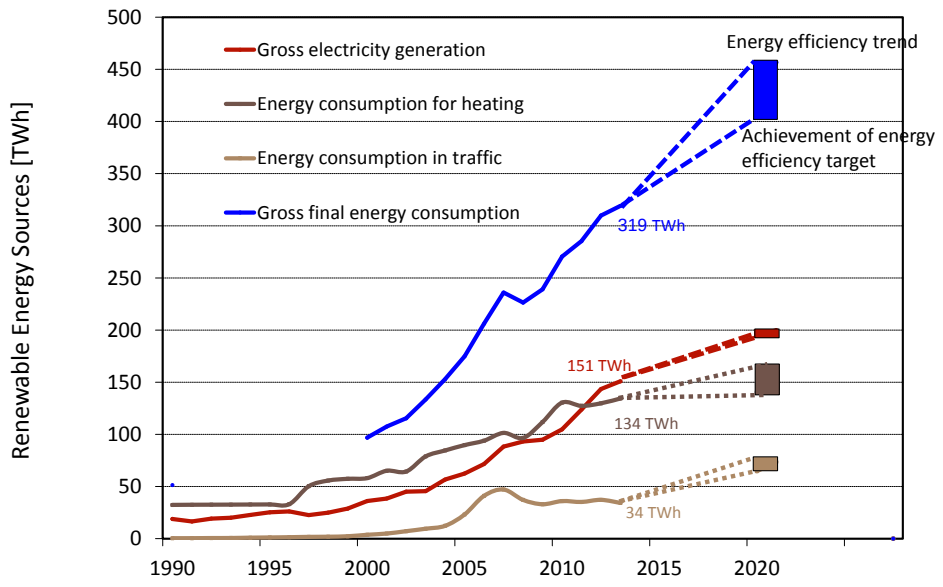
In the electricity sector one of the major challenges to implementing the expansion corridor for onshore wind power is the intended enlargement of the installed capacity by 2,500 MW per year. More and more installations will be reaching the end of their technical service life and/or their subsidy period by 2020, when they will either be shut down or repowered. In order to still meet the expansion corridor the gross new capacity required by 2020 rises to over 4,000 MW per year. The challenge here is to generate the necessary market volume, which would need to be even higher than the capacity added in the strong year 2013 (2,997 MW) and sustain it over a long period. Though the 35 % target in the electricity sector still appears feasible within the formulated growth corridors, these mean that the expansion of the renewable energy sources in the electricity market will no longer be able to compensate for potential target shortfalls in other areas of the use of renewable energy, if the expansion corridors are consistently adhered to.

To meet the target in the heat market, growth of 3 % p.a. in the renewable energy volume will be required, which roughly corresponds to the trend in the last three years, if final energy consumption for heating without electricity is taken as the baseline. The Federal Government has adopted two key measures which are in principle expedient for achieving the target: in the field of new construction the Renewable Energy Sources Heat Act (EEWärmeG), which introduces an obligatory renewable energy quota for new residential and non-residential buildings, and the market incentive program for renewable energy backfitting, which gives financial incentives for refurbishing existing buildings. Both of these instruments are accompanied by other measures such as subsidies for heat-and-power co-generation or further incentives for energy-saving refurbishment of buildings. It should be noted, however, that the number of applications for assisted funding for small-scale units under the market incentive program for renewable energy refurbishment dropped by almost a quarter in the first three quarters of 2014. A check should therefore be performed to determine how the trend can be made sustainable again. In this context and in the light of currently comparatively low fuel oil prices, it may also be necessary to enhance public awareness and if necessary the attractiveness of the funding programmes. Likewise, attention should be paid to the trend in the supply of heat from renewable heat-and-power co-generation, because the recent amendment to the Renewable Energy

Sources Act (EEG) corrected the expansion path for the electricity generation from biomass significantly downwards.

In the transport sector, the obligatory admixture of fuel from renewable sources in principle guarantees that a renewable share of 10 % will be achieved, even if this corresponds to approximately doubling the share. This makes it all the more important to maintain or refine the existing sanction mechanisms for failing to achieve targets.

Figure: Supply of energy from renewable sources subject to the progress made in the field of energy efficiency



With a view to the period beyond the year 2020, the Expert Commission recommends the Federal Government to detail as soon as possible how the proportion of renewable energy in gross final energy consumption is to be increased to 30 % in 2030 in line with the target set in the Energy Concept. For this purpose, it would be expedient to update the targets and strategies in those areas in which this has not yet been done, i.e. for renewable energy in the heat market and the transport sector.

In the electricity sector, it is foreseeable even today that in the field of onshore wind power as of the year 2021 the intended annual net growth of

2,500 MW can be achieved only by adding gross new capacity of 5,000 to 6,000 MW per year, which means sustainably doubling the market volume compared to 2013. This appears very ambitious and only viable against the background of propitious framework conditions. As regards the development of offshore wind power after 2020, the question remains open whether it will be possible to achieve the technical progress required to bring about the necessary cost-reducing effects and to acquire the requisite experience for establishing funding models to make the envisaged expansion to 15,000 MW by 2030 possible. Irrespective of the potential for technical development in the various engineering disciplines involved, further expansion depends crucially on the future terms of reference on the electricity market. Here the necessary prudence must be exercised and action taken with enough lead time to achieve the objective of a more cost-effective incentive system, to accelerate the transformation process in the electricity sector, and at the same time to push for the market integration of electricity from renewable sources. In this context, close intermeshing with the evolution of the electricity market design triggered with the Green Paper "An electricity market for the energy transition" is necessary.

Given restricted potential for the use of biofuels in the heating market, structural changes should be introduced in the near future. They should successively tap solar and geothermal resources, which today account for only a good ten percent of heating from renewable sources. The best way to do this is by significantly accelerating the expansion of the grid-bound heat supply, which, furthermore, provides additional leeway for the management of combined heat-and-power systems. Although this has been known for many years, no attempt has been made to create sustainable terms of reference. This also applies to organisational issues such as drawing up wide-area and reliable heating and cooling plans by the local authorities to map the available heat sources and sinks as the basis for tapping district heating potentials, elaborating strategic refurbishment programs for the local building stock, etc. Besides, in view of the importance of renewable energy for a climate-neutral building stock, it will hardly be possible to sustain funding from the national budget in the long term. One option would be the nation-wide inclusion of the building stock in the Renewable Energy Sources Heat Act (EEWärmeG).

As regards the transport sector, the Federal Government should swiftly revise its hitherto rather vague mobility and fuel strategy in the near future to bring it in line with traffic predictions and specify in much more concrete terms which milestones are to be achieved on the path to CO_2-neutral mobility by 2030. Apart from the goal of having 6 million electric vehicles on the road by 2030, there is neither any quantitative guidance given nor any distinction made between battery-powered vehicles and those running on fuel cells. In the context of renewable fuels, the aim should be to develop alternatives to the first-generation biofuels. Options include e.g. biomethane, biomass-to-liquid fuels, and electricity-based fuels such as power-to-gas or power-to-liquid. Here, the Federal Government is focusing mainly on research, development and demonstration, but a market introduction strategy is also needed to tap the considerable cost-reduction potential, which would best be possible via large-scale commercialisation. Various initiatives have developed conceptual approaches for this, which the Government should review.

Power plants and grids

The Expert Commission welcomes the fact that the 2014 Progress Report has taken up the recommendation it made last year of using the power balance at the time of the peak load for the year as a key criterion for assessing the security of the power supply system. This approach compares the generating capacity that can be assumed to be certain with the highest anticipated demand to be met in Germany. The electricity supply would be assured if the remaining capacity is positive (surplus). For the period from 2014 to 2016, the 2014 Progress Report estimates a surplus of more than 10 GW, but in several places it somewhat misleadingly speaks of over-capacities. The existing surplus together with the planned additions of new guaranteed capacity ought to be sufficient in the nation-wide balance for Germany to ensure that further nuclear power plants can be shut down as scheduled.

The various calculations arrive at different surpluses. Clearly, a methodological discussion is also needed. For instance the Progress Report rightly criticises that up to now the power balance has been drawn up from an exclusively national perspective, despite large-scale and predictably increasing exchanges of electricity with other countries. Thus, the proposal that the methodology

used to draw up the power balance should be revised to allow for international cooperation deserves support.

The statements made on power plants and grids in the 2014 Green Paper can likewise be considered an accurate analysis. Particularly noteworthy are the passages in Chapter 1 and Chapter 4 which point out that the balance responsible party/entity – and thus not the transmission system operators – are primarily responsible for the power supply. Accordingly, the legislator demands that the balance responsible party/entity balance their grids and provides for finely staggered sanctions if they fail to do so. This prescription naturally also marks out the course for deliberation on the further development of the electricity market.

The system operators also serve important functions in guaranteeing a reliable electricity supply by providing grid stabilization services. Situation-based competitive tendering for supplying control power as proposed in the 2014 Green Paper can make a contribution to avoiding critical supply situations such as those experienced in the spring of 2013.

Monitoring of power plants by the Federal Network Agency (BNetzA) has up to now found no evidence of capacity shortage for Germany as a whole. However, this does not hold true from a regional perspective. In southern Germany there is currently about 1.1 GW of new generating capacity under construction, whereas a total of 6.8 GW of generating capacity is scheduled for shutdown by the end of 2017. Of this figure, power plants with a total capacity of 3.9 GW have notified the intention to close down permanently, of which in turn 1 GW has been classified as vital to the system and thus belongs to the strategic power plant reserve.

It is widely known that the existing power transmission capacities are not enough to make up the supply shortage that these shutdowns will leave. Although annual investment by the transmission system operators has trebled since 2011, at the present pace of expansion many of the 23 projects launched under the Power Grid Expansion Act (EnLAG) are unlikely to be completed before the end of the decade, not to mention the planned direct-current transmission lines between northern and southern Germany, which are facing substantial political opposition. As a result, the transmission grid operators are increasingly forced to resort to redispatch interventions. As the Green Paper

accurately states, this situation is not viable in the long term, and unless significant progress is made in extending and expanding the grid, the power trading area would have to be divided up (market splitting).

In that case the normally unified German price zone would, in the event of a grid bottleneck, break down into several price zones, currently presumably into a northern and a southern zone. Assuming that there is an adequate supply in the northern zone but not enough electricity can be generated in the southern zone, different price levels in each of the two zones would restore the balance between supply and demand in the short term. In this situation, wholesale trading prices would tend to be higher in the southern zone than in the northern zone. In the medium term, the associated expectations on the part of the market players would trigger investment in power plants in the southern zone, whereas investment in the northern zone would be curbed. Relocation of electricity-intensive industrial processes to the northern zone could also not be ruled out. Unlike redispatching, market splitting would allocate the cost of inadequate transmission capacities directly to the region responsible for the shortage. All in all, market splitting would eliminate the problem of inadequate transmission grids in the course of time. This is not possible by means of redispatching.

If the current backlog in the expansion of the grid cannot be overcome, in the extreme case a scenario could arise in which nuclear power plants in southern Germany are assigned to the strategic grid reserve, even if that contradicts the current legal situation. The Expert Commission is of the opinion that this scenario must be prevented by all means, because the phase-out of nuclear power is one of the two superordinate objectives of the energy transition, and these should on no account be jeopardized.

Energy research and innovation

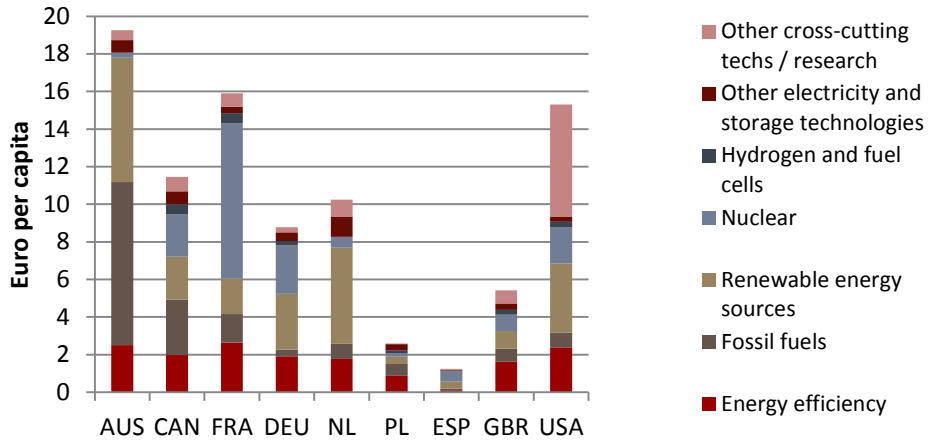
Successful implementation of the energy transition harbours opportunities for modernizing Germany’s national economy. This stems from the fact that innovation in the fields of environment and energy is eminently compatible with Germany's traditional output and competition profile and thus builds on a broad foundation. More innovation ought not only to strengthen the domestic economy but also to spill over to the global economy. There are numerous examples of the energy transition having triggered innovation with

beneficial effects, though some very heterogeneous transmission mechanisms can be observed. This makes it difficult to generalize.

The Expert Commission has already attempted in previous reports to compile a bundle of indicators to describe the innovation impetus associated with the energy transition. Besides government expenditure on R&D and the share of private equity going into energy innovations, the proposed indicators include the proportion of energy efficiency patents and the percentage of patents on renewable energy forms among all German patents. The 2014 Progress Report follows this proposal in substantial parts. It also highlights the downsides of this approach. For instance, private R&D expenditure on energy innovations is missing due to the lack of a sound statistical data foundation.

An international comparison of government funding for R&D per capita specifically on energy technologies reveals that Germany is only mid-field in terms of spending on research (see Figure). The questions as to whether, on what scale and in which direction spending on energy research should be increased do not permit any general answer, as the precise baseline point and the stage in the innovation process at which government spending sets in are important for its efficient use. However, comparative empirical estimates of the scale of research that would be desirable from the macroeconomic perspective are lacking.

Figure: Government spending on R&D in euros per capita in 2012



Since R&D expenditure, patents and venture capital alone are not enough to accurately gauge the macroeconomic opportunities associated with

innovation, the Expert Commission suggests extending the bundle of quantitative indicators by adding diffusion indicators. A core aspect here is the cost reductions in individual technologies associated with "learning-by-doing". By way of example, the related aggregate technology-specific cost advantages can be contrasted with the technology-specific annual expenditure – in the case of renewable technologies for instance the annual difference costs.

A rule-of-thumb estimate suggests that, without the investment made in PV in Germany and the learning effects it has triggered, the average global investment cost today would not yet have dropped below 2,000 euros per kilowatt of installed capacity. If it is assumed that the installed PV capacity in the rest of the world would have achieved its present-day level of 70 GW (2012) even if no additional PV capacity had been installed in Germany, the specific PV investment cost would be about 30 % higher than the current figure. Without the learning effect triggered by the Renewable Energy Sources Act (EEG), investment in PV abroad in 2012 would have required a 40 bn euros higher funding volume. This learning effect exceeds the amounts paid by German electricity consumers under the EEG funding scheme in 2012 more than 5-fold. The Expert Commission considers this learning effect a suitable indicator for characterizing the innovation-driven benefits of the growth of PV.

Energy prices and the cost of energy

The Expert Commission remains convinced that aggregate final consumer spending on energy is a good indicator of general affordability. It also makes it possible to observe the individual components of spending and how they change over time. As a result of the rise in grid charges and the costs driven by the Renewable Energy Sources Act, final consumer spending has increased significantly, a development that has not been fully compensated by falling wholesale prices for electric power. As a result, aggregate final consumer spending on electricity as the indicator proposed by the Expert Commission has risen from 2.5 % in 2012 to 2.6 % of gross domestic product in 2013.

Table: Structure of final consumer spending on electricity

	2010	2011	2012	2013
	[bn euros]			
Total spending [1]	**60.9**	**63.6**	**64.3**	**70.4**
Government-induced elements	**17.2**	**23.0**	**23.3**	**30.0**
of which				
Electricity consumption taxes [2]	6.4	7.2	7.0	7.0
Licence fees [3]	2.1	2.2	2.1	2.1
EEG surcharge (difference costs) [4]	8.3	13.4	14.0	19.8
Co-generation surcharge (KWK-G) [5]	0.4	0.2	0.3	0.4
Offshore surcharge (§ 17F ENWG) [6]	-	-	-	0.8
Government-regulated elements	**16.9**	**17.6**	**19.0**	**21.2**
of which				
Transmission grid charges [7]	2.2	2.2	2.6	3.0
Distribution grid charges [8]	14.7	15.4	16.4	18.2
Market- driven elements	**26.8**	**23.1**	**22.0**	**19.2**
of which				
Market value of renewable electricity[9]	3.5	4.4	4.8	4.2
Generation and marketing [10]	23.3	18.6	17.2	15.0

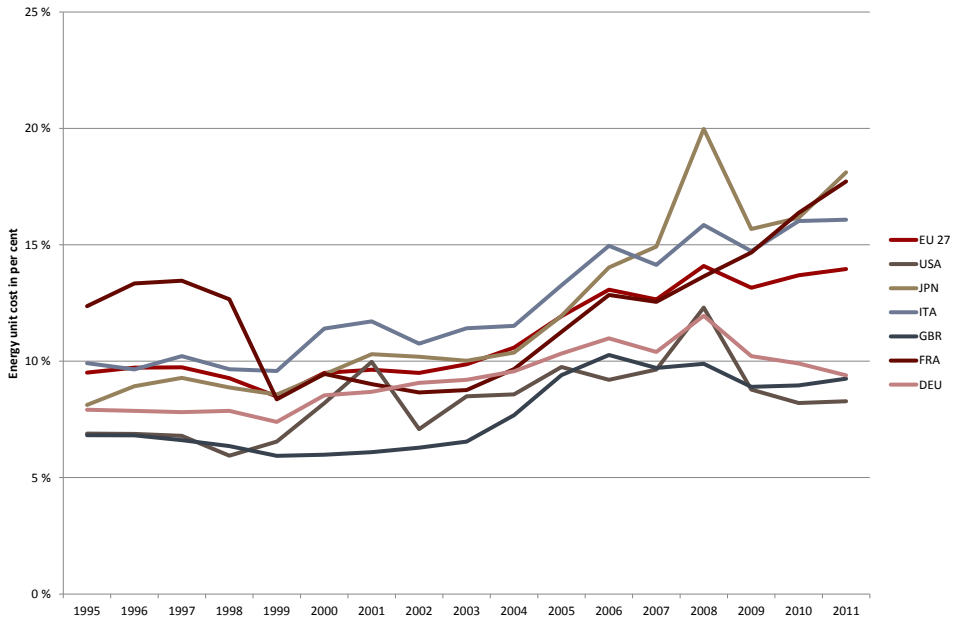
In addition to general affordability, differences in the energy prices paid by the various consumers must also be noted. The reasons for these include, among others, exceptions granted under the terms of the Special Compensation Arrangement (BesAR) under the Renewable Energy Sources Act. Furthermore, the preferential treatment given to power from renewable sources enables these to benefit from a merit-order effect. As a result of Germany's integration into the European internal market for electricity, this merit-order effect presumably applies in other European countries, too. In its previous Statements, the Expert Commission had already suggested that businesses should participate in the cost of renewable energy at least in the amount of the merit-order effect. If the merit-order effect spills over to other European markets, the contribution of the companies thereby relieved would need to be reduced by the amount of the merit-order effect abroad.

A mere comparison of energy prices is not sufficient. A company's actual energy cost also needs to be taken into account. The 2014 Progress Report identifies this in terms of the share of the energy cost in the gross value added for the sector in question. The Expert Commission recommends building on this approach and also comparing the "energy unit cost" indicator at the international level. This shows that the cost of energy in the manufacturing industry in Germany as a whole is still moderate compared to other countries. The time history of the energy unit cost in manufacturing is similar in

magnitude to those in the USA and the UK and is below the average for the European Union (EU 27). What is more, a downward trend can be seen as of 2008, by contrast with the slightly rising trend in the European average. The gap between the EU and Germany is widening accordingly (see Figure).

The various sectors within manufacturing industry are very heterogeneous. Thus the statement that the unit cost of energy is moderate in an international comparison does not apply in all sectors and especially not within some sectors, so that a more detailed examination is recommended. To be able to draw conclusions as to the competitiveness of businesses, further factors need to be taken into consideration additionally to energy cost. These include differences in national regulatory frameworks and classical location factors, such as the (business) tax system, wage levels and the quality of the workforce on the local labour market.

Figure: Energy unit cost in manufacturing industry



Another decisive factor is the level of competition, above all how easy it is to access the local market. This is because a rising cost of energy will have little impact on (industrial) competitiveness if the increase can be passed on to consumers in the long term. It is difficult to ascertain this and thus to evaluate the effects of cost increases by describing and comparing energy costs alone.

Thus, in addition to purely fact-based monitoring, more in-depth analyses are needed to obtain a more comprehensive picture of the cost of energy (cf. the discussion on the merit-order effect), distinguish it by sectors, trace its time history and make international comparisons.

Macroeconomic effects

The macroeconomic effects identified in the 2014 Progress Report are, in the opinion of the Expert Commission, somewhat marginal. However, this is due to the fact that the Progress Report examines the macroeconomic effects of the energy transition only starting with the year 2010. Although the energy transition was formally declared only in 2010 (the Energy Concept) and 2011 (phase-out of nuclear power), the public at large associates the investment and cost effects triggered as of the year 2000 (introduction of the Renewable Energy Sources Act) with the transformation of the electricity supply system. A macroeconomic analysis of the energy transition should therefore start with the year 2000. The counterfactual scenario "no energy transition" would then be based on the assumption that the share of renewable energy had not increased on the primary-energy side nor on the electricity side since 2000.

The Expert Commission focuses its reflections on the macroeconomic impact of the energy transition on the electricity sector, because this is where the most significant effects to date can be assumed to lie. If the guaranteed feed-in payments for electricity from renewable sources are maintained as promised under the various amendments of the Renewable Energy Sources Act (EEG), all units installed to date under the terms of the EEG will be entitled for a more or less long period to minimum payments to a cumulative amount of around 250 bn euros. Assuming that the investments made in renewable energy in recent years have not crowded out private consumption nor private investment, they can be seen as additional domestic demand with positive effects on growth and employment (equivalent in macroeconomic terms to deficit spending). The increase in Germany's international trade surpluses in recent years may also be attributable at least in part to the energy transition (e.g. substitution of energy imports through domestic value creation) and must not only be a result of other competitive advantages (wage restraint, relative weakness of the euro compared to other currencies, etc.).

In the years to come, however, the positive growth effects of the Renewable Energy Sources Act (EEG) are likely to disappear or even go into reverse. This is due, among other factors, to declining specific expenditure on less highly subsidized renewable energy installations accompanied by further annual increases in the EEG surcharge. The more the EEG surcharge exceeds annual investment in new EEG-funded installations, the more the macroeconomic deficit associated with the Renewable Energy Sources Act will be reduced and thus macroeconomic demand will contract. There are therefore plausible reasons for assuming that the hitherto positive growth and employment effects of the energy transition may be reversed in the coming years – unless new programmes funded via additional macroeconomic debt, for instance to enhance energy efficiency or to build up a storage infrastructure, are able to turn this negative trend around again.

Societal effects of the energy transition

The societal effects of the energy transition are crucial to its success or failure. The following comments are limited to questions of societal acceptance. There are also diverse distribution effects that are highly important and should therefore be dealt with in more detail in the future. For example, last year's Statement discussed the problem of energy poverty.

It would be short-sighted to understand public acceptance only in the sense of a positive assessment by citizens and the absence of opposition to energy transition projects. The Expert Commission recommends defining the concept of public acceptance in the context of the energy transition more precisely and then re-assessing the situation accordingly.

In the 2014 Progress Report the Federal Government presents a selective list of survey results that suggest a generally high level of approval for the energy transition – albeit with a downward trend. More than two thirds of the public still speak out in favour of the energy transition, even if – as they see it – they are currently bearing the major part of the burden themselves. On the other hand, many opinion polls also show dissatisfaction with how the energy transition is being implemented.

The correlation between public acceptance and the trend in the cost of energy, though highlighted by the Government and validated by studies, is in the opinion of the Expert Commission too simplistic. All the objectives of the energy-policy triangle - affordability, security of supply and environmental compatibility – play a role. Yet other important aspects are (possibly a lack of) trust in the protagonists of the energy transition and a (perceived) equity deficit. Here greater involvement of all stakeholders (public participation) might be helpful.

The second level of the public acceptance issue relates to specific measures, for instance erection of overhead high-voltage transmission lines. Such projects give some immediately affected citizens the feeling of being put at an unfair personal disadvantage for the sake of the energy transition. In the 2014 Progress Report the Federal Government announced new measures for improving public acceptance of specific energy transition projects. In the opinion of the Expert Commission, however, these proposals lack a sound analytical foundation and are in many cases again not specific enough. To obtain a more objective picture, public acceptance of the energy transition should be judged not only on the outcome of opinion polls but also on the basis of studies of actual deeds.