

National Energy Efficiency Action Plan (NEEAP) 2017 for the Federal Republic of Germany

*pursuant to Directive 2012/27/EU of the European
Parliament and of the Council of 25 October 2012 on energy
efficiency*

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1 Introduction

The European Union (EU) has set itself the goal of achieving a 20 % reduction in primary energy consumption in the EU by 2020 compared to projections. One of the most important tools for meeting that goal is the EU's Energy Efficiency Directive (Directive 2012/27/EU), which entered into force on 5 December 2012. This Directive contains additional cross-sectoral provisions aimed at increasing energy efficiency at EU level which have been transposed into national law.

The new Directive also repealed certain directives on energy end-use efficiency and energy services (2006/32/EC; Energy Services Directive) and cogeneration (2004/8/EC) and amended other directives (2009/125/EC and 2010/30/EU).

This National Energy Efficiency Action Plan (NEEAP) 2017 meets the Federal Government's reporting obligations pursuant to Article 24(2) in conjunction with Annex XIV Part 2 and Article 4, third sentence, of the Directive, as well as providing information on the current framework conditions and past successes of Germany's energy efficiency policies. The NEEAP 2017 documents Germany's recent and ongoing efforts and progress in the field of energy efficiency. The Federal Government has furthermore enclosed (in Annex IV) the annual report required by Article 24(1) in conjunction with Annex XIV Part 1 of the Energy Efficiency Directive.

Germany had adopted a comprehensive range of policy instruments for increasing energy efficiency even before the Directive was adopted, and has already achieved an observable decoupling of energy consumption from economic development; future measures will be aimed at ensuring that that positive trend continues. Increased energy efficiency, together with the associated energy savings, is one of the fundamental pillars of the energy transition in Germany.

Since December 2014, the Federal Government has set out its energy efficiency strategy in the National Action Plan on Energy Efficiency (NAPE) in conjunction with the 2020 Action Programme for Climate Protection. The NAPE is intended to gain support and buy-in from all the social actors for the task of increasing energy efficiency by highlighting possibilities and opportunities for them and ensuring that a commitment to energy efficiency is viewed positively. Based on an intelligent mix of consultancy, communication and information about worthwhile efficiency measures, funding and standards for new installations, the NAPE contains a set of instruments which incentivise increases in energy efficiency while also paving the way for the enormous potential to be harnessed. Both immediate tasks and areas of longer-term work are described in the NAPE.

The structure and content of the NEEAP 2017 are mainly based on the template for NEEAPs provided by the European Commission as guidance, and the reporting obligations set out in the Energy Efficiency Directive.

As well as the indicative national energy efficiency target for 2020, which has already been notified pursuant to Article 3 of the Energy Efficiency Directive, Chapter II contains an estimate of the likely total primary energy consumption in Germany in 2020 and the Federal Government's specific energy targets. Information is also provided on significant primary and final energy-saving measures. An updated comprehensive overview of the outcomes achieved in respect of the final energy consumption savings targets referred to in Article 4 of the Energy Services Directive is included.

Chapter III describes the alternative measures adopted pursuant to Article 7(9) of the Energy Efficiency Directive. It also provides additional information with a view to discharging specific reporting obligations under the Energy Efficiency Directive, relating inter alia to the energy audit obligation, metering and billing measures, energy efficiency in publicly owned buildings, progress made in relation to comprehensive assessments of the potential for use of highly efficient

cogeneration units and efficient district heating and district cooling and updates to the long-term strategy for the mobilisation of investments into the renovation of the national building stock.

Finally, Chapter IV provides an overview of the current situation and likely future development of the energy services market in Germany, which is healthy and expanding and will continue to show robust growth in the future. This market is composed of many different segments (e.g. contracting, energy audits, energy management, building renovations, measuring and metering services) and providers (e.g. energy companies, engineering firms, architectural practices, tradespeople) and is characterised by vigorous competition.

2 Overview of national energy targets and achieved savings

Germany had adopted a comprehensive range of policy instruments for increasing energy efficiency even before the Energy Efficiency Directive was adopted, and has already achieved an observable decoupling of energy consumption from economic development; future measures will be aimed at ensuring that that positive trend continues. Increased energy efficiency, together with the associated energy savings, is one of the fundamental pillars of the energy transition in Germany.

2.1 National efficiency targets

Indicative national energy efficiency target for 2020 as required by Article 3(1) of the Energy Efficiency Directive

Pursuant to Article 24(2) in conjunction with Annex XIV Part 2 No 1 of the Energy Efficiency Directive, the NEEAP must contain the indicative national energy efficiency target for 2020 pursuant to Article 3(1) of the Energy Efficiency Directive.

In a letter dated 27 October 2010, the Federal Government notified an indicative national energy efficiency target to the European Commission within the framework of the ‘Europe 2020’ strategy and stated the following:

‘The Federal Republic of Germany assumes that macroeconomic energy productivity will increase by an average of 2.1 % a year between 2008 and 2020. Based on an annual increase in gross domestic product (GDP) of 1.1 %, this will mean a reduction in the energy-related share of primary energy consumption from 314.3 million tonnes of oil equivalent (Mtoe) in 2008 to 276.6 Mtoe in 2020. Whether or not this reduction can be achieved depends inter alia on actual GDP developments, other factors such as weather and inventory changes which cannot be influenced and the composition of the German power plant park which is seen in the market.’ This corresponds to a reduction in final energy consumption from 220.7 Mtoe in 2008 to 194.3 Mtoe in 2020.

The figures notified in 2010, which were based on Eurostat data, were confirmed by the Federal Government in a letter dated 11 June 2013 and have not changed since.

Estimate of likely total primary energy requirement pursuant to Article 24(2) in conjunction with Annex XIV Part 2 No 2

Estimates carried out recently by the Federal Government for the purpose of the 2017 projection report for Germany pursuant to Regulation (EU) No 525/2013 indicate that total primary energy consumption in Germany is likely to fall by at least 12 % between 2008 and 2020. The Federal Government therefore assumes that estimated primary energy consumption in 2020, expressed on the basis of the primary energy consumption of 314.3 Mtoe notified in the 2010 notification under the Energy Efficiency Directive for 2008 (without non-energy consumption), will be approximately 273.8 Mtoe¹ and therefore slightly below the expected value of 276.6 Mtoe specified in the 2010 notification for 2020. This value may change as a result of future developments, particularly those relating to economic development and other indicators. The following analysis-based values have been used on a supplementary basis by the Federal Government as an indication of sectoral developments in final energy consumption by 2020:

¹ Changes in non-energy consumption between 2008 and 2020 are assumed to be an average of energy-related primary energy consumption.

- Private households: 54.5 Mtoe (NEEAP 2014: 52.8 Mtoe)
- Commerce/trade/services: 31.8 Mtoe (NEEAP 2014: 27.2 Mtoe)
- Industry: 61.0 Mtoe (NEEAP 2014: 54.2 Mtoe)
- Transport: 64.3 Mtoe (NEEAP 2014: 57.6 Mtoe)

Pursuant to Article 24(2), second sentence, of the Energy Efficiency Directive, the NEAAP must contain not only updated estimates for likely total primary energy consumption in 2020, but also estimated levels of primary energy consumption in the sectors of industry, transport, households and commerce. As a general rule, however, the national energy balance only states levels of final energy consumption for each sector rather than levels of primary energy consumption. The national energy forecasts and scenarios used as a basis for both the NEEAP 2014 and the 2020 estimates in this document also follow that approach. In order to meet the requirements of the Energy Efficiency Directive, the above-mentioned levels of final energy consumption per sector will therefore also be converted into primary energy in the rest of this document. It should, however, be noted that only the figures for final energy consumption per sector are based on official statistical data sources and the 2020 scenarios modelled on these sources. The levels of final energy consumption per sector were converted into levels of primary energy consumption on the basis of the following assumptions:

- The share of electricity and fuel consumption in the sectoral figures for final energy consumption in 2020 is based on the ‘with measures’ scenario in the 2017 projection report.
- A primary energy factor of 1.1 has been assumed to be generally valid for fuels.
- The assumed primary energy factor for electricity in 2020 reflects the changes in the electricity sector which formed the basis for the primary energy consumption estimates for 2020 in the ‘with measures’ scenario of the 2017 projection report. The PEF was at least 2.6 in 2008 and will drop to below 2.1 by 2020.

These assumptions give rise to the following figures for primary energy consumption per sector in 2020:

- Private households: 70.5 Mtoe
- Commerce/trade/services: 46.3 Mtoe
- Industry: 85.2 Mtoe
- Transport: 71.7 Mtoe

2.2 Specific energy targets set by the Federal Government

In its communication of 11 June 2013, the Federal Government notified its indicative national energy efficiency target to the European Commission by way of transposition of Article 3 of the Energy Efficiency Directive, as well as highlighting the significant additional contribution to achievement of the European energy efficiency target which Germany had made by implementing its energy concept.

The Federal Government’s national energy concept includes the ambitious target of reducing primary energy consumption by 20 % by 2020 and by 50 % by 2050 (in both cases compared to 2008). It also provides for an annual average increase of 2.1 % in final energy productivity and a reduction of 20 %

in final energy consumption for heat and a reduction of 10 % in electricity consumption and final energy consumption in the transport sector by 2020 compared to 2008.

2.3 Primary energy savings

Pursuant to Article 3(1) and Article 24(2) of the Energy Efficiency Directive in conjunction with Annex XIV Part 2 No 2(a) of the Energy Efficiency Directive, this section provides an overview of significant measures and actions undertaken in relation to primary energy savings.

It also provides an overview of measures which are particularly significant in terms of changes in the level of primary energy consumption in Germany. A distinction is made between measures which target distribution losses or efficiency and internal consumption within the transformation sector, and measures which result in primary energy savings by means of final energy savings.

Wherever available, estimates of the savings expected by 2020 and the savings achieved by the reporting date are provided for each measure or each package of measures/actions. Any other available information on further impacts/benefits of the measures is also provided.

The efficiency of the transformation sector (including internal consumption within this sector) holds a great deal of scope for primary energy savings. The Federal Republic of Germany has over many years implemented a large number of policy measures in this area which, together with ongoing technological innovations, have achieved significant primary energy savings in the past and will continue to do so in future. A number of these measures are described briefly below; these are intended to serve as examples rather than as an exhaustive list.

The EU Emissions Trading System is aimed at thermal power plants with an output of 20 MW_{el} or above and a large number of industrial installations in the transformation sector, including coking plants, refineries and crackers. In line with the 'cap & trade' principle, the level of greenhouse gas emissions is capped on an installation-specific basis on the one hand while trading in emissions allowances is permitted on the other. The assignment of a monetary value to greenhouse gas emissions and accordingly to the use of energy incentivises increases transformation efficiency. The market-focused nature of this tool may also allow the targeted allocation of investments with a view to reducing emissions.

In addition to the market-focused tool of emissions trading, power plants and industrial installations in the transformation sector are also subject to the regulatory frameworks outlined in Directive 2010/75/EU on industrial emissions. These include regulations on the licensing, operation and closure of industrial installations, as well as binding datasheets on the best available technologies for the licensing of new installations and emissions limits for power plants and large combustion plants, thus laying down minimum standards for energy use efficiency. The Directive on industrial emissions has been transposed in Germany by means of amendments to the Federal Immissions Protection Act [Bundes-Immissionsschutzgesetzes, BImSchG], the Water Act [Wasserhaushaltsgesetz, WHG], the Waste Management and Product Recycling Act [Kreislaufwirtschaftsgesetz, KrWG] and two packages of regulations which contain numerous emissions limits.

The marketplace transition entailed by §19a of the Energy Act [Energiewirtschaftsgesetz, EnWG] provides a further example of increases in energy efficiency achieved as a result of a measure implemented by the Federal Government. A drop in imports and fewer sources of domestic funding for L-gas will mean that around one third of the German gas market will in future switch to H-gas (which has a higher calorific value). Technical modifications to an estimated 5.5 million end devices will be necessary as a result. Owners may, however, decide to purchase new devices instead of carrying out these technical modifications. The explanatory statement for §19a of the Energy Act states that replacement of an old device by a new device will generally result in increased efficiency. If the owners of the gas-powered end devices decide to purchase a new heating system, a new flow-

type heater or another new device as a result of the marketplace transition, it will be possible to leverage significant energy efficiency potentials in German households.

A further bundle of measures of vital importance for increasing transformation efficiency relates to the promotion of cogeneration, and includes a differentiated system of related measures at various levels in areas such as the following:

- From a regulatory point of view, a licence is generally necessary for the cogeneration of electricity and heat in certain industrial installations (such as waste incineration plants, cf. the 17th Federal Immissions Protection Regulation [Bundes-Immissionsschutzverordnung, BImSchV]) or installations above a certain size (heat output of 50 MW or above, 13th BImSchV). The necessary conditions for the use of local and district heating are also in place on the demand side (Renewable Energies Heat Act [Erneuerbare-Energien-Wärmegesetz, EEWärmeG], tenancy law, Energy Saving Regulation [Energieeinsparverordnung, EnEV]).
- On the cost side, an energy tax exemption applies to highly efficient cogeneration plants (§53a of the Energy Tax Act [Energiesteuerergesetz, EnergieStG]). Funding programmes also exist for various investment types, for example the KfW programmes ‘IKK [Investment Credit for Municipalities]/IKU [Investment Credit for Community and Social Enterprises] Energy-Efficient Urban Redevelopment – Supplying Neighbourhoods’ in the public sector, the market incentive programme [Marktanreizprogramm, MAP] for the funding of measures to promote the use of renewable energies in the heating market, the Mini Cogeneration Programme for small-scale and micro cogeneration units and heating networks and the funding of investments under the Cogeneration Act [Kraft-Wärme-Kopplungsgesetz, KWK-Gesetz] for heating networks and heat reservoirs.
- On the revenue side, the bonus for cogenerated electricity and the exemption from the levy under the Renewable Energies Act [Erneuerbare-Energien-Gesetz, EEG] for self-generated electricity offer examples of how cogeneration has been made a more attractive option.

In the 2010 energy concept and the decisions accelerating the energy transition which were adopted in June 2011, the Federal Government decided to phase out the use of nuclear energy and expand the use of renewable energies, providing a crucial impetus for the development of future energy generation structures. In view of the fact that installations generating electricity from renewable energies have a calculated efficiency of 100 % and will therefore push plants with a lower level of efficiency out of the market (nuclear power plants have a calculated efficiency of 33 %, for example), the developments upon which these political decisions are based will also result directly in significant primary energy savings.

Reduced distribution losses also offer potential for primary energy savings. In energy balance terms, the distribution losses relate to flare and pipeline losses for electricity, gas and district heating.² Reducing these distribution losses will also help to reduce primary energy consumption. The grids for fixed-line energy sources are regulated by the state on the basis of the Energy Act (Part 3 ‘Regulation of grid operation’), which also lays down the requirements which apply to the production of grid development plans. These plans not only pursue the goal of needs-based, technically secure and system-stable grid expansion, but also consistently prioritise profitability requirements for investment and operation. The responsible handling of distribution losses is a vital prerequisite for the profitable operation of a grid.

One example of how distribution losses have been targeted by state regulation is the fee structure enshrined in the Electricity Grid Fee Regulation [Stromnetzentgeltverordnung, StromNEV]. Pursuant to §10 of this Regulation, distribution losses must be listed under a separate cost item. This ensures

² Distribution losses are not shown directly for the other energy sources, but are listed together with other arithmetical discrepancies in the energy balance under ‘statistical differences’.

that the costs of distribution losses are visible,³ thus incentivising operators to reduce this cost item yet further.

2.4 Final energy savings

All consumption savings on the final energy side also result in primary energy savings. A large number of Germany's policy measures are therefore aimed at reducing final energy consumption.

Final energy savings have been converted into primary energy savings using primary energy factors specific to the individual energy sources, on the basis of an expert opinion produced by Prognos AG and the Fraunhofer Institute for Systems and Innovation Research ISI on behalf of the Federal Office for Energy Efficiency (Prognos/Fraunhofer ISI 2014). In order to carry out these calculations, assumptions had to be made regarding the proportion of savings which can be attributed to each energy source. For simplicity's sake, a distinction was made between electricity savings and fuel savings, with a primary energy factor of 1 used for fuel savings and a primary energy factor of 2.5 used for electricity savings, and the specific features of renewable energies, district and local heating and the conversion cost for fuels (e.g. refineries, briquetting plants) were ignored. The efficiency of the power plant park was also assumed to be constant at an average value of 40 %. This is equivalent to using an electricity factor of 2.5.

The proportion of electricity saved for the energy sources in the energy mix was also determined as part of the calculation for each measure. In cases where this was not directly apparent from the nature of the measure or an evaluation, reference was made to the national consumption balances produced by AG Energiebilanzen (AGEB 2014).

Updated comprehensive overview of outcomes achieved in respect of the final energy consumption savings targets referred to in Article 4(1) and (2) of Directive 2006/32/EC

In accordance with Article 24(2) in conjunction with Annex XIV Part 2 No 2(b) of the Energy Efficiency Directive, the NEEAP contains a list of outcomes achieved in respect of the final energy consumption savings targets referred to in Article 4(1) and (2) of Directive 2006/32/EC (Energy Services Directive); this list is an updated version of the list included in the NEEAP 2014. The mandatory evidence that these indicative savings targets pursuant to Article 4 of the Energy Services Directive are currently being achieved is not linked in any way to evidence of the binding energy savings target pursuant to Article 7 of the Energy Efficiency Directive or other provisions of the Energy Efficiency Directive.

For further details of the requirements which apply to the reporting of indicative energy savings targets and their achievement, reference should be made to Article 4 in conjunction with Annexes I, III and IV to the Energy Services Directive and to the European Commission's recommendations on the measurement and control methods to be used in connection with the Energy Services Directive. For a more detailed description of Germany's approach to discharging these obligations, please refer to the NEEAP 2011 and the methodological document which accompanied the NEEAP 2011.

In the NEEAP 2011, the Federal Government specified Germany's energy savings target for 2016 as 748 petajoules (PJ) on the basis of an electricity factor of 1 (electricity factor 2.5: 995 PJ). These two energy savings targets were exceeded by far under the NEEAP 2011 and NEEAP 2014 on the basis of the energy savings calculated in line with the methodological requirements of the Energy Services Directive.

³ Operators are obliged to publish average losses and the costs of procuring electricity to cover grid losses.

The NEEAP 2017 reviews the outcomes and savings notified in the NEEAP 2014, and updates them where necessary. This review, which was performed by the Federal Government with scientific support from independent institutes (Prognos/ Fraunhofer ISI 2017), reveals that Germany continues to exceed by far the final energy savings target pursuant to the Energy Services Directive.

Overall, the top-down calculations updated in the NEEAP 2017 show that energy savings of 2 195 PJ at an electricity factor of 1 and 2 723 PJ at an electricity factor of 2.5 had been achieved by 2016. Energy savings for the period between 2008 and 2016 were 1 234 PJ, and energy savings for the early action period between 1995 and 2007 (which is also eligible) were 962 PJ (electricity factor: 1). The calculated savings are therefore higher than the indicative energy savings target pursuant to the Energy Services Directive by a factor of approximately 3 (electricity factor of 1: 2 195 PJ compared to 748 PJ / electricity factor of 2.5: 2 723 PJ compared to 995 PJ), and the target would have been achieved without the savings made during the early action period.

Reference should be made to the outcomes of previous NEEAPs for further details of bottom-up calculations. In 2011 and 2014 the bottom-up savings alone exceeded the energy savings target. This means that only savings achieved directly by means of policy instruments have been included. The Federal Government remains firmly committed to the achievement of the targets pursuant to Article 4(1) and (2) of the Energy Services Directive, and only top-down calculations have therefore been updated.

When evaluating these outcomes, it is (as ever) necessary to take into account the fact that the savings resulting from top-down calculations are arithmetical values which represent model-based energy savings. They are the outcome not only of policy-driven instruments and programmes, but also of technical progress, which is predominantly market-driven. This makes it clear that not only policy instruments but also market and technical progress play a major role in increasing energy efficiency.

Nevertheless, this result shows that the vigorous and continuing efforts undertaken by the German state to improve energy efficiency in the country have made it possible to exceed the savings target by far at the end of the 2016 measuring and reporting period. The numerous measures which have been implemented as independent initiatives by Federal States, municipalities or private stakeholders have been largely or wholly overlooked. This means that the figures shown are conservative estimates.

As a basic principle, the Federal Government regards these positive findings as confirmation that its energy efficiency policies to date have been successful. They represent a vital starting point for further measures aimed at achieving the more demanding targets of the national energy concept.

Annex I contains a list of detailed outcomes as proof of compliance with the energy savings target pursuant to the Energy Services Directive, including in particular a breakdown of the outcomes by sector.

3 Important measures in Germany

3.1 Energy efficiency obligations pursuant to Article 7 of the Energy Efficiency Directive

In accordance with Article 24(2) of the Energy Efficiency Directive in conjunction with Annex XIV Part 2 No 3.2 to the Energy Efficiency Directive, the NEEAP 2017 contains a brief description of the national system pursuant to Article 7(1) of the Energy Efficiency Directive or the alternative measures adopted pursuant to Article 7(9) of the Energy Efficiency Directive.

The Federal Republic of Germany makes use of the option granted by Article 7(9) of the Energy Efficiency Directive by taking particular strategy measures to achieve the savings target pursuant to Article 7(1) of the Energy Efficiency Directive. On 4 December 2013 the Federal Government forwarded a first communication to the European Commission (followed by an updated version on 5 June 2014) on the planned transposition of Article 7 of Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC (the Energy Efficiency Directive).

As notified in its communication of 5 June 2014, the Federal Government's 'National Action Plan on Energy Efficiency' (NAPE) represents a comprehensive energy efficiency strategy which summarises the relevant goals as well as outlining a great many new immediate measures and other areas of work, funding sources and the remits of individual stakeholders, thus establishing energy efficiency as the second pillar of the energy transition in Germany. The NAPE was adopted by the Federal Government on 3 December 2014 and is aimed at achieving the ambitious energy efficiency targets outlined in Germany's energy concept. It contains a large number of immediate measures which will play a significant role in improving the existing mix of policy tools, thereby guaranteeing that progress is also made towards the savings target pursuant to Article 7 of the Energy Efficiency Directive.

The NAPE serves as the basis for immediate measures aimed at optimising and further developing existing measures. These include quality assurance and optimisation measures in relation to the Federal Government's existing energy advice programmes, further development of the KfW's 'CO₂ Building Renovation Programme' and the KfW's energy efficiency programmes for the promotion of corporate investments in energy-efficient technologies. The Federal Government has also introduced a large number of new measures, such as a competitive tendering model in the field of energy efficiency (STEP up!), the 'Energy Efficiency Networks' initiative, mandatory energy audits for non-SMEs, support for contracting, a national efficiency label for heating systems and the 'Waste Heat Utilisation' initiative.

In addition to immediate measures, the NAPE also defines areas of longer-term work with the ultimate aim of adopting additional energy efficiency improvement measures over the coming years and optimising and further developing existing measures.

The most recently updated version of the communication pursuant to Article 7 of the Energy Efficiency Directive, which now also includes the above-mentioned new NAPE measures, was forwarded to the European Commission on 26 March 2015. The figures set out in this NEEAP regarding the effects (resulting from the NAPE) of certain strategic measures and bundles of measures pursuant to Article 7(9) of the Energy Efficiency Directive, including an estimate of the cumulative final energy savings to be achieved in the period 2015-2020 in each case, are updated versions of the figures set out in the Federal Government's communication of 26 March 2015. The corresponding requirements of Article 7 and Annex V to the Energy Efficiency Directive have been taken into account when estimating the cumulative final energy savings resulting from the measures. The outcomes are listed in Annex II.

Germany has deviated from the requirements set out in Annex IV to the Energy Efficiency Directive in the case of 7 of the 29 measures notified in total by using conversion values provided by AG Energiebilanzen to quantify final energy savings. Pursuant to Annex IV of the Energy Efficiency Directive, the Member States may use other conversion factors if the use of these other factors can be justified. The seven measures which have been notified are as follows: Energy Saving Regulation for New Buildings (M01), Energy Saving Regulation for Existing Buildings (M02), Renewable Energies Heat Act (M03), Cogeneration Act (M07), Energy and Electricity Tax (M13), HGV Toll (M14) and Air Traffic Tax (M15). These are macro-level measures, and therefore require an underlying data set which incorporates detailed information on Germany's energy balance. The central energy balance database has been compiled on the basis of work carried out by AG Energiebilanzen. Annex III compares the conversion factors stipulated in Annex IV to the Energy Efficiency Directive against those used by AG Energiebilanzen. The deviations are within the ranges specified in Annex IV to the Energy Efficiency Directive, which means that they only differ slightly from the requirements set out in the Energy Efficiency Directive, and on average they amount to less than 2.5 %, with the largest deviation (approximately 7 %) applying to the conversion factors for wood. The conversion factors used reflect the composition and physical properties of the fuels used in Germany more accurately than the statistical data in Annex IV to the Energy Efficiency Directive. A brief analysis of the conversion factors has been produced by Prognos AG (Prognos 2015).

As was the case for the NEEAP 2014, the current annual report is again enclosed with the NEEAP 2017 (see Annex IV); this report outlines the final energy savings achieved in 2015 for the most important alternative measures adopted pursuant to Article 7(9) of the Energy Efficiency Directive.

The Federal Government makes use of the option granted by Article 7(2) in conjunction with Article 7(3) of the Energy Efficiency Directive whereby the value calculated pursuant to Article 7(1) of the Energy Efficiency Directive (2 344 PJ) may be offset by measures pursuant to Article 7(2)(a) to (d) in conjunction with Article 7(3) of the Energy Efficiency Directive, resulting in a 25 % reduction (586 PJ) which brings the total to 1 758 PJ. The main measures to be offset are those pursuant to Article 7(2)(d) (early action).

The Federal Government will continue to provide the European Commission with regular updates on any future changes within the framework of its annual reporting obligations pursuant to Article 24(1) of the Energy Efficiency Directive in conjunction with Annex XIV Part 1(e) to the Energy Efficiency Directive.

3.2 Energy audits and energy management systems pursuant to Article 8 of the Energy Efficiency Directive

According to the definition used in DIN EN 16247-1, an energy audit is a systematic inspection and analysis of the energy use and energy consumption of a plant, a building, a system or an organisation, with the aim of identifying and reporting on the energy flows and the potential for energy improvements. Its purpose is to highlight the potential energy savings which could be made by the company in question. The energy auditor systematically gathers information regarding the existing energy consumption profile of a building or group of buildings, an industrial operation or a private or public service as a basis for identifying targeted measures to improve energy efficiency. The energy audit which is performed must meet the requirements of DIN EN 16247-1.

The Energy Efficiency Directive (2012/27/EU) was adopted with a view to achieving the EU's energy policy goals. The provisions of Article 8(4) to (7) stipulate that all companies which do not qualify as small and medium-sized enterprises (SMEs) must perform an energy audit pursuant to DIN EN 16247-1. The Federal Government transposed this requirement into national legislation on 15 April 2015 by amending the Act on energy services and other energy efficiency measures [Gesetz über

Energiedienstleistungen und andere Energieeffizienzmaßnahmen, EDL-G]. The Bundestag's Economic Affairs Committee also adopted a decision relating to this legislative amendment (in BT-Drs. 18/39342).

The amendments to the Act on energy services and other energy efficiency measures obliged all non-SMEs to perform an energy audit by 5 December 2015 and every 4 years thereafter. Companies may alternatively introduce an energy management system (pursuant to DIN EN ISO 50001). The Federal Office for Economic Affairs and Export Control has been tasked with carrying out random checks to ensure compliance with the audit obligation.

The first findings to emerge from the evaluation exercise which commenced in the fourth quarter of 2016 are summarised in the following detailed information on the energy audit obligation. The project is monitored by the Federal Office for Energy Efficiency and the Federal Ministry for Economic Affairs and Energy. It is assumed that around 50 000 non-SMEs throughout Germany were obliged to carry out an energy audit under the Act on energy services and other energy efficiency measures before the end of 2015, and either did so or introduced an energy management system (EMS) pursuant to DIN EN ISO 50001.

In addition, certain SMEs have voluntarily performed energy audits or introduced an EMS, either under funding programmes or outside such programmes; in the latter case they are not obliged to supply evidence of compliance, and it is therefore impossible to ascertain the number of companies involved. Before the performance of an energy audit became mandatory, the market for independent energy audits was effectively limited to those carried out under funding programmes such as 'Energy Advice for SMEs'. It is estimated that approximately 60 000 energy audits or energy management systems had been performed or introduced in Germany under such programmes by 2016.

The Federal Office for Economic Affairs and Export Control keeps a list of the accredited internal or external auditors who perform the audits. The list currently numbers 3 760 auditors who work either for one of the 2 659 accredited and listed companies or on a freelance basis.

Although implementation of the measures proposed in the energy audit is not obligatory, it is of vital importance for achieving the energy efficiency targets which have been set.

Various findings regarding the audit/EMS obligation have already emerged from the ongoing evaluations. An analysis of industry trends reveals that companies with a local or national presence tend to prefer audits (local: 45 % audit, 27 % EMS); by way of contrast, the likelihood that a company will introduce an EMS increases the more it moves into the international market (international: 18 % audit, 45 % EMS). It can also be observed that companies in energy-intensive industries and in the manufacturing/processing sectors prefer to introduce an EMS, whereas companies in the services sector tend to perform energy audits since their energy requirements account for only a small proportion of their actual value creation.

In summary, these findings concerning industry structure indicate that demand for energy audits is particularly high among companies in the services sector which operate at a local or national level from multiple locations and which assign a low priority to energy costs. Companies in the manufacturing sector which consume high levels of energy prefer to introduce an EMS. The political goal of encouraging companies to identify potential energy-saving measures by means of mandatory audits has been achieved. The most important task in the future will be to increase the implementation rate of the measures identified in these audits. Since an EMS may be introduced as an alternative to an energy audit, the demand for these systems has also increased since the introduction of the audit obligation. As predicted, however, the increase in demand for energy management systems has been much smaller than that for audits, since 48 % of companies with an EMS had already put it in place before the audit obligation was introduced.

3.3 Metering and billing pursuant to Articles 9 to 11 of the Energy Efficiency Directive

After having been previously adopted by the Bundestag, the Act on the digitisation of the energy transition entered into force on 29 August 2016. The Act regulates the requirements and obligations which apply to both producers and consumers in connection with the introduction of smart metering systems, which function as a secure communication platform and thereby ensure that the electricity transmission system is fit for the needs of the energy transition. By recording and displaying data on power generation and consumption and the grid, these systems encourage households to use energy more efficiently by allowing them to see at a glance when and how much electricity is being used. They can also be used on a cross-sectoral basis; in future it will be possible to bundle the metering of electricity, water, gas and heat and to incorporate extra value-added 'smart home' or 'age-appropriate living' applications.

The new rules strike a balance between the costs and benefits of installing and operating smart metering systems, and include a clear charging framework with price caps to ensure that the costs do not outweigh the expected benefits. The Act furthermore sets out binding new protection profiles and technical guidelines for smart metering systems with a view to guaranteeing data security, data integrity and interoperability.

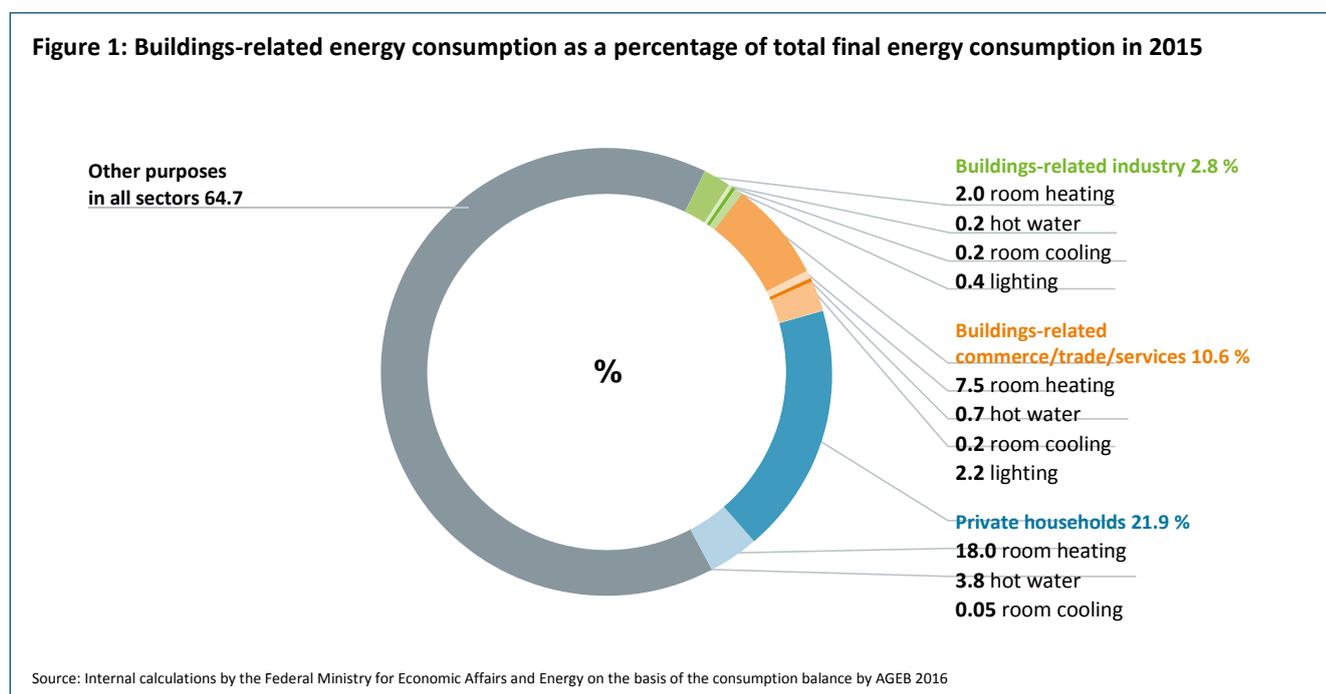
In 2016 the Federal Government also launched the pilot programme 'Energy-Saving Meters', under which the Federal Office for Economic Affairs and Export Control promotes the development, testing and market launch of innovative digital metering systems. These 'energy-saving meters' allow users (both private households and businesses in industrial or services sectors) to monitor their consumption of electricity, gas, heating or cooling on a continuous basis and even to identify how much is being consumed by which devices. The meters can also reliably quantify energy savings on the basis of 'before and after' measurements, and provide users with further information on how to reduce their energy consumption (e.g. product advice, maintenance tips or ideas of what to do or not to do) on the basis of the data which has been gathered.

3.4 Energy Efficiency National Fund pursuant to Article 20 of the Energy Efficiency Directive

The Energy Efficiency National Fund was established in 2011 as part of the Special Energy and Climate Fund on the basis of the Act establishing a Special Energy and Climate Fund [Gesetz zur Errichtung eines Sondervermögens Energie- und Klimafonds, EKFG] of December 2010 (Federal Law Gazette I, p. 1807), most recently amended by Article 1 of the Act of 22 December 2014 (Federal Law Gazette I, p. 2431). The overall aim of the Special Energy and Climate Fund is to enable additional spending under programmes aimed at promoting an environmentally friendly, reliable and affordable energy supply and climate protection, for example by means of research projects relating to the efficient generation, distribution and use of renewable energies. The programmes planned under the Energy Efficiency National Fund also play a key role in implementing the National Action Plan on Energy Efficiency. The specific tasks, areas for action and goals of the Energy Efficiency National Fund are stipulated in the Federal Government's energy concept of 28 September 2010 (which outlines the overall strategy for the energy market through to 2050). The measures which are necessary to leverage the significant energy and electricity saving potentials (particularly in the fields of 'Economy', 'Consumers' and 'Municipalities') range from consumer information and product innovation through to the market launch of energy-efficient products. Concrete examples of measures currently being funded under the Energy Efficiency National Fund include the market launch of highly efficient cross-cutting technologies in the SME sector, the promotion of energy-efficient and climate-friendly production processes and energy efficiency measures for municipalities.

3.5 Updated long-term strategy for mobilising investment in the renovation of the national building stock pursuant to Article 4 of the Energy Efficiency Directive

The buildings sector was responsible for 35.3 % of total final energy consumption in 2015 (Figure 1). It will play a key role in the success of the energy transition in Germany, and the country's 2010 energy concept therefore set the long-term goal of achieving an almost climate-neutral building stock by 2050, meaning a reduction of around 80 % in non-renewable primary energy consumption compared to 2008. In October 2015 the Federal Cabinet adopted an Energy Efficiency Strategy for Buildings with a view to achieving this goal. The Energy Efficiency Strategy for Buildings represents the energy transition strategy for the buildings sector and also forms the basis for the chapter on buildings in the 2050 Climate Protection Plan adopted by the Federal Government in 2016. It outlines the steps that must be taken to achieve an almost climate-neutral building stock by 2050, based on a combination of energy-saving measures and the use of renewable energies.



Overview of Germany's building stock

Germany's building stock is extremely heterogeneous and comprises a large number of buildings of different types and ages with very different energy characteristics. In 2015 the country's residential building stock comprised approximately 19 million buildings with over 40 million dwellings, of which around 15.6 million were detached houses and semi-detached houses with around 18.7 million dwellings, and around 31.1 million were apartment blocks with almost 21 million dwellings. There are also around 1.4 million dwellings in non-residential buildings. The average living space per dwelling is just over 91 m².

The number of building permits granted in 2015 (for 313 296 dwellings) was around 10 % higher than the previous year, and higher than 2011 by around 85 000 dwellings (Table 2: Building permits for superstructures).

Table 1: Housing stock in Germany

Characteristic	Unit	2011	2012	2013	2014	2015
Dwellings (residential and non-residential buildings)	1 000	40 630	40 806	40 995	41 221	41 446
Dwellings per 1 000 residents	Number	506	507	508	508	504
Living space per dwelling	m ²	91.1	91.2	91.3	91.4	91.6
Living space per resident	m ²	46.1	46.2	46.3	46.5	46.2
Rooms per resident	Number	4.4	4.4	4.4	4.4	4.4

Source: Federal Statistical Office

Table 2: Building permits for superstructures in Germany

Category	Unit	2011	2012	2013	2014	2015
Building/construction measures	Number	213 305	208 923	213 362	209 295	222 280
Total dwellings	Number	228 311	241 090	272 433	285 079	313 296
Living space	1 000 m ²	26 645	27 293	29 714	30 425	33 022
Estimated construction costs	EUR million	68 396	71 194	77 266	78 397	84 606
including: new buildings						
Buildings	Number	144 797	139 492	141 902	138 375	147 304
Dwellings	Number	204 724	216 594	242 149	251 175	271 916
Living space	1 000 m ²	23 324	23 953	25 967	26 499	28 510
Estimated construction costs	EUR million	55 751	58 279	63 357	63 937	69 596

Source: Federal Statistical Office

Around 73 % of all dwellings are located in buildings constructed before 1979. Around 14 % of dwellings are located in buildings constructed after 1991. Most buildings (around 46 %) were constructed between 1949 and 1978, which means that their energy and physical building characteristics are likely to be sub-optimal (Table 3: Dwellings by year of construction).

Table 3: Dwellings by year of construction (as at 2014)

Year of construction	Germany, in thousands
Total dwellings	39 195
of which constructed between... and...	
before 1918	5 500
1919-1948	5 126
1949-1978	18 134
1979-1986	3 895
1987-1990	1 076
1991-2000	3 066
2001-2010	1 916
2011 and later	482

¹ Dwellings in residential buildings (not including hostels)

Source: Federal Statistical Office

The lack of data means that the existing non-residential building stock can only be estimated through extrapolation. It is assumed on that basis that there are at least three million heated non-residential buildings in Germany, with an estimated net area of between 1.5 and 2.5 billion m². The rate of construction of new non-residential buildings fell continuously between 2012 and 2015 from 28 473 to 25 123. At the same time, the estimated costs of the completed structures increased from approximately EUR 20 billion to approximately EUR 22 billion. No conclusions can be drawn from these extrapolations regarding the age distribution of the non-residential building stock.

Development of cost-effective renovation concepts

There is no straightforward method for developing cost-effective energy renovation concepts in the buildings sector. To date Germany has focused on reducing energy consumption, increasing efficiency and substituting fossil fuels, which has proven to be a successful strategy. The Energy Efficiency Strategy for Buildings, however, made clear the need to evaluate the use of renewable energies and efficiency measures aimed at reducing primary energy consumption in the context of existing cost-efficient technologies and the existing building stock structure. Cost-effective renovation concepts must therefore take account of existing restrictions on energy efficiency improvements, the integration of renewable energies and the existing structure of the building stock.

- On the basis of current calculations, the total potential of **renewable energies** which could be used for the buildings sector in 2050, including heat networks and electricity from renewable energies, is estimated at between around 1 400 PJ and 1 800 PJ. This corresponds to between 40 % and 50 % of current final energy consumption and (depending on improvements in efficiency) a share of approximately 60 % to 70 % of renewable energies in 2050. Restrictions result inter alia from the available technologies and their levels of efficiency. For example, the use of biomass is restricted by the limited availability of arable land and competing uses, and the potential of solar thermal energy is limited by the size and direction of the available roof space, future earnings and competition from alternatives to photovoltaics. Similarly, heat pump systems are not freely scalable.
- Current calculations indicate that it will be possible to reduce final energy consumption to approximately 1 600 PJ by 2050 as a result of **efficiency measures**. This corresponds to a reduction of 54 % in final energy consumption compared to 2008. Examples of the restrictions

which apply in this respect include current and future technical options for insulating exterior walls and increasing the energy efficiency of windows, as well as for plant-specific systems.

- The existing **structure of the building stock** (around 18 million tenant-occupied households compared to just under 10 million owner-occupied households) represents the third major obstacle on the path to an almost climate-neutral building stock; problems faced in this respect include the tenant/landlord dilemma and preservation orders.

In 2017 the Federal Government launched the **Tailored Renovation Roadmap** for buildings in order to provide building owners with harmonised cost-effective renovation concepts. These concepts will be reliable multi-stage and multi-year strategies which owners can follow in order to improve the energy efficiency of their buildings, and which take into consideration not only purely energy-related issues but also the individual options which are available in view of the nature of the building and the owner's resources.

Future outlook for the buildings sector: strategies and measures for ensuring that extensive renovations are cost-effective

The strategic approach followed with a view to encouraging owners of the existing building stock to carry out comprehensive modernisation measures must be as broad as possible. The Energy Efficiency Strategy for Buildings makes it clear firstly that the goal of achieving an almost climate-neutral building stock by 2050 is ambitious but technically feasible, and secondly that additional measures must be taken to achieve the relevant targets. The Energy Efficiency Strategy for Buildings thus describes itself as a dynamic learning strategy, and the Federal Government has initiated additional measures and deployed a comprehensive mix of tried-and-tested policy instruments involving the provision of information, advice and funding, the imposition of new requirements and the implementation of research projects to encourage owners, the real-estate sector, companies and municipalities to make investment decisions which support the energy transition. The following measures have been launched by the Federal Government since the last report in 2014:

- The majority of the measures under the **National Action Plan on Energy Efficiency (NAPE)**, including an increase in funding for the CO₂ Building Renovation Programme (to EUR 2 billion per year), amendments to the market incentive programme and the Energy Efficiency Incentive Programme as a replacement for the tax incentives which were originally planned, are aimed at the buildings sector.
- Since 2016, the '**Deutschland macht's effizient [Germany Makes It Efficient]**' campaign has provided information on efficiency potentials and sources of funding to those involved in the energy transition, with a particular focus on the buildings sector.
- The '**Heating Optimisation Funding Programme**' provides funding for low-investment measures to optimise existing heating systems.
- The initiative '**EnEff.Building.2050**' provides funding for model projects which demonstrate ambitious energy concepts for buildings and districts in order to encourage their widespread adoption.
- The initiative '**Solar Construction/Energy-Efficient City**' provides funding for research and development into energy-efficient and climate-friendly buildings and districts. It focuses on technologies which improve energy efficiency and the integration of renewable energies, with a view to supporting the energy transition in buildings and cities.

As well as the measures described above, the following measures are also at the planning stage:

- The Federal Government is planning a funding programme for **fourth-generation heat networks** in order to leverage existing heat supply potentials.
- The **Tailored Renovation Roadmap** for Buildings will be launched in 2017, initially for residential buildings and subsequently for other buildings as well.

In November 2016 the Federal Government adopted the 2050 Climate Protection Plan, which included confirmation of the national targets for the buildings sector. This plan outlines strategic directions which are to be fleshed out by concrete programmes of measures by 2018. The goal of an almost climate-neutral building stock can only be achieved by means of demanding new standards for the construction of new buildings and long-term renovation strategies for the existing building stock, as well as a gradual move away from fossil fuel heating systems.

Expected energy savings and further benefits

Energy savings for selected measures are shown on the basis of bottom-up calculations in the 2017 annual report pursuant to Article 24(1) of the Energy Efficiency Directive (Annex IV). It should, however, be noted that not all measures are quantifiable, and these unquantifiable measures may make a significant contribution to the achievement of targets.

Table 4: Top-down energy savings in buildings

Energy saving	2010	2013	2016
Unit		PJ/a	
Top-down		compared to 2007	
Total for room heating and hot water	525.8	504.9	685.9
Room heating	494.7	527.9	637.5
Hot water	31.1	-23.0	48.4

Source: Prognos/Fraunhofer ISI 2017

Table 4 shows current energy savings in the fields of room heating and hot water on the basis of top-down calculations.

Funding made available by the Federal Government, e.g. under the CO₂ Building Renovation Programme or the Market Incentive Programme for Renewable Energies in the Heating Market, helps to make energy efficiency improvements more easily achievable by tenants, users and owners. Only the non-funded share of the investment may be passed on to tenants.

3.6 Energy efficiency in public bodies pursuant to Articles 5 and 6 of the Energy Efficiency Directive

Energy efficiency plans for public bodies pursuant to Article 5(7)

Pursuant to Annex XIV Part 2 No 3.1 of the Energy Efficiency Directive, the NEEAP 2017 must include a list of public bodies which have produced an energy efficiency plan pursuant to Article 5(7) of the Energy Efficiency Directive.

The Federal Government is taking action at regional and local level through the provision of information to the public, the presentation of energy policy goals and the production of a national Energy Efficiency Renovation Roadmap for State-Owned Properties. The approach which has been

developed and the framework which has been put in place in connection with the Energy Efficiency Renovation Roadmap for State-Owned Properties will also encourage other public bodies to plan and implement energy efficiency measures in the buildings and properties which fall within their area of responsibility. To date, the federal states of Baden-Württemberg, Brandenburg, Hessen and Thuringia have produced Energy Efficiency Renovation Roadmaps for the properties they own. A Renovation Roadmap is currently being drawn up for the properties owned by the federal state of Berlin.

To date, 63 German municipalities have joined the Covenant of Mayors for Climate and Energy.⁴ The Covenant of Mayors is an official European movement whose members (cities and municipalities) undertake voluntarily to increase energy efficiency and use sustainable sources of energy. The members of the Covenant of Mayors have set themselves the goal of exceeding the EU's energy policy goal of reducing CO₂ emissions by 20 % by 2020.

Energy-efficient procurement by public bodies pursuant to Article 6 of the Energy Efficiency Directive

The public sector is the largest customer of goods and services in Germany, with purchases amounting to a total of EUR 300 billion a year (approximately 13 % of GDP) (Environment Agency 2014). This puts it in a position to provide a vital impetus for increased market penetration of energy-efficient products and services, particularly in view of the considerable level of energy consumption in the public sector and the significant potential for improving its levels of energy efficiency (McKinsey 2008). Article 6 of the Energy Efficiency Directive requires that the Member States should purchase only products, services and buildings with high energy efficiency performance (except in a few narrowly defined exceptions). The following regulations and acts which require and promote energy-efficient procurement have accordingly been adopted over the past few years:

§67 (Procurement of energy-related supplies or services) of the Regulation on Public Procurement [Vergabeverordnung, VgV], which must be observed by all public-sector contracting authorities which issue Europe-wide calls for tender, states that the highest energy efficiency performance and, where applicable, the highest energy efficiency class should be required whenever energy-related goods are procured or constitute a vital prerequisite for the provision of a service. As a general rule, tenderers must also be required to provide concrete information on energy consumption and, wherever suitable, an analysis of minimised life cycle costs or comparable data. Energy efficiency must also be taken into account when assessing the tenders based on the criterion of cost-effectiveness. §8 of the EU Construction Tendering and Contract Regulations, Part A [Vergabe- und Vertragsordnung für Bauleistungen, EU VOB/A] contains a substantially identical provision.

By way of supplement to §67 of the Regulation on Public Procurement and §8c of the EU Construction Tendering and Contract Regulations, Part A, the General Administrative Provisions on the Procurement of Energy-Efficient Products and Services [Allgemeine Verwaltungsvorschrift zur Beschaffung energieeffizienter Produkte und Dienstleistungen, AVV-EnEff] state that all government offices and agencies must ascertain the most energy-efficient system solution on the basis of a needs analysis, and take energy consumption during the use phase into account when drawing up tender documents. They thus flesh out the statutory requirements at regulation level and (by way of contrast to §67 of the Regulation on Public Procurement and §8c of the EU Construction Tendering and Contract Regulations, Part A) also apply to the award of public contracts below the EU threshold values. Wherever possible and appropriate, contractual terms relating to the environment and energy efficiency must also be required for performance of the contract. In addition to the procurement costs, the expected operating costs over the period of use and the costs of depreciation and disposal must also be considered when making the final decision on the most cost-effective tender (life cycle costs principle). The General Administrative Provisions on the Procurement of Energy-Efficient Products and Services were comprehensively revised in December 2016 and brought into line with the new

⁴ http://www.covenantofmayors.eu/about/covenant-step-by-step_en.html

legal framework established in connection with the reform of public procurement law which took place in April 2016. The revised version entered into force on 25 January 2017 (Federal Gazette BAnz AT 24 January 2017 B1).

In addition to these obligations, energy-efficient procurement is also promoted by the Restriction of Competition Act [Gesetz gegen Wettbewerbsbeschränkungen, GWB], the Regulation on Public Procurement, Section 1 of the Services Tendering and Contract Regulations, Part A [Vergabe- und Vertragsordnungen für Leistungen, Teil A, VOL/A], the Construction Tendering and Contract Regulations, Part A, and the Defence and Security Contract Regulations [Vergabeordnung Verteidigung und Sicherheit, VSVgV]. The Federal Office for Energy Efficiency also publishes lists of energy efficiency criteria for various product categories as additional guidance for contracting authorities.

In order to ensure that greater account is taken of sustainability considerations (and therefore also energy efficiency considerations), since 2010 the Federal Government, the federal states and the municipalities have been collaborating through the ‘Alliance for Sustainable Procurement’, the aim of which is to increase yet further the proportion of sustainable products and services procured by the public sector. The Alliance serves as a forum for the systematic exchange of information between the largest public-sector purchasers, and is intended to support the increased application of uniform national and international sustainability standards at all three levels (Federal Government, federal states and municipalities). Energy efficiency considerations are also taken into account.

Since 2013, the Competence Centre for Sustainable Procurement [Kompetenzstelle für Nachhaltige Beschaffung, KNB] has also operated as an administrative department within the Procurement Agency of the Federal Ministry of the Interior. As well as providing advice to public-sector contracting authorities on specific points of concern, it offers a comprehensive web presence, a telephone and email hotline and on-site training courses. There are no indications that German public procurement law imposes regulatory and non-regulatory barriers to energy efficiency, inter alia within the meaning of Article 19(b) of the Energy Efficiency Directive.

3.7 Efficiency of energy supply

In general terms, the Federal Government has provided a crucial impetus for the development of future energy generation structures by means of its 2010 energy concept and the decisions accelerating the energy transition which were adopted in June 2011. In specific terms, the 2011 amendments to the Atomic Energy Act [Atomgesetz, AtG] meant that eight nuclear power plants were decommissioned immediately (or not put back into service following the moratorium imposed on 14 March 2011), and the lifetimes of the remaining nuclear power plants were shortened. From 2022 onwards, electricity will no longer be generated from nuclear power. At the same time, the Federal Government is accelerating the expansion of renewable energies through a comprehensive bundle of measures, including the Renewable Energies Act, the KfW programmes ‘Offshore Wind Energy’ and ‘Renewable Energies Standard/Premium’, the market incentive programme for the funding of measures to promote the use of renewable energies in the heating market and accompanying regulatory measures. In view of the fact that installations generating electricity from renewable energies have a calculated efficiency of 100 % and will therefore push plants with a lower level of efficiency out of the market (nuclear power plants have a calculated efficiency of 33 %, for example), the political decisions underlying this development will also result directly in significant primary energy savings.

Promotion of efficiency in heating and cooling pursuant to Article 14(1) of the Energy Efficiency Directive

Article 14(1) of the Energy Efficiency Directive stipulates that the Member States must carry out a comprehensive assessment of the potential and a cost/benefit analysis of the application of

cogeneration by the end of 2015 at the latest. Annex XIV Part 2 No 3.4 of the Energy Efficiency Directive states that the Member States must report on the progress made in respect of this comprehensive assessment.

The Act on the maintenance, modernisation and expansion of cogeneration (Cogeneration Act), which is the main incentive programme in Germany for expanding the use of cogeneration, was scheduled for evaluation in 2014. The Federal Government therefore decided to move forward the potential and cost/benefit analysis to 2014 and combine it with the evaluation of the Cogeneration Act which had been provided for by law.

In winter 2013 a comprehensive study was commissioned as a basis for the Federal Government's decisions on the use of cogeneration (Prognos et al. 2014). The study assessed the potential for the use of cogeneration and efficient district heating and district cooling in Germany on the basis of Article 14(1) and Annex VIII of the Energy Efficiency Directive, and included a corresponding cost/benefit analysis on the basis of Article 14(3) and Annex IX Part 1 of the Energy Efficiency Directive. Particular account was taken of the following factors:

- The potential and cost/benefit analysis focused on the period up until 2030. The period between 2030 and 2050 was also taken into account in order to identify potential longer-term trends.
- When analysing potential (heating/electricity), particular consideration was given to potential future limiting factors such as a drop in heating demand owing to improved insulation and a restricted share of the electricity market as a result of the expansion of renewable energies.

Wherever possible, a differentiated analysis was carried out for the categories of residential buildings, non-residential buildings and industry, as well as for the different performance classes. Additional categories were also taken into account wherever possible (nature of use, sector affected, etc.).

- The cost/benefit analysis examined in detail the alternative options for the provision of heating/cooling which compete with cogeneration (boilers, heat pumps, etc.), in particular the opportunities for improved heat insulation in the buildings sector.
- Account was also taken of the options for generating power using either industrial waste heat and 'power-to-heat' or smaller and possibly decentralised cogeneration units. Energy management impacts (contributions to grid relief, flexibility, system services, controllability, etc.) were assessed, as well as economic factors.

The final outcomes of the cost/benefit analysis were as follows:

- in certain cases, cogeneration offers greater micro- and macroeconomic benefits than uncoupled systems. This is one of the reasons why the further expansion of cogeneration has been identified as an area of major potential, particularly in the case of general supply (district heating) and industry. In areas which are not connected to the district heating network, separate cogeneration units also offer additional potential.
- Even small changes to the framework conditions, e.g. the funding rules, have a significant impact on outcomes. Achieving high rates of connection to district heating networks is vitally important, and requires accompanying policy measures.
- Electricity generation by industry may rise by 50 % to 43 TWh by 2030. The largest potential for growth lies in the food-processing sector and the sectors for capital, consumer and commodity goods. Conservative estimates suggest that between 0.7 TWh and 1.5 TWh of electricity could potentially be generated through the use of waste heat per year.

Measures to remove barriers which might hamper participation of demand response pursuant to Article 15(4) of the Energy Efficiency Directive

The legal and regulatory framework in Germany does not prevent the implementation of load management measures such as those outlined in Article 15 of the Energy Efficiency Directive.

Participation of demand response in the electricity-balancing market is therefore possible. In particular, the framework conditions for the participation of third-party aggregators in the electricity-balancing market are enshrined at regulation level in order to provide the relevant stakeholders with increased legal certainty. The Federal Network Agency plans to adopt provisions in the near future which will provide further details in this respect. As a basic principle, balancing energy is procured by means of a non-discriminatory and transparent tendering procedure substantiated by findings of the Federal Network Agency on the procurement of primary balancing energy, secondary balancing energy and the minute reserve. These findings facilitate the participation of demand response resources in the electricity-balancing markets, as well as the pooling of installations and changes to the composition of this pool over time.

The Regulation on interruptible loads [Verordnung zu abschaltbaren Lasten, AbLaV] represents a further load-management tool which is enshrined in law. This allows large load facilities which are connected to the high and extra-high voltage grid to commit to turning down capacity for a fee with a view to maintaining grid and system security. The Regulation was amended in 2016, inter alia with a view to further opening that market, with the total interrupting capacity of load facilities increased from 1 000 to 1 500 MW and the minimum lot size reduced to 10 MW. Capacity is now tendered out on a weekly basis rather than a monthly basis, as was previously the case. Those amendments have made it significantly easier for industrial providers to access potential load transfers, as well as greatly expanding the number of possible participants.

§14a of the Energy Act provides a foundation for ‘grid-friendly’ load management, inter alia in the low-voltage grid, and provides for grid fee waivers for controllable load facilities. This provision currently requires further specification at regulation level.

4 Energy services market

Pursuant to Article 18(1)(e) of the Energy Efficiency Directive, the NEEAP 2017 should contain a qualitative assessment of the present and future development of the energy services market.

Pursuant to Annex XIV Part 2 No 3.7 of the Energy Efficiency Directive, the NEEAP should also include information on the availability of qualification, accreditation and certification systems (Article 16). Furthermore, pursuant to Annex XIV Part 2 No 3.8 of the Energy Efficiency Directive, the NEEAP should contain a link to the webpage where the list or the interface of energy service providers referred to in Article 18(1)(c) of the Energy Efficiency Directive can be accessed.

Finally, pursuant to No 3.1.4 of the Commission Implementing Decision of 22 May 2013 establishing a template for National Energy Efficiency Action Plans under Directive 2012/27/EU of the European Parliament and of the Council (C(2013) 2882), the NEEAP should contain information on measures adopted or planned to be adopted to promote and facilitate efficient use of energy by SMEs and domestic customers. These requirements are met below.

4.1 Present and future development of the energy services market

A diverse, competitively organised and transparent energy services market is particularly well suited to harnessing energy efficiency potentials. The Federal Government's ambitious energy efficiency targets are only achievable if all the stakeholders implement measures, and if these measures are backed up by government action. Development of the market for energy audits, energy services and further energy efficiency measures is a vitally important step towards allowing energy users to use energy as efficiently as possible. Pursuant to §9(2)(5) of the Act on energy services and other energy efficiency measures, the Federal Office for Energy Efficiency is therefore obliged to monitor and assess the market for energy services, energy audits and other energy efficiency measures and to develop proposals for its further development.

For many years, Germany has had one of the largest and best developed markets for energy services in the EU (European Commission, 2014). The textbook definition of energy services is relatively narrow and for the most part excludes activities such as consultancy services and management. This term is therefore interpreted much more broadly by many market players, including the Federal Office for Energy Efficiency. Market observation by the Federal Office for Energy Efficiency focuses on service products which are particularly characteristic of the German market for energy audits, energy services and other energy efficiency measures. The products are assigned to four market segments: information on energy efficiency, energy efficiency advice, energy consumption management services and energy contracting.

The market volume for all four segments stood at around EUR 9.8 billion in 2015, and it is expected that the market will continue to grow over the years to come. The individual market segments are examined in further detail below.

Information

The aim of providing information on energy efficiency is to increase the available knowledge base on energy efficiency improvements. Although the information may be provided in an interactive format, it differs from energy advice in that there is no two-way communication between individuals. Information on energy efficiency is offered free of charge in many cases. Building energy certificates represent an exception to this rule; according to the Energy Saving Regulation Registration Body

within the German Institute for Structural Engineering [Deutsches Institut für Bautechnik, DIBt], a total of 253 974 registered energy demand certificates were issued in 2015, of which approximately 240 000 were for residential buildings and 14 000 were for non-residential buildings. By way of comparison, approximately 185 000 energy consumption certificates were issued in the same year (around 166 000 for residential buildings and 19 000 for non-residential buildings).

An estimated turnover of EUR 135 million was achieved in 2015 for energy demand certificates in Germany, including around EUR 22 million for energy demand certificates for non-residential buildings.

Advice services and audits

There is no single agreed definition of the terms ‘energy advice’ and ‘energy advisor’, and the number of energy advice providers in Germany can therefore only be estimated on an approximate basis. Extremely conservative estimates suggest that between 12 500 and 13 500 energy advisors were present on the German market in 2015 and provided advice to around 375 000 customers during that year. Advice is furthermore provided in connection with the implementation of energy efficiency measures, and the energy suppliers also offer energy advice. On the basis of extensive surveys, it is estimated that the total energy advice market in Germany in 2015 was worth around EUR 1 billion across all product categories.

The number of providers of energy advice in Germany is adequate, and it can be assumed that the market will continue to grow.

Energy management

The exact number of providers offering services in the field of energy management is difficult to estimate owing to the fast tempo of change in the sector and the rapidly expanding diversity of both services and providers. It is estimated that the portfolios of approximately 4 000 providers include services relating to energy management (e.g. the provision of advice on energy management systems, remote energy control, the installation of energy monitoring software, etc.). Technology providers are entering the market in particularly large numbers, and it is almost impossible to give any precise figures in that respect at present.

Using these provider figures as a basis for extrapolation, this results in a total of around 740 initial certifications, almost 200 re-certifications and 6 000 consultancy sessions on the introduction of energy management systems, as well as several tens of thousands of distributed software licences, in 2015. The services provided by energy advisors must also be added to these figures; based on the extrapolated outcomes of a survey carried out among advisors, 1 000 extra consultancy sessions were carried out in relation to initial certifications, and 600 in relation to re-certifications. The number of ISO 50001-certified companies in Germany has increased significantly in recent years as a result of various incentives enshrined in law (exemption from the levy under the Renewable Energies Act, peak equalisation, energy audit obligation). The total market volume for the aforesaid services is around EUR 200 million.

This market segment is characterised by the largest growth potential, which is a result on the one hand of the following incentives that were adopted to encourage energy-intensive companies to implement an energy management system:

- ‘Peak equalisation’ incentivises the certification of energy management systems. Pursuant to §10(3) of the Electricity Tax Act [Stromsteuergesetz, StromStG] and §55(4) of the Energy Tax Act [Energiesteuer-gesetz, EnergieStG], companies in the manufacturing sector can benefit from

the peak equalisation rules for energy and electricity tax if they can supply evidence that a certified energy management system pursuant to DIN EN ISO 50001 or a certified environmental management system pursuant to the EMAS Regulation is in place during the year in which the application is submitted. In accordance with §10(3) of the Electricity Tax Act, §55(4) of the Energy Tax Act and §10(3) of the Electricity Tax Act in conjunction with the Peak Equalisation Efficiency System Regulation of 6 August 2013 [Spitzenausgleich-Effizienzsystemverordnung, SpaEfV], SMEs can be granted tax relief if they put in place alternative systems for improving energy efficiency which meet the requirements of DIN EN 16247-1 or §3 of the Peak Equalisation Efficiency System Regulation, instead of a comprehensive energy or environmental management system.

- Pursuant to §§40 and 41 of the Renewable Energies Act, energy-intensive companies may in some cases also be exempted from the levy under this Act if they can supply evidence that an energy management system is in place or is being introduced.

Innovations and developments, particularly in the areas of control, software and infrastructure, have on the other hand also had a positive effect on the growth of energy management services such as energy monitoring, building automation and energy control.

Energy contracting

The total number of contracting providers in Germany in 2015 was around 600, including around 440 energy supply companies. The overwhelming majority of those providers (an estimated 90 %) primarily offer energy supply contracting. The number of companies offering comprehensive energy performance contracting services on a Germany-wide basis (around 10 to 15) is relatively small in comparison. No systematic surveys have yet been carried out of the other contracting services on offer.

Contracting services in Germany are primarily offered by energy supply companies (municipal utilities and other energy suppliers) (over 60 % of providers) and companies which refer to themselves as 'specialist contractors' (21 %). A number of companies whose core competencies lie in the field of energy advice, however, also offer services in that field, and engineering and building firms represent another small group of providers. The structure of the energy performance contracting sector differs significantly from that of the overall market, since most of the providers have a background in the fields of facility management or building services.

The turnovers achieved over the past business year by the main groups of contracting providers (energy suppliers and specialist contractors) differed significantly. The energy suppliers which were surveyed achieved overall turnovers of more than EUR 10 million, whereas the majority of specialist contractors recorded annual turnovers in the region of EUR 500 000 to EUR 10 million. Only a small proportion of specialist contractors recorded turnovers which exceeded EUR 10 million. The overall market volume for 2015 is estimated at between EUR 7.2 billion and EUR 8.4 billion. These figures are relatively large in comparison to the other market segments examined; this can be explained by the fact that the contracting market is overwhelmingly dominated by energy supply contracting projects, and part of the turnover recorded is accounted for by energy procurement. Energy saving contracting accounted for an estimated EUR 80 to 150 million per year of the overall market volume.

4.2 Selected measures aimed at promoting the energy services market

The Federal Government has implemented a great many measures which directly or indirectly promote the further development of the market. The following paragraphs describe a selection of measures which implement the requirements of the Energy Efficiency Directive or which relate to

further aspects of the development of the market for energy audits, energy services and other energy efficiency measures.

An empirical study of the market for energy audits, energy services and other energy efficiency measures revealed that the providers of energy services, energy audits and energy management services present on the market back in 2013 were adequately qualified. The services on offer are improving continually in terms of their quality and transparency. As well as the benchmarks set by government funding programmes in that respect, an extensive market for further training in the field of energy efficiency has also sprung up. The latest market survey carried out in 2016 correspondingly revealed that qualified providers of energy audits, energy services and other energy efficiency measures can be found easily in Germany.

§4 of the Act on energy services and other energy efficiency measures obliges energy suppliers to provide information to their end customers (at least once a year and in a suitable format) on the effectiveness of energy efficiency measures and the services available to them. When sending out contracts, modified contracts, bills or receipts to end customers, energy companies must also provide clear and easy-to-understand contact information for consumer organisations, energy agencies or similar bodies, including their web addresses, so that these customers can obtain information on the available energy efficiency measures, comparative end-user profiles and (where applicable) technical specifications for energy-using products. The Federal Government therefore also complies with its duty of transposition pursuant to Article 12(1) of the Energy Efficiency Directive.

Pursuant to §9(2)(11) in conjunction with §7 of the Act on energy services and other energy efficiency measures, the Federal Office for Energy Efficiency keeps a publicly accessible list of providers. All providers can apply to be entered on the list free of charge.⁵ The Federal Government therefore also complies with its transposition and reporting obligations pursuant to Article 18(1)(c) in conjunction with Annex XIV Part 2 No 3.8 of the Energy Efficiency Directive. Providers under funding programmes are also regarded as service providers if they meet specific requirements. The providers approved under the programmes ‘On-Site Energy Advice’, ‘Energy-Efficient Construction and Renovation’, ‘KfW Efficient House for Listed Buildings, Monuments and Other Valuable Buildings’, ‘Energy Advice for SMEs’ and ‘Energy-Efficient Construction and Renovation – Non-Residential Buildings’ can be found on the Federal Government’s list of energy efficiency experts.⁶

⁵ Available at: www.anbieterliste.info

⁶ Available at: <https://www.energie-effizienz-experten.de/die-energieeffizienz-experten-fuer-foerderprogramme-des-bundes/>

5 Bibliography

Abbreviation	Source
AGEB 2014	Arbeitsgemeinschaft Energiebilanzen 2014: Energy balances for the Federal Republic of Germany 1990-2012 and evaluation tables 1990-2014 (as at: July 2014).
AGEB 2016	AGEB 2016: AG Energiebilanzen: Consumption balances for final energy sectors 2013-2015. As at October 2016 (http://www.ag-energiebilanzen.de).
AGEB 2017	AGEB 2017: AG Energiebilanzen: Consumption balances for final energy sectors 2010-2015. As at January 2017. Berlin, Cologne, 2017.
AGEB/BDEW 2010	AG Energiebilanzen, BDEW: Final energy consumption in Germany on the basis of sector, energy source and area of use. 2008 and previous years. Estimates based on the evaluation balances for the energy balances (in some cases internal data from AG Energiebilanzen).
BMVI/DIW 2016	BMVI/DIW 2016: Federal Ministry of Transport and Digital Infrastructure [Bundesministerium für Verkehr und digitale Infrastruktur, BMVI], German Institute for Economic Research [Deutsches Institut für Wirtschaftsforschung, DIW]: Verkehr in Zahlen [Transport in Figures] 2016/2017.
BMWi 2014	Federal Ministry for Economic Affairs and Energy 2014: National Action Plan on Energy Efficiency. Berlin, December 2014.
European Commission 2014	European Commission (Joint Research Centre, Institute for Energy) 2014: ESCo Market Report 2013, Report EUR 26691 EN, Ispra.
Fraunhofer ISI et al. 2014	Fraunhofer ISI; Fraunhofer IFAM; ifeu; Prognos AG; Ringel, M. 2014: Ausarbeitung von Instrumenten zur Realisierung von Endenergieeinsparungen in Deutschland auf Grundlage einer Kosten-/Nutzen-Analyse. Wissenschaftliche Unterstützung bei der Erarbeitung des Nationalen Aktionsplans Energieeffizienz (NAPE) [Development of tools for the achievement of energy end-use savings in Germany on the basis of a cost/benefit analysis. Scientific support for the development of the National Action Plan on Energy Efficiency (NAPE)]. Berlin, November 2014.
Fraunhofer ISI/IfE/GfK/IREES 2014	Fraunhofer ISI; IfE; GfK; IREES 2014: Energieverbrauch des Sektors Gewerbe, Handel, Dienstleistungen (GHD) für die Jahre 2011 bis 2013. Zwischenbericht an das Bundesministerium für Wirtschaft und Technologie (BMWi) [Energy consumption in the sector 'Commerce, trade, services' in the period 2011-2013. Interim report to the Federal Ministry for Economic Affairs and Technology]. Karlsruhe, Munich, Nuremberg, March 2014.
IfE/TUM 2016	IfE; TUM 2016: Erstellen der Anwendungsbilanzen 2013 bis 2017 für den Sektor Gewerbe, Handel, Dienstleistungen (GHD) [Production of consumption balances for the period 2013-2017 for the sector 'Commerce, trade, services']. On behalf of Arbeitsgemeinschaft Energiebilanzen e.V. Munich, September 2016.

McKinsey 2008	McKinsey 2008: Potenziale der öffentlichen Beschaffung für ökologische Industriepolitik und Klimaschutz [Public-sector procurement: potential for an environmentally friendly industrial policy and climate protection].
Prognos 2015	Weinert, K. 2015: Umsetzung des Art. 21 EED bei der Mitteilung der Bundesregierung bzgl. Art. 7 EED. Studie im Auftrag der BfEE [Transposition of Article 21 of the Energy Efficiency Directive in the Federal Government's communication under Article 7 of the Energy Efficiency Directive. Study commissioned by the Federal Office for Energy Efficiency]. Berlin, October 2015.
Prognos et al. 2014	Prognos AG; Fraunhofer IFAM; IREES; BHKW-Consult 2014: Potenzial- und Kosten- Nutzen-Analyse zu den Einsatzmöglichkeiten von Kraft-Wärme-Kopplung (Umsetzung der EU-Energieeffizienzrichtlinie) sowie Evaluierung des KWKG im Jahr 2014 [Potential and cost/benefit analysis of the potential uses of cogeneration (transposition of the EU Energy Efficiency Directive) and 2014 evaluation of the Cogeneration Act]. Available at: https://www.prognos.com/publikationen/alle-publikationen/460/show/1bd3e90963bbefefc374e9bc1f71eb5b/ (as at: 17 March 2017).
Prognos/EWI/GWS 2010	Schlesinger, M.; Lindenberger, D.; Lutz, Ch. 2010: Energieszenarien für ein Energiekonzept der Bundesregierung. Projekt-Nr. 12/10 [Energy scenarios for an energy concept by the Federal Government. Project No 12/10]. Study commissioned by the Federal Ministry for Economic Affairs and Technology. Basel, Cologne, Osnabrück, August 2010.
Prognos/Fraunhofer ISI 2014	Prognos AG; Fraunhofer ISI 2014: Kurzstudie NEEAP 2014 [Short study on the NEEAP 2014].
Prognos/Fraunhofer ISI 2017	Prognos AG; Fraunhofer ISI 2017: Kurzexpertise – Zuarbeiten zum Nationalen Aktionsplan Energieeffizienz 2017 (NEEAP) und zum Jahresbericht 2017. Studie im Auftrag der BfEE [Short report – Preliminary work for the National Energy Efficiency Action Plan 2017 (NEEAP) and the 2017 annual report. Study commissioned by the Federal Office for Energy Efficiency]. Berlin, Karlsruhe, March 2017.
RWI 2013	Rhine-Westphalia Institute for Economic Research [Rheinisch-Westfälisches Institut für Wirtschaftsforschung, RWI] 2013: Erstellung der Anwendungsbilanzen 2011 und 2012 für den Sektor Private Haushalte [Production of consumption balances for the period 2011-2012 for the sector 'Private households']. On behalf of AG Energiebilanzen. Essen, Berlin, October 2013.
UBA 2014	Federal Environment Agency 2014: Energieeffiziente öffentliche Beschaffung [Energy-efficient public procurement].

Annex I:

Supplementary information regarding the updated comprehensive overview of outcomes achieved in respect of the final energy consumption savings targets referred to in Article 4(1) and (2) of Directive 2006/32/EC

The outcomes achieved in connection with the energy savings target pursuant to the Energy Services Directive and outlined in general terms in Chapter 2.4 are specified in more detail below, in particular by means of a breakdown on the basis of sector and area of action. The Federal Government again obtained scientific support from renowned independent institutes when updating the overview of outcomes achieved in respect of the energy savings target (Prognos/Fraunhofer ISI 2017). The study produced by these institutes constituted the main basis for the updated overview of outcomes achieved in respect of the energy savings target, particularly in the case of the top-down calculations.

Top-down: current trends

1 Preliminary methodological remarks/dataset and data sources

In the second and third NEEAPs drawn up by the Federal Republic of Germany under Directive 2006/32/EC, final energy savings in Germany were calculated for the Directive's period of application. Calculations were carried out both for the early action period (1995-2007) and for the period 2008-2016 (highlighting the interim years 2010 and 2013), and were performed separately for the sectors 'Private households', 'Commerce, trade and services', 'Industry' and 'Transport' and for total final energy consumption. The methodological recommendations of the European Commission were used as a basis for calculations of top-down energy savings. In the case of the second and third NEEAPs, most of the data required could be obtained from official statistics up to the reporting year 2009 or 2012 (in some cases only up to the reporting year 2008 or 2011).⁷

These calculations are updated below for the fourth NEEAP under Directive 2012/27/EU (Energy Efficiency Directive) for the same reporting period. The calculation method and statistical data sources used are identical to those used for the third NEEAP. Statistical data for almost all indicators are now available up to 2015 or 2016. The time series have in some cases been updated retroactively if more recent data were available. Table A.I-1-1 shows the data sources used to update the final energy savings in the fourth NEEAP.

⁷ In addition to data from the Federal Statistical Office [DESTATIS], in particular the energy and consumption balances for Germany [AGEB 2010; AGEB 2016; AGEB/BDEW 2010] and data for the transport sector from [BMVBS/DIW 2009; BMVI/DIW 2016].

Table A.I-1-1: Data sources used to update the figures for final energy savings in the individual consumption sectors and areas of action

Sector/area	Data source
Private households	
Final energy consumption according to energy sources	AGEB 2016
Final energy consumption according to purpose of use	AGEB 2017
Living space, dwellings, population	DESTATIS 2017
Existing devices, specific consumptions	Prognos 2017
Commerce, trade, services	
Total final energy consumption	AGEB 2016
Final energy consumption by sub-sector	FhISI/IfE/GfK/IREES 2014; IfE/TUM 2016
Working population, other activity variables	DESTATIS 2016
Industry	
Final energy consumption by sector	AGEB 2016
Production index	DESTATIS 2017
Transport and mobility	
Final energy consumption by means of transport	BMVI/DIW 2016
Fuel consumption by vehicle type	BMVI/DIW 2016
Transport services	BMVI/DIW 2016

2 Results: overview of energy savings on the basis of top-down calculations

Top-down energy savings were achieved in all consumption sectors in the early action period up to 2007 (Table A.I-2-1). The highest savings were recorded in the sectors ‘Industry’ and ‘Transport’. The total savings achieved in the early action period were already significantly higher than the national savings target of 748 PJ (electricity factor of 1) or 995 PJ (electricity factor of 2.5). They were, however, 31 PJ lower than the savings calculated in the third NEEAP (962 PJ compared to 993 PJ in the third NEEAP; electricity factor of 1). This was chiefly the result of retrospective data updates, as well as amendments to the data for the sector ‘Trade/commerce/services’.

Further significant savings are expected for the period up to 2016. The savings in 2016 were 19 PJ lower than the third NEEAP (1 234 PJ compared to 1 253 PJ in the third NEEAP; electricity factor of 1). This was the result of a discrepancy between the forecasts in the third NEEAP and the changes in the statistical indicators up to 2015 (cf. also the following section).

Table A.I-2-1: Overview of total top-down savings in the various sectors (electricity factor of 1 and electricity factor of 2.5)

Energy saving		2007	2010	2013	2016	Total
Unit		PJ in reporting year				
Top-down		compared to 1995	compared to 2007			compared to 1995
Total	Electricity factor of 1	962	776	887	1 234	2 195
	Electricity factor of 2.5	1 134	884	1 080	1 588	2 723
Private households	Electricity factor of 1	222	547	557	779	1 001
	Electricity factor of 2.5	281	623	656	978	1 260
Trade/commerce/services	Electricity factor of 1	36	240	213	234	269
	Electricity factor of 2.5	36	263	263	286	322
Industry	Electricity factor of 1	288	-66	-25	24	312
	Electricity factor of 2.5	351	-58	-9	90	441
Transport	Electricity factor of 1	416	55	142	197	613
	Electricity factor of 2.5	466	56	170	234	700

3 Results: sectors and areas of action

Room heating and hot water

Table A.I-2.1-1: Top-down savings for room heating and hot water

Energy saving	2007	2010	2013	2016	Total
Unit	PJ in reporting year (electricity factor of 1)				
Top-down	compared to 1995	compared to 2007		compared to 1995	
Total for room heating and hot water	166.7	525.8	504.9	685.9	852.6
Room heating	250.9	494.7	527.9	637.5	888.4
Hot water	-84.2	31.1	-23.0	48.4	-35.8

The savings compared to the third NEEAP for the early action period 1995-2007 have been updated in cases where more recent data were available. From the reporting year 2008 onwards, Germany used a different methodology for producing the consumption balances (AGEB 2014) used as a basis for

calculating room heating and hot water indicators. The data have not been retrospectively adjusted, however, meaning that the savings up to 2007 are still calculated using the old method (AGEB 2010).

Germany can document top-down savings of 251 PJ for room heating in the early action period. By way of contrast, an increase in energy consumption of 84 PJ was observed for hot water, owing to a slight increase in the specific hot water consumption per head of population. The savings achieved in the field of room heating increased significantly again during the reference period 2008-2016 compared to the third NEEAP. This is due to the steep drop in final energy consumption for room heating from 2011 onwards which emerges from the results of the new consumption balances (AGEB 2016), and which is attributed in particular to the decommissioning of night storage heaters. It may, however, have been caused in part by changes to the method followed when collecting the underlying data on energy consumption in private households. Final energy savings for hot water were also only recorded from 2008 onwards, and no significant savings for this indicator can be observed for the overall reporting period up to 2016.

Appliances and lighting

Table A.I-2.1-2: Top-down savings for appliances and lighting

Energy saving	2007	2010	2013	2016	Total
Unit	PJ in reporting year (electricity factor of 1)				
Top-down	compared to 1995		compared to 2007		compared to 1995
Total for appliances and lighting	55.5	21.5	52.1	92.2	148.4
Appliances	58.4	20.4	51.8	84.5	142.9
Lighting	-2.9	1.1	0.3	8.4	5.5

The indicator for electrical household appliances has been updated since the third NEEAP. As was the case in the third NEEAP, the calculation is therefore based on (updated) model data from Prognos.

A slight increase in consumption was recorded for lighting in the early action period, since the electricity consumption for lighting rose slightly per dwelling between 1995 and 2007 according to the data in the consumption balances (AGEB/BDEW 2010). This is, however, chiefly attributable to the fact that lighting accounts for a higher proportion of the final energy consumption for 2007. On the basis of the new consumption balances (AGEB 2016), moderate electricity savings in the field of lighting are anticipated for the reporting period until the interim target and until the target year 2016.

The data currently available does not allow an energy efficiency indicator for room cooling to be calculated for Germany.

Sectors 'Industry' and 'Commerce'

Table A.I-2.1-3: Total top-down savings in the sectors 'Industry' and 'Commerce, trade and services'

Energy saving	2007	2010	2013	2016	Total
Unit	PJ in reporting year (electricity factor of 1)				
Top-down	compared to 1995 (Commerce, trade and services compared to 2001)		compared to 2007		compared to 1995
Total for the sectors 'Industry' and 'Commerce'	323.4	158.2	163.4	232.0	555.4
Commerce, trade and services (fuels)	35.3	219.8	179.8	198.9	234.2
Commerce, trade and services (electricity)	0.1	4.7	9.2	9.6	9.7
Industry (fuels)	246.0	-71.6	-36.2	-21.0	225.0
Industry (electricity)	42.0	5.3	10.9	44.5	86.5

The efficiency indicators for the sector 'Commerce, trade, services' (including agriculture and the construction trade but without fuels used by the military) are based on the specific fuel and electricity consumption of the individual sub-sectors. Figures for energy consumption at sub-sectoral level are currently available for the reporting period 2001-2015 on the basis of regular consumption surveys in the sector 'Commerce/trade/services' (Fraunhofer ISI/IfE/GfK/IREES 2014; IfE/TUM 2016). Calculations for the early action period can therefore only be performed from 2001 onwards rather than from the start of this period. Savings were achieved for fuels and (at a very low level) the electricity indicator over this abbreviated early action period. Comparatively high savings were achieved for fuels during the period 2007-2016, while only small savings were recorded for the electricity indicator.

Savings were achieved by industry in the case of both fuels and electricity during the early action period. These are identical to the savings specified in the third NEEAP, since the underlying data have not been updated for this period. Compared to the third NEEAP, fuel consumption was slightly higher in the period 2007-2016. The savings for the electricity indicator were also slightly higher than in the third NEEAP.

Transport and mobility

Table A.I-2.1-4: Overview of total top-down savings in the field of transport and mobility (electricity factor of 1)

Energy saving	2007	2010	2013	2016	Total
Unit	PJ in reporting year (electricity factor of 1)				
Top-down	compared to 1995	compared to 2007			compared to 1995
Total for transport and mobility	415.8	55.4	141.9	197.2	613.0
Motorised private transport	183.4	60.5	82.9	98.5	281.9
Road freight traffic	217.1	-1.0	37.6	78.0	295.1
Rail passenger transport	15.3	-0.2	16.1	20.5	35.8
Rail freight transport	27.6	1.1	7.7	10.1	37.8
Percentage of public transport compared to total passenger transport by land	2.5	-1.5	-0.5	-2.0	0.4
Percentage of freight transport by rail and inland shipping compared to all freight transport	-30.1	-3.5	-1.9	-7.9	-38.0

Since no significant statistical changes were recorded, the data for the transport sector have not been updated for the early action period 1995-2007. During the period 2008-2016, savings in the transport sector for motorised private transport for the reporting years 2010 and 2013 were higher than estimated in the third NEEAP. The savings were higher in the case of rail freight and passenger transport, particularly in the reporting years 2013 and 2016. These developments were primarily due to the retrospective updating of the data sources and the replacement of data forecasts with statistical time series.

Annex II: Overview of primary energy savings achieved

As described and illustrated in Chapter 2.4, the following table summarises the primary energy savings for selected measures resulting from energy end-use efficiency measures. Further information on the key measures carried out under the NAPE can be found in the annual report pursuant to Article 24(1) of the Energy Efficiency Directive (cf. Annex IV).

Measure	Primary energy factor	Primary energy saving (PJ)				Final energy saving (PJ)	Source of primary energy factor
		2009-2013	2014-2020	2009-2013	2014-2020		
Standard-setting measures							
Energy Saving Regulation (for new buildings)	1.16	167	119	144	103	(Prognos/Fraunhofer ISI 2017)	
Energy Saving Regulation (for existing buildings)	1.16	392	367	338	316	(Prognos/Fraunhofer ISI 2017)	
Renewable Energies Heat Act (-15 %)	1.16	35	28	30	24	(Prognos/Fraunhofer ISI 2017)	
Price-impulse-setting measures							
Energy and electricity tax	1.20	0	613	0	511	(Prognos/Fraunhofer ISI 2017)	
Air traffic surcharge	1.10	0	32	0	29	(Prognos/Fraunhofer ISI 2017)	
Emissions trading	2.40	0	29	0	12	(Prognos/Fraunhofer ISI 2017)	
Investment promotion							
Market incentive programme, Federal Office for Economic Affairs and Export Control portion	1.16	56	21	48	18	(Prognos/Fraunhofer ISI 2017)	
KfW CO ₂ Building Renovation Programme (including extra funding): - KfW Energy-Efficient Renovation - KfW Energy-Efficient Construction	1.16	292	229	252	197	(Prognos/Fraunhofer ISI 2017)	
Investment promotion in companies: - KfW Energy Efficiency Programme/KfW Environmental Programme - Efficiency Fund: Energy-Efficient Cross-Cutting Technologies/Energy-Efficient and Climate-Friendly Production Processes - Market Incentive Programme, KfW portion (Renewable Energies Premium)	1.51	381	210	252	139	(Prognos/Fraunhofer ISI 2017)	
Advice and labelling programmes							

Federal Government advice programmes: - On-site energy advice (Federal Office for Economic Affairs and Export Control) - Energy advice provided by consumer advice centres (Federation of German Consumer Organisations [Verbraucherzentrale Bundesverband, vzbv]) - Energy checks (Federation of German Consumer Organisations) - Electricity-saving checks for low-income households (caritas) - Energy advice for SMEs (KfW)	1.16	79	57	68	49	(Prognos/Fraunhofer ISI 2017)
Immediate measures under the NEEAP						
Introduction of a competitive tendering model (STEP up!)	2.40	0	70 to 137	0	29 to 57	(Fraunhofer ISI et al. 2014)
Support for contracting (including indemnity bond)	1.40	0	15 to 28	0	11 to 20	(Fraunhofer ISI et al. 2014)
'Energy Efficiency Networks' initiative	1.49	0	182	0	122	(Fraunhofer ISI et al. 2014)
Energy audit obligation for non-SMEs	1.53	0	178	0	116	(Fraunhofer ISI et al. 2014)
National efficiency label for heating systems	1.19	0	27	0	23	(Fraunhofer ISI et al. 2014)
'Waste Heat Utilisation' initiative	1.16	0	49	0	42	(Fraunhofer ISI et al. 2014)

Annex III: Comparison of conversion factors stipulated in Annex IV to the Energy Efficiency Directive with those used by AGEB

Annex IV to the Energy Efficiency Directive contains a table with conversion factors which can be used to convert natural units (kilograms) of energy commodities into net calorific value (megajoules). Table A.III-1.1-1 compares the conversion factors for selected energy sources stipulated in Annex IV to the Energy Efficiency Directive with those used by AGEB for 2012.

Table A.III-1.1-1: Calorific values for energy sources and factors for the conversion of natural units into energy units for the energy balance sheet 2012 and on the basis of Annex IV to the Energy Efficiency Directive

Source of energy	Natural unit	Net calorific value in MJ	
		Annex IV to the Energy Efficiency Directive	AGEB
Hard coal ¹	kg	17.2-30.7	27.4
Brown coal briquettes	kg	20.0	19.5
Brown coal	kg	5.6-10.5	9.0
Heavy fuel oil	kg	40.0	40.3
Light fuel oil	kg	42.3	42.8 ²
Petrol fuels	kg	44.0	43.5 ³
Liquefied petroleum gas	kg	46.0	46.0
Wood (25 % humidity)	kg	13.8	14.8 ⁴
Pellets/wood bricks	kg	16.8	17.6 ⁵

¹ Average value for primary energy consumption; different calorific values apply.

² Cf. also minimum calorific value pursuant to DIN 51603-1.

³ Without biofuels.

⁴ [RWI 2013], taking into account the proportions of the different wood types.

⁵ [RWI 2013], corresponds to the minimum calorific value pursuant to DIN 51731.

Source: Prognos 2015; AGEB 2014

Annex IV: 2017 annual report pursuant to Article 24(1) of the Energy Efficiency Directive (for information purposes)

The following information is forwarded by the Federal Government as the 2017 annual report on the progress made in achieving the national energy efficiency targets pursuant to Article 24(1) in conjunction with Annex XIV Part 1 of the Energy Efficiency Directive 2012/27/EU:

(a) Estimates for the following indicators in the year preceding the previous year (year X-2)

			2011	2012	2013	2014	2015	Source
B1	(i) Primary energy consumption	PJ	13 599.3	13 447.1	13 821.6	13 179.6	13 292.7	AGEB
B2	(ii) Total final energy consumption	PJ	8 881.4	8 918.5	9 178.5	8 698.8	8 876.6	AGEB
Final energy consumption, by sector								
B3	Industry	PJ	2 634.0	2 587.1	2 550.7	2 545.4	2 575.6	AGEB
B4	Transport	PJ	2 567.8	2 558.6	2 611.6	2 615.5	2 618.8	AGEB
B6	Households	PJ	2 333.4	2 427.5	2 556.0	2 188.0	2 289.2	AGEB
B7	Services	PJ	1 346.1	1 345.4	1 460.3	1 349.8	1 393.1	AGEB
Gross value added by sector (real 2010)								
B10	Industry	EUR billion	633.0	631.4	629.0	660.6	671.0	Federal Statistical Office
B11	Services	EUR billion	1 771.4	1 787.2	1 801.9	1 808.1	1 836.2	Federal Statistical Office
B12	(v) Available household income	EUR billion	1 608.3	1 642.4	1 671.8	1 710.1	1 757.7	Federal Statistical Office
B13	(vi) Gross domestic product (real 2010)	EUR billion	2 674.5	2 687.6	2 700.8	2 743.9	2 791.1	Federal Statistical Office
B14	Electricity generation from thermal power plants	TWh	520.1	523.4	526.2	507.8	504.1	AGEB
B15	Electricity generation from cogeneration units	TWh	101.4	106.5	104.9	104.1	105.5	AGEB
B16	Heat generation from thermal power plants	PJ	751.3	786.2	783.4	755.6	770.8	AGEB
B17	Industrial waste heat*							
B18	Heat generation in cogeneration units, including industrial waste							

	heat*							
B19	Heat recovery from industrial waste heat*							
B20	Fuel consumption in thermal power plants	PJ	4 848.5	4 700.2	4 710.7	4 576.9	4 432.3	AGEB
B21	Passenger-kilometres (Pkm)	Billion	1 131.0	1 135.6	1 162.5	1 163.5	1 179.2	BMVI
B22	Tonne-kilometres (Tkm)**	Billion	628.1	618.2	636.0	642.6	650.1	BMVI
B23	Population	Million	80.3	80.4	80.6	81.0	81.6	Federal Statistical Office

* taking into account amendments to the Energy Statistics Act [Energiestatistikgesetz, EnStatG] where applicable.

** domestic transport.

Sources: Arbeitsgemeinschaft Energiebilanzen (AGEB)
Federal Ministry for Transport and Digital Infrastructure
Federal Statistical Office

Final energy consumption for all the sectors shown in the table above stagnated or rose in 2015. The reasons for this include in particular a significant rise in economic output (increase in price-adjusted gross domestic product of 1.7 % compared to the previous year), population growth and less favourable weather than the previous year. Future reductions in final energy consumption are, however, expected, particularly as a result of the implementation of measures under the National Action Plan on Energy Efficiency and the 2020 Action Programme for Climate Protection.

(b) Updated information on the most important legislative and other measures undertaken during the past year with a view to improving energy efficiency

On 3 December 2014 the Federal Government adopted the ‘National Action Plan on Energy Efficiency’ (NAPE), which represents a comprehensive energy efficiency strategy summarising the relevant goals as well as outlining a great many new immediate measures and other areas of work, funding sources and the remits of individual stakeholders. The 2020 Action Programme for Climate Protection, which was also adopted on 3 December 2014, contains further measures aimed at improving energy efficiency and thereby protecting the environment, making energy efficiency a key pillar of the energy transition in Germany.

The NAPE is aimed at achieving the ambitious energy efficiency targets outlined in Germany’s energy concept. It contains a large number of immediate measures which will play a significant role in improving the existing mix of policy tools, thereby guaranteeing that progress is also made towards the savings target pursuant to Article 7 of the Energy Efficiency Directive. The full text of the NAPE, with more detailed information on the individual immediate measures and areas of longer-term work, is available via the following link: http://www.bmwi.de/Redaktion/EN/Publikationen/nape-national-action-plan-on-energy-efficiency.pdf?__blob=publicationFile&v=1. On 1 July 2015 further measures were adopted which will make a significant contribution to improving energy efficiency in Germany and will cut CO₂ emissions by a total of 5.5 million tonnes by 2020.

The following are the most important measures which were either introduced or significantly expanded in 2016:

Funding of highly efficient cross-cutting technologies

The programme for funding highly efficient cross-cutting technologies was revised in May 2016 and has continued to run ever since. As was the case between 2012 and 2015, it allows funding (in the form of subsidies) to be provided as an incentive for the replacement of inefficient systems or units with highly efficient cross-cutting technologies such as engines, compressors or pumps. The programme is aimed in particular at SMEs, and an average of 5 000 applications are submitted each year. It also serves as a ‘gateway’ and a key tool for raising awareness of more demanding or complex efficiency measures in industry or commerce.

Funding for waste heat avoidance and waste heat utilisation

In May 2016 a new programme was launched to provide funding for waste heat avoidance and waste heat utilisation in commercial enterprises. The programme is open to all applicants and technologies. Investments in the replacement, modernisation, expansion or new construction of installations are funded if they will result in the avoidance of waste heat or the utilisation for the first time (internally or externally) of waste heat.

Expanded provision of energy advice

The qualification requirements for energy advisors have been tightened up and specified in greater detail in order to ensure that the energy advice provided is of a high quality. A Tailored Renovation Roadmap for On-Site Advice has been developed for residential buildings and, with the help of software, presents the relevant outcomes in a standardised format which is easy for consumers to understand. This Renovation Roadmap will be available for energy advisors in 2017. In order to improve consumer access to energy advice, ‘regional managers’ were appointed from mid-2016 onwards with a view to increased cooperation with municipalities, districts or energy agencies as part of a project involving the Federation of German Consumer Organisations and the consumer support centres of the federal states.

In 2016 the Federal Government also launched a comprehensive information campaign to accompany the energy efficiency measures and to encourage consumers, companies and public bodies to use energy as efficiently as possible. Multipliers such as associations and institutions are also involved with a view to targeting the individual groups more effectively. Various channels such as posters, advertisements, cinema commercials, online advertising, a website, etc. have been deployed to raise awareness of the topic of energy saving and the Federal Government’s funding programmes in this area. Further information can be found at www.deutschland-machts-effizient.de.

Pilot programme ‘Energy-Saving Meters’

The aim of the funding programme is to help consumers in private households and the sectors ‘Commerce, trade and services’ and ‘Industry’ to identify and use options for reducing energy consumption through the use of digital metering systems (‘energy-saving meters’) by funding innovative and IT-based pilot projects. Companies are eligible to take part if they develop energy-saving meters and demonstrate their use to end consumers (who participate on a voluntary basis). End users should be put in a position to make informed decisions on the basis of energy-saving tips tailored to their existing individual devices or systems. As noted in Section 3.3, the Funding Guidelines also transpose Article 12 of the Energy Efficiency Directive, which stipulates that the EU Member States must introduce a ‘consumer information and empowering programme’, in particular through the use of ‘smart’ technologies. The programme entered into force on 21 May 2016; the

earmarked funding was increased in March 2017 from EUR 30 million to around EUR 55 million for the period up to and including December 2018 in response to the high level of demand.

Energy Efficiency Incentive Programme

On 1 January 2016 the Federal Ministry for Economic Affairs and Energy launched the new Energy Efficiency Incentive Programme [Anreizprogramm Energieeffizienz, APEE] with the funding components ‘heating package’ and ‘ventilation package’. This programme serves as an alternative to the measure ‘Tax incentives for the energy-efficient renovation of buildings’ which was initially planned under the NAPE. The aim of the Energy Efficiency Incentive Programme is to provide impetus for new innovations and investments which promote the heating transition. A total of EUR 150 million of funding per year will be available over a three-year period for interest subsidies and grants relating to investments under the Energy Efficiency Incentive Programme. Three investment priorities have been identified, which are primarily targeted at private owners, and the funding of efficient combination solutions has been prioritised for the first time.

The heating package offers funding for the installation of particularly efficient heating systems, including measures to optimise the entire heating system. This is intended to incentivise the switch to more efficient heating systems based on condensing boiler technology or renewable energies, at the same time as upgrading the entire heating system. Fossil-fuel heating systems are eligible for funding under the KfW programme ‘Energy-Efficient Renovation’, and heating systems which use renewable energies are eligible for funding under the Market Incentive Programme for Renewable Energies in the Heating Market. The ‘ventilation package’, under which funding is provided for the installation of ventilation systems in combination with energy-efficient renovation of the building envelope, represents a further funding component. This not only improves energy efficiency, but also prevents structural damage (e.g. mould) and improves the interior climate. Funding of this kind is also provided under the KfW programme ‘Energy-Efficient Renovation’. In August 2016 funding eligibility under the Energy Efficiency Incentive Programme was expanded to include stationary fuel cell heating systems. Funding is provided in the form of subsidies for systems with an electrical output of up to 5 kW, and will initially be available for renovation and new-build projects in privately owned residential buildings and homes (natural persons) under the programme ‘Energy-Efficient Construction and Renovation – Fuel Cell Subsidy’.

Funding programme for heating optimisation

On 1 August 2016 the Federal Ministry for Economic Affairs and Energy launched a new programme aimed at providing funding for heating optimisation. The programme is intended to help citizens, companies and municipalities to replace old heating pumps and hot water pumps and to optimise the operation of heating systems through hydraulic balancing and additional low-investment measures (e.g. the replacement of thermostatic valves). Owners of heating systems are eligible for funding which covers up to 30 % of costs, up to a maximum of EUR 25 000.

Funding initiative EnEff.Building.2050

The new funding initiative ‘EnEff.Building.2050’ was launched in April 2016. Innovative projects aimed at achieving an almost climate-neutral building stock by 2050 are promoted under a new funding initiative by the Federal Ministry for Economic Affairs and Energy, which represents a crucial step towards implementation of the Energy Efficiency Strategy for Buildings adopted by the Federal Cabinet in November 2015. The intention behind this measure is to demonstrate ambitious concepts aimed at achieving almost climate-neutral buildings and districts, thus encouraging their widespread adoption. The projects are designed to address on a comprehensive basis the obstacles

which stand in the way of achieving an almost climate-neutral building stock, to highlight current research outcomes and innovations and to serve as representative models which illustrate the wide range of possible uses. The initiative covers three funding areas, each of which has different priorities and target groups: innovative projects, transformation projects and an idea contest. A total of EUR 38 million have been earmarked for the measure between 2016 and 2020.

Funding initiative ‘Solar Construction/Energy-Efficient City’

In 2016 the Federal Ministry for Economic Affairs and Energy and the Federal Ministry of Education and Research [Bundesministerium für Bildung und Forschung, BMBF] also launched a joint research initiative for energy-efficient and climate-friendly buildings and districts under the Sixth Energy Research Programme. The research initiative ‘Solar Construction/Energy-Efficient City’ is focused on technologies for improved energy efficiency and the integration of renewable energies, with a view to advancing the energy transition in buildings and cities. The aim of the projects is to demonstrate how innovations and smart networking can be used to create houses and districts which are not only highly energy-efficient but also highly liveable. As well as technological factors, particular consideration will also be given to matters of social policy and socio-economic issues. The Federal Government has earmarked up to EUR 150 million for ‘Solar Construction/Energy-Efficient City’. This project supports the implementation of the Energy Efficiency Strategy for Buildings under the NAPE.

National efficiency label for heating systems

Since 1 January 2016, an efficiency label has been affixed free of charge to existing heating systems with the aim of improving consumer knowledge about the energy efficiency of their boiler and encouraging them to purchase a replacement. Consumers are also alerted to further sources of energy advice such as the ‘On-Site Energy Advice’ scheme, and to the funding programmes operated by the KfW and the Federal Office for Economic Affairs and Export Control. It is expected that the efficiency label will increase the boiler replacement rate by around 20 % a year. Since 2016, heating engineers, chimney sweeps and certain energy advisors have been entitled to affix a label to old heating devices. From 2017 onwards, district chimney sweeps will be obliged to affix labels to unlabelled devices. Around 13 million boilers will be labelled over the next 8 years as a result of the measure.

Competitive tendering for power efficiency – STEP up!

STEP up! is a competitive funding programme which is operated by the Federal Ministry for Economic Affairs and Energy and is aimed at providing funding for corporate investments into power efficiency improvements, with no restrictions on technologies or sectors. The intention is to incentivise companies to invest in highly efficient power-saving technologies, to reduce their power consumption and at the same time to become more competitive. Funding is awarded for power efficiency measures which are found to have the best ‘cost/benefit values’, or in other words the highest savings per euro of funding, on the basis of a tendering procedure. Two rounds of competitive tendering take place each year (one in the spring and one in the autumn). Two different tendering categories are available at the same time in each round: open tendering, which is open to all technologies, sectors and stakeholders, and closed tendering, which is targeted at specific sectors, groups, technologies or issues which are known to be characterised by high potentials and significant barriers. STEP up! is designed as a ‘learning’ programme. EUR 300 million of funding is available for the pilot phase, which will run until 31 December 2018. If the programme proves successful, it will be extended from 2019 onwards and may also be expanded.

National Top Runner Initiative (NTRI)

The aim of the National Top Runner Initiative (NTRI) is to accelerate the market penetration of energy-efficient and high-quality devices (top runners) and to ensure that consumers attach yet greater importance to energy efficiency as a purchase criterion by means of a bundle of measures. The initiative focuses on three points in the value creation chain, namely production, distribution and purchase/use of the product. In order to bring about more effective synergies, the NTRI increases the amount of information provided and exchanged on product efficiency:

- A product finder informs consumers about energy-efficient products and their use. Consumers can access a range of online materials on energy-efficient products. Plans are also in place for information campaigns on various product groups and the revision of the EU energy label.
- A retailer network allows the exchange and development of information on sales activities, customer information or the joint establishment of training courses for retailers, for example.
- Manufacturers are encouraged to innovate, for example by means of innovation workshops.
- The National Top Runner Initiative was launched on 1 January 2016 and is subject to continuous further development on the basis of dialogue between consumers, retailers and manufacturers.

Support for market surveillance

With a view to increasing the reliability, effectiveness and efficiency of existing and (where applicable) new test methods or standards, thereby ultimately increasing the effectiveness and credibility of the EU's product-related energy efficiency tools, the Federal Institute for Materials Research and Testing [Bundesanstalt für Materialforschung und -prüfung, BAM] of the Federal Ministry for Economic Affairs and Energy was commissioned to provide the market surveillance authorities of the federal states with support under the aegis of the 'Support for Market Surveillance' project. The main topics of research are as follows:

- (i) identification of product defects and the main areas of product defects, and development of screening methods as a further tool for the market surveillance authorities,
- (ii) validation of existing test procedures.

Work started in 2016, and the first outcomes are expected in late 2017.

Green Paper on Energy Efficiency

On the basis of the NAPE, in summer 2016 the Federal Ministry for Economic Affairs and Energy opened a public debate on the medium to long-term development of energy efficiency policies with a Green Paper on Energy Efficiency. This document focuses in particular on Efficiency First, the further development of the range of policy instruments, the EU's energy efficiency policies, sectoral coupling and efficiency-related aspects of digitisation. A debate on these topics was also held on 7 October 2016 in Brussels with European stakeholders. The publication of an evaluation report on the Green Paper consultation is scheduled for the first 6 months of 2017, and a White Paper on Energy Efficiency with concrete options for action will then be developed on that basis. At the end of the consultation process, the Federal Government will have a medium to long-term strategy for reducing energy consumption in Germany through efficient energy use.

(c) Total floor space of buildings to be renovated under Article 5 of the Energy Efficiency Directive

In accordance with Annex XIV Part 1(c) of the Energy Efficiency Directive, the 2017 annual report contains information on the total floor space of buildings with an overall useful area of more than 250 m² which are owned and used by the central government of the relevant Member State and which did not meet the energy efficiency requirements referred to in Article 5(1) on 1 January 2016.

In view of the terminology used in Article 5(1) of the Energy Efficiency Directive ('owned by central government' and 'owned by administrative departments at a level below central government'), the buildings of the following organisations fall under the definition of the calculatory scope for the application of Article 5 of the Energy Efficiency Directive:

- All Federal Government buildings, with the exception of social welfare institutions (job centres, pension insurance companies, etc.) which are engaged in service administration.
- All administrative departments in the material sense (government buildings and administrative buildings used for administrative purposes, e.g. by executive agencies in the material sense which are authorised to adopt binding official regulations, generally in the field of public law, including single living quarters and office buildings of the military command authorities (pursuant to Article 5(2)(b)).

The primary basis for implementation will be the Energy Efficiency Renovation Roadmap for Federal Government Properties, which has not yet been finalised. Checks will be carried out in the near future to ascertain the extent to which additional properties will need to be included in order to meet the requirements of Article 5.

Net floor space of approximately 4.8 million m² in heated and/or cooled buildings can be estimated on the basis of the above calculatory scope for the relevant organisations. The following partial areas can be deducted from that figure in order to calculate the renovation rate of 3 % a year:

- Article 5(2)(a) of the Directive stipulates that the Member States may decide not to set or apply the energy renovation requirements to certain categories of buildings. This includes protected buildings, which are estimated to account for around 10 % of the floor space.
- Around 23 % of the buildings in question which are not protected under preservation orders were built after 1995 in accordance with the requirements of the 1995 Heat Insulation Regulation and the associated Heating System Regulation, and therefore correspond to the minimum overall energy efficiency requirements of the Directive on the energy performance of buildings.
- Around 3.5 % of the remaining buildings have a useful floor area of less than 250 m².

The overall floor space in buildings with a total useful area of more than 250 m² which fall under the aforesaid calculatory scope and which did not meet the requirements referred to in Article 5(1) on 1 January 2016 is therefore around 3.2 million m².

The following overview shows how the overall floor space was calculated with a view to identifying the 3 % annual renovation rate:

Total area (net floor space) of the relevant organisations			approximately 4.8 million m ²
	Percentage	Reference area	Partial area
less buildings subject to preservation orders	approximately 10.0 %	of 4.8 million m ²	~ 0.5 million m ²
less buildings built after 1995	approximately 23.0 %	of 4.3 million m ²	~ 1.0 million m ²
less buildings with < 250 m ² net floor space	approximately 3.5 %	of 3.3 million m ²	~ 0.1 million m ²
Total area (net floor space) for calculation of the 3 % renovation rate			approximately 3.2 million m ²

The previously cited floor space of around 3.2 million m² is therefore based on:

- heated and/or cooled buildings of the central government with a total useful area of over 250 m²,
- which were built before 1995,
- which are not subject to preservation orders and
- which do not meet the minimum overall energy efficiency requirements of the Directive on the energy performance of buildings.

This does not necessarily mean that these buildings do not meet the national minimum overall energy efficiency requirements; the stated overall floor space may be reduced if energy renovation measures have already been carried out since the relevant buildings were constructed. Further data is currently being gathered in that respect (cf. details in Section (d) below).

(d) Total savings achieved in the previous year pursuant to Article 5 of the Energy Efficiency Directive

Pursuant to Annex XIV Part 1(d) of the Energy Efficiency Directive, the annual report must contain information on the total floor area of heated and/or cooled buildings owned and occupied by the Member States' central government that was renovated in the previous year as referred to in Article 5(1) or the amount of energy savings in eligible buildings owned and occupied by their central government as referred to in Article 5(6).

In its communications to the European Commission of 20 December 2013 and 5 June 2014, the Federal Government reported that with a view to transposing Article 5 of the Energy Efficiency Directive, the Federal Government had made use of the alternative option (pursuant to Article 5(6) of the Energy Efficiency Directive) of complying with Article 5(1)-(5) and taking other cost-efficient measures including deep renovations and measures for behavioural change of occupants in order to achieve energy savings pursuant to Article 3 of the Energy Efficiency Directive by 2020.

Work started back in 2011 on a national Energy Efficiency Renovation Roadmap for Federal Government Properties, which builds on the Federal Government's energy objectives (Energy Efficiency Priorities, 3 June 2011, Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, formerly the Federal Ministry of Transport, Building and Urban Development) with a view to the achievement of an almost climate-neutral building stock by 2050. It has become apparent that the measures which need to be taken to achieve these objectives must go significantly beyond the national minimum requirements for the energy-efficient renovation of the

building stock, but must at the same time be cost-effective. The Energy Efficiency Renovation Roadmap for Federal Government Properties lists properties on the basis of their energy efficiency improvement potential. Properties with a higher renovation potential are prioritised over properties with a lower energy renovation potential, and will therefore be investigated at an earlier date. In the years to come, the building stock will be systematically improved on the basis of this order of priority. As a first step, the individual buildings on all civilian Federal Government properties (civilian properties and military properties used for civilian purposes) will undergo an energy assessment carried out on the basis of a uniform Property Energy Concept, which in turn will serve as the basis for a report listing the recommended renovation measures. Each Property Energy Concept will follow a standard format ('energy concept' standard), ensuring that the same methods are always used when collecting and processing the relevant data and performing calculations. The standard format will allow the relevant outcomes to be processed and represented more easily in a database, meaning that they can be compared on a Germany-wide basis.

Property Energy Concepts are currently being produced for the first properties. Around 275 properties are scheduled for assessment, around 50 of which fall under the calculatory scope of Article 5 of the Energy Efficiency Directive. These 50 or so properties account for a total thermally conditioned net floor space of approximately 740 000 m². Initial outcomes indicate that the energy performance of the buildings on Federal Government properties is for the most part better than was originally assumed when calculating the saving potentials, and that the options for energy saving are therefore more limited.

The first Property Energy Concepts have been submitted to the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety as a basis for checks and the adoption of further measures. Owing to the organisational and time constraints associated with the implementation of the Energy Efficiency Renovation Roadmap for Federal Government Properties, including the deadlines for the tendering procedure, no construction measures pursuant to Article 5(1) of the Energy Efficiency Directive have been completed to date on the basis of the Property Energy Concepts in heated and/or cooled buildings owned and used by the central government of the relevant Member State. Only minor measures and immediate actions which were not based on Property Energy Concepts were implemented in 2016 (as was the case in the preceding years). Since measures of this kind were not previously recorded centrally, the database developed with a view to implementation of the Energy Efficiency Renovation Roadmap for Federal Government Properties is currently being expanded for that purpose. At the same time, the relevant building authorities have been asked to put together lists of any such measures. A corresponding data-gathering exercise is also underway for the properties used by the military.

A number of energy efficiency improvement measures have furthermore been implemented on all civilian Federal Government properties within the framework of the 'Energy Saving Programme for Federal Government Properties', which was launched before the introduction of the Energy Efficiency Renovation Roadmap for Federal Government Properties. The measures completed in 2015 resulted in savings of 7 008 MWh/year from 2016 onwards, the measures completed in 2013 resulted in savings of 7 366 MWh/year in 2014, and the measures completed in 2014 resulted in savings of 8 556 MWh/year in 2015. Not all of the measures planned under the 'Energy Saving Programme for Federal Government Properties' have as yet been completed or reported as complete.

(e) Energy savings through alternative measures adopted pursuant to Article 7(9) of the Energy Efficiency Directive

The table below provides an overview of new final energy savings achieved through alternative measures reported pursuant to Article 7(9) of the Energy Efficiency Directive in 2015. These are updated versions of the figures provided in the 2016 annual report. By 2020, these measures alone will achieve around 80 % of the savings target reported by the Federal Government under Article 7 of

the Energy Efficiency Directive.

Checks were carried out to ascertain the extent to which the outcomes recorded in 2015 for the measures described below deviated from the reported savings, and the actual savings were amended wherever necessary.

Further measures were also launched in 2015 for the purpose of implementing the National Action Plan on Energy Efficiency. As well as the energy audit obligation for non-SMEs described in Section 3.2, these included in particular the 'Energy Efficiency Networks' initiative.

In the period 2015-2016, 102 networks were established within the framework of that initiative. Based on the 38 savings targets reported to date (targets must be submitted no later than 1 year after the network commences operation), an average savings target per network of around 40 GWh primary energy could be calculated. Extrapolated to 100 networks, this would result in a primary energy saving of 14.5 PJ by the end of 2020. Analyses have also revealed that the Federal Government's forecast savings target of around 75 PJ by the end of 2020 is achievable if a total of 500 networks follow these first 35 by setting comparable savings targets and initiating corresponding measures.

Notification number:	Name of measure:	Final energy savings in 2015 in petajoules:
M13	Energy and electricity tax	74.0
M02	Energy Saving Regulation (for existing buildings)	11.8
M06	Funding of corporate investments	6.7
M04	KfW Funding Programme for Energy-Efficient Construction and Renovation (CO ₂ Building Renovation Programme)*	7.1
M01	Energy Saving Regulation (for new buildings)	4.6
M15	Air traffic tax	4.2
M16	Emissions trading	1.7
M17	Federal Government energy advice programmes	1.0
M03	Renewable Energies Heat Act	1.0
M08	Market incentive programme for the promotion of the use of renewable energies in the heating market (Federal Office for Economic Affairs and Export Control portion)	0.3

* including the increase in funding to cover the expansion to include non-residential buildings notified under measure M21.

Glossary of abbreviations

AGEB	Arbeitsgemeinschaft Energiebilanzen (Working Group on Energy Balances)
AtG	Atomgesetz (Atomic Energy Act)
AVV-EnEff	Allgemeine Verwaltungsvorschrift zur Beschaffung energieeffizienter Produkte und Dienstleistungen (General Administrative Provisions on the Procurement of Energy-Efficient Products and Services)
BAFA	Bundesamt für Wirtschaft und Ausfuhrkontrolle (Federal Ministry for the Economy and Export Control)
BfEE	Bundesstelle für Energieeffizienz (Federal Office for Energy Efficiency)
BGBI.	Bundesgesetzblatt (Federal Law Gazette)
BImSchG	Bundes-Immissionsschutzgesetz (Federal Immissions Protection Act)
BImSchV	Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes (Regulation implementing the Federal Immissions Protection Act)
BMUB	Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit (Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety)
BMVI	Bundesministerium für Verkehr und digitale Infrastruktur (Federal Ministry of Transport and Digital Infrastructure)
BMWi	Bundesministerium für Wirtschaft und Energie (Federal Ministry for Economic Affairs and Energy)
BT-Drs.	Drucksache des Deutschen Bundestages (Publication of the German Bundestag)
DIBt	Deutsches Institut für Bautechnik (German Institute for Structural Engineering)
DIN	Deutsches Institut für Normung (German Institute for Standardisation)
EDL-G	Gesetz über Energiedienstleistungen und andere Energieeffizienzmaßnahmen (Act on energy services and other energy efficiency measures)
EEG	Erneuerbare-Energien-Gesetz (Renewable Energies Act)
EEWärmeG	Gesetz zur Förderung Erneuerbarer Energien im Wärmebereich (Erneuerbare-Energien-Wärme-Gesetz) (Act on the promotion of renewable energies for heat (Renewable Energies Heat Act))
EC	European Community
EKFG	Gesetz zur Errichtung eines Sondervermögens Energie- und Klimafonds (Act on the establishment of a Special Energy and Climate Fund)
EMS	Energy management system
EnEG	Gesetz zur Einsparung von Energie in Gebäuden (Energieeinsparungsgesetz) (Act on saving energy in buildings (Energy Saving Act))
EnergieStG	Energiesteuergesetz (Energy Tax Act)
EnEV	Verordnung über energiesparenden Wärmeschutz und energiesparende Anlagentechnik bei Gebäuden (Energieeinsparverordnung) (Regulation on energy-saving heat protection and energy-saving plant technology in buildings (Energy Saving Regulation))
EnStatG	Energiestatistikgesetz (Energy Statistics Act)
EnWG	Gesetz über die Elektrizitäts- und Gasversorgung (Energiewirtschaftsgesetz) (Act on electricity and gas supply (Energy Act))
ESB	Energetischer Sanierungsfahrplan Bundesliegenschaften (Energy Efficiency Renovation Roadmap for Federal Government Properties)
ESG	Energieeffizienzstrategie Gebäude (Energy Efficiency Strategy for Buildings)
EU	European Union
EUA	EU allowances
EVU	Energieversorgungsunternehmen (energy supply companies)
GDP	Gross domestic product

GHD	Gewerbe, Handel und Dienstleistungen (commerce, trade and services)
GWB	Gesetz gegen Wettbewerbsbeschränkungen (Restriction of Competition Act)
IED	Industrial emissions
KfW	Kreditanstalt für Wiederaufbau (Credit Institute for Reconstruction)
KNB	Kompetenzstelle für Nachhaltige Beschaffung (Competence Centre for Sustainable Procurement)
KrWG	Kreislaufwirtschaftsgesetz (Waste Management and Product Recycling Act)
kWh	Kilowatt hour
KWK/G	Kraft-Wärme-Kopplungsgesetz (Cogeneration Act)
LEK	Liegenschaftsenergiekonzept (Property Energy Concept)
MAP	Marktanreizprogramm zur Förderung der Nutzung erneuerbarer Energien (Market Incentive Programme for the Promotion of the Use of Renewable Energies)
MJ	Megajoule
Mtoe	Million tonnes of oil equivalent
MW	Megawatt
MWeI	Megawatt electrical
MWh	Megawatt hour
NAPE	National Action Plan on Energy Efficiency
NEEAP	National Energy Efficiency Action Plan
PJ	Petajoule
Pkm	Passenger kilometre
RWI	Rheinisch-Westfälisches Institut für Wirtschaftsforschung (Rhine-Westphalia Institute for Economic Research)
SME	Small and medium-sized enterprise
StromNEV	Stromnetzentgeltverordnung (Electricity Grid Fee Regulation)
StromStG	Stromsteuergesetz (Electricity Tax Act)
Tkm	Tonne kilometre
TWh	Terawatt hour
UBA	Umweltbundesamt (Federal Environment Agency)
VgV	Verordnung über die Vergabe öffentlicher Aufträge (Vergabeverordnung) (Regulation on Public Procurement (Procurement Regulation))
VOB/A	Vergabe- und Vertragsordnung für Bauleistungen – Teil A (Construction Tendering and Contract Regulations, Part A)
VOL/A	Vergabe- und Vertragsordnung für Leistungen – Teil A (Services Tendering and Contract Regulations, Part A)
VSVgV	Vergabeverordnung Verteidigung und Sicherheit (Defence and Security Contract Regulations)
WHG	Wasserhaushaltsgesetz (Water Resources Act)

