Federal Republic of Germany

Progress report pursuant to Article 22 of Directive 2009/28/EC on the promotion of the use of energy from renewable sources

TABLE OF CONTENTS

0 INTRODUCTION AND SUMMARY

The Federal Government is embarking on the energy transition with a view to securing a reliable, affordable and environmentally friendly energy supply in the future. Renewable energies will supply an increasing proportion of the country's energy, paired with a consistent rise in energy efficiency.

Germany's energy policy is driven by three objectives: security of supply, affordability and environmental compatibility. This three-pronged approach to energy policy is based on the Federal Government's Energy Concept from 2010 and the energy transition resolutions passed by the German Bundestag in 2011. The expansion of renewable energies in the electricity sector and in the heating and cooling sector is already a mainstay of the energy transition, and is continuing to gain in importance.

During the reporting period, it was laid down in law that the proportion of gross electricity consumption supplied from renewable energies should increase to 40-45% by 2025, to 55-60% by 2035 and to at least 80% by 2050[1]. Under the coalition agreement signed in March 2018, the Federal Government is striving to achieve a 65% share of renewable energies by as early as 2030. This was confirmed in the decisions adopted by the Climate Cabinet on 20 September 2019 and the Climate Action Programme 2030 adopted by the Federal Government on 9 October 2019. According to these latter, renewable energies will play a key role in electricity generation in both the medium and long term.

Overall, the proportion of the total gross final energy consumption supplied from renewable energies in Germany during the reporting period increased to 15.5% in 2017 and to 16.5% in 2018 (according to the calculation rules pursuant to Directive 2009/28/EC). At the same time, the normalised proportion of gross electricity consumption from renewable energies rose during the reporting period from 34.6% in 2017 to 38.0% in 2018.

The growing proportion of renewable energies means that the electricity markets face the challenge of providing more flexibility. At the same time, renewable energies

[1] The national targets in Section 1 of the Renewable Energy Sources Act [Erneuerbare-Energien-Gesetz, EEG] are not directly comparable to the figures reported under the National Renewable Energy Action Plan (NREAP) and listed in the progress report, as they are not subject to the calculation rules in accordance with Directive 29/2009/EC.

must become an integral part of the electricity markets, by providing ancillary services for the electricity supply system, for example.

The transition to mandatory direct marketing of renewable electricity and competitive calls for tender for the amount of funding represent two important steps towards further integration of renewable energies in the market and better synchronisation with grid expansion and the rest of the electricity supply.

As a result of the calls for tender, competition has opened up for the most cost-effective energy facilities and sites. A decrease in remuneration (contract award values as an outcome of competitive calls for tender) has subsequently been observed, particularly in the field of photovoltaics, where the average volume-weighted contract award value dropped from 9.17 ct/kWh in the first bidding round of the pilot call for tender in April 2015 to 4.33 ct/kWh in the first bidding round in 2018 under the Renewable Energy Sources Act 2017. The average contract award value for 2018 was approximately 4.5 ct/kWh. In the case of onshore wind energy, the volume-weighted contract award value fell from 5.78 ct/kWh in the first bidding round in May 2017 to 3.82 ct/kWh in the third bidding round in 2017.

Community energy companies accounted for more than 95% of the contract award amounts from the first three calls for tender in the field of onshore wind energy. In 2017, community energy companies had two advantages over other stakeholders in the tender procedure: firstly, they could submit a bid for a wind farm even without approval, unlike other stakeholders, and they were also eligible for an extended implementation period (54 months instead of 30 months). Secondly, the amount of funding was not calculated according to the bid price, as was the case for the other stakeholders, but according to the highest successful bid. Owing to the long implementation period, community energy companies could thus offer prices that were not competitively viable for projects at a more advanced stage of planning. The strong dominance of community energy companies is accompanied by the risk of a gap in the expansion of onshore wind energy. This results from the extended implementation period and an increased implementation risk due to the possibility of participating without approval and exemptions from contractual penalties for non-performance. In summer 2017, the privileges for community energy companies were temporarily restricted in response to these developments.

Calls for tender for onshore wind power installations were signed in 2018. After a steep increase in 2017, the net capacity of newly installed wind power installations dropped by around 55% to only 2 273 MW in 2018. Reasons for this drop include the knock-on effects of introducing a system of public tendering, the aforementioned rules for community energy companies and other issues relating to acceptance of wind energy projects, some of which led to a downturn in approvals. Measures that

might increase acceptance of onshore wind energy were outlined both in the decisions adopted by the Climate Cabinet on 20 September 2019 and in the Climate Action Programme adopted by the Federal Government on 9 October 2019; the approval and planning procedures are also to be designed more efficiently.

As regards the calls for tender relating to biomass installations that took place in September 2017 and 2018, the low bid volume (33% in relation to the tendered quantity of 122 MW in 2017 and 40% in relation to the tendered quantity of 225 MW in 2018) reflects a low level of competition. This also had an impact on the bid values and contract award values. The bid values ranged from 9.86 ct/kWh to 16.9 ct/kWh. The volume-weighted average of the contract award values for biomass calls for tender was 14.5 ct/kWh as an average over both rounds, which was thus near to the highest values. These values were 14.88 ct/kWh for new installations in 2017 (2018: 14.73 ct/kWh) and 16.9 ct/kWh for existing installations in 2017 (2018: 16.73 ct/kWh).

The implementation rate is an important indicator of successfully conducted calls for tender; the average implementation rate for the first eight rounds of the calls for tender for photovoltaic energy (six of which were carried out as pilot calls for tender) is around 95%.

The Federal Government continued to press ahead with the task of grid expansion during the reporting period. For example, 65 projects with approximately 7 700 km of lines were stipulated by law, and their planning and approval were fast-tracked by law. Around 2 400 km of this distance was planned as large high-voltage direct current transmission lines. This will significantly improve electricity exchange and also considerably reduce loop flows to our neighbours. Many of these lines are planned as underground cables to increase public acceptance.

In total, Germany will invest around EUR 50 billion over the period up to 2030 with a view to expanding the electricity transmission systems.

System integration measures will also be necessary in future. The expansion of renewable energies must continue to be coordinated with grid expansion. This involves further accelerating grid expansion, improving the utilisation and optimisation of the existing grids, better managing renewable energies on a regional basis and reducing internal bottlenecks by means of further measures.

Throughout this process, the importance of a cost-effective supply of energy for both consumers and industry must be kept in mind at all times.

One building block of European integration under the Renewable Energy Sources Act was the partial opening for cross-border calls for tender. The Renewable Energy

Sources Act 2017 provides for 5% of the annual capacity to be installed to be put out to cross-border tender, and thus to be opened up to participation by installations in other EU Member States. Germany is currently in ongoing discussions with neighbouring countries on this matter. The aim is to integrate the expansion of renewable energies on a cross-border basis as well.

During the reporting period, surpluses of 3 945 ktoe in 2017 and 6 141 ktoe in 2018 were recorded in respect of the production of renewable energy compared to the indicative interim trajectory. Initial estimates for the continued use of renewable energies and changes in gross final energy consumption indicate that small surpluses will also be recorded for the remaining years, 2019 and 2020.

The sectors in detail

The Renewable Energy Sources Act is the key instrument for achieving the objectives relating to the expansion of renewable energies in the electricity sector. It has been subject to repeated amendments in recent years in response to the rapidly accelerating development of renewable energies. The amendments to the Renewable Energy Sources Act adopted back in 2014 meant that costs were limited, the expansion of renewable energies was managed in a methodical manner and renewable energies were made more competitive on the market. Since then, a range of instruments have been used to manage volumes and to focus the development of renewable energies on cost-effective technologies. Overall, the costs for achieving the expansion targets are thus coming down, and the energy transition is becoming more predictable for all stakeholders involved.

In particular, renewable energies have become gradually subject to mandatory direct marketing and therefore made more competitive on the market as a result of the amendments to the Renewable Energy Sources Act over the past few years. The Renewable Energy Sources Act 2012 initially introduced an optional market premium. This meant that operators could choose either to market their electricity directly on the market themselves or to supply the electricity to system operators on the basis of a feed-in tariff, after which the system operators would sell this electricity on the market. The Renewable Energy Sources Act 2014 introduced mandatory direct marketing for larger installations. As a result, operators of renewable energy installations are solely responsible for marketing their electricity on the electricity market. They must find customers for their electricity on the market, and they are solely responsible for the balancing group. This move also boosted the security of the energy supply. In addition, the Renewable Energy Sources Act 2014 paved the way for switching to a system under which the amount of funding is determined by the market. The first stage involved introducing calls for tender for the funding of ground-mounted solar installations in 2015.

The funding systems for other renewable energies were switched over to calls for tender by the Renewable Energy Sources Act 2017. Since then, the funding of renewable energies has in principle been determined on a competitive basis via calls for tender. Calls for tender allow expansion to be better managed, and also make it easier to respond to unforeseeable market developments. In addition, they improve planning certainty for other stakeholders in the electricity industry. Ultimately, the changeover to a system based on calls for tender is therefore also consistent with the European Commission's approach of promoting market-driven funding of renewable energies.

Another mechanism that has been introduced is the system of calls for tender based on a sliding market premium, which ensures that funding will no longer be paid once an installation is in a position to refinance itself via the electricity market. Funding automatically stops being paid out as soon as the bids submitted in response to calls for tender fall below the current monthly spot electricity prices. This has already happened for offshore wind power installations and (in some cases) for large solar installations, meaning that these installations are no longer eligible for funding and refinance themselves from market profits.

More specifically, the Renewable Energy Sources Act 2017 introduced calls for tender for biomass installations (from an installed capacity of over 150 kW), for onshore wind power installations and solar installations (in each case from an installed capacity of over 750 kW) and for offshore wind power installations. At the same time, the design of the tender procedure for the specific technologies was adapted in each case to the individual market conditions:

- As early as 2015, the method for calculating the level of funding for ground-mounted photovoltaic installations was changed to calls for tender by means of the Regulation on calls for tender for ground-mounted solar installations [Freiflächenausschreibungsverordnung, FFAV]. The tender volume was initially set at 400 MW per year, and from 2017 it was increased to 600 MW per year. The strips of land available for ground-mounted solar installations were expanded by authorising the federal states to permit the awarding of contracts to installations on farmland or grassland areas in less-favoured regions within their territory by means of legislative regulations.

- Calls for tender were also introduced in respect of onshore wind power installations, with the exception of prototypes and installations up to 750 kW. In principle, all installations with a permit under immission control legislation can take part. In 2017, projects operated by community energy companies were exempted from the requirement for a permit. Alongside this, the reference yield model was further developed from a two-stage model into a one-stage model, and the maximum contract award volume in

a grid expansion area was temporarily limited on a local basis. This is intended to ensure that the increase in the number of new wind power installations covers as much of the country as possible.

- Calls for tender were likewise introduced in respect of offshore wind power installations. In order to ensure sufficient competition, areas for future offshore wind farms were put out to tender under a 'central model'. The areas in question have undergone preliminary investigation by the Federal Government, and their suitability for offshore expansion has been checked. At the same time, efforts were undertaken to improve the interactions between systems for area planning and spatial organisation, authorisation of installations, funding under the Renewable Energy Sources Act and network connections and to make them more cost-effective. All the relevant regulations were combined into a single act with that in mind (Offshore Wind Energy Act [Windenergie-auf-See-Gesetz, WindSeeG]). However, in order to take account of the long lead times for the construction of wind farms and network connections, this system-level change will only be effective for installations commissioned from 2026 onwards. Use of the central model is intended to ensure planning certainty at an early stage for the industry in respect of the post-2026 period and to avoid a 'break in the thread', or in other words an abrupt interruption of the expansion of offshore wind energy, since this is still a young technology. For the transitional period, the annual expansion was managed by means of calls for tender in 2017 and 2018, in which only wind farms that were already well advanced in terms of planning and approval were allowed to participate. For that purpose, two bidding rounds were conducted for commissioning in the years 2021 to 2025.

- Calls for tender were likewise introduced for biomass installations with an installed capacity of over 150 kW. The tendering system is intended to offer a prospect of financial continuity not only for new installations, but also for particularly efficient existing biomass installations: In the period up to 2024, current funding arrangements will come to an end for biogas installations providing approximately 500 MW of capacity. The tender volume was therefore set at a level which – based on the figures – enables a fair chance of participation for existing biogas installations with sufficient lead time, and also promotes an increase in new installations. Solid biomass installations can also participate in the calls for tender. By way of contrast to other technologies, the de minimis limit for calls for tender is 150 kW in the case of biomass installations.

In the heating and cooling sector, the aim is to achieve a virtually climate-neutral building stock by 2050. The Energy Efficiency Strategy for Buildings adopted by the Federal Government in 2015 states that this goal must be achieved through an appropriate combination of an increased use of renewable energies and a rise in the energy efficiency of buildings. The 'efficiency first' principle therefore also applies in the buildings sector. The 'efficiency first' principle therefore also applies in the buildings sector. There must be a drop of up to 50% in energy consumption in the heating and cooling sector by 2050. The proportion of renewable energies must also be increased further by a considerable amount in the period between 2020 and 2050.

A large number of measures have been implemented to support the expansion of renewable energies in the heating and cooling sector. Specifically:

- The Renewable Energies Heat Act [Erneuerbare-Energien-Wärmegesetz, EEWärmeG], which came into force in 2009 and was revised in 2011, stipulates that building contractors constructing new builds must obtain heating and cooling proportionately from renewable energies or compensating measures such as the provision of additional insulating measures or the use of cogeneration/district heating.

- The Market Incentive Programme for the promotion of renewable energies in the heating market (MAP) has been enshrined in the Renewable Energies Heat Act since 2009. The support programme promotes the installation of different technologies in the field of renewable energies within the buildings sector. By means of amendments to the MAP funding guideline in April 2015, the scope of funding was expanded (e.g. to include yield-dependent funding for solar thermal installations) and opened up to the commercial sector to a greater extent. In the funding years 2017 and 2018, approximately EUR 467 million was paid out in total under both MAP funding parts (Federal Office of Economics and Export Control [Bundesamt für Wirtschaft und Ausfuhrkontrolle, BAFA] and KfW), releasing an estimated investment volume of approximately EUR 2 billion. More specifically, investment grants of approximately EUR 392 million for 108 100 renewable heating systems were paid out in 2017 and 2018 under the grant section of the MAP (BAFA), primarily to private individuals in one-family and two-family dwellings. Furthermore, a lending envelope of approximately EUR 214 million was value-dated in 2017 and 2018 under the part of the MAP administered by KfW in connection with repayment grants of around EUR 75 million, for a total of 3 341 installations. Applications were also submitted for 3 846 new installations.

- Under the CO_2 Building Renovation Programme, energy-efficient construction and renovation are promoted by means of low-interest loans and repayment subsidies and grants. Funding for the programmes handled via the KfW was stabilised until 2018 at a level of EUR 2 billion per annum. In addition, funding was extended to cover the non-residential buildings sector in 2015.

- The Energy Efficiency Incentive Programme [Anreizprogramm Energieeffizienz, APEE], which was implemented in 2016, forms part of the National Energy Efficiency Action Plan (NEEAP). The heating and ventilation package that was integrated into the CO_2 Building Renovation Programme and the MAP further strengthened the existing funding landscape. As a further component of the Energy Efficiency Incentive Programme, the market launch of innovative fuel cell heating systems for new and existing buildings has been funded since August 2016. In 2017 and 2018, around 21 700 funding commitments (for the heating package bonus via the Energy Efficiency Incentive Programme) were issued under the MAP for heating systems based on renewable energies.

The following funding measures were implemented or continued during the reporting period with a view to increasing the share of renewable energies in the transport sector.

- An obligation to reduce greenhouse gases was introduced in 2015 as a funding instrument for biofuels (replacing the biofuel quota). This obligation means that anyone placing petrol, diesel and biofuels on the market must ensure that the total GHG emissions of these latter are reduced by a fixed percentage with respect to the fossil reference value. Since 2017, this reference value has been 4%.

- The National Electromobility Platform [Nationales Plattform Elektromobilität, NPE], which brings together representatives of industry, science and politics, was founded in 2010. Its members draft and propose concrete actions for implementation with a view to advancing electromobility. For example, its recommendations were included in the Federal Government's Electromobility Programme in 2011. In 2018, the progress report on the market launch phase was also published. When the National Electromobility Platform ceased to exist on 31 December 2018, the topics were transferred to the National Platform for the Future of Mobility [Nationale Plattform Zukunft der Mobilität, NPM].

- Since 12 June 2015, the Electromobility Act [Elektromobilitätsgesetz, EmoG] has allowed municipalities to grant concessions on public roads and rights of way and exemptions from access restrictions and restricted-use lanes with a view to promoting the use of electrically operated vehicles (passenger vehicles and light commercial vehicles). An environmental bonus was also introduced in 2016. This is a support programme (worth EUR 600 million in total) under which premiums are made available for the purchase of new electric vehicles. The amounts involved by the end of 2019 were around EUR 2 000 for a battery-powered electric vehicle or fuel cell vehicle, and EUR 1 500 for an externally charged hybrid electric vehicle. By the end of 2018, 91 498 applications had been submitted. The funding guidelines were amended in early 2020 with a view to increasing the amounts of funding per vehicle and extending the term until the end of 2025.

Renewable energies: progress during the reporting period

In accordance with the requirements of Directive 2009/28/EC, this report focuses on the period between 1 January 2017 and 31 December 2018.

Overall, the consumption of energy from renewable sources in Germany in the period from 2005 to 2018 rose from a total of 16 258 ktoe (oil equivalent) to 36 804 ktoe. In 2017, consumption stood at 35 031 ktoe.

In total, the share of renewable energies in the gross final consumption of energy in Germany was 15.5% in 2017 and 16.5% in 2018, which was slightly below the value of 16.7% forecast in the 2018 National Renewable Energy Action Plan (NREAP).

The normalised share of renewable energies in gross electricity consumption increased in the reporting period from 34.6% in 2017 to 38.0% in 2018 (at almost 224 TWh). Electricity generation from renewable energy sources thus surpasses the NREAP estimate for 2018 (191 TWh) by around 14%.

The gross final consumption of energy for heat from renewable energies was somewhat above the NREAP estimates in both reporting years (14 758 ktoe in 2017 compared to the NREAP estimate of 13 071 ktoe, and 14 877 ktoe in 2018 as compared with an estimate of 13 524 ktoe). The accelerated increase since 2005 is attributable primarily to the expanded use of solid and gaseous biomass and of ambient heat and near-surface geothermal energy. By way of contrast, solar thermal and deep geothermal energy increased at a rate that was significantly below that forecast in the NREAP.

The volume of renewable energies in the transport sector in the reporting years was significantly below the values estimated in the NREAP, with 2 875 ktoe in 2017 and 3 022 ktoe in 2018. The volume of conventional biofuels was also significantly below the NREAP estimates, while the use of biofuels based on residues or waste substantially exceeded the values forecast in the NREAP, even after the discontinuation of double counting.

Some of the data available for the reporting years 2017 and 2018 are of a provisional nature. The Federal Government will provide details of any updated values in the next progress report.

Climate protection and socio-economic effects of renewable energies

In 2017, the use of renewable energy helped to prevent emissions totalling 182 million tonnes of CO_2 equivalent (CO_{2eq}); in 2018, this figure was around 187 million tonnes CO_{2eq}. The largest reduction in greenhouse gases came in the electricity sector, with approximately 139 million tonnes CO_{2eq} in 2017 and approximately 144 million tonnes CO_{2eq} in 2018.

In the ‘heating and cooling’ sector, the use of renewable energy sources resulted in greenhouse gas emissions being avoided in the amount of approximately 35 million tonnes CO_{2eq} in both 2017 and 2018.

In the transport sector (without fuel consumption in agriculture, the building industry and the military), the estimated greenhouse gas savings were around 7.4 million tonnes CO_{2eq} in 2017 and around 7.7 million tonnes CO_{2eq} in 2018 (without taking into account indirect land use changes).

Germany imports the majority of the petroleum, natural gas and hard coal that it uses. These fossil primary energy sources are increasingly being replaced by renewable energy sources, lowering Germany's import demand. Without renewable energies, the import demand for fossil fuels in the reporting period would have been higher.

Employment in the renewable energy sector in Germany dropped over the most recent reporting period. In 2017, around 317 000 people in total were employed in this sector (2016: 348 000). An increase in employment compared to 2014 was however recorded in particular sectors, namely offshore wind energy, ambient heat and near-surface geothermal energy. A downward trend was observed in the other sectors, especially onshore wind and solar energy (German Institute for Economic Research [Deutsches Institut für Wirtschaftsforschung, DIW], German Aerospace Centre [Deutsches Zentrum für Luft- und Raumfahrt, DLR], 2019).

Reporting under the Federal Government's Biomass Sustainability Regulations

In its Biomass Sustainability Regulations (Section 64 of the Biofuel Sustainability Regulation [Biokraft-Nachhaltigkeitsverordnung, Biokraft-NachV] and Section 72 of the Biomass Electricity Sustainability Regulation [Biomassestrom-Nachhaltigkeitsverordnung, BioSt-NachV], Germany has undertaken to report to the European Commission on compliance with the requirements imposed by these Regulations within the scope of its progress reports. This information is included in Section 14, as a supplement to the prescribed template for the report, and thus falls outside the reporting obligation relating to the progress report itself.

Reporting as part of the 'Energy for the future' monitoring process

In autumn 2011, the Federal Government launched its own monitoring process called 'Energy for the future'. The aim of this process is to review the implementation of the measures relating to the energy transition and of the Energy Concept and its targets, with a view to securing a reliable, cost-effective and environmentally friendly supply of energy, so that corrective action can be taken if necessary. An annual monitoring report presents the facts and evaluates progress made towards achieving targets and implementing measures. As a basic principle, a more comprehensive progress report is to be produced every three years (starting in 2014) as a basis for deeper analysis, using data covering several years. An independent committee of energy experts oversees the monitoring process. The committee issues an opinion on the Federal Government's monitoring report. This opinion is taken into account in the continued monitoring process.

The developments in the area of renewable energy presented in this progress report are also described in the 'Energy for the future' monitoring process, albeit in a wider

context that also covers areas such as energy efficiency, security of supply, grid expansion, the stock of power stations or energy prices and costs. The second and most recent ‘Energy of the future’ progress report was published in June 2019.

Structure of the progress report

This progress report sets out the content required by Article 22 of EU Directive 2009/28/EC. The template provided was used to produce the progress report. Information supplementary to the template, such as reports under the Biomass Sustainability Regulations and more detailed annexes, is identified as such.

1 SECTORAL AND OVERALL SHARES AND ACTUAL CONSUMPTION OF ENERGY FROM RENEWABLE SOURCES IN THE PRECEDING TWO YEARS (2017 AND 2018)

(Article 22(1)(a) of Directive 2009/28/EC)

The statements below are largely based on values calculated using the SHARES tool[2] developed by Eurostat. They are essentially based on data from the Working Group on Renewable Energies and Statistics [Arbeitsgruppe Erneuerbare Energien-Statistik, AGEE Stat] (Federal Ministry of Transport and Digital Infrastructure [Bundesministerium für Verkehr und digitale Infrastruktur, BMWi] 2019), which rely substantially on official data and also on scientific surveys, models and in some instances on association data.

All data in this fifth progress report are in accordance with the definitions and calculation rules set out in the NREAP, as specified in Directive 2009/28/EC. The years 2017 and 2018 that form the focus of this report are identified as such.

Gross final consumption of energy

The gross final consumption of energy in the individual sectors and the total gross final consumption of energy are shown in Table A. The total gross final consumption of energy in Germany during the period from 2005 to 2018 remained largely constant, but significantly obscured by economic and temperature-related fluctuations. It stood at 226 597 kilotonnes oil equivalent (ktoe) in 2005, and 226 410 ktoe in 2017, which was a warmer year than 2005. In 2018, which was significantly warmer than 2005 and also warmer than the previous year, the total gross final consumption of energy was 223 305 ktoe. In the NREAP, gross final consumption of energy under the 'scenario with further efficiency measures' was estimated at 206 984 ktoe in 2017 and 203 760 ktoe in 2018; these figures are significantly lower.

In the 'heating and cooling' sector, a fall to 110 386 ktoe was observed during the period from 2005 to 2017 (-4 341 ktoe, which corresponds to -3.8%), in particular as a result of temperature conditions. In 2018, the gross final consumption of energy for 'heating and cooling' was even lower, partly as a result of temperature conditions and partly as a result of inventory effects for light heating oil, at 109 162 ktoe (-4.9% compared to 2005). The NREAP value ('scenario with further efficiency measures') for 2018 was 97 449 ktoe (2017: 99 551 ktoe).

Gross final consumption of energy in the 'electricity' sector was 51 183 ktoe in 2017 and 50 580 ktoe in 2018, which was lower than the figure of 52 634 ktoe for 2005

[2] Eurostat (2018), SHARES Tool Manual: http://ec.europa.eu/eurostat/web/energy/data/shares.

(2.8% and 3.9% respectively). The total estimate for 2018 (2017) in the NREAP ('scenario with further efficiency measures') was 49 346 ktoe (49 799 ktoe).

No significant changes were observed for final energy consumption in the 'transport' sector during the period from 2005 to 2013. Consumption rose continuously from 2014 to 56 451 ktoe in 2017, and dropped significantly again in 2018 to 54 728 ktoe. The corresponding NREAP values ('scenario with further efficiency measures') are 50 034 ktoe (2017) and 49 414 ktoe (2018).

Table A: Evolution of (gross) final consumption of energy in Germany in the heating and cooling, electricity and transport sectors and total gross final consumption of energy (in ktoe/year)

	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018
Gross final consumption of energy Heating and cooling[3]	114 727	118 675	107 767	111 941	116 292	105 376	108 224	110 296	110 386	109 162
Gross final consumption of energy Electricity[4]	52 634	52 648	51 893	51 735	51 653	50 564	51 084	51 104	51 183	50 580
EEV Transport[5]	53 000	51 330	51 971	51 602	52 697	53 419	54 215	55 414	56 451	54 728
Gross final consumption of energy Total[6,7,8]	**226 597**	**229 748**	**218 337**	**222 589**	**227 968**	**216 522**	**220 614**	**224 465**	**226 410**	**223 305**

Shares of renewable energies in the gross final consumption of energy

The total consumption of energy from renewable sources rose from 16 258 ktoe to 35 031 ktoe (+115% compared to 2005) in the period between 2005 and 2017 and increased further to 36804 ktoe (+126% compared to 2005) in 2018 (Table 1a). Overall, this results an average annual growth rate of around 6.6% in the period from 2005 to 2017 and 6.5% in the period from 2005 to 2018. If the three sectors are

[3] Final consumption of energy for all energy products, except electricity, for purposes other than transport, plus the consumption of heat for internal use in heat and power plants and heat losses in networks (points '2. Own use by plant' and '11. Transmission and distribution losses', p. 23 and 24 of the Regulation on energy statistics, OJ L 304 of 14.11.2008).

[4] Gross electricity consumption: gross national electricity production (including own generation), plus imports, minus exports and minus pumping.

[5] Consumption in the transport sector according to the definition in Article 3(4)(a) of Directive 2009/28/EC.

[6] As defined in Article (2)(f) of Directive 2009/28/EC. This includes final consumption of energy plus network losses and own consumption of heat and electricity in heat and power plants (NB: not electricity used for pumped storage or for conversion in electric boilers or heat pumps in district heating plants).

[7] The aviation clause in Article 5(6) has no bearing in the reporting period, as the share of aviation in the gross final consumption of energy in Germany in 2015-2017 and 2016-2018 was 4.5% and 4.7% respectively, and hence below 6.18%.

[8] The total gross final consumption of energy is greater than the sum of the three sub-components, in particular on account of the jet fuel only taken into consideration there.

compared, electricity displayed the highest growth rate during the period from 2005 to 2018, averaging around 10.0% per year. The average annual increase between 2005 and 2018 was around 4.1% in the 'heating and cooling' sector, and around 3.5% in the transport sector.

The electricity sector also contributed the most in absolute terms to the increase in the consumption of renewable energies. Gross electricity production from renewable energies rose by 13 425 ktoe from 2005 to 2018, which corresponds to an increase of around 145%. Gross final consumption of energy from renewable sources for heating and cooling grew by 6 031 ktoe (+68%) during the period from 2005 to 2018. Final consumption of energy from renewable sources in the transport sector rose by 1 087 ktoe (+56%) during the same period.

The shares of renewable energies in the gross final consumption of energy for the individual sectors as shown in Table 1 can be calculated from the gross final consumption of energy shown in Table A and the consumption of renewable energies in Table 1a.

Between 2005 and 2018, the share of all renewable energies in the total gross final consumption of energy rose from 7.2%[9] to 16.5%; 16.7% (15.7%) was estimated in the NREAP for 2018 (2017).

Specifically, the share of renewable energy in gross consumption of electricity, after applying the normalisation for wind energy and hydropower, stood at 38% in the 'electricity' sector in 2018, which was 4.7 percentage points higher than the value in the NREAP. This is solely due to an increase in renewable electricity production. In the 'heating and cooling' sector, the share of renewable energy stood at 13.6% in 2018, which fell short of the value forecast in the NREAP (13.9%) by 0.3 percentage points. In the same year, the contribution of renewable energy sources in the 'transport' sector (7.9%) was significantly below the estimate in the NREAP (9.4%).

Energy from renewable sources was transferred to Germany from other Member States for the first time in 2018; this involved several photovoltaic projects in Denmark that had received funding from Germany. The additional volume of energy (electricity) that can be counted against Germany's targets for 2018 in this connection is 2.7169 ktoe overall, which corresponds to around 0.001% of total gross final energy consumption in 2018 (see also Chapter 11).

[9] The share of renewable energy in the gross final consumption of energy for Germany in 2005 (7.1%) given here and in Table 1 differs from the value given in Annex I, Table A in Directive 2009/28/EC (5.8%), since it is based on more recent statistical data.

Table 1: The sectoral (electricity, heating and cooling, and transport) and overall shares of energy from renewable sources[10]

	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	…	2020 targets
Renewable energies – Heating and cooling[11] (%)	7.7	12.1	12.6	13.4	13.4	13.4	13.4	13.0	13.4	13.6		
Renewable energies – Electricity[12] (%)	10.6	18.3	21.0	23.6	25.3	28.2	30.9	32.3	34.6	38.0		
Renewable energies – Transport[13] (%)	4.0	6.4	6.5	7.3	7.3	6.9	6.6	7.0	7.0	7.9		10.0
Overall RES share[14] (%)	**7.2**	**11.7**	**12.5**	**13.6**	**13.8**	**14.4**	**14.9**	**14.9**	**15.5**	**16.5**		**18.0**
Of which from cooperation mechanism[15] (%)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Surplus for cooperation mechanism[16] (%)			4.3	5.4	4.3	4.9	3.6	3.6	1.8	2.8		
For information: Overall share of renewable energy according to the indicative trajectory given in Directive 2009/28/EC			8.2	8.2	9.5	9.5	11.3	11.3	13.7	13.7		18.0
Overall share of renewable energy according to NREAP		10.1	10.8	11.4	12.0	12.8	13.5	14.4	15.7	16.7		19.6

[10] Facilitates comparison with Table 3 and Table 4a of the NREAP.
[11] Share of renewable energy in heating and cooling: gross final consumption of energy from renewable sources for heating and cooling (as defined in Articles 5(1)(b) and 5(4) of Directive 2009/28/EC) divided by gross final consumption of energy for heating and cooling. The same methodology as in Table 3 of the NREAP applies.
[12] Share of renewable energy in electricity: gross final consumption of electricity from renewable sources for electricity (as defined in Articles 5(1)(a) and 5(3) of Directive 2009/28/EC) divided by total gross final consumption of electricity. The same methodology as in Table 3 of the NREAP applies.
[13] Share of renewable energy in the transport sector: final energy from renewable sources consumed in transport (cf. Article 5(1)(c) and Article 5(5) of Directive 2009/28/EC), divided by the consumption in transport of (1) petrol, (2) diesel, (3) biofuels used in road and rail transport and (4) electricity in land transport. Electricity consumption from renewable energy in road transport is multiplied by 2.5 in accordance with Article 3(4c). The contribution of biofuels made from waste, residues, non-food cellulosic material, and ligno-cellulosic material carries twice the weight of other biofuels when verifying target attainment in the transport sector pursuant to the former Article 21(2).
[14] Share of renewable energy in gross final energy consumption. The same methodology as in Table 3 of the NREAP applies (Row G of Table 1a, divided by Row 4 of Table A).
[15] In percentage point of overall RES share.
[16] The potential surplus for cooperation mechanisms in percentage points of the overall share from renewable energy sources is simply the arithmetical difference from the minimum shares for the indicative trajectory given in Directive 2009/28/EC.

Table 1a*: *Calculation table for the renewable energy contribution of each sector to (gross) final energy consumption (ktoe/year)[17]

		2005	2010	2011	2012	2013	2014	2015	2016	2017	2018
(A)	*Gross final consumption of RES for heating and cooling*	8 846	14 305	13 546	15 018	15 593	14 130	14 537	14 374	14 758	14 877
(B)	*Gross final consumption of energy from electricity from RES*	5 477	9 487	10 718	12 045	12 865	14 021	15 533	16 208	17 398	18 902
(C)	*Final consumption of energy from RES in transport*	1 935	3 056	2 963	3 110	2 924	2 998	2 804	2 830	2 875	3 022
(D)	***Gross total RES consumption[18]***	**16 258**	**26 848**	**27 227**	**30 173**	**31 382**	**31 149**	**32 874**	**33 411**	**35 031**	**36 801**
(E)	*Transfer of RES to other Member States*	0	0	0	0	0	0	0	0	0	0
(F)	*Transfer of RES from other Member States and third countries*	0	0	0	0	0	0	0	0	0	3
(G)	***Gross total RES consumption adjusted for target (D)-(E)+(F)***	**16 258**	**26 848**	**27 227**	**30 173**	**31 382**	**31 149**	**32 874**	**33 411**	**35 031**	**36 804**

Electricity sector

In the electricity sector[19], the gross final consumption of energy for electricity from renewable sources (without renewable household waste), taking into account the normalisation rules in accordance with Annex II to Directive 2009/28/EC (normalised consumption) in 2018 (217 567 GWh) exceeded the estimate in the NREAP for 2018 (191 092 GWh) by just under 14%; in 2017, there was a difference of around 11% (200 073 GWh versus 179 626 GWh in the NREAP).

Owing to strong growth in the area of onshore wind energy, in particular in 2017 (4 891 MW; the same figure in 2018 was 2 273 MW), the installed wind capacity at the end of 2018 was around 52.4 GW, or in other words 17 GW higher in total than the NREAP. The two reporting years were also characterised by comparatively strong momentum in the area of offshore wind energy. The capacity added in 2017 totalled 1 254 MW, with a further 990 MW added in 2018. By the end of 2018, offshore wind power installations with a total capacity of 6.4 GW had been installed (Table 1.b.i).

[17] Facilitates comparison with Table 4a of the NREAP. The differences in 'heating and cooling' and 'electricity' in Tables 1b and 1c result from the inclusion of biogenic municipal waste which is not reported there/does not need to be reported there.

[18] According to Article 5(1) of Directive 2009/28/EC, gas, electricity and hydrogen from renewable energy sources shall only be considered once. No double counting is allowed.

[19] The generation of electricity from the biogenic share of waste is not taken into account at this point but is included in the gross final consumption of energy from renewable sources (Table 1a).

In 2018, the normalised total electricity production from wind energy (onshore and offshore) of 106 111 GWh overall was 16 901 GWh more than forecast in the NREAP (Table 1.b.ii).

While the increase in photovoltaic capacity up to 2012 took place significantly faster than in the NREAP, in 2017 (1.6 GW_p) and 2018 (around 2.9 GW_p) it was below the NREAP estimate (in each case 3.5 GW_p increase per year), as has been the case every year since 2013. The installed capacity at the end of 2018 of 45.2 GW_p was slightly above the value in the NREAP (by around 0.4 GW_p). Electricity generation in 2018 was more than 30% above the estimate in the NREAP (35 144 GWh), standing at 45 784 GWh. This was attributable in particular to the especially high level of solar radiation.

Electricity production from biogas in the years 2009 to 2014 also saw a very large increase compared to the estimates in the NREAP (installed capacity in 2014: 5.4 GW compared to 3.0 GW in the NREAP). In the reporting years 2017 and 2018, however, there was only a small increase in capacity (around 0.3 GW and around 0.6 GW respectively), aimed in particular at increasing the flexibility of installations, and electricity production thus remained at a largely constant level (2017: 33 879 GWh, 2018: 33 416 GWh); this continued a trend that had already been observed in 2015 and 2016.

Electricity production from solid biomass increased significantly between 2005 and 2010 and has since remained at a similar level (2017: 10 644 GWh, 2018: 10 827 GWh), and electricity production from liquid biomass also remained at the same level observed in 2015/2016 during the reporting period (2017: 405 GWh and 2018: 463 GWh).

Furthermore – and as already pointed out in previous reports – the estimates made at the time in the NREAP for installed capacity and electricity generation from hydropower were conservative to allow for uncertainties in the data available, and adjustments were carried out at a later date. Therefore both the total installed capacity and the (normalised) electricity production are somewhat higher than projected in the NREAP.

Despite the huge technical potential (German Environment Agency [Umweltbundesamt, UBA], 2010), economic restrictions meant that geothermal electricity generation in Germany developed significantly more slowly than assumed in the NREAP (2018: 178 GWh in comparison to 976 GWh in the NREAP).

The gross figure for renewable electricity supplies from cogeneration[20] (not including renewable household waste) again increased slightly in comparison to 2015/2016, reaching a total of 32 173 GWh in 2018, which corresponded to a share of around 72% of total cogeneration-enabled electricity provision from biomass.

Table 1.b.i ***Total actual contribution (installed capacity, in MW) from each renewable energy technology in Germany to meet the binding 2020 targets and the indicative interim trajectory for the shares of energy from renewable resources in electricity***[21]

	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018
Hydro	**10 858**	**11 218**	**11 436**	**11 257**	**11 239**	**11 234**	**11 255**	**11 207**	**11 120**	**10 940**
non-pumped	4 134	4 252	4 469	4 451	4 433	4 424	4 433	4 442	4 449	4 456
pumped	5 648	5 811	5 811	5 650	5 650	5 654	5 666	5 578	5 493	5 355
mixed[22]	1 076	1 155	1 156	1 156	1 156	1 156	1 156	1 187	1 178	1 129
Geothermal	**0**	**7**	**6**	**16**	**26**	**29**	**29**	**33**	**32**	**36**
Solar	**2 056**	**18 006**	**25 916**	**34 077**	**36 710**	**37 900**	**39 224**	**40 679**	**42 293**	**45 181**
photovoltaic	2 056	18 004	25 914	34 075	36 708	37 898	39 222	40 677	42 291	45 179
concentrated solar power	0	2	2	2	2	2	2	2	2	2
Tide, wave, ocean	0	0	0	0	0	0	0	0	0	0
Wind	**18 248**	**26 903**	**28 712**	**30 979**	**33 477**	**38 614**	**44 580**	**49 435**	**55 580**	**58 843**
onshore	18 248	26 823	28 524	30 711	32 969	37 620	41 297	45 283	50 174	52 447
offshore	0	80	188	268	508	994	3 283	4 152	5 406	6 396
Biomass	**2 374**	**5 460**	**6 419**	**6 756**	**7 034**	**7 258**	**7 467**	**7 681**	**7 978**	**8 592**
solid biomass	1 218	1 502	1 554	1 558	1 623	1 589	1 592	1 600	1 601	1 608
biogas	1 096	3 548	4 520	4 921	5 148	5 437	5 643	5 850	6 147	6 754
bioliquids[23]	60	410	345	277	263	232	232	231	230	230
TOTAL	**33 536**	**61 594**	**72 489**	**83 085**	**88 486**	**95 035**	**102 555**	**109 035**	**117 003**	**123 592**
of which in CHP	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

[20] Gross electricity production from cogeneration. This takes into account electricity generation from cogeneration which is associated with cogeneration heat output to other consumers as well as electricity generation from cogeneration corresponding to internal heat consumption in some cases (in particular fermenter heating in biogas installations).

[21] Facilitates comparison with Table 10a of the NREAP. Table 1b as shown in the template has been split into Tables 1b-i and 1b-ii for the sake of clarity.

[22] In accordance with new Eurostat methodology.

[23] Taking into account only those complying with applicable sustainability criteria, cf. Article 5(1) last subparagraph of Directive 2009/28/EC.

Table 1.b.ii: Total actual contribution (gross electricity generation, in GWh) from each renewable energy technology in Germany to meet the binding 2020 targets and the indicative interim trajectory for the shares of energy from renewable resources in electricity

	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018
Hydro[24]	**21 737**	**21 662**	**22 061**	**21 971**	**22 008**	**21 731**	**21 447**	**21 211**	**20 922**	**20 788**
non-pumped	20 906	20 889	21 310	21 236	21 285	21 042	20 794	20 574	20 332	20 242
pumped	6 779	6 400	5 840	6 094	5 784	5 857	5 921	5 588	6 005	6 170
mixed	830	773	751	736	723	688	652	637	590	546
Geothermal	**0**	**28**	**19**	**25**	**80**	**98**	**134**	**175**	**163**	**178**
Solar	**1 282**	**11 729**	**19 599**	**26 380**	**31 010**	**36 056**	**38 726**	**38 098**	**39 401**	**45 784**
photovoltaic	1 282	11 729	19 599	26 380	31 010	36 056	38 726	38 098	39 401	45 784
concentrated solar power	0	0	0	0	0	0	0	0	0	0
Tide, wave, ocean	0	0	0	0	0	0	0	0	0	0
Wind[25]	**27 217**	**44 833**	**48 222**	**50 801**	**53 522**	**59 623**	**72 852**	**81 431**	**94 659**	**106 111**
onshore[26]	27 774	38 371	49 281	50 948	51 819	57 026	72 340	67 650	88 018	90 484
offshore[27]	0	176	577	732	918	1 471	8 284	12 274	17 675	19 467
Biomass	**11 340**	**27 899**	**32 126**	**38 154**	**40 089**	**42 210**	**44 548**	**44 963**	**44 928**	**44 706**
solid biomass	7 479	10 351	10 516	10 693	10 555	10 798	11 034	10 798	10 644	10 827
biogas[28]	3 861	17 548	21 237	27 314	29 255	31 086	33 098	33 711	33 879	33 416
bioliquids[29]	0	0	373	147	279	326	416	454	405	463
TOTAL[30]	**61 576**	**106 151**	**122 027**	**137 332**	**146 708**	**159 717**	**177 705**	**185 878**	**200 073**	**217 567**
of which in CHP[31]	6 664	19 168	20 457	23 619	25 552	28 106	30 859	31 791	32 496	32 173

Heating and cooling sector

In the 'heating and cooling' sector, the consumption of renewable energy (without renewable household waste) in 2017 was 13 571 ktoe, which was slightly higher than the estimate given in the NREAP (13 071 ktoe); the same figure in 2018 was 13 511 ktoe, or in other words equivalent to the NREAP estimate (13 524 ktoe), owing to the warm weather conditions (Table 1c). The main reason for the increase from 2005 was the expansion in the use of solid and gaseous biomass and the increase in the use of ambient heat and near-surface geothermal energy made available by means of heat pumps.

[24] Normalised in accordance with Directive 2009/28/EC and Eurostat methodology.
[25] Normalised in accordance with Directive 2009/28/EC and Eurostat methodology.
[26] Actual gross electricity production (not normalised).
[27] Actual gross electricity production (not normalised).
[28] Including electricity generation from sewage treatment and landfill gas.
[29] Only electricity generation from liquid biomass complying with the applicable sustainability criteria in Directive 2009/28/EC.
[30] Excluding hydropower generation in pure pump storage plants ('pumped')
[31] Gross electricity production from cogeneration. This takes into account electricity generation from cogeneration which is associated with cogeneration heat output to other consumers as well as electricity generation from cogeneration corresponding to internal heat consumption in some cases (in particular fermenter heating in biogas installations).

The use of solid biomass (wood and charcoal) to generate heat for private households was 5 493 ktoe in 2018, which – again for temperature-related reasons – was lower than the estimate in the NREAP (5 910 ktoe), and accounted for almost 41% of the total consumption of renewable energies in the 'heating and cooling' sector. At 675 ktoe in 2017 and 763 ktoe in 2018, the further expansion of solar thermal energy was considerably below the estimates in the NREAP (943 ktoe in 2017; 1 043 ktoe in 2018). By way of contrast, at 1 057 ktoe in 2017 and 1 152 ktoe in 2018, the use of ambient heat and near-surface geothermal energy via heat pumps was slightly above the NREAP forecast (938 ktoe in 2017; 1 007 ktoe in 2018). Externally used heat from biogas installations was likewise above the NREAP forecast and has increased more than ninefold since 2005, in step with electricity production from biogas (1 680 ktoe in 2018). As in the electricity sector, deep geothermal energy for the production of heat has continued to grow much more slowly than assumed in the NREAP (107 ktoe in 2018, compared to 505 ktoe in the NREAP) (Table 1c).

Table 1c: ***Total actual contribution (final energy consumption[32]) from each renewable energy technology in Germany to meet the binding 2020 targets and the indicative interim trajectory for the shares of energy from renewable resources in heating and cooling (ktoe/year)[33]***

	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018
Geothermal[34]	**46**	**59**	**62**	**69**	**74**	**90**	**83**	**99**	**100**	**107**
Solar	**260**	**481**	**549**	**571**	**576**	**620**	**663**	**661**	**675**	**763**
Biomass	**7 719**	**12 600**	**11 607**	**12 881**	**13 125**	**11 536**	**11 796**	**11 547**	**11 738**	**11 489**
solid biomass	7 345	11 441	10 404	11 680	11 817	10 042	10 147	9 825	9 969	9 623
biogas	270	870	1 026	1 025	1 149	1 322	1 481	1 561	1 603	1 680
bioliquids[35]	103	290	177	176	159	173	167	162	166	185
Renewable energies: from heat pumps[36]	**168**	**493**	**570**	**653**	**737**	**816**	**892**	**970**	**1 057**	**1 152**
- of which aerothermal	20	170	214	264	317	368	418	472	533	604
- of which geothermal	117	263	291	318	344	369	390	410	432	453
- of which hydrothermal	32	60	65	70	75	80	84	88	92	95
TOTAL	**8 193**	**13 633**	**12 789**	**14 173**	**14 513**	**13 063**	**13 433**	**13 277**	**13 571**	**13 511**
Of which DH[37]	216	430	508	642	659	705	823	861	842	956
Of which biomass in *households*[38]	4 490	6 819	6 107	7 254	7 506	5 974	5 979	5 503	5 664	5 493

[32] Direct use and district heat as defined in Article 5(4) of Directive 2009/28/EC.
[33] Facilitates comparison with Table 11 of the NREAP. The differences in 'heating and cooling' and 'electricity' in Tables 1b and 1c result from the inclusion of biogenic municipal waste which does not need to be reported there.
[34] (excluding low temperature geothermal heat in heat pump applications)
[35] Taking into account only those complying with applicable sustainability criteria, cf. Article 5(1) last subparagraph of Directive 2009/28/EC.
[36] Includes only the renewable ambient heat harnessed by heat pumps according to Directive 2009/28/EC.
[37] District heating and cooling from total renewable heating and cooling consumption. The gross final consumption of energy in the form of heat from heating plants and cogeneration plants for general consumption is reported in the official energy statistics as district heat. The 'net' value is reported in line with the SHARES tool, however.
[38] As share of total renewable heating and cooling consumption, includes wood and charcoal

Transport sector

The use of renewable energy in the transport sector (Table 1d) was 2 875 ktoe in 2017 and 3 022 ktoe in 2018.

In 2018, consumption of biodiesel (including HVO) stood at 1 918 ktoe (2017: 1 804 ktoe), and consumption of bioethanol (including bio-ETBE) stood at 735 ktoe (2017: 716 ktoe). In the case of biomethane, current use stood at 38 ktoe in 2017 and 33 ktoe in 2018.

Even after the discontinuation of double counting with the introduction of the GHG quota, biofuels based on waste and residues were used in significant quantities, as was the case in the reporting years 2015 and 2016. In 2017 the total amount was approximately 740 ktoe and in 2018 approximately 959 ktoe, representing another significant rise. The largest share was accounted for by used cooking oils, which fall under Annex IX, Part B to Directive 2009/28/EC (600 ktoe in 2017; 783 ktoe in 2018). On the other hand, fuels based on the feedstocks covered by Annex IX, Part A to Directive 2009/28/EC were again of very low significance in 2017 and 2018 (see Chapter 8). By way of comparison, the consumption of fuels pursuant to Article 3(4)(e) of Directive 2009/28/EC was significantly higher during the reporting period.

The use of biofuels based on energy crops [Article 3(4)(d) of Directive 2009/28/EC] was approximately 1 818 ktoe in 2017 and approximately 1 727 ktoe in 2018.

This meant that the quantity of conventional biofuels was significantly lower than the value estimated in the NREAP, and the quantity of biofuels based on waste and residues was significantly higher.

The consumption of electricity from renewable sources in road transport was around 4 ktoe in 2017 and around 6 ktoe in 2018. The quantity of electricity from renewable sources used in rail transport in 2018 was approximately 329 ktoe[39] 313 ktoe in 2018).

As before, the use of hydrogen/synthetic gas from renewable energy sources in the transport sector played only a very minor role. No verified data are available in this respect.

[39] The consumption of electricity from renewable sources in rail and road transport is determined by the same method as in the NREAP: it is based on the national share of renewable energy in gross electricity consumption two years before the reporting year, which was in turn calculated from the normalised wind and hydroelectric power supplies for these years.

Table 1d: ***Total actual contribution from each renewable energy technology in Germany to meet the binding 2020 targets and the indicative interim trajectory for the shares of energy from renewable resources <u>in the transport sector</u> (ktoe/year)***[40, 41, 42]

	2017	2018
Bioethanol	716	735
Biodiesel (FAME)	1 772	1 892
Hydrated vegetable oil (HVO)	32	26
Biomethane	38	33
Fischer-Tropsch diesel	-	-
Bio-ETBE	included in bioethanol	included in bioethanol
Bio-MTBE	-	-
Bio-DME	-	-
Bio-TAEE	-	-
Biobutanol	-	-
Biomethanol	-	-
Pure vegetable oil	0	0
Total sustainable biofuels	**2 558**	**2 686**
Of which		
sustainable biofuels produced from feedstock listed in Annex IX Part A	5	8
other sustainable biofuels eligible for the targets set out in Article 3(4)(e)	135	168
sustainable biofuels produced from feedstock listed in Annex IX Part B	600	783
sustainable biofuels for which the contribution towards the renewable energy target is limited pursuant to Article 3(4)(d)	1 818	1 727
Imported from third countries	749	1 238
Hydrogen from renewables	**0**	**0**
Renewable electricity	**317**	**335**
Of which		
road transport	4	6
rail transport	313	329
other transport sectors	0	0
others (please specify)	0	0
others (please specify)	0	0
TOTAL	**2 875**	**3 022**

[40] Amended reporting on the use of sustainable biofuels for the period 2011-2016; direct comparability with the data published by the Federal Office for Agriculture and Food [Bundesanstalt für Landwirtschaft und Ernährung, BLE] under Section 63 Biokraft-NachV is not possible, *inter alia* because of the different method of taking account of biofuels used outside the transport sector.

[41] Facilitates comparison with Table 12 of the NREAP.

[42] For biofuels take into account only those compliant with the sustainability criteria, cf. Article 5(1) last subparagraph.

2 MEASURES TAKEN IN THE PRECEDING TWO YEARS AND/OR PLANNED AT NATIONAL LEVEL TO PROMOTE THE GROWTH OF ENERGY FROM RENEWABLE SOURCES TAKING INTO ACCOUNT THE INDICATIVE TRAJECTORY FOR ACHIEVING THE NATIONAL RES TARGETS AS OUTLINED IN THE NREAP

(Article 22(1)(a) of Directive 2009/28/EC)

(Reporting pursuant to Article 22(1)(a) of Directive 2009/28/EC is covered in detail in subparagraphs (b) to (f) of Directive 2009/28/EC)

Table 2: Overview of all key policies and measures

Name and reference of the measure	***Type of measure****	***Expected result***	***Targeted group and/or activity*****	***Existing or planned******	***Start and end dates of the measure***	***Amendments to the NREAP***
Renewable Energy Sources Act	Regulatory	Increased share of renewable energy in electricity supply	Investors, private households	Existing	Start date: April 2000 (as a successor to the Electricity Feed-In Act [Stromeinspeisungsgesetz] that had been in force since 1991); amendments in 2004, 2009, 2012, 2014, 2017 and 2018; the Act has no end date. -	Amendments to the Renewable Energy Sources Act in 2017 • Market premium model with mandatory direct marketing is retained. As a basic principle, the amount of the market premium is now determined predominantly on a competitive basis for photovoltaic, onshore wind, biomass and offshore wind by way of sector-specific tenders. • To a certain extent, tenders take place on a cross-border basis. • Concrete expansion strategies for wind power, photovoltaic power and bioenergy are accompanied by the tender volumes provided for each year. • Pilot tender procedures allowing competition between photovoltaic and onshore wind were established under the Renewable Energy Sources Act 2017 in order to

Name and reference of the measure	*Type of measure**	*Expected result***	*Targeted group and/or activity****	*Existing or planned*****	*Start and end dates of the measure*	*Amendments to the NREAP*
						trial cross-sector tenders from 2018 to 2020. • Certain (small) stakeholders are privileged in the calls for tenders in order to maintain diversity of stakeholders and acceptance of renewable energy production installations. • Regional control mechanisms are used to take account of the costs for grid and system integration (e.g. extension cap in grid expansion areas, regulations for offshore wind in the Offshore Wind Energy Act). • The extension is ensured by means of contractual penalties, which in turn are safeguarded through the deposit of securities. • Introduction of regional certificates for funded and directly marketed electricity. • Landlord-to-Tenant Electricity Act [Mieterstromgesetz, MietStrFG] of 15 July 2017: funding eligibility for photovoltaic electricity supplied outside the public grid directly to tenants. • Omnibus Energy Act [Energiesammelgesetz, EnSaG] of 21 December 2018: 8 GW in special calls for tenders (4 GW each for wind and photovoltaic) from 2019 to 2021 Innovation auctions

Name and reference of the measure	*Type of measure**	*Expected result***	*Targeted group and/or activity****	*Existing or planned*****	*Start and end dates of the measure*	*Amendments to the NREAP*
						for 250 MW in 2019, for 400 MW in 2020 and for 500 MW in 2021, with new pricing mechanisms and aimed at maximising the benefits to the grid.
KfW special programme for 'Offshore wind energy'	Financial	To speed up the expansion of offshore wind energy	Project companies, investors	Existing	Start date: June 2011: programme ends when the funding volume has been used up.	Support for the financing of max. 10 offshore wind farms Total loan volume: EUR 5 billion
Grid Expansion Acceleration Act [Netzausbaubeschleunigungsgesetz, NABEG]	Regulatory	To speed up the approval process for grid expansion (electricity)	Transmission system operators	Existing	In force since 5 August 2011, last amended by the Act accelerating the expansion of power lines [Gesetz zur Beschleunigung des Energieleitungsausbaus] of 13 May 2019. 27 July 2013, entry into force of the Regulation on the Allocation of Planning Approval [Planfeststellungszuweisungsverordnung], last amended by the Act accelerating the expansion of power lines of 13 May 2019.	Introduction of a federal sectoral plan for extra-high-voltage lines crossing federal state or national borders where there is an overriding public interest, and new provisions for a planning approval procedure for such lines Transfer of responsibility for approval procedures for lines covered by the Grid Expansion Acceleration Act to a federal authority (Federal Network Agency [Bundesnetzagentur, BNetzA]) Requirement to achieve as straight a path as possible for a route corridor The most recent amendments to the Grid Expansion Acceleration Act related in particular to the following: - anticipatory planning (e.g. by means of empty cable conduits), - streamlining of procedures, e.g. federal sectoral plans can be dispensed with in certain cases,

Name and reference of the measure	*Type of measure**	*Expected result***	*Targeted group and/or activity****	*Existing or planned*****	*Start and end dates of the measure*	*Amendments to the NREAP*
						- facilitation of the notification procedure, - premature start of construction work, - compensation payments for agriculture and forestry. The Offshore Federal Sectoral Plan, and from June 2019 the Land Development Plan under the Offshore Wind Energy Act, are to be taken into account in the case of offshore connection lines.
Power Line Expansion Act [Energieleitungsausbaugesetz, EnLAG]	Regulatory	To accelerate electricity grid expansion as a result of the fact that this 'justification for planning' is laid down in law.	Transmission system operators	Existing	In force from 26 August 2009 Last amended by the Act accelerating the expansion of power lines of 13 May 2019.	Definition of 22 grid expansion projects (originally 24) that are intended to be implemented as a top priority ('initial grid') as opposed to later projects under the Federal Requirements Plan Act [Bundesbedarfsplangesetz, BBPlG]. These projects need to be carried out on the grounds of an overriding public interest and in the interests of public safety. Six (originally four) AC projects may be implemented on subsections as pilot projects for the use of underground cables on the extra-high-voltage level (to collect experience with this innovative technology). Possible underground cabling under certain conditions (minimum distances from housing developments, protection of species and sites and the crossing of large

Name and reference of the measure	*Type of measure**	*Expected result***	*Targeted group and/or activity****	*Existing or planned*****	*Start and end dates of the measure*	*Amendments to the NREAP*
						rivers).
Federal Requirements Plan Act	Regulatory	To speed up further electricity grid expansion – for the incorporation of electricity from renewable energy sources, for the interoperability of electricity grids within the European Union, for the connection of new power stations or for the avoidance of structural grid bottlenecks, also 'justification for planning' by way of analogy to the Power Line Expansion Act.	Transmission system operators	Existing	In force from 27/07/2013 Last amended by the Act accelerating the expansion of power lines of 13 May 2019.	Definition of (at present) 43 grid expansion projects – which are required by the energy industry and urgently required in order to ensure secure and reliable grid operation – as the Federal Requirements Plan. These projects need to be carried out on the grounds of an overriding public interest and in the interests of public safety. Identification of lines that are approved under the Grid Expansion Acceleration Act Identification of pilot projects (high-voltage direct current transmission lines, high-temperature conductors, underground cables in the three-phase current range) Underground cables for extra-high-voltage transmission lines: priority given to underground cabling for direct current and five extra pilot procedures for three-phase current No federal sectoral plans for projects that are identified as particularly urgent. Urgent need for empty cable conduits in the case of identified projects.

Name and reference of the measure	*Type of measure**	*Expected result***	*Targeted group and/or activity****	*Existing or planned*****	*Start and end dates of the measure*	*Amendments to the NREAP*
System Stability Regulation [Systemstabilitätsverordnung, SysStabV]	Regulatory	Solution to the '50.2 Hz' and the '49.5 Hz' problem (risk of simultaneous disconnection of renewable energy installations)	Distribution system operators	Existing	Regulation amending the System Stability Regulation of 9 March 2015. Entered into force on 14 March 2015. Amended on 14 September 2016.	Provisions on the upgrading of renewable energy and cogeneration installations so that these installations are no longer instantly disconnected from the grid in the event of an underfrequency of 49.5 Hz or overfrequency of 50.2 Hz Addition of landfill gas, sewage gas and mine gas.
Energy Industry Act [Energiewirtschaftsgesetz, EnWG]	Regulatory	Transposition of EU regulations under the Third Internal Energy Market Package, including unbundling	Energy supply companies	Existing	Energy Industry Act of 7 July 2005, amended on 14 December 2012, amended on 1 August 2014 Amended on 21/12/2015. Amended by the Act accelerating the expansion of power lines of 13 May 2019.	Specification of unbundling (Section 6) Changes to the grid connections for offshore wind power installations (Section 17d) Two-year cycle for network development planning for the electricity and gas sector (previously annual)
Act on the operation of measuring points and data communication in smart networks [Gesetz über den Messstellenbetrieb und die Datenkommunikation in intelligenten Energienetzen, MsbG]	Regulatory	Legal basis for the economically viable introduction of 'smart measuring systems'	Energy suppliers, system operators, final consumers	Existing	Entered into force on 30 August 2016.	The power to issue statutory instruments under the Energy Industry Act was rescinded at the same time.
Regulations on the operation of an electronic register of regional certificates (Implementing Regulation on Certificates of Origin	Regulatory	Transposition of Section 79a EEG 2017	Electricity market	Existing	Entry into force of the Implementing Regulation on Certificates of Origin and Regional Certificates on 21 November 2018 Normal operation of the register commenced on	Operationalisation of the provisions of Section 79 EEG in the form of sub-statutory regulations Increase in local acceptance of the energy transition through

Name and reference of the measure	*Type of measure**	*Expected result***	*Targeted group and/or activity****	*Existing or planned*****	*Start and end dates of the measure*	*Amendments to the NREAP*
and Regional Certificates; [Herkunfts- und Regional-nachweis-Durchführ-rungsver-ordnung, HkRNDV])					1 January 2019.	the allocation of sub-sidised volumes of electricity to final consumers in the region.
Regulation on the central directory of energy industry data (Market Master Data Register Regulation MaStRV: [Marktstammda tenregisterver-ordnung, MaStRV])	Regula-tory	Establishment of a central elec-tronic directory of energy indus-try data	Electricity market	Exist-ing	Entry into force of the Market Master Data Register Regulation on 1 July 2017, last amended by the Regula-tion of 15 November 2018, in force since 21 November 2018. Normal operation of the register commenced on 31 January 2019.	Operationalisation of the provisions of Sections 111e and 111f EnWG in the form of a sub-statutory regulation Establishment of an extensive database of all master data relating to the electricity and gas market Pooling of reporting obligations; transpar-ency of the energy market Changes to the rules on deadlines for the registration of stake-holders and units/installations
Gas Grid Ac-cess Regula-tion [Gasnetz-zugangsver-ordnung, GasNZV]	Regula-tory	Promotion of biogas fed into the natural gas grid by means of specific regula-tions to this effect in Part 6	Investors, operators of biogas installations	Exist-ing	Entered into force on 9 September 2010; last amended by the Regula-tion of 11 August 2017, with gradual entry into force of the amend-ments.	The amendments are general in nature and do not specifically relate to biogas: • withdrawal of the obligation to report the feeding in of bio-gas to the Federal Network Agency, • withdrawal of the provisions on meas-urement, which is now regulated in the Act on the operation of measuring points and data communi-cation in smart net-works.
Combined Heat and Power Act [Kraft-Wärme-Kop-	Regula-tory	New construc-tion, mainte-nance and modernisation of	Power station operators, energy	Exist-ing	Existing since 2002; Amendments in 2008, 2012, 2015; 2016, 2017, 2018, last (sixth) set of	Amendments to the Combined Heat and Power Act in 2016,

Name and reference of the measure	*Type of measure**	*Expected result***	*Targeted group and/or activity****	*Existing or planned*****	*Start and end dates of the measure*	*Amendments to the NREAP*
plungsgesetz, KWKG]		cogeneration installations and upgrading of conventional installations, and construction of new heating and cooling networks and storage systems	suppliers, investors		amendments in force since 17 December 2018.	2017 and 2018: • The 25% expansion target for total net electricity production was amended to 110 TWh by 2020 and 120 TWh by 2025. By amending the target figure, the Federal Government is also deviating from the commitments made in the coalition agreement. • With the amendments to the Combined Heat and Power Act in 2016, the funding cap was increased to EUR 1.5 billion and the funding framework was extended until 2022. • Cogeneration installations that replace a coal-fired cogeneration installation receive a bonus. • Existing gas cogeneration installations above 2 MW_{el} that are threatened with closure receive limited-term funding up to 2019. • The funding rates for new and modernised gas cogeneration installations were increased significantly overall compared to the Combined Heat and Power Act 2012. • Introduction of a limit on the funding of own consumption for small installations (up to 100 kW_{el}) and energy-intensive operations • The amendments to

Name and reference of the measure	*Type of measure**	*Expected result***	*Targeted group and/or activity****	*Existing or planned*****	*Start and end dates of the measure*	*Amendments to the NREAP*
						the Combined Heat and Power Act in 2017 introduced tender procedures for cogeneration installations in the capacity range between 1 MW_{el} and 50 MW_{el}, and for innovative cogeneration systems. • Harmonisation of privileges in respect of the Combined Heat and Power Act and the levy under the Renewable Energy Sources Act. Adjustment of the limit on costs for heavy electricity consumers in industry on the basis of the Special Equalisation Scheme under the Renewable Energy Sources Act. Amendments to the Combined Heat and Power Act in 2018 under the Omnibus Energy Act: • new rules on the levy privilege under the Renewable Energy Sources Act for cogeneration plants with own supply • Limit on the funding of existing installations, gradual reduction in funding rates for installations >50 MW_{el} and withdrawal of funding currently in place for installations >300 MW_{el} • Extension of the Combined Heat and Power Act until 2025.
Renewable Energies Heat	Regulatory	Increased share of renewable	Building owners	Existing	Has existed since January 2009; the Act has no	A progress report must be produced

Name and reference of the measure	*Type of measure**	*Expected result***	*Targeted group and/or activity****	*Existing or planned*****	*Start and end dates of the measure*	*Amendments to the NREAP*
Act		energy in heating and cooling supplies (priority: new builds)	(private and public)		end date.	every four years under the Renewable Energies Heat Act. The last progress report was published as scheduled in late 2015. The progress report focuses in particular on the status of the market introduction of installations for the generation of heating and cooling from renewable energy sources.
Market Incentive Programme for the promotion of renewable energies in the heating market (MAP)	Financial	Increased investment in installations that use renewable energy sources for generation of heating or cooling and in heating networks and heat storage systems	Private households, companies, self-employed persons, municipalities, other legal entities under private law	Existing	The funding guideline has existed in various versions for many years, last major amendment to the funding guideline on 1 April 2015.	The last major amendments to the MAP were adopted in spring 2015. Funding was expanded, improved and scaled to a greater extent according to the efficiency of the installations. Furthermore, new funding options were created, such as yield-dependent funding for solar thermal energy and funding for particularly efficient heat pumps in new builds.
CO_2 Building Renovation Programme (KfW funding programmes for energy-efficient construction and renovation)	Financial	Energy efficiency measures in buildings	Private households, housing associations, commonhold associations, commercial companies, municipalities, municipal companies, social bodies	Existing	No end date specified for measures.	Improvement of funding conditions, strengthening of quality assurance, development of funding provision for non-residential buildings: new programmes for energy-efficient renovation of commercial buildings and the construction of new commercial buildings and expansion of the existing renovation programmes to include new-build support for buildings for municipal and social bodies.

Name and reference of the measure	*Type of measure**	*Expected result***	*Targeted group and/or activity****	*Existing or planned*****	*Start and end dates of the measure*	*Amendments to the NREAP*
KfW funding programme for photovoltaic battery storage devices	Financial	Funding for feed-ins from photovoltaic installations that are beneficial to the system and market and technology development of stationary battery storage systems	Private individuals, freelancers, farmers, commercial companies and companies in which municipalities, churches and charitable organisations are involved.	In existence during the reporting period	Term of the programme from 1 March 2016 to 31 December 2018. The programme was not extended beyond 2018.	
Energy Efficiency Incentive Programme	Financial	Part (a): Energy efficiency measures in buildings, Part (b): Increased investment in installations that use renewable energy sources for the generation of heat Part (c) Support for the market introduction of fuel cell heating	Part (a): Private households, commonhold associations made up of private individuals Part (b): Private households, companies, self-employed persons, municipalities, other legal entities under private law Part (c) Private households, commonhold associations, freelancers, domestic and foreign undertakings, contractors, municipalities, municipal companies and municipal special-purpose	Existing	No end date specified for measures.	As an alternative to the fiscal support planned under the NEEAP, since 2016 funds in the amount of EUR 165 million per year have been provided to the Energy Efficiency Incentive Programme. The programme was launched on 1 January 2016. It supplements and enhances the existing funding landscape and was integrated into the CO_2 Building Renovation Programme and Market Incentive Programme (MAP).

Name and reference of the measure	***Type of measure****	***Expected result*** **	***Targeted group and/or activity**** **	***Existing or planned*****	***Start and end dates of the measure***	***Amendments to the NREAP***
			associations, charitable organisations and churches.			
National efficiency label for old heating systems	Regulatory/for information purposes	Information by means of labels and leaflets on the energy efficiency of boilers that are older than 15 years.	Owner of the boiler or tenant of the dwelling	Existing	Entered into force on 1 January 2016.	Implementation of an urgent measure from the NEEAP.
Energy Saving Regulation [Energieeinsparverordnung, EnEV]	Regulatory	Compliance with minimum standards for the overall energy efficiency (value to be attained for annual primary energy demand and certain requirements relating to the quality of the building envelope) of newly constructed residential and non-residential buildings.	Building owners (private and public)	Existing	The amended Regulation entered into force on 1 May 2014. Tightening up of energy requirements for new builds, effective from 1 January 2016.	Tightening up/amending of the Energy Saving Regulation 2009 to bring it into line with the EU Directive on the energy performance of buildings (Directive 2010/31/EU).

Name and reference of the measure	*Type of measure**	*Expected result***	*Targeted group and/or activity****	*Existing or planned*****	*Start and end dates of the measure*	*Amendments to the NREAP*
Funding Programme for Heating Optimisation	Financial	Funding for the replacement of inefficient pumps and optimisation measures concerning the entire heating system.	Private individuals, companies, freelancers, municipalities, municipal authorities and municipal special-purpose associations, other legal persons under private law	Existing	1 August 2016 until 31 December 2020 (according to current plans).	

Name and reference of the measure	*Type of measure**	*Expected result***	*Targeted group and/or activity****	*Existing or planned*****	*Start and end dates of the measure*	*Amendments to the NREAP*
Heating Networks 4.0	Financial	Systematic funding in the heating infrastructure sector, with a focus on supply systems as a whole Module I: funding of the costs associated with feasibility studies examining the practicability and cost effectiveness of a Heating Network System 4.0. Module II: funding for additional investment costs incurred by heating network operators who intend to construct either new modern low-temperature heating networks with high proportions of renewable energies and waste heat (at least 50%;'fourth-generation heating networks') or transform their existing heating networks into modern low-CO_2 networks. Module III: information measures. Module IV: regional scientific cooperation.	Operators of heating networks (companies, municipal enterprises, municipal special-purpose associations, registered associations, registered cooperatives, contractors)	Existing	Programme start date: July 2017, funding guideline was revised in late 2019, will run until the end of 2022.	

Name and reference of the measure	***Type of measure****	***Expected result*** **	***Targeted group and/or activity**** **	***Existing or planned*****	***Start and end dates of the measure***	***Amendments to the NREAP***
Greenhouse gas quota under the Federal Immission Control Act [Bundesimmissionsschutzgesetz, BImSchG]	Regulatory	Minimum share of biofuels in the total quantity of fuel placed on the market; from 2015, minimum GHG savings from road transport.	Marketers of fuels	Existing	Existing since 2007; switch from quantity-based to minimum GHG savings quota in 2015; no end date.	Transposition of EU law
37th Federal Immission Control Regulation [Bundesimmissionsschutzverordnung, BImSchV], 38th Federal Immission Control Regulation	Regulatory	Sub-statutory regulations on the greenhouse gas quota	Marketers of fuels	Adopted in 2017	The 37th and 38th Federal Immission Control Regulations were adopted for the purpose of transposing Directives (EU) 2015/652 and 2015/1513. Key points included: - upper limit for conventional biofuels - sub-quota for advanced biofuels - Recognition of electricity used in electric vehicles and renewable fuels of non-biogenic origin	Transposition of EU law
Biofuel Sustainability Regulation	Regulatory	Transposition of the sustainability requirements for biofuels under Directive 2009/28/EC	Persons placing taxable petrol or diesel fuels on the market either commercially or as part of economic undertakings; Biofuel manufacturers	Existing	Most provisions entered into force on 2 November 2009.	Adapted by the Act transposing Directive 2009/28/EC on the promotion of the use of energy from renewable sources [Gesetz zur Umsetzung der Richtlinie 2009/28/EG zur Förderung der Nutzung von Energie aus erneuerbaren Quellen, EAG-EE] Applicable since 1 January 2011 without restrictions. Adjustment after changeover of the quota to the greenhouse gas quota. The significance of Annex 1 (Section 8(3)), Method for calculation

Name and reference of the measure	*Type of measure**	*Expected result***	*Targeted group and/or activity****	*Existing or planned*****	*Start and end dates of the measure*	*Amendments to the NREAP*
						of the greenhouse gas reduction on the basis of actual values, has increased greatly as a result of the introduction of the GHG quota.
Government Electromobility Programme	Financial	Increased share of electromobility in road transport; strategy for the promotion of research, development and market launch of electromobility	Investors, research, industry	Existing	Implementation of the announced measures started in 2011.	Actions envisaged (examples): • R&D programme for accelerated market launch • Education and training • Charging infrastructure and energy supply • Resources, materials and recycling
Promotion of sales of electrically powered vehicles (environmental bonus)	Financial	Increase in the share of electromobility in road transport	Private individuals, companies, foundations, corporations and associations	Existing	Applications possible since 2 June 2016. Revised in early 2020. Programme runs until the end of 2025.	Purchase premium for electric vehicles registered for the first time (passenger cars and commercial vehicles in classes N1 and N2).
Electromobility Act	Regulatory	Increase in the share of electromobility in road transport	Vehicle drivers	Existing	entered into force on 12 June 2015.	Privileges granted to electric vehicles in road transport (e.g. parking, parking fees, use of public roads or rights of way intended for specific purposes).
'Energy transition in transport: sector coupling through the use of electricity-based fuels' funding initiative	Financial	Technology development and demonstration: production and use of alternative, electricity-based fuels and incorporation of the new technologies into the energy industry.	Research, industrial partnerships	Existing	Announcement of funding: 27 February 2017. Start of project: spring 2019.	Funding initiative under the Federal Government's Energy Research Programme.

Name and reference of the measure	***Type of measure****	***Expected result*** **	***Targeted group and/or activity**** **	***Existing or planned*****	***Start and end dates of the measure***	***Amendments to the NREAP***
'Solar construction/energy-efficient city' funding initiative	Financial	Technology development and demonstration: lowering energy consumption, achieving smart networking of electricity, heating and mobility and integrating renewable energy in urban districts	Research, industrial partnerships	Existing	Programme start date: 1 October 2017.	Funding initiative under the Federal Government's Energy Research Programme.
'Energy storage' funding initiative	Financial	Technology development and optimisation, including increased storage capacity for electricity and heat storage systems, system integration	Research, industrial partnerships	Existing	In force since 17 May 2011 First phase completed in 2016. Report on accompanying review of results published in 2017.	Funding initiative under the Federal Government's Energy Research Programme.
'Sustainable grids' funding initiative	Financial	Development of sustainable grid technologies, improvement of environmental compatibility, cost effectiveness and resource efficiency of electricity grids and security of the electricity supply	Research, industrial partnerships	Existing	In force since 11 January 2013.	Funding initiative under the Federal Government's Energy Research Programme.
Act on the establishment of a special 'Energy and Climate Fund' [Gesetz zur Errichtung eines Sondervermögens 'Energie- und Klimafonds', EKFG]	Financial	Measures in the following areas: energy efficiency, renewable energy, energy storage and grid technologies to support an environmentally sound, reliable and affordable energy supply and climate protection.	Programme owners and those eligible to apply.	Existing	Entered into force on 1 January 2011. Amendment entered into force on 29 July 2011 Last amended by Article 3 of the Act of 12 December 2019	Other measures: further funding available for the development of electromobility. Subsidies for heavy electricity consumers from 2013 to compensate for electricity price increases caused by emissions trading. Includes financing of the CO_2 Building Renovation Pro-

Name and reference of the measure	*Type of measure**	*Expected result***	*Targeted group and/or activity****	*Existing or planned*****	*Start and end dates of the measure*	*Amendments to the NREAP*
						gramme and MAP.

* Indicate if the measure is (predominantly) regulatory, financial or soft (i.e. information campaign).
** Is the expected result behavioural change, installed capacity (MW; t/year), energy generated (ktoe)?
*** Who are the targeted persons: investors, end users, public administration, planners, architects, installers etc.? or what is the targeted activity/sector: biofuel production, energetic use of animal manure etc.?
**** Does this measure replace or complement measures contained in Table 5 of the NREAP?

Provisions enacted by the federal states and municipalities

This progress report sets out the provisions enacted by the Federal Government to promote renewable energies, updated since the NREAP. The measures described in the NREAP, mostly model projects by the federal states and municipalities, are too numerous to be presented in updated form in the progress report. However, these regional measures and objectives continue to play a major role in the attainment of national targets in the field of renewable energy.

2.a. Please describe the progress made in evaluating and improving administrative procedures to remove regulatory and non-regulatory barriers to the development of renewable energy.

(Article 22(1)(e) of Directive 2009/28/EC)

During the drafting of the Act transposing Directive 2009/28/EC on the promotion of the use of energy from renewable sources, it was established that there were no legal barriers to the expanded use of renewable energies in Germany.

Although, for example, wind power installations with a total height of over 50 metres are in principle subject to approval according to Annex 1 No 1.6 to the Fourth Federal Immission Control Regulation, this approval is granted automatically if the criteria are met. Nevertheless, the number of new approvals in the onshore wind energy sector has dropped in recent years. This is attributable in particular to the protracted nature of the current planning and approval procedures. The Federal Government thus believes that the further expansion of renewable energies will require optimisation measures in the area of planning and approval procedures, and intends to identify and implement these measures. Factors involved include firstly the role of species and nature conservation in the approval procedure, and secondly the acceleration of planning procedures aimed at making available land upon which onshore wind power installations can be constructed. At the same time, investigations will be carried out into the compatibility of expansion in this area with civil aviation concerns (e.g. rules on civil VOR) and military aviation concerns (e.g. airspace surveillance or low-flying flight paths).

2.b. Please describe the measures in ensuring the transmission and distribution of electricity produced from renewable energy sources and in improving the framework or rules for bearing and sharing of costs related to grid connections and grid reinforcements.

(Article 22(1)(f) of Directive 2009/28/EC)

2.b.1. Energy Industry Act

The amendments to the Energy Industry Act in 2011 introduced a national grid development plan for extra-high-voltage lines for the first time. The relevant provisions of the Energy Industry Act were adapted for this purpose in December 2015. According to these provisions, the transmission system operators (TSOs) are obliged to develop a network development plan (NDP) for electricity every two years on the basis of an agreed scenario framework to determine the nationwide demand for grid expansion at the extra-high-voltage level over the next 10-15 years. The network development plan currently pending examination by the Federal Network Agency relates to the year 2030.

Since the amendments of 14 December 2012, the sequence of network connections to offshore wind power installations was laid down in an offshore network development plan (O-NDP) from 2013 onwards. The **Act on the development and funding of offshore wind energy** (Offshore Wind Energy Act) that entered into force on 1 January 2017 replaced the O-NDP with the 'Land Development Plan' of the Federal Maritime and Hydrographic Agency [Bundesamt für Seeschifffahrt und Hydrographie] and information in the network development plan (in particular regarding measures for the expansion of offshore connection lines including the onshore grid connection points). The TSOs hold a public consultation on the draft NDP and then present it to the Federal Network Agency, which reviews it. The NDP and the associated environmental report drafted by the Federal Network Agency also undergo a consultation process organised by the authority and are then confirmed; other authorities and the public are involved in this process. The confirmed NDP is forwarded by the Federal Network Agency to the Federal Government at least every four years as a draft Federal Requirements Plan. In the years in which an NDP is not confirmed, the TSOs must present 'implementation reports'. The first implementation report was presented to the Federal Network Agency in September 2018 by the TSOs. Members of the public were able to submit an opinion on this report until 9 December 2018.

The **Electricity Market Act** of 26 July 2016 (Federal Law Gazette I p. 1 786) accorded a more prominent place to the costs of grid expansion in the Energy Industry Act. Section 1a EnWG sets out the principle that electricity distribution networks should be expanded according to need, with due consideration for the expansion of electricity production from renewable energies pursuant to Section 3 EEG, security of supply and economic efficiency. The rules on planning that apply to distribution system operators (DSOs) were amended with effect from 30 July 2016. When carrying out grid planning exercises, DSOs may base their calculations on the assumption that the projected annual electricity production can be reduced by up to 3% for each onshore wind power or solar power installation connected directly to their grid (peak capping). The TSOs must apply these rules while drafting the NDP (Section 12b(1), sentence 3). This option is intended to boost the cost effectiveness and social acceptability of measures to expand distribution and transmission systems. These amendments mean that the grid will no longer be designed to cope with the 'last kilowatthour', but will instead be expanded according to need and to a size that is economically expedient.

With the **Act introducing tendering procedures for electricity from renewable energies and further amendments to the law on renewable energies of 13 October 2016 (Renewable Energy Sources Act 2017)**, various measures for strengthening grid management and grid development for the integration of new tender models for renewable energy installations were introduced, the options for grid bottleneck management were improved and the distribution of costs for delayed connection of offshore installations to the electricity grid were updated. At present, renewable energy installations, in particular wind power installations, are curtailed to an increasing extent in northern Germany due to bottlenecks, in particular in the trans-

mission network, because the electricity is not consumed locally and cannot be transported to the areas of high consumption in the south. In order to avoid further exacerbating the bottlenecks, in future the contracts awarded in response to calls for tender for new wind power installations in a ‘grid expansion area’ will be temporarily restricted in terms of volume. The grid expansion area includes the northern part of Lower Saxony and Bremen, Schleswig-Holstein, Hamburg and Mecklenburg-Western Pomerania. Each year 58% of the average growth over the years 2013 to 2015 will be permitted in these areas. The need for these provisions will be reviewed for the first time on 31 July 2019 and then every two years. This will ensure that due consideration is given to progress made in grid expansion. The principle continues to hold that system operators must expand power lines as required in order to integrate electricity from renewable energies. Section 1 EEG 2017 also clarifies that the further expansion of renewable energies should take place on an ongoing, cost-effective and network-compatible basis.

A new paragraph 6a in Section 13 EnWG introduces the option of supplementing cogeneration installations with sheddable loads and integrating them more proactively into the grid bottleneck scheme. In the past there was no clear legal framework and no suitable processes to allow this to happen. Section 13(6a) EnWG provides for sheddable loads to be integrated into the existing redispatch scheme in the event of bottlenecks at the transmission system level in the grid expansion area. The aim of the provision is to reduce the amount of electricity from renewable energy sources that is curtailed as a result of bottlenecks in the transmission system.

In order to improve grid bottleneck management, a new paragraph 10 was added to Section 13 EnWG. On the basis of the agreed input parameters of the system analyses pursuant to Section 3(2) of the Regulation on network reserves, in future a forecast of the annual extent of the measures for grid bottleneck relief should be made, in particular for redispatch and feed-in management. The forecast must include an estimate of the expected costs.

In addition, Section 19(4) EnWG updates the technical requirements for the connection to the grid of generating installations, referring to the provisions of Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators (OJ L 112 of 27 April 2016, p. 1). The aim was to stipulate relevant technical requirements for electricity-generating installations as a prerequisite for grid connection in order to harmonise the technical rules on grid connection to the greatest extent possible. The earlier provisions were inconsistent with the aforementioned EU network code and thus needed to be repealed.

The **Act amending the conditions for the production of electricity from cogeneration and own supply** of 22 December 2016 (Federal Law Gazette I p. 3 106) also amended various provisions of the Energy Industry Act: All high-voltage system operators are obliged to disclose their expansion plans on an annual basis, thereby making them transparent for all stakeholders. The requirements are therefore

adapted to the previous grid expansion report by operators of high-voltage systems with a nominal voltage of 110 kV. With reference to the entire system, the system operator should indicate the location of bottleneck problems and the expected future development of the installed capacity of feed-in installations and take-off loads. The bottleneck regions must be clearly recognisable from the grid maps which are to be published on an annual basis, and which are aimed at improved clarity and assessment of the planned measures. High-voltage system operators must also provide a detailed overview of the specific expansion or reinforcement measures planned for the next five years on their websites. In addition, system operators should estimate the measures that will be necessary for a period of between five and ten years, taking into account the 'NOVA' principle (grid optimisation before grid reinforcement before grid expansion [Netz-Optimierung vor Verstärkung vor Ausbau]). In addition, publication of the DSOs' estimates will serve as a key basis for coordinating planning by the DSOs and network development planning by the TSOs. Another new feature is that the limitation to grid expansion on the feed-in side will no longer apply. Furthermore, a distinction will no longer be made in future between grid expansion triggered by conventional energy installations and by renewable energy installations.

The introduction of Section 119 EnWG and the SINTEG (Schaufenster intelligente Energie – Digitale Agenda für die Energiewende [Showcase on smart energy – Digital agenda for the energy transition]) Regulation of 14 June 2017 based on this latter expanded the framework for use of the SINTEG funding programme as a real-life laboratory for the energy transition. This will allow project participants to test out new technologies, procedures and business models, for example, relating to digitalisation and sector coupling; any financial disadvantages incurred as a result will for the most part be compensated. The funding programme is aimed at developing and testing scalable solutions for a safe, cost-effective and environmentally friendly supply of energy with high proportions of fluctuating electricity production from wind and solar energy in large-scale 'showcase regions'.

The **Network Charges Modernisation Act** amended Section 24, sentence 2, point 4(b) EnWG (with effect from 22 July 2017) by adding further details about the target under (a) for TSOs. The target under (a) states that the assignable costs of grid operation incurred as a result of the integration of decentralised installations for the production of electricity from renewable energy sources can be apportioned on a Germany-wide basis. This provision enshrines in the Act the power to issue statutory instruments that introduce Germany-wide transmission system charges. The harmonisation is intended to take place gradually, with completion scheduled for 1 January 2023. The revenue ceilings for TSOs are however still to be determined using a company-specific and cost-based approach in line with the incentive rules set out in Section 21a, even if the power to issue statutory instruments is utilised. The power to issue statutory instruments is further supplemented in Section 24a EnWG. Section 24a(1) contains examples of how harmonisation of this kind might be achieved, and Section 24a(2) refers to the transitional provisions of Section 118(24). The latter

relate to load compensation for heavy electricity consumers in industry in accordance with the rules set out in Sections 27 to 29 of the Combined Heat and Power Act.

The above power to issue statutory instruments is transposed in the Regulation on the gradual introduction of Germany-wide transmission system charges [Verordnung zur schrittweisen Einführung bundeseinheitlicher Übertragungsnetzentgelte] of 20 June 2018. This Regulation (which amends the Electricity System Charges Regulation [Stromnetzentgeltverordnung]) provides for the gradual standardisation of charges for use of the transmission systems on a Germany-wide basis. As provided for in the law, implementation will take place over the period between 1 January 2019 and 1 January 2023. Harmonisation will be carried out in five equally large increments pursuant to Section 32a of the Electricity System Charges Regulation.

The System Charges Modernisation Act [Netzentgeltmodernisierungsgesetz] also grants TSOs the option of procuring special system equipment as an ancillary service in order to guarantee appropriate operation of the transmission system. The Act added a Section 120 to the Energy Industry Act, which introduces and regulates the gradual phase-out of non-levied system charges. This provides further details of the power to issue statutory instruments enshrined in Section 24, sentence 5 EnWG, and outlines the parameters for a method for calculating non-levied system charges. At the same time, Section 120 EnWG regulates the non-levying of system charges in respect of eligible installations and the period of eligibility. The Act contains provisions amending the Electricity System Charges Regulation accordingly.

The **Landlord-to-Tenant Electricity Act** (Act promoting landlord-to-tenant electricity and amending other provisions of the Renewable Energy Sources Act of 17 July 2017) created a special funding condition ‘landlord-to-tenant electricity’ to push forward the expansion of solar energy on residential buildings. This was accompanied by the addition of Section 42a to the Energy Industry Act, which is intended to ensure that consumers continue to benefit from the liberalisation of the electricity market even if they are supplied with ‘landlord-to-tenant electricity’. The legal framework created in this way is designed to allow an appropriate balance of interests to be achieved, without restricting private autonomy any more than is absolutely necessary.

The **Act amending the Renewable Energy Sources Act, the Combined Heat and Power Act, the Energy Industry Act and other provisions of energy law [Gesetz zur Änderung des Erneuerbare-Energien-Gesetzes, des Kraft-Wärme-Kopplungsgesetzes, des Energiewirtschaftsgesetzes und weiterer energierechtlicher Vorschriften, EEGuaÄndG] of 17 December 2018** combined the disparate schemes that had previously applied to system operators in the event of grid bottlenecks relating to renewable energy and cogeneration installations on the one hand (feed-in management) and conventional power stations on the other hand (redispatch) into a uniform scheme under the Energy Industry Act. The aim of doing so was to optimise system management and reduce the costs of eliminating grid bot-

tlenecks. In addition, Section 118(25) EnWG imposed a transitional period for electricity-generating installations that were planned on the basis of the previous technical connection conditions and that need to be upgraded to new technical standards pursuant to Regulation (EU) 2016/631 (pursuant to Section 19 EnWG). According to these transitional rules, installations that were purchased after 17 May 2018 can also be connected in line with the previous technical connection rules and do not need to be upgraded. The transitional rules are intended to avoid upgrading measures that are not required for system stability purposes.

The **Act accelerating the expansion of power lines of 13 May 2019** introduced further legislative measures into the Energy Industry Act aimed at accelerating approval procedures for grid expansion projects.

2.b.2. Federal Requirements Plan Act

The version of the **Federal Requirements Plan Act** that entered into force on 31 December 2015 marks the completion of the third determination of requirements. The list of projects required by the energy industry was updated with respect to the earlier version of July 2013. With the adoption of the Federal Requirements Plan Act by the federal legislator, the grid expansion projects which are required by the energy industry and for which an urgent need exists became binding for the planning stages of federal sectoral planning, regional planning and planning approval procedures. In addition, the current Federal Requirements Plan Act also amended the statutory provisions on the use of underground cables. For instance, the high-voltage direct current transmission lines specifically identified with ‘E’ are to be constructed as a matter of priority as underground cables instead of overhead lines as previously. The options for underground cabling are moderately expanded for alternating current projects, which are identified correspondingly. In this case, implementation as underground cables in sections is possible for individual pilot projects. The Federal Requirements Plan Act was last amended by the Act accelerating the expansion of power lines of 13 May 2019. The amendments simplify and accelerate certain procedures, in particular those relating to the optimisation, reinforcement and construction of power lines in the extra-high-voltage network.

2.b.3. Grid Expansion Acceleration Act (Transmission Grids)

The **Grid Expansion Acceleration Act (Transmission Grids)** entered into force on 5 August 2011. It provides for a Germany-wide procedure for extra-high-voltage lines crossing federal state or national borders. It was last amended by the Act accelerating the expansion of power lines, which entered into force on 17 May 2019. These amendments introduced additional legislative measures aimed at streamlining and accelerating procedures (e.g. no requirement for federal sectoral plans under certain circumstances, streamlining of the notification procedure, anticipatory planning and joint approval of empty cable conduits).

2.b.4. Renewable Energy Sources Act

Since its introduction in 2000, the Renewable Energy Sources Act has arguably been the most significant statutory funding instrument for electricity production from renewable energy sources. The Renewable Energy Sources Act 2017 entered into force on 1 January 2017 and was further amended during the course of 2017. In 2017, the most extensive amendments were made as a result of the Landlord-to-Tenant Electricity Act.[43] Other key amendments entered into force on 20 December 2018 as a result of the Omnibus Energy Act[44] (further details can be found in the relevant sections below). In terms of funding, the Renewable Energy Sources Act 2017 adheres to the principles that were already set out in the Renewable Energy Sources Act 2014. The focus is accordingly on the market integration of electricity produced from renewable energies, cost-efficient capacity increases and effective management of capacity increases along the expansion corridor.

The tendering system (explained in detail in Section 3.0.1) is intended to facilitate carefully managed, cost-effective and targeted expansion in accordance with the prescribed expansion trajectory. Capacity increases are managed on the basis of the sector-specific tender volumes stipulated per calendar year in Section 28 EEG 2017, which (with the exception of solar installations) correspond to the relevant expansion corridor under Section 4 EEG 2017.

One of the legislator's explicit concerns when implementing the tendering system was to maintain the diversity of stakeholders (Section 2(3), sentence 2 EEG 2017). The Renewable Energy Sources Act resulted in the decentralisation of electricity production, and the energy transition as a whole will bring about decentralisation of the energy system, providing opportunities for players that are completely new to the sector to make a difference. For example, citizens (or associations of citizens) operating solar installations have played a significant role in the expansion of renewable energy production installations, and their commitment and the creation of value at grassroots level often results in a higher level of acceptance within the region than measures aimed at achieving the objectives of the energy transition.

Sections 53 et seqq. EEG 2017 contain new provisions that are intended to prevent over-subsidisation. For example, electricity tax exemptions and anticipated additional revenues through the use of regional certificates (Section 79a EEG 2017) will in principle be offset against the funding entitlement.

---

[43] Act promoting landlord-to-tenant electricity and amending other provisions of the Renewable Energy Sources Act of 17 July 2017, Federal Law Gazette I No 49, p. 2 532, entered into force on 25/07/2017.

[44] Act amending the Renewable Energy Sources Act, the Combined Heat and Power Act, the Energy Industry Act and other provisions of energy law of 17 December 2018, Federal Law Gazette I No 47, p. 2 549, entered into force on 21/12/2018.

2.b.5. System Stability Regulation

The Regulation to guarantee the technical safety and system stability of the electricity supply system (System Stability Regulation) has been in force since 26 July 2012. According to this Regulation, the inverters installed in existing photovoltaic installations must be upgraded so they do not all disconnect at 50.2 Hz, but at different frequency levels.

However, action must also be taken in respect of existing wind power, biomass, cogeneration and small-scale hydropower installations. A study commissioned by the Federal Ministry for Economic Affairs and Energy (‘Developing a strategy for upgrading power-generating installations in the medium- and low-voltage systems in order to maintain system security in the event of over-frequency and under-frequency’) shows that installations with a total installed capacity of 27 GW disconnect automatically when the system frequency is reduced to 49.5 Hz. If such a case arose, system operators would no longer be able to stabilise the electricity grid. The frequency protection settings of these installations therefore need to be modified. The amendments to the System Stability Regulation entered into force on 14 March 2015, and as a result the operators of the existing installations concerned (which number approximately 21 000) are obliged to upgrade the frequency protection settings of their installations in line with the requirements.

The amendments of 14 September 2016 expanded the list of installations for the production of electricity from gaseous and liquid biomass that needed to be upgraded to include installations for the production of electricity from landfill, sewage and mine gas.

2.b.6. ACER: General guidelines and network codes

The Federal Network Agency is affiliated with the European Agency for the Cooperation of Energy Regulators (ACER), which was established in 2009. The purpose of ACER includes drawing up general guidelines with standards for the electricity network codes produced by the European Network of Transmission System Operators for Electricity (ENTSO-E). The main purpose of the European network codes is to promote the implementation of the European internal market for electricity and to overcome problems in cross-border network and market integration through standard rules for all market participants.

2.b.7. Ten-Year Network Development Plan and Projects of Common Interest

In November 2018, the ENTSO-E published the fourth legally valid Europe-wide Ten-Year Network Development Plan (TYNDP), containing grid expansion projects of European importance. It is not binding and is intended to create greater transparency regarding the expansion measures required throughout the entire EU transmission system. Once again, grid expansion within Germany plays a major role in the TYNDP.

The EU-wide list of ‘projects of common interest’ (PCIs), which is updated every two years, is an instrument enshrined in Regulation (EU) 347/2013 on guidelines for trans-European energy infrastructure (TEN-E Regulation), which has been in force since 2013. The third list entered into effect on 26 April 2018 and remains in force today. The PCIs in the EU’s list which have a direct connection to Germany include 13 PCIs in the electricity sector, two in the petroleum sector and one each in the sectors of gas, smart grids and carbon dioxide. For the most part, the projects in the electricity sector are also included in the Federal Requirements Plan Act and the Power Line Expansion Act. Other projects include an offshore gas pipeline (‘Baltic Pipe’) routed across the Baltic Sea and the UK/Denmark project Viking Link, the proposed route of which crosses through Germany’s Exclusive Economic Zone. The Federal Network Agency acts as the central contact partner (‘one-stop-shop’) for the German PCIs.

The planning approaches applied in connection with the German NDP have been coordinated with those applied at EU level in connection with the TYNDP, and the relevant grid expansion plans of European partners documented in the TYNDP were taken into account in the NDP.

3 PLEASE DESCRIBE THE SUPPORT SCHEMES AND OTHER MEASURES CURRENTLY IN PLACE THAT ARE APPLIED TO PROMOTE ENERGY FROM RENEWABLE SOURCES AND REPORT ON ANY DEVELOPMENTS IN THE MEASURES USED WITH RESPECT TO THOSE SET OUT IN THE NREAP.

(Article 22(1)(b) of Directive 2009/28/EC)

A key goal of the energy transition, along with the complete phasing out of nuclear energy by the end of 2022, is the accelerated expansion of renewable energy. According to the NREAP, the proportion of renewable energies in the gross final consumption of energy for electricity is to rise to 38.6% by 2020. The decision on the energy transition fleshes out the objectives of the Energy Concept of 28 September 2010 and accelerates their implementation. It has hitherto been enshrined in law that the proportion of renewable energies in gross electricity consumption should increase to 40-45% by 2025, to 55-60% by 2035 and to at least 80% by 2050.[45] In accordance with the coalition agreement signed in March 2018, the Federal Government aims to achieve an additional expansion of renewable energies by 2030 by following a targeted, efficient, network-synchronised and increasingly market-based approach. Under these conditions, it its striving to achieve a proportion of renewable energies of around 65%.

The following points summarise the measures decided on in the Energy Transition Package for the renewable energies sector and the progress made in relation to key measures set out in the NREAP.

3.0. Support schemes

3.0.1 Renewable Energy Sources Act

Introduction

The Renewable Energy Sources Act 2017 that entered into force on 1 January 2017 was amended – in some cases substantially – in 2017 by the Landlord-to-Tenant Electricity Act[46] and in 2018 by the Omnibus Energy Act, which entered into force on 21 December 2018[47]. Details of the most significant changes are provided below.

[45] The national targets in Section 1 of the Renewable Energy Sources Act are not directly comparable to the figures reported under the NREAP and listed in the progress report, as they are not subject to the calculation rules in accordance with Directive 29/2009/EC.

[46] Act promoting landlord-to-tenant electricity and amending other provisions of the Renewable Energy Sources Act of 17 July 2017, Federal Law Gazette I No 49, p. 2 532, entered into force on 25/07/2017.

[47] Act amending the Renewable Energy Sources Act, the Combined Heat and Power Act, the Energy Industry Act and other provisions of energy law of 17 December 2018, Federal Law Gazette I No 47, p. 2 549, entered into force on 21/12/2018.

The Renewable Energy Sources Act 2017 promotes the production of electricity from renewable energy sources. In the context of the provisions on the distribution of costs (levy under the Renewable Energy Sources Act), it furthermore provides incentives for direct own use of electricity produced with dedicated renewable energy installations before this electricity is fed into the grid (‘own production’).

The Renewable Energy Sources Act contains medium- and long-term targets for the expansion of renewable energies. According to Section 1(2), the proportion of electricity in the gross consumption of electricity that is produced from renewable energies is intended to be increased to 40-45% by 2025, to 55-60% by 2035 and to at least 80% by 2050.

Since the Renewable Energy Sources Act 2014, and against the backdrop of the EU’s environmental and State aid guidelines, increased efforts have been made to establish a funding mechanism based on market principles. In order to further speed up the market integration of renewable energies expressly provided for in Section 2(2) EEG 2014/2017, the systems for mandatory direct marketing and funding via a market premium were gradually expanded; as a result, the fixed feed-in payment that had originally been provided for under the Act was sidelined. Even under the Renewable Sources Act 2014, installations with a commissioning date after 31 December 2015 were only able to claim the payment under the Act if their nominal capacity was equal to or less than 100 kW; in addition, the payment was reduced in proportion to the sum of the market premium and market revenues. The Renewable Energy Sources Act 2017 carries over these restrictions (Section 21(1), point 1 in conjunction with Section 53 EEG 2017).

On this basis, substantial changes have been made in the area of supported direct marketing through the introduction of a tendering system, taking market integration to a new level. A preparatory pilot tendering system was already planned under the Renewable Energy Sources Act 2014 for ground-mounted photovoltaic installations. Under the Renewable Energy Sources Act 2017, calls for tender are as a basic principle used in the sectors of onshore wind, offshore wind, photovoltaic and biomass. In the sector-specific calls for tender, the funding entitlement awarded under the Renewable Energy Sources Act (in the form of a market premium) is determined on a competitive basis. The amount of the market premium is still calculated on the basis of the ‘reference value’ principle, whereby this value now (in the case of a contract award) corresponds to the bid value. The system of prescribing the tendering volume for each calendar year provides a new and effective means of managing the increase in capacity. In the case of onshore wind, the specific features of each region are also taken into account on a temporary basis when capacity is increased, in order to give due consideration to network and system integration concerns. The calls for tender facilitate not only expansion that is aligned with market conditions but also competitive pricing, and therefore ultimately result in cost-effective electricity production.

Despite simple and transparent conditions, a tendering system by its very nature represents a major challenge for some stakeholders (in particular relatively small ones). At the same time, it is precisely these stakeholders that can make a considerable contribution to ensuring the success and acceptance of the energy transition, by being actively involved in shaping energy systems and adding value locally. They should continue to be able to perform this role in the context of the tendering system. The legislator took this circumstance into account in the Renewable Energy Sources Act 2017 by including it in the principles set out in Section 2(3), sentence 2 EEG 2017, and also addressed it by means of specific provisions, for example the privileging of community energy companies in calls for tender for onshore wind in Section 36g EEG 2017. Ultimately, the special rules in this area resulted in over 95% of the contracts awarded for onshore wind power installations across all calls for tender in 2017 going to community energy companies. The legislator responded to the associated risk of a gap in expansion on account of an extended implementation period and an increased implementation risk by suspending the privileges in summer 2017. Following the amendments made by the Omnibus Energy Act, Section 36e(1) EEG 2017 reduced the implementation period for onshore wind power installations from 30 months to 24 months for the first three bidding rounds in 2019. Pursuant to Section 36g(3), sentence 1 EEG 2017, this six-month reduction also applies to community energy companies; the implementation period prescribed for these latter in calls for tender has dropped from 54 months to 48 months . This short-term adjustment in the implementation period is intended to counteract the concern that there might be a drop in the number of new onshore wind power installations constructed in 2019 and 2020, by ensuring that a certain number of projects are implemented more rapidly.

Alongside the feed-in payment, a landlord-to-tenant electricity supplement has been available under the Renewable Energy Sources Act 2017 since 25 July 2017. Pursuant to Section 21(3) EEG 2017, only solar installations up to 100 kW affixed to or on residential buildings are eligible. In addition, electricity from the installation must be consumed by tenants (final consumers) within the building or within residential and adjacent buildings that are directly linked to the building, without passing through a network. The aim is to allow tenants to become directly involved in the energy transition, thereby providing a further boost to the expansion of electricity production using solar installations.

Alongside guarantees of origin, the Renewable Energy Sources Act 2017 recognises an additional electricity labelling instrument for regional and directly marketed electricity supported under the Renewable Energy Sources Act in the form of regional certificates (Section 79a EEG 2017). These certificates help to increase local acceptance of the energy transition.

With regard to the levy under the Renewable Energy Sources Act, the provisions relating to the obligation to pay this levy and the associated restrictions in connection

with self-supply concepts, and granting privileges to companies exposed to international competition, essentially remain unchanged in terms of content. The scope of the storage privilege was however extended so that the imminent double loading of a temporarily stored volume of electricity could be more effectively countered and this investment obstacle eliminated.

Overview of funding

This chapter provides an overview of the main amendments in the Renewable Energy Sources Act 2017 from the perspective of their funding effect. These include in particular funding mechanisms that were set up for certain technologies and stakeholders as part of the changeover to a tendering system and the development of landlord-to-tenant electricity concepts funded under the Renewable Energy Sources Act.

The tendering system

The key aim of the market integration of electricity from renewable energy sources was strengthened in the Renewable Energy Sources Act 2017 through the introduction of the tendering system. The feed-in payment under the Renewable Energy Sources Act (which was originally a fixed payment in most cases) plays an increasingly secondary role. Since the Renewable Energy Sources Act 2014, the standard approach has been mandatory direct marketing (Section 2(2) EEG 2014/2017). The (exceptional) rule stipulating that installations with a nominal capacity up to a maximum of 100 kW and a commissioning date after 31 December 2015 can still benefit from a comparatively low fixed feed-in payment is however present in essentially unchanged form in Section 21(1), point 1 EEG 2017 (see progress reports from 2015 and 2017, Chapter 3.0.2).

The Renewable Energy Sources Act 2017 places further emphasis on supported direct marketing as the top-priority funding mechanism under this Act that justifies the entitlement to the market premium (see Sections 20 and 19(1), point 1 EEG 2017). The tendering system takes the following approach in determining the entitlement to apply and the amount of the market premium: the market premium is the difference between the reference value and the monthly market value (monthly average spot price of electricity specific to the energy source, calculated on an ex-post basis). Until the entry into force of the Renewable Energy Sources Act 2017, the reference value was in most cases defined by law (and corresponded to the funding entitlement for the fixed feed-in payment). In future, it will essentially be determined on a competitive basis, by way of sector-specific calls for tender. The innovation auctions planned for the future are intended to make it possible to test out new pricing mechanisms and tendering procedures that might result in higher levels of competition and greater network and system benefits. For example, the market premium will no longer be paid in connection with innovation auctions in the event of negative prices, competi-

tion will be guaranteed through competition clauses stipulating that contracts can be awarded to no more than 80% of the bids submitted, and technology-neutral fixed market premiums and requirements for system-oriented behaviour will apply.

Following a successful trial of calls for tender for ground-mounted solar installations, and upon the entry into force of the Renewable Energy Sources Act 2017, technology-specific calls for tender were introduced as a general rule for solar, onshore wind, biomass and offshore wind. In accordance with the prescribed expansion trajectory, the tendering system is intended to facilitate carefully managed, cost-effective and targeted expansion. Capacity increases are managed on the basis of the sector-specific tender volumes stipulated per calendar year in Section 28 EEG 2017, which (with the exception of solar installations) correspond to the relevant expansion corridor under Section 4 EEG 2017.

For funding under the Renewable Energy Sources Act in the form of supported direct marketing, this means: following the changeover to the tendering system, the funding entitlement will be justified by the contract award value for the technologies and installations covered by this system. The level of the funding entitlement will also be determined by the bid value, which is included in the calculation of the market premium as the reference value. In this respect, the calculation basis will be determined on a competitive basis and will no longer solely be defined by law (see Section 22(1) EEG 2017). This also marked a shift from a price-controlled to a quantity-controlled funding system.

As a basic principle, solar installations will only take part in calls for tender above a de minimis limit of over 750 kW of installed capacity (Section 22(3), sentence 2 EEG 2017). The main purpose behind this rule is to ensure that a variety of stakeholders are represented among the operators of relatively small-scale solar installations, and to keep the administrative burden low. Solar installations below 750 kW can continue to benefit from the funding conditions which were established under the Renewable Energy Sources Act 2014 and which applied from January 2016 onwards, and do not need to participate in the calls for tender.

For onshore wind power installations, participation in calls for tender is likewise only mandatory above the limit of 750 kW of installed capacity (Section 22(2), point 1 EEG 2017). The average size of newly installed onshore wind power installations in 2018 was 3.2 MW, which means that this limit should have only a very restricted effect (by way of contrast to the situation as regards solar installations). Pursuant to Section 22(2), point 2 EEG 2017, it was also possible for wind power installations approved prior to 1 January 2017 to be exempt from the tendering system. The deadline for this exemption expired upon the latest possible commissioning date on 1 January 2019, however, and so it no longer applies. The third exemption concerns pilot onshore wind power installations within the meaning of Section 3(37) EEG 2017 with a total installed capacity of up to 125 MW per year (Section 22(2), point 3 EEG 2017). The purpose behind this provision is to provide support for the develop-

ment of innovations and new technologies without restricting them by imposing a requirement to take part in calls for tender.

In principle, biomass installations participate in calls for tender above an installed capacity of more than 150 kW (Section 22(4), point 1 EEG 2017). Existing installations whose funding comes to an end can participate in calls for tender and are thus entitled to claim a 10-year follow-on funding grant on a one-off basis (Section 39g(3) EEG 2017). For installations that were approved or authorised before 1 January 2017 and were commissioned before 1 January 2019, transitional regulations apply in accordance with Section 22(4), point 2 EEG 2017.

The tender procedure is defined by the general rules set out in Sections 28 et seqq. EEG 2017 and associated technology-specific rules. Annual technology-specific tender volumes are specified and (with the exception of biomass and offshore wind) distributed across a number of bidding rounds per year. The tender volume should be designed to bring about the desired scarcity situation for a functional market and thereby instigate competition for capacities and funding. The Omnibus Energy Act provides for additional special tender volumes for onshore wind power installations and solar installations in the period 2019-2021 (4 000 MW in both cases; see Table 3.2 and Table 3.4). With a view to boosting competition, the additional tender quantities will increase to 1 GW in 2019, 1.4 GW in 2020 and 1.6 GW in 2021 (in each case per energy type). Similarly, special tender volumes for offshore wind energy are envisaged in the coalition agreement, but have not yet been quantified or implemented. The Omnibus Energy Act also adjusted the standard tender quantities (see below for further details).

The special calls for tender are a short-term tool for achieving the national climate protection target for 2020 and avoiding gaps in the expansion of capacity, particularly in the field of onshore wind energy. The installed capacity of the solar installations awarded contracts as part of these special calls for tender will not be counted against the 52-GW cap (Section 48(5), sentence 2 EEG 2017). The standard tender volumes (with the exception of solar installations) will follow the expansion trajectory prescribed in Section 4 EEG 2017, thereby exerting their own steering effect (see Table 3.1, Table 3.3, Table 3.5 and Table 3.6). The quantities for innovation auctions (see Table 3.10) have been deducted on a pro-rata basis from the standard tender quantities under the column for the relevant renewable energy, meaning that a corresponding reduction of tender quantities has taken place pursuant to Section 28(1) sentence 1 and Section 28(2), sentence 1 EEG 2017.

Table 3.1: Tender volumes and bidding rounds for onshore wind, Section 28(1), sentence 1 EEG 2017.

Onshore wind	1 February	1 May 2017 to 2019; from 2020: 1 June	1 August	1 November 2017; since 2018: 1 October	Total
2017		800 MW	1 000 MW	1 000 MW	2 800 MW
2018	700 MW	700 MW	700 MW	700 MW	2 800 MW
2019	700 MW	650 MW	650 MW	675 MW	2 675 MW
2020	900 MW	900 MW		900 MW	2 700 MW
2021	900 MW	900 MW		850 MW	2 650 MW
from 2022	1 000 MW	950 MW		950 MW	2 900 MW

Table 3.2: Tender volumes and bidding rounds for special calls for tender for onshore wind, Section 28(1), sentence 2 EEG 2017.

Onshore wind	1 March	1 July	1 September	1 December	Total
2019			500 MW	500 MW	1 000 MW
2020	300 MW	300 MW	400 MW	400 MW	1 400 MW
2021	400 MW	400 MW	400 MW	400 MW	1 600 MW

Table 3.3: Tender volumes and bidding rounds for solar installations, Section 28(2), sentence 1 EEG 2017.

Solar	1 February	1 June	1 October	Total
2017	200 MW	200 MW	200 MW	600 MW
2018	200 MW	200 MW	200 MW	600 MW
2019	175 MW	150 MW	150 MW	475 MW

2020	100 MW	150 MW	150 MW	400 MW
2021	150 MW	100 MW	100 MW	350 MW
from 2022	200 MW	200 MW	200 MW	600 MW

Table 3.4: Tender volumes and bidding rounds for special tenders for solar installations, Section 28(2), sentence 2 EEG 2017.

Solar	1 March	1 July	1 September	1 December	Total
2019	500 MW			500 MW	1 000 MW
2020	300 MW	300 MW	400 MW	400 MW	1 400 MW
2021	400 MW	400 MW	400 MW	400 MW	1 600 MW

Table 3.5: Tender volumes and bidding rounds for biomass installations, Section 28(3) EEG 2017.[48]

Biomass	Since 2019: 1 April	1 September from 2017 to 2018; since 2019: 1 November	Total
2017		150 MW	150 MW
2018		150 MW	150 MW
2019	75 MW	75 MW	150 MW
2020	100 MW	100 MW	200 MW
2021	100 MW	100 MW	200 MW
2022	100 MW	100 MW	200 MW

[48] The tender volume is reduced by the installed capacity of the installations put into operation in the previous year with statutory funding in each case, and increased by the tender volume that was not awarded in the relevant previous year (Section 28(3a) EEG 2017).

Table 3.6: Tender volumes and bidding rounds for offshore wind, Section 17/Sections 26, 27 WindSeeG.

Offshore wind	1 September (for the first time in 2021, for areas that have undergone preliminary investigations and installations with a commissioning date from 1 January 2026 onwards)	1 April (in 2017 and 2018, special call for tender for the transitional phase for existing projects with a commissioning date from 1 January 2020 onwards)
2017		1 550 MW
2018		1 550 MW
from 2021	700 to 900 MW (Depending on the Land Development Plan, on average 840 MW per year)	

Table 3.7: Expansion trajectories at a glance, Section 4 EEG 2017, Sections 1, 17, 27 WindSeeG.

	Onshore wind	Offshore wind	Solar	Biomass
2017	2 800 MW		2 500 MW	150 MW
2018	2,800 MW		2 500 MW	150 MW
2019	2 800 MW		2 500 MW	150 MW
2020	2 900 MW		2 500 MW	200 MW
2021	2 900 MW	500 MW (exclusively Baltic Sea, Section 27(4), point 1 WindSeeG)	2 500 MW	200 MW
2022	2 900 MW	500 MW (Section 27(4), point 2 WindSeeG)	2 500 MW	200 MW
2023 to 2025	2 900 MW	700 MW	2 500 MW	

(Section 27(4), points 3-5 Wind-SeeG)

Table 3.8: Increase in installed capacity of offshore wind energy, Section 4 EEG 2017, Section 1(2) WindSeeG.

	Offshore wind
up to 2020	6 500 MW
up to 2030 in total	15 000 MW

In its decision on the Climate Action Programme 2030 (adopted on 9 October 2019), the Federal Government stipulated, among other things, that the expansion target for offshore wind should be increased to 20 000 MW by 2030. Special arrangements are needed in respect of cross-border and joint calls for tender for the tender volume of onshore wind and solar installations:

the Renewable Energy Sources Act 2017 opens up the funding mechanism within the framework of the standard tendering system for the expansion of renewable energies abroad following the successful trial of ground-mounted photovoltaic installations. Pursuant to Section 5 EEG 2017, bids for solar installations and onshore wind from other Member States of the European Union can also be awarded contracts, up to a maximum of 5% of the capacity to be installed annually. Certain key requirements apply; in particular, the electricity produced from renewable energies must be physically imported to Germany, or must at least have a comparable effect on the German electricity market. In addition, an international agreement must have been concluded and the principle of reciprocity must be observed before renewable energy installations in other EU Member States can participate. The capacity for which contracts are awarded in this context reduces the relevant annual tender volume for onshore wind and solar (Section 28(1a), point 1, Section 28(2a), point 1 EEG 2017). The details of cross-border calls for tender are clarified in a regulation adopted on the basis of Section 88a EEG 2017. In general terms, contractual fines will be used to ensure that winning tenderers do in fact implement their projects, and that the expansion trajectory for attainment of climate protection targets is followed. In particular, the Cross-Border Renewable Energies Regulation (which originally applied to pilot calls for tender for ground-mounted solar installations) was amended for this purpose, and its scope extended to include onshore wind energy. The Regulation entered into force on 16 August 2017.

Joint calls for tender are established under the Renewable Energy Sources Act 2017 for the first time as pilot procedures (Section 39i in conjunction with Section 88c EEG 2017). The associated Regulation on joint calls for tender [Verordnung zu den gemeinsamen Ausschreibungen, GemAV] entered into force on 18 August 2017. Solar installations and onshore wind turbines are to compete against each other in the calls for tender. The Omnibus Energy Act extended the trial period for joint calls for tender by one year, meaning that it will now cover the period between 2018 and 2022. The practical experiences gained in the process are to be taken into account during future regulatory activities. An annual volume of 400 MW of capacity to be installed is provided for the joint calls for tender for the period between 2019 and 2021 (Section 28(5) EEG 2017). In addition, a call for tender is planned for 1 April 2022; the amount will be equivalent to the volume that was not awarded in connection with the innovation auction in 2021 (Section 39j EEG 2017). The 400 MW of capacity for the years between 2019 and 2021 will be split between two closing dates for calls for tender in each case. From 2020 onwards, the volumes awarded contracts in connection with joint calls for tender during the preceding year – halved in each case – will be offset against the tender volumes for the standard calls for tender for onshore wind and solar (Section 28(1a), point 3, Section 28(2a), sentence 2, point 3 EEG 2017). The contract award procedure will be modified in this connection for 'distribution system expansion areas' (Section 11 GemAV) (Section 7 GemAV). The demand for grid expansion at distribution system level is to be taken into account when awarding contracts by means of a surcharge (specific to the distribution system expansion area) added when ranking bids. This 'distribution system component' (Section 10 GemAV) is intended to give due consideration to the costs of network and system integration, and to achieve a local steering effect for solar and onshore wind expansion. The distribution system expansion areas are defined in the Regulation on joint calls for tender, and are based on the amount of energy back-fed from the distribution system into the upstream extra-high-voltage system. With the exception of the participation conditions for community energy companies, which do not apply in this instance, and the reference yield model, the sector-specific provisions on standard calls for tender will remain unchanged in the typical case.

The Federal Network Agency will launch the first innovation auctions on 1 September 2020. Auctions for a total volume of 1 150 MW will be carried out by 2021 (see Table 3.10). The tender quantities for innovation auctions have been deducted from the standard volumes under the column for the relevant renewable energy, meaning that a corresponding reduction of tender quantities has taken place pursuant to Section 28(1), sentence 1 and Section 28(2), sentence 1 EEG 2017.

Participation in calls for tender is technology-neutral and not restricted to individual renewable energies. Furthermore, bids can also be submitted for combinations or consortia of different renewable energies. Tender volumes for which contracts have not been awarded can be transferred to the following calendar year. The year 2021

represents an exception to this rule, since the final quantity remaining will be transferred to the volume for the joint calls for tender pursuant to the Regulation on joint calls for tender (Section 28(6), sentence 2 EEG 2017). Following amendments to the Omnibus Energy Act, the focus of the innovation auctions is now on testing out new pricing mechanisms and tender procedures intended to bring about a higher level of competition and increased benefits for networks and systems. By way of derogation from Section 15(1), sentence 1 EEG 2017, installations awarded contracts in connection with calls for tender in 2019 will not receive any financial compensation for the lost market premium in the event of curtailment owing to grid bottlenecks (feed-in management). Any findings that emerge from an evaluation of the innovation auctions will be carried over into the standard tendering system.

Table 3.9: Tender volumes and bidding rounds for joint tenders for onshore wind power installations and solar installations, Section 28(5) EEG 2017.

Solar & onshore wind	**1 April**	**1 November**
2019	200 MW	200 MW
2020	200 MW	200 MW
2021	200 MW	200 MW
2022	Tender volumes from the innovation auctions in 2021 that were not awarded contracts, Section 28(4), point 2 EEG 2017.	

Table 3.10: Tender volumes and bidding rounds for technology-neutral innovation auctions, Section 28(5) EEG 2017.

Technology-neutral	**1 September**
2019	250 MW
2020	400 MW
2021	500 MW

2022	Tender volumes from the innovation auctions in 2021 that were not awarded contracts will be carried over to the joint calls for tender (Section 28(4), point 2 EEG 2017).

For 2019 and 2020, regionally differentiated maximum values for onshore wind are also set for the joint calls for tender (Section 14 et seqq. GemAV). Three regions are selected for this purpose on the basis of wind conditions. Pursuant to Section 15 GemAV, Annex 3 contains a list of specific rural districts assigned to the three regions specified in Section 16 GemAV. This mechanism is intended to take account of the fact that the reference yield model does not apply to joint calls for tender. Further aims include compensating for the financial disadvantages of locations where winds are low, and avoiding over-subsidisation in locations where winds are high.

Table 3.11: Highest bid values at a glance for joint tenders for onshore wind power installations and solar installations.

Year/highest value	Solar	Wind
2018	Section 12 GemAV: corresponds to the highest value from the last sector-specific call for tender for solar pursuant to Section 29 and Section 37b(2) EEG 2017	Section 13: corresponds to the highest values pursuant to Section 12 GemAV
2019	see 2018	Section 16 GemAV: area-specific uniform highest value, based on Section 36b EEG 2017
2020	see 2018	Section 16 GemAV: area-specific uniform highest value, based on Section 36b EEG 2017

The general provisions on tender procedures (Sections 28 et seqq. EEG 2017) also specify the date and content of the invitation to tender by the competent body, including in particular details of the relevant highest bid value (Section 29 EEG 2017) and requirements pertaining to bids (Sections 30 and 30a EEG 2017) and tenderers

(Section 34 EEG 2017). The provisions of Section 32 EEG 2017 on the tender procedure describe how admissible bids should be sorted in a transparent process so that successful bidders can be identified in a non-discriminatory and transparent fashion. The Offshore Wind Energy Act modifies certain provisions by setting out special rules for calls for tender in the offshore wind sector, but incorporates most general provisions without any changes.

Table 3.12: Highest bid values at a glance

	Onshore wind	Solar	Biomass	Offshore wind
2017	7 ct/kWh for the reference location pursuant to Annex 2	8.91 ct/kWh; 8.84 ct/kWh (reduced on 1 October 2017 by way of analogy to Section 49 EEG old version)	14.88 ct/kWh (16.9 ct/kWh for existing installations)	12 ct/kWh for existing projects, Section 33 WindSeeG
2018	6.3 ct/kWh for the reference location pursuant to Annex 2	8.84 ct/kWh	14.73 ct/kWh (16.73 ct/kWh for existing installations)	10 ct/kWh for existing projects, Section 33 WindSeeG
2019	6.2 ct/kWh for the reference location pursuant to Annex 2	7.50 ct/kWh (valid since 13 May 2019, again without changes, Section 37b EEG 2017)	14.58 ct/kWh (16.56 ct/kWh for existing installations)	
from 2020	108% of the average for the last highest bids awarded contracts for the last three bidding deadlines	7.50 ct/kWh	Reduction in the previous year's highest value by 1% in each case	Section 16 GemAV: From 2021, lowest bid value by the bidding deadline of 1 April 2018, Section 22(1)

	WindSeeG; different value set by the Federal Network Agency, Section 22(2) WindSeeG

In order to support and ensure attainment of the expansion targets, the Renewable Energy Sources Act 2017 and the Offshore Wind Energy Act provide for the depositing of a security as part of the tender procedure (Section 31 EEG 2017). As a basic principle, the security is to be deposited by the bidding deadline, and serves as security against a contractual penalty pursuant to Section 55 EEG 2017. The implementation of installations after the awarding of a contract is to be ensured by penalty payments after the expiry of a technology-specific deadline corresponding to the usual implementation period for the installation. The amount of the security to be deposited (EUR X/kW of capacity to be installed) is regulated on a technology-specific basis.

Table 3.13: Amount of the securities at a glance

Onshore wind	Solar	Biomass	Offshore wind
Section 36a EEG 2017	Section 37a EEG 2017	Section 39a EEG 2017	Section 21/Section 31 WindSeeG
Bid amount x EUR 30/kW of the capacity to be installed	Bid amount x EUR 50/kW of the capacity to be installed (first security EUR 5/kW, second security EUR 45/kW; reduced under certain circumstances to EUR 20/kW with proof of an advanced stage of planning)	Bid amount x EUR 60/kW of the capacity to be installed	Bid amount x EUR 200/kW of the capacity to be installed for areas that have undergone preliminary investigations Bid amount x EUR 100/kW of the capacity to be installed for existing projects

The general provisions relating to calls for tender are modified and supplemented by technology-specific provisions under Sections 36 to 39h EEG 2017 and the Offshore Wind Energy Act. Significant mechanisms are outlined below.

Onshore wind energy

Temporary provision was made for special contract award conditions under the Renewable Energy Sources Act 2017 in relation to the increase in onshore wind power installations in 'grid expansion areas' (which are currently all located in northern Germany), in order to be able to take into account the costs of network and system integration during this increase (Section 36c in conjunction with Section 88b EEG 2017). The details were regulated in Sections 10 to 13 of the Regulation implementing the Renewable Energies Regulation [Erneuerbaren-Energien-Verordnung, EEAV]. The primary aim was to improve the relationship between the numerous production units and the grid infrastructure in the regions concerned (which was already overloaded) by setting an upper limit for the increase in wind power installations in grid expansion areas. Stronger links between expansion efforts on both the production and grid side were intended to promote a more cost-effective restructuring of the energy system.

Moreover, the tender conditions for onshore wind power installations of a certain size were modified with respect to the participation conditions for community energy companies (Section 36g EEG 2017). Through the optional privileging of community energy companies, the Renewable Energy Sources Act 2017 promoted continued diversity of stakeholders and was thus intended to increase local acceptance of the energy transition. To prevent abuse, the objective and subjective prerequisites were designed in a restrictive and detailed manner. Community energy companies eligible for privileged arrangements within the meaning of Section 3(15) EEG 2017 essentially benefited from more advantageous participation conditions under Section 36g EEG 2017, which limited the planning, award and price risks. . This was achieved firstly through a de minimis threshold (if the threshold was not reached, participation in the call for tender was not a prerequisite for a funding entitlement under the Renewable Energy Sources Act), and secondly through special participation conditions and a special price rule for community energy companies that wished to implement onshore wind power installations covered by the tendering system. In this context, community energy companies were in particular permitted to submit a bid even prior to undertaking the time- and cost-intensive process for obtaining a grant of approval under the Federal Immission Control Act. The seriousness of their project was able to be substantiated by an expert report on the expected electricity yield, in line with recognised practice in the sector (Section 36g(1), point 1 EEG 2017). The security to be paid likewise did not have to be deposited in full at the time when the bid was submitted, but could be divided into two instalments (Section 36g(2) EEG 2017). The implementation period for community energy companies was also extended by 24 months, which in particular took account of the fact that approval had not yet been granted under the Federal Immission Control Act. The price risk was reduced by means of the ‘uniform pricing method’, in contrast to the ‘pay-as-bid principle’. According to this method, the contract award value for bids by community energy partnerships corresponded to the highest bid that was also successful for the same bidding deadline (Section 36g(5), sentence 1 EEG 2017).

The calls for tender for onshore wind energy in 2017, in which the successful bids came almost exclusively from community energy companies, showed that the rule/exception relationship between Section 36 EEG 2017 and Section 36g EEG 2017 had effectively been reversed. The result was that community energy companies were submitting virtually all of the bids that were ultimately successful. In order to reduce the incentives to exploit a regulation that was intended as an exception and for the purpose of evaluating the impact of Section 36g EEG 2017, certain changes were made for the bidding rounds scheduled to take place on 1 February 2018, 1 May 2018, 1 August 2018, 1 October 2018, 1 February 2019, 1 May 2019, 1 October 2019, 1 February 2020 and 1 June 2020; in particular, there was no longer an exemption from the requirement to present an approval under the Federal Immission Control Act, and the implementation period was adjusted on a mutatis mutandis basis (Section 36(1), (3) and (4) EEG 2017, Section 104(8) EEG 2017). The exemp-

tion of community energy companies from the obligation to submit an approval under the Federal Immission Control Act when participating in an auction and the 24-month extension in the commissioning deadline meant that the other participants in the calls for tender had to compete with future technologies, and were therefore at a disadvantage against their competitors from the outset. It was agreed in the coalition agreement that the diversity of stakeholders should continue to be maintained in future, but that only approved projects should be allowed to participate in calls for tender.

In the case of onshore wind energy, the level of the funding entitlement has to be determined in the call for tender in accordance with Section 36h EEG 2017, by calculating the reference value on the basis of the surcharge value. In this case, the determination is based on the reference yield model for the statutory determination of the reference value for onshore wind (Section 46 EEG 2017). The reference yield model takes into account the different characteristics of the various locations: financial disadvantages of locations where winds are low are compensated for, and oversubsidisation is avoided at locations where winds are high. In a departure from the two-stage reference yield model that applied until 2016, the calculation under Section 36h EEG 2017 is carried out in one stage, which means that there is no differentiation between basic and initial payments. On the basis of the bid at the 100% location, taking into account the quality factor (intended in particular to reflect the actual conditions at the location, in particular wind patterns), the reference value is calculated for the entire funding period. The values to be invested are adjusted at the beginning of the sixth, eleventh and sixteenth year following the commissioning of the installation. If, as a consequence of the review, it is found that too many or too few payments have been made, they should be refunded under certain conditions.

Solar installations

The provisions on calls for tender for solar installations (Section 37 et seqq. EEG 2017) include in particular special rules on usable land and the security to be provided.

Special arrangements apply to increases in capacity on agricultural cropland and (for the first time) grassland areas (Section 37(1), points 3(i) and (h) EEG 2017) in 'less-favoured areas'. Less-favoured areas within the meaning of Section 3(7) EEG 2017[49] exhibit relevant persistent natural disadvantages, in particular on account of the nature of the soil, the gradient of slope and a shorter growing season. Bids relating to these areas can only be awarded a contract if the relevant federal state has issued a

[49] Section 3(7) EEG 2017 refers to the EU directives that define the term.

legislative decree to this end (Section 37c(1) EEG 2017). To date, Bavaria, Baden-Württemberg, Rhineland-Palatinate, Hessen and Saarland have issued relevant decrees. In parallel to the legislative procedure relating to the Renewable Energy Sources Act 2017, a number of federal states have excluded (in relatively explicit terms) the option of using agricultural cropland for photovoltaic installations. These include Lower Saxony, Saxony-Anhalt, Thuringia, North Rhine-Westphalia and Brandenburg.

Privileges for certain stakeholders are not specified in the technology-specific provisions relating to calls for tender for solar installations. Above the de minimis threshold of 750 kW of capacity to be installed, the depositing of the security payment as provided for in Section 37a EEG 2017 in two instalments should have a beneficial impact on small stakeholders, however. By way of analogy to the special provisions for community energy companies that wished to erect onshore wind power installations, the first (small) security payment must be provided when submitting the bid by way of security against any contractual penalty (Section 55(2), point 1 EEG 2017) and any insolvency risk, and the second security must be provided within 10 working days of the announcement of the successful bid. Successful bidders that provide evidence of an advanced stage of planning for green spaces, sealed soils and structural installations may moreover benefit from a reduced second security payment (Section 37a(2) second clause EEG 2017) This exemption, which is usually of benefit to relatively small projects, is justified by the fact that the seriousness of the project and its implementation is adequately demonstrated through the providing of evidence. Since roof-mounted installations do not usually require approval, it is not possible to provide evidence of planning (for example by presenting a certificate), and the second security must thus be paid in full.

Biomass installations

The Renewable Energy Sources Act 2017 restricts the pool of installations eligible to participate in calls for tender in comparison with previous Acts, with a view to introducing a number of changes.

Installations that are eligible to participate in the call for tender must enclose an approval for construction or operation of the installation with the bid in order to demonstrate a genuine intention to implement the project. The Renewable Energy Sources Act 2017 moreover makes the reserving of flexible production capacity mandatory, and no longer merely encouraged by means of an additional payment for voluntary provision of flexibility (Section 50 EEG 2017). To this end, the reference value that is awarded in the tender procedure is only taken into consideration in its full amount up to the maximum rated capacity, which is 50% of total capacity for biomass installations and 80% of total capacity for solid biomass installations (Section 39h(2) EEG 2017). This is intended to encourage a demand-oriented method of operation.

A further difference in the rules on calls for tender for biomass installations in comparison to the other technology-specific rules is that the Renewable Energy Sources Act 2017 takes into consideration the continued operation of existing installations in terms of eligibility for support by allowing them to participate in the calls for tender. This is intended to take account of the fact that some installations need additional investment before the end of the funding period (for the purpose of upgrading the installation, for example) in order to facilitate a flexible mode of operation. Moreover, the admissible highest bids for existing installations are higher than for new installations. By way of analogy to the rules on participation by community energy companies, the 'uniform pricing' principle also holds true for existing plants smaller than 150 kW, meaning that the value of the highest bid that is also successful serves as a basis for calculating the level of the payment Existing installations that are awarded contracts are subsequently regarded as new installations, are included in the planned tender volume and may be entitled to the market premium that is determined on a competitive basis for 10 years at most. Existing installations, just like new installations, must however also comply with the requirements to provide flexibility, and demonstrate that they are technically suitable for demand-oriented operation.

Offshore wind energy

Special tender specifications are likewise defined for offshore wind energy. Significant features include the following: by way of a supplement to the provisions of the Renewable Energy Sources Act 2017, offshore wind energy is regulated in a dedicated act (the Offshore Wind Energy Act). Firstly, a distinction is made between calls for tender for areas that have undergone preliminary investigations (Section 16 et seqq., Section 9 et seqq. WindSeeG) from 2021 onwards and calls for tender for existing projects (Section 26 et seqq. WindSeeG) in 2017 and 2018. In accordance with Section 26(2) WindSeeG, existing projects are considered to be those for which a plan was drawn up or approval was issued prior to 1 August 2016 under Section 5 or 17 of the Offshore Installations Regulation [Seeanlagenverordnung], for which an approval is available under the Federal Immission Control Act, or for which a discussion meeting has been conducted and the installations are planned in specific clusters (cf. Section 3(1) WindSeeG). This distinction has a particular impact on the prescribed expansion trajectory (see

Table 3.7), the tender volume and the bidding deadlines (see Table 3.6), the highest bid values (see Table 3.12) and the security to be deposited (see Table 3.13) and the requirements for bids, Section 20 or Section 31 WindSeeG.

Calls for tender for areas that have undergone preliminary investigations are preceded by land development (Section 9 et seqq. WindSeeG) on the basis of a land development plan (Section 4 et seqq. WindSeeG). Areas under consideration will firstly be identified, and the designated areas will be examined with regard to their suitability. The results of the preliminary examination also serve as a basis for potential bidders

to calculate their bid in respect of areas that have undergone a preliminary investigation.

It is important to emphasise, both for calls for tender for areas that have undergone preliminary investigations and for existing projects, that the legal consequence of a contract goes beyond the entitlement to the market premium. In both tender variants, an entitlement is also created for the connection of the successful installation to the specified connection line. In the case of installations that participate in calls for tender for areas that have undergone preliminary investigations, the relevant connection line is identified (in accordance with Section 24(1), point 3 WindSeeG) from the land development plan within the meaning of Chapter 1 of the Offshore Wind Energy Act. By way of contrast, existing projects must be guided by the offshore network development plan (Sections 17b and 17c EnWG), Section 37(1), point 2 WindSeeG.

In accordance with Section 24(1), point 1 WindSeeG, a right to conduct a planning approval procedure in respect of the land for which the contract has been awarded is moreover justified for bidders who have been successful in calls for tender for areas that have undergone preliminary investigations.

Supported direct marketing outside of the tendering system

New installations that do not participate in calls for tender on the grounds of an exemption, existing installations and hydropower and geothermal installations will also continue to be supported under the established system of direct marketing by means of the market premium. This means that the reference value is in each case defined by law. Any amendments adopted since the introduction of the Renewable Energy Sources Act 2017 are presented below for each technology.

The gradual decrease in the values to be invested will be maintained and is regulated on a technology-specific basis in Section 40 et seqq. EEG 2017 in connection with the relevant provisions for the values to be invested. The detailed provisions in this area increase the level of clarity.

Solar

The provisions relating to the values to be invested in solar installations within the framework of supported direct marketing have not significantly changed in terms of content following the entry into force of the Renewable Energy Sources Act 2017. The provisions relating to the ‘flexible cap’ in Section 31 EEG 2014 have now been moved to Section 49 EEG 2017 and were amended by the Omnibus Energy Act. One significant change that has occurred since the entry into force of the Renewable Energy Sources Act 2017 is that installations whose reference value is determined within the framework of calls for tender (including installations supported by means of special calls for tender) no longer influence the degression for non-tendered installations. The basic degression of the reference value (0.5% per month) has applied since 21 December 2018 from an extrapolated annual increase of over 1 700 MW to

1 900 MW (previously over 2 300 MW to 2 500 MW). The intervals of the expansion quantities and degression values below and above these values were not modified.

Table 3.14: Values to be invested in solar, from 1 January 2017 to 1 April 2019, Sections 48, 49 EEG 2017.

Commissioned from	Values to be invested in ct/kWh for installed capacity up to				Degression with respect to the reference value for the previous calendar month
	Solar installations affixed to, on or in buildings			Ground-mounted solar installations	
	10 kW	40 kW	750 kW	10 MW	
1 January 2017 – 1 April 2017	12.70	12.36	11.09	8.91	0.00%
1 May 2017	12.67	12.33	11.06	8.89	0.25 %
01 June 2017	12.64	12.30	11.03	8.87	0.25 %
01 July 2017 – 01 July 2018	12.60	12.27	11.01	8.84	0.25 %
01 August 2018	12.48	12.14	10.90	8.75	1.00 %
01 September 2018	12.35	12.02	10.79	8.67	1.00 %
01 October 2018	12.23	11.90	10.68	8.58	1.00 %
01 November 2018	12.11	11.78	10.57	8.49	1.00 %
01 December 2018	11.99	11.67	10.47	8.41	1.00 %
01 January 2019	11.87	11.55	10.36	8.33	1.00 %
01 February 2019	11.75	11.43	9.87	8.24	1.00 %
01 March 2019	11.63	11.32	9.39	8.16	1.00 %
01 April 2019	11.51	11.21	8.90	8.08	1.00 %

Gradual reduction of the reference value after exceeding 2 500 MW (until the end of 2018) or 1 900 MW (from 2019 onwards) by specific amounts in the range 1% to 2.8%, Section 49(2) EEG 2017
Gradual decrease in the reduction of the reference value after failing to reach specific growth values from 200 MW, in the range 0.25% to 0%, Section 49(3), points 1 and 2 EEG 2017; From a failure to reach 800 MW in combination with a one-off increase of the reference value to 1.5% or 3%, Section 49(3), points 3 and 4 EEG 2017.
The reference value is zero if 52 000 MW capacity from solar is increased, Section 49(5) EEG 2017
Payment period: 20 years plus start-up year

Onshore wind

The reference yield model, which was already adjusted in the Renewable Energy Sources Act 2014, takes into consideration the different characteristics of locations and is intended, over the period during which the higher initial payment is made, to offset financial disadvantages at locations with low levels of wind; it was carried over to the Renewable Energy Sources Act 2017 and continues to prevent over-subsidisation at locations with high levels of wind. From 2019 onwards, however, the reference value will be calculated by the system operator by way of analogy to the principles of the one-stage reference yield model in accordance with Section 36h EEG 2017 (Section 49b EEG 2017).

The decrease in the reference value formerly defined in Section 29 EEG 2014 has been moved to Section 46a EEG 2017, and has not been amended since 1 January 2017. A relatively significant degression in the reference value took place in the period between 1 October 2017 and 1 October 2018. The provisions of Section 46a EEG 2017, which applied to onshore wind power installations commissioned until 2018, were intended to slow down further growth in the short term, since the specified expansion corridor for onshore wind was considerably exceeded again in 2016 and 2017. Past developments indicate that the ‘flexible cap’ established for the first time under the Renewable Energy Sources Act 2014 was unable to achieve an adequate volume steering effect, which might be attributable to the fact that the values did not sufficiently reflect the cost-cutting potential and low-interest situation. The Renewable Energy Sources Act 2017 improved this control mechanism, which is suitable in and of itself, in order to be able to ensure a return to the expansion trajectory. This was also necessary for this period because the steering effect based on the tender volume is only applicable to installations constructed in 2018/2019. Since 2019, the reference value for onshore wind energy has been determined pursuant to Section 46b EEG 2017 and is calculated by the system operator on the basis of the previous year’s tender outcomes.

Table 3.15: Values to be invested for onshore wind, from 1 January 2017 to 1 October 2018, Sections 46-46b EEG 2017.

Commissioned from	Values to be invested in ct/kWh		Degression in respect of the reference value for the previous calendar month
	Basic value, Section 46(1) EEG 2017	**Initial value*, Section 46(2), sentence 1 EEG 2017**	
1 January 2017**	4.66	8.38	
01 March 2017	4.61	8.29	1.05%***
01 April 2017	4.56	8.20	1.05%***
1 May 2017	4.51	8.12	1.05%***
01 June 2017	4.47	8.03	1.05%***
01 July 2017	4.42	7.95	1.05%***
01 August 2017	4.37	7.87	1.05%***
01 October 2017	4.27	7.68	2.40%****
01 January 2018	4.17	7.49	2.40%****
01 April 2019	4.07	7.31	2.40%****
01 July 2018	3.97	7.14	2.40%****
01 October 2018	3.87	6.97	2.40%****
From 2019, the reference value is based on tender outcomes (from 2017 for values to be invested in 2019, from 2018 for values to be invested in 2019, etc.), Section 46b EEG 2017 (Calculation of the reference value by way of analogy to Section 36h: **one-stage** reference yield model, contract award value is replaced with the average of the bid values for the highest successful bid after the bidding deadlines from the year before last)			
2019		4.63	
2020		6.29	
*The increased initial value applies for five years. Pursuant to Section 46(2), sentence 2 EEG 2017, this period is extended by one month for each 0.36% of the			

reference yield by which the installation's yield falls short of 130% of the reference yield; plus a one-month extension for each 0.48% of the reference yield by which the installation's yield falls short of 100% of the reference yield; (The reference yield is the yield calculated for the reference installation, cf. Annex 2 to the Renewable Energy Sources Act 2017 of 31 December 2016, Section 46(2), sentence 4 EEG 2017)
**Values to be invested pursuant to Section 46(1) and (2) EEG 2017
***Basic degression pursuant to Section 46a(1) EEG 2017
****Values to be invested pursuant to Section 46a(2) and (3) EEG 2017: Gradual increase in the reduction of the reference value after failing to reach specific growth values, in the range 0.5% to 2.4%.
Payment period: 20 years plus start-up year

Biomass

The respective values to be invested for electricity from biomass within the meaning of the Biomass Regulation and from the fermentation of biowaste and slurry have likewise decreased as a result of the degression that continues to apply. Since adoption of the Renewable Energy Sources Act 2017, the increase has been managed solely via tender volumes; this prevents a deviation from the expansion trajectory for biomass (increase of 150 MW per year up to 2019).

Table 3.16: Value to be invested for biomass, fermentation of biowaste and slurry, from 1 January 2017, Sections 42 to 44a EEG 2017.

Commissioned from	**Values to be invested in ct/kWh for installed capacity up to**						
	Biomass				**Fermentation of biowaste**		**Fermentation of slurry**
	150 kW	**500 kW**	**5 MW**	**20 MW**	**500 kW**	**20 MW**	**75 kW**
01 January 2017	13.32	11.49	10.29	5.71	14.88	13.05	23.14
01 April 2017	Degression by 0.5% in each case on 1 April and 1 October of the year, Section 44a EEG 2017						

01 April 2019	13.19	11.38	10.19	5.65	14.73	12.92	22.91
Payment period: 20 years plus start-up year							

Landfill gas and sewage treatment gas

The uniform rules on the values to be invested and their degression for landfill gas and sewage treatment gas (and mine gas) set out in Section 41 EEG 2017 have not been amended since the adoption of the Renewable Energy Sources Act 2017. The values to be invested take into account the previous degression. They are still subject to an annual degression of 1.5% in comparison with the values to be invested in the preceding calendar year in each case.

Table 3.17: Value to be invested for landfill gas, sewage treatment gas and mine gas, from 1 January 2017, Section 41 EEG 2017.

Commissioned from	**Values to be invested in ct/kWh for installed capacity up to**						
	Landfill gas		**Sewage gas**		**Mine gas**		
	500 kW	**5 MW**	**500 kW**	**5 MW**	**1 MW**	**5 MW**	**over 5 MW**
01 January 2017	8.17	5.66	6.49	5.66	6.54	4.17	3.69
01 January 2018	Annual degression of 1.5%, Section 41(4) EEG 2017						
01 January 2019	7.93	5.49	6.30	5.49	6.35	4.05	3.58
Payment period: 20 years plus start-up year							

Offshore wind

The provisions relating to the legally stipulated payment for offshore wind have not been amended since the adoption of the Renewable Energy Sources Act 2017. The provisions on legitimate expectations pursuant to Section 47(1), sentence 2 EEG 2017 continue to apply. The values to be invested have been lowered further pursuant to Section 47(5) to (7) EEG 2017.

Table 3.18: Values to be invested for offshore wind, from 1 January 2017, Section 47 EEG 2017.

Year of commissioning	**Values to be invested in ct/kWh**				
	Basic value, Section 47(1), sentence 1 EEG 2017	**Initial value*, Section 47(2), sentence 1 EEG 2017**	Degression of the values to be invested pursuant to Section 47(2) and (3), sentence 2 EEG 2017 with respect to the previous year in ct/kWh	**Payment at start**, Section 47(3) EEG 2017**	Degression of the reference value pursuant to Section 47(3), sentence 1 EEG 2017 with respect to the previous year in ct/kWh
2017	3.90	15.40		19.40	
2018	3.90	14.90	0.5	18.40	1.0
2019	3.90	14.40	0.5	117.40	1.0
2020	3.90	13.40	1.0	17.40	

*The increased initial value is granted for the first 12 years from the commissioning of the installation. It is extended by 0.5 months for every full nautical mile beyond 12 nautical miles and for every additional full metre of water depth beyond a water depth of 20 metres.

**This increased value is granted for the first eight years from commissioning upon request by the operator of the installation. It can be extended in the amount of 15.40 ct/kWh, by way of analogy to Section 47(2), sentence 2 EEG 2017.

Payment period: 20 years plus start-up year

Hydropower

The reference value for hydropower is determined in Section 40 EEG 2017 and has not been altered since the adoption of the Renewable Energy Sources Act 2017. It continues to be subject to an annual degression of 0.5% in comparison with the reference value for the preceding calendar year in each case.

Table 3.19:Value to be invested for hydropower, from 1 January 2017, Section 40 EEG 2017.

Commissioned from	Values to be invested in ct/kWh for installed capacity up to						
	500 kW	2 MW	5 MW	10 MW	20 MW	50 MW	over 50 MW
01 January 2017	12.40	8.17	6.25	5.48	5.29	4.24	3.47
01 January 2018	Annual degression of 0.5%, Section 40(5) EEG 2017						
01 January 2019	12.28	8.09	6.19	5.43	5.24	4.20	3.44
Payment period: 20 years plus start-up year							

Geothermal

The legally stipulated reference value for geothermal energy remains the same at 25.20 ct/kWh (Section 45(1) EEG 2017). The envisaged degression of 5% only comes into effect from 1 January 2021 and is regulated in Section 45(2) EEG 2017, without any amendments.

Table 3.20:Value to be invested for geothermal, from 1 January 2017, Section 45 EEG 2017.

Commissioned from	Value to be invested in ct/kWh
1 January 2017-	25.20
from 2021	Annual degression of 5 % pursuant to Section 45(2) EEG 2017
01 January 2021	23.94
Payment period: 20 years plus start-up year	

Reduction in the funding entitlement

The reference value may be reduced in certain cases, and sometimes even retrospectively. The provisions of Chapter 5, Section 51 et seqq. EEG 2017 on the prerequisites and breaches of obligation that may lead to a reduction in the reference value to 'zero' remain essentially unchanged in terms of content (for further substantive details, see Chapter 3.0.2 of the 2017 Progress Report). Only minor adjustments have been made. For example, the applicability of Section 53 EEG 2017 has been widened to include the landlord-to-tenant electricity supplement introduced for the first time in mid-2017; the feed-in payment has also been reduced.

Section 53b EEG 2017 continues to provide for a reduction in the reference value of 0.1 ct/kWh in respect of the use of regional certificates in accordance with Section 79a EEG 2017 for electricity from installations which is sold outside the tendering system within the framework of supported direct marketing. The rule is intended to prevent over-subsidisation on the basis of anticipated additional revenues on account of the use of regional certificates.

The reduction in the reference value pursuant to Section 53c EEG 2017 by the electricity tax exemption granted for a kilowatt-hour of electricity routed through the grid continues to apply, and is intended to avoid over-subsidisation in a situation where an operator benefits from both an electricity tax exemption and funding under the Renewable Energy Sources Act for the kilowatt-hour of electricity.

The (retrospective) reduction in the reference value in the event of breaches of obligations pursuant to the list set out in Section 52 EEG 2017 was only expanded to include the newly added Section 9(8) EEG 2017. The provisions of Section 9(8) EEG 2017 were adopted with a view to ensuring needs-oriented night identification of onshore wind power installations, taking into account the transitional provisions that are necessary under constitutional law for all wind power installations; they therefore apply on a mandatory basis to both existing and new installations.

The provisions on operators of installations whose entitlement has been determined on the basis of calls for tender and who use a proportion of it for own consumption also remain largely unchanged (see Section 27a EEG 2017). In the event of feed-in management measures in accordance with Section 14 EEG 2017 and in times of negative electricity power exchange prices within the meaning of Section 51 EEG 2017, the electricity may still be used upstream of the system feed-in point. By means of these exemptions, the Renewable Energy Sources Act 2017 facilitates the development of meaningful concepts for utilisation of volumes of electricity that are surplus to requirements from the system or market perspective, upstream of the system feed-in point. This electricity might otherwise not be produced as a result of cur-

tailment. This result is consistent with the principle that electricity from renewable energy sources must be used as comprehensively and efficiently as possible.

Regional certificates

The provisions on the use of regional certificates pursuant to Section 79a EEG 2017 (for further substantive details, see Chapter 3.0.2 of the 2017 Progress Report) continue to apply without changes, with the exception of provisions regarding the administrative procedure (§ 79a(11) EEG 2017).

Landlord-to-Tenant Electricity Act

The Landlord-to-Tenant Electricity Act entered into force on 25 July 2017 (for further substantive details, see Chapter 3.0.2 of the 2017 Progress Report). Its aim is to promote involvement on the part of tenants and attainment of the expansion trajectory for solar installations. In future, it should accordingly be possible to claim separate funding for electricity supplied to tenants from new solar installations. The coalition agreement contains a commitment to optimise the rules on landlord-to-tenant electricity, and these rules were evaluated in 2019.

Based on current experience, the promotion of landlord-to-tenant electricity is not associated with significant additional (financial) costs for reallocation systems and network charges. The growth of (solar) landlord-to-tenant electricity projects under the Landlord-to-Tenant Electricity Act is well below the statutory cap of 500 MW per calendar year pursuant to Section 23b(3) EEG 2017, even though the pace of growth has increased slightly. In 2017, for example, 88 landlord-to-tenant electricity projects were installed, totalling just under 2.2 MW (0.36 MW per month); between July 2017 and the end of 2018, 314 projects with a total capacity of around 6.6 MW (0.55 MW per month) were installed.

Following the addition of Section 23b(1), sentence 2 EEG 2017, calculations of the landlord-to-tenant electricity supplement for operators of solar installations pursuant to Section 21(3) EEG 2017 with an installed capacity of over 40 kW in the capacity class above 40 kW were adjusted with effect from 1 January 2019. The deduction is now only 8 ct/kWh (previously 8.5 ct/kWh). This adjustment was carried out with a view to alleviating the effects on the landlord-to-tenant electricity supplement of the reduction in the reference value for solar installations pursuant to Section 48(2), point 3 EEG 2017 (cf. Table 3.14). This does not affect the reduction in the landlord-to-tenant electricity supplement pursuant to Section 53, sentence 1, point 2 EEG 2017.

The supplement is granted solely in respect of installations that have been or will be commissioned upon or after the entry into force of the Landlord-to-Tenant Electricity Act (25 July 2017). The European Commission issued an approval under State aid law for the funding of landlord-to-tenant electricity under the Renewable Energy Sources Act on 20 November 2017.

Funding for support via the levy under the Renewable Energy Sources Act

The provisions on the levy under the Renewable Energy Sources Act are intended to distribute the costs incurred in connection with promoting the production of electricity from renewable energies. In keeping with the principle of solidarity, the levy is initially applied to each final consumption of electricity. Moreover, the partial exemption from this burden for certain concepts or stakeholders (unlike in the case of direct support) means that energy policy and industrial policy goals can be pursued in terms of real-location. The privileges in the sector of own consumption and special equalisation schemes for heavy electricity consumers have remained essentially unchanged since the adoption of the Renewable Energy Sources Act 2017.

Own supply

End consumption for own supply (Section 3(19) EEG 2017) is essentially subject to an obligation to pay the levy under the Renewable Energy Sources Act in the full amount, just like any other electricity consumption in Germany (Section 61(1), point 1 EEG 2017). As the expansion of renewable energies is a mission for all of society and the burden should be distributed uniformly across all electricity consumers, in principle the levy under the Renewable Energy Sources Act should be applied to every kilowatt-hour of electricity consumed in Germany, regardless of its origin. Moreover, externally supplied end consumers should not be disadvantaged with re-spect to end consumers who produce their own electricity. Instead, the aim is to achieve a ‘level playing field’ consistent with the key importance of the energy-only market for efficient implementation of the energy transition (cf. Electricity Market Act). Distortions of competition and disincentives (such as the price-inelastic ‘passing through’ of conventional own supply power plants, to the detriment of production from renewable energy sources) are to be avoided.

However, under the Renewable Energy Sources Act 2017, own supply arrangements continue to be privileged in terms of the levy if the electricity is produced from renew-able energy sources. There has thus been a steady growth in own supply under the Renewable Energy Sources Act 2014 and the Renewable Energy Sources Act 2017.

The full exemption of end consumers with existing installations and old existing in-stallations from the obligation to pay the levy under the conditions of Section 61f EEG 2017 was kept in place for the purpose of safeguarding the existing stock, and continues to account for the bulk of the special rules in terms of the volume of ex-emptions. These existing installations relate in particular to traditional industrial and commercial own production, which was estimated at approx. 63 TWh/year in Germa-ny in 2017 (cf. Prognos ‘Evaluation of the special equalisation schemes and the ex-emption from the levy for own-production electricity and electricity use under the Re-newable Energy Sources Act, Key outcomes of the project’, Berlin, 10 May 2019).

Special equalisation schemes

The provisions on the 'special equalisation schemes', under which heavy electricity consumers only need to pay a reduced levy under the Renewable Energy Sources Act, have not been modified since the entry into force of the Renewable Energy Sources Act 2017 (for further substantive details, see Chapter 3.0.2 of the 2017 Progress Report).

3.0.2 Renewable Energies Heat Act

The Renewable Energies Heat Act, which entered into force on 1 January 2009 and was amended at the beginning of 2011 on the basis of the Act transposing Directive 2009/28/EC on the promotion of the use of energy from renewable sources (*inter alia* by expanding its scope from 'heating' to 'heating and cooling'), primarily addresses the supply of heating and cooling in new builds through an obligation to use renewable energies. In accordance with Section 1(2) EEWärmeG, the aim of the Act is to help increase the share of renewable energies in final energy consumption for heating and cooling in Germany to 14% by 2020. This figure had already reached 14.2% by the end of 2018. In accordance with Section 18, the Federal Government regularly submits a progress report in relation to this Act. The progress reports for the Renewable Energies Heat Act (most recent: second progress report of 18 November 2015) examine the status of the market introduction of installations for the generation of heating and cooling from renewable energies, the technical developments, cost trends and economic viability of these installations, the quantities of fossil fuels saved as a result of the Act and the associated GHG emission savings. The enforcement experiences of the federal states with respect to the Act are also presented and recommendations made for the further development and future design of the Renewable Energies Heat Act, *inter alia* for alignment of the Act with other instruments of the heating market (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety [Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, BMU], 2012; BMWi, 2015).

It is envisaged that the provisions of energy saving legislation for buildings will be amended during this legislative period, and that the requirements of the Energy Savings Act, the Energy Savings Regulation and the Renewable Energies Heat Act will be merged in a new Buildings Energy Act. The draft Buildings Energy Act is currently passing through the parliamentary legislative procedure. It will integrate energy efficiency and renewable energies into a uniform system of requirements.

3.0.3 Market Incentive Programme for the promotion of renewable energies in the heating market

The Market Incentive Programme for the promotion of renewable energies in the heating market (MAP) has for many years been a key instrument used by the Federal Government to promote the use of renewable energies in the heating and cooling

sector, and has been enshrined in the Renewable Energies Heat Act since 2009 (Section 13 Funding). While the regulatory approach of the Renewable Energies Heat Act targets new builds, the financial support under the MAP is aimed primarily at existing buildings.

Details of the MAP funding are set out in the funding guidelines. These 'Guidelines for the funding of measures for the use of renewable energies in the heating market' are adapted as and when necessary to reflect the state of technology and changes in the market. The programme includes two funding sections. For solar thermal installations, heat pumps and biomass installations in the relatively small capacity range, investment grants are awarded by the Federal Office of Economics and Export Control. Larger installations and heating networks and storage facilities are supported under the KfW Renewable Energies (Premium) programme with repayment grants for early, proportionate repayment of low-interest loans from the KfW.

The MAP was last amended in 2015, and the new version of the funding guidelines has been in force since 1 April 2015. The funding was extended, improved and scaled to an even greater extent according to the efficiency of the supported installations. New funding options were also created, such as yield-dependent support for solar thermal installations and funding for particularly efficient heat pumps in new builds. The amendments also opened the programme up to the commercial sector to an even greater extent.

In the funding years 2017 and 2018, total funds of around EUR 467 million were paid out under the two funding sections of the MAP (BAFA, KfW), meaning that an estimated investment volume of roughly EUR 2 billion was released. Specifically, in 2017 and 2018 investment subsidies of approximately EUR 392 million for 108 100 renewable heating installations were disbursed from the grant section of the MAP (BAFA), primarily to private individuals in one-family and two-family dwellings. Furthermore, in 2017 and 2018 a lending envelope of approximately EUR 214 million was value-dated under the section of the MAP managed via the KfW in connection with repayment grants amounting to around EUR 75 million, for a total of 3 341 installations. Applications were also submitted for 3 846 new installations.

3.0.4 KfW support programmes for energy-efficient construction and renovation (CO_2 Building Renovation Programme)

The KfW support programmes for energy-efficient construction and renovation are funded by resources from the CO_2 Building Renovation Programme and are an essential component of energy saving in the buildings sector. The support programmes are targeted at all owners of residential buildings, commercial buildings and buildings housing municipal and social bodies (owner-occupiers, private landlords, commonhold associations, housing associations, municipalities, municipal and social organisations and commercial companies). Support is provided for energy improvements – both individual measures (insulation, replacement of windows, upgrading of heating

systems) and major renovations – and the construction of new energy-efficient buildings. The levels of support go far beyond the requirements of the Energy Savings Regulation. The principle followed is that the more energy-efficient the building, the greater the level of support.

Support is provided mainly through low-interest loans, which can also be combined with a repayment grant of up to 27.5% of the amount of the loan depending on the level of energy efficiency. Alternatively, private owners of one- and two-family dwellings or owners of flats (owner-occupiers and landlords) can also receive a one-off grant for up to 30% of the investment costs incurred in connection with energy improvements to residential buildings.

Low-interest loans help to reduce the financial costs, and grants help to reduce the investment costs. The support also benefits tenants, since it reduces the apportionable costs (modernisation levy).

The funds for the CO_2 Building Renovation Programme were kept at the same level up to 2018 and topped up to EUR 2 billion in 2019.

Between 2006 and the end of 2018, the funding has supported the energy-efficient renovation or construction of over 5.3 million homes with an investment volume of around EUR 350 billion. Furthermore, since 2007, support has been provided for energy-saving measures in more than 8 200 buildings that form part of the commercial, social and municipal infrastructure. The investments supported since 2006 have helped to reduce CO_2 emissions by around 10.9 million tonnes per year (calculation based on an average use period of the measures of 30 years).

A new KfW programme for the promotion of energy improvements and the construction of new commercial buildings was launched on 1 July 2015. Since 1 October 2015, support has been provided not only for energy improvements but also for the construction of new energy-efficient buildings for municipal and social bodies.

3.0.5 Energy Efficiency Incentive Programme

As an alternative to the fiscal support planned under the NEEAP, since 2016 federal funds totalling EUR 165 million per year have been provided to the Energy Efficiency Incentive Programme. The Energy Efficiency Incentive Programme consists of three investment support components and is aimed not only at boosting energy efficiency measures in the buildings sector and investment in installations that use renewable energy to generate heat, but also at promoting the market launch of fuel cell heating.

The energy efficiency measures in the buildings sector are funded as package measures under the KfW ‘Energy-efficient renovation’ programmes. The package measures cover the installation of ventilation systems (ventilation package) combined with measures for renovation of the building envelope and the replacement of inefficient heating systems with efficient ones (heating package); this includes measures for optimisation of the heating system (heating and heat distribution). For owners of residential buildings, either a loan or a subsidy variant are available. In the

case of the loan variant, a low-interest loan combined with a repayment subsidy of 12.5% is granted. The amount of the alternative investment subsidy is 15.0% of the investment costs.

If a heating system based on renewable energies is installed, for example a pellet heater, a heat pump or a solar thermal installation, the Energy Efficiency Incentive Programme is linked to the MAP. If the prerequisites for the heating package are met, additional support totalling 20% of the normal MAP funding amount is possible for the installation of the new heating system. In addition, there is a one-off payment of EUR 600 for the simultaneous optimisation of the entire heating system. This additional support can be applied for by private households, companies, freelancers, municipalities and other legal persons under private law within the framework of a MAP application.

The market launch of innovative fuel cell heating systems for new builds and existing buildings has been supported since August 2016 via the KfW programme 'Energy-efficient construction and renovation – fuel cell subsidy'. Owner-occupiers, common-hold associations of private individuals, freelancers, domestic and foreign companies, contractors, municipalities, municipal companies and municipal special-purpose associations, non-profit organisations and churches that install fuel cell heating systems in a residential or non-residential building are eligible to apply for this support. For fuel cell heating systems with an electrical capacity of 0.25 to 5.0 kilowatts, it is possible to apply for a subsidy in the amount of up to EUR 28 200, depending on the capacity.

In 2017 and 2018, around 21 700 funding commitments (for the heating package bonus via the Energy Efficiency Incentive Programme) were issued under the MAP for heating systems based on renewable energies.

3.0.6 Funding Programme for Heating Optimisation

The Funding Programme for Heating Optimisation supports the replacement and installation of highly efficient 'circulating pumps' for heating or hot water supply systems in the buildings sector; it also supports hydraulic balancing of the heating system and supplementary low-investment measures. Measures that are eligible for support must be carried out by a specialist company and documented with an invoice. This is a low-threshold funding mechanism under the Buildings Energy Programme that is open to a broad target audience. The programme was launched on 1 August 2016 and will run until the end of 2020 (according to current plans). To date, over 160 000 pump replacements, over 30 000 hydraulic balancing measures and over 50 000 accompanying measures have been funded.

3.0.7 Energy Savings Regulation

More stringent requirements for new builds came into force on 1 January 2016. It is envisaged that the provisions of energy saving legislation for buildings will be amended during this legislative period, and that the requirements of the Energy Sav-

ings Act, the Energy Savings Regulation and the Renewable Energies Heat Act will be merged in a new Buildings Energy Act. The draft Buildings Energy Act is currently passing through the parliamentary legislative procedure. It will integrate energy efficiency and renewable energies into a uniform system of requirements.

3.0.8 National efficiency label for old heating systems

The EU's energy consumption labelling scheme for heating appliances, water heaters and boilers in accordance with Regulations (EU) No 811/2013 and No 812/2013 became mandatory from September 2015 onwards. It applies only in respect of products that are newly placed on the market. To date, the EU rules have not addressed the efficiency potential of existing products. The aim of the national regulations is to increase the motivation of building owners to replace old and inefficient heating appliances, thereby accelerating the replacement rate for old boilers. The transition from an old and inefficient heating system to efficient technologies and renewable energies requires sufficient notice for planning, and this is why building owners have to be encouraged to do so in good time; by the time that the old heating system fails, there is usually too little time to make the switch to renewable energies. This problem can be remedied by the national heating label scheme, which prompts owners to purchase a new boiler even if they do not need to repair or replace it.

From 1 January 2016, the new efficiency label for old heating systems will gradually be affixed to boilers that are more than 15 years old. The aim of the scheme is to provide consumers with information about the efficiency status of their heating appliances and the channels via which they can apply for energy consultations and funding. Heating engineers, chimney sweeps and certain energy consultants are authorised to affix the labels as from 2016; from 2017 onwards, it is obligatory for district chimney sweeps to affix the labels after inspecting a fireplace.

The labelling process will take place over a period of eight years in order to ensure that the demand created thereby for energy consultations and heating improvements is distributed evenly. The efficiency label for old heating systems is intended to be used up to a rated capacity of 400 kW (one-family or two-family dwellings through to the construction of large multi-storey residential buildings). The efficiency class of the boiler can be determined in a straightforward way using a publicly available calculator (online and app versions), without having to take measurements or make calculations. The legislative process for the national efficiency label for old heating systems was completed in November 2015 by means of amendments to the Energy Consumption Labelling Act [Energieverbrauchskennzeichnungsgesetz, EnVKG].

3.0.9 Measures under building and spatial planning law – amendments to the Federal Building Code [Baugesetzbuch, BauGB]

Germany has also stepped up its climate action efforts under planning law. The Act to strengthen urban development in towns and municipalities and to further enhance

town planning law of 11 June 2013 entered into force on 20 September 2013. These amendments were aimed at strengthening urban development in towns and municipalities under the Federal Building Code and adapting the Regulation on Land Use [Baunutzungsverordnung, BauNVO]. However, a number of the changes also related to climate action:

Simplification of the granting of approvals for biogas installations under planning law

The privileged treatment of biogas production installations on white land is no longer linked to the combustion heat output, but only to the capacity of an installation to generate a maximum of 2.3 million standard cubic metres of biogas per year. This allows more flexible operation of the installations to compensate for fluctuations in other sources of renewable energy.

Climate protection and climate adaptation as a catalyst for urban redevelopment measures

In addition to other shortcomings in the field of urban planning, since 2013 the failure to adequately address the requirements of climate protection and adaptation has served as a catalyst for urban redevelopment measures. Explicit identification of climate protection and adaptation issues as grounds for urban redevelopment measures means that the construction of renewable energy installations can be included as one of the measures in the redevelopment area, for example (Section 136(2), sentence 2, point 1 BauGB).

Granting of approvals for photovoltaic and solar thermal installations and cogeneration installations in urban areas

Subsidiary ancillary installations for the use of solar radiation energy in and on roofs and outside walls of buildings in urban areas are now also explicitly permitted under planning law as ancillary installations pursuant to Section 14(1), sentence 1 BauNVO even if all or most of the energy produced is fed into the public grid (commercial use). Cogeneration installations benefit from the same classification, albeit with an elucidatory effect only and for reasons of equal treatment with solar installations. They were previously included as part of the building or under Section 14(1) BauNVO. The amendments to the Federal Building Code and the Regulation on Land Use during the reporting period did not relate to renewable energies.

In addition, the Act establishing a flexibility clause for the federal states on the stipulation of minimum distances between wind power installations and permitted uses of 15 July 2014 also entered into force on 1 August 2014. For a limited period (up until 31 December 2015), it gave the federal states the authority to make eligibility for privileged treatment under planning law for wind power installations on white land dependent on compliance with certain distances from permitted building uses named

in federal state law. The amendments made possible the adoption of specific rules by the individual federal states on the distances between wind power installations and other permitted uses, such as residential development, thus helping to make planning law more flexible.

Federal Government/Federal State Initiative on Wind Energy

In its Energy Concept adopted in September 2010, the Federal Government undertook to work together with the federal states to launch an initiative to earmark new sites for wind power installations based on modifications to spatial development plans, and to identify and further develop approaches allowing the use of wind energy to be expanded while safeguarding nature and the environment and promoting acceptance among the population. Since May 2011, representatives of the Federal Government and the federal states have therefore been meeting regularly within the framework of the Federal Government/Federal State Initiative on Wind Energy to exchange information and experiences. Current problems associated with the expansion of onshore wind energy are addressed, and possible solutions are discussed.

3.0.10 Federal Requirements Plan Act

The Federal Requirements Plan Act lists conversion and expansion projects which are required by the energy industry and for which an urgent need exists with a view to ensuring safe and reliable operation of the transmission system.

The cross-border and transnational extra-high-voltage lines play a key role and are identified accordingly. These account for 16 of the current total of 43 projects in accordance with the Federal Requirements Plan Act. The Grid Expansion Acceleration Act then applies to these projects during the subsequent stages of the process.

Other projects that are identified include pilot projects which are possible under the Federal Requirements Plan Act and on the basis of which the system operators can trial the use of new technologies (high-voltage direct current transmission (HVDC), high-temperature conductors, underground cables). The HVDC transmission lines that are specially identified as such are to be constructed primarily as underground cables.

3.0.11 Grid Expansion Acceleration Act

The conversion and expansion of the grid infrastructure is essential with a view to ensuring that electricity can be transported from renewable energy installations to consumers. In August 2018, the Federal Minister for Economic Affairs presented the ambitious ‘Electricity Grid Action Plan’, which pursues the goal of accelerating grid expansion through better management and streamlining of planning procedures and at the same time optimising existing grids by means of new technologies and operating concepts. As part of this process, in autumn 2018 the departmental draft of the amendments to the Grid Expansion Acceleration Act was presented (‘Act accelerat-

ing the expansion of power lines'). The Bundestag adopted the Act in April 2019; it entered into force on 17 May 2019.
The amendments to the Grid Expansion Acceleration Act and the accompanying changes to other acts, in particular the Energy Industry Act, have helped to simplify and accelerate planning and approval procedures for new buildings and to reinforce and optimise power lines. For example, the interlinking of the various planning stages has been improved (with the omission of individual planning stages in certain cases), a uniform legal framework for the payment of compensation to land owners affected by the grid expansion has been created, and system operators have been provided with an opportunity to carry out anticipatory planning under certain circumstances through the laying (where appropriate) of empty cable conduits. The latter approach makes it possible to avoid multiple interventions and extra procedures, and to establish a needs-oriented electricity grid with a long-term perspective on the way to an electricity supply based wholly on renewable energies.
Despite the streamlining of procedures, the consideration and weighing up of private and public concerns and the existing protection and precautionary standards will remain unchanged in respect of electric and magnetic fields. Environmental standards have not been watered down.

Federal Sectoral Plan and Federal Grid Plan

As a result of the Grid Expansion Acceleration Act, it has been possible since 2011 for the planning and approval procedures for cross-border and transnational extra-high-voltage lines to be conducted by the Federal Network Agency with a view to accelerating the expansion of these lines.

The procedure is divided into two stages: in the first of these stages, route corridors in which the lines are later to run are defined in the Federal Sectoral Plan. In the second stage (the planning approval procedure), the exact construction of the line in question is planned. Through the Regulation on the Allocation of Planning Approval, the federal states have transferred the responsibility for the planning approval procedure to the Federal Network Agency. The Federal Network Agency is thus a 'one-stop-shop' for procedures under the Grid Expansion Acceleration Act. The federal states, public interest parties and the general public are involved in all procedural steps.

New provisions in the Grid Expansion Acceleration Act mean that a federal sectoral plan is unnecessary in certain cases, for example when a route is already defined by an existing line, making it possible to accelerate the procedure. Clarification of the notification procedure under the Energy Industry Act and the Grid Expansion Acceleration Act is a further starting point for the streamlining of approval procedures in connection with grid optimisation and grid reinforcement measures.

Grid expansion for offshore wind energy

The organised and economically efficient connection of offshore wind farms will advance the expansion of offshore wind energy. From June 2019 onwards, a Land Development Plan developed by the Federal Maritime and Hydrographic Agency for this purpose will apply. The Land Development Plan sets out a graduated planning and tendering process for offshore wind power installations. It outlines the requirements for a geographically sensible and space-saving expansion of wind energy and for an organised and efficient use and exploitation of offshore connection capacities in step with electricity production. The procedure also complies with the requirements of environmental and nature conservation law. The central model, under which the Federal Maritime and Hydrographic Agency is responsible for carrying out preliminary investigations of areas and the Federal Network Agency is responsible for calls for tender, applies to installations commissioned from 2026. The previous Offshore Federal Sectoral Plan and parts of the previous Offshore Network Development Plan confirmed by the Federal Network Agency will be included in the Land Development Plan.

3.0.12 Energy Industry Act

The Energy Industry Act was amended and supplemented multiple times with effect from 1 January 2016:

By means of the **Electricity Market Act** of 26 July 2016 (Federal Law Gazette I p. 1 786), the aims and basic principles of an enhanced electricity market (‘Electricity Market 2.0’) were incorporated into the Energy Industry Act. These provisions ensure free competitive pricing and allow price peaks on the electricity markets. The provisions relating to balancing group management and to the equalisation energy system are further developed as a key instrument for a secure electricity supply.

The **Electricity Grid Access Regulation** [Stromnetzzugangsverordnung, StromNZV] was also amended to this end. In order to use existing capacities in a more cost-effective and environmentally compatible manner, entry barriers for providers of load management measures and renewable energy installations were removed in the controlled energy market; as a result, the use of flexibility options was facilitated.

The legal bases for a capacity reserve were established in order to ensure security of supply, even under altered conditions on the electricity market. The capacity reserve serves to safeguard the electricity supply. It is used in order to ensure security of supply when – despite free pricing on the electricity power exchange – the supply is not sufficient to enable a balance to be achieved between supply and demand. To that end, capacities are kept available outside of the electricity market and used as required. Finally, improvements were made to the monitoring of security of supply, owing to the vital importance of this latter. The **report on security of supply** on the electricity markets is published at least every two years and also examines the situa-

tion in Germany in the context of the European electricity markets. This takes account of the fact that real synergies are created as a result of the increasing integration of the electricity market into the European electricity markets. Load peaks and production capacities can be equalised much more effectively in the regional grouping, and as a result fewer production capacities overall are required.

In addition, the **regulations on the grid reserve (Grid Reserve Regulation)** were extended beyond 31 December 2017, and the regulations relating to reimbursement of costs were amended. The amendments to the Grid Expansion Acceleration Act (see Section 3.0.11) integrate the grid reserve pursuant to Section 13(1c) EnWG into the redispatch process.

The reorganisation of grid bottleneck management (**redispatch and feed-in management**) in Section 13 EnWG constitutes a particular focus of the amendments to the Grid Expansion Acceleration Act. The provisions on feed-in management that were previously enshrined in the Renewable Energy Sources Act are transferred to the Energy Industry Act, where they join the provisions of that Act on redispatch. The aim of these amendments is to make it possible for system operators to use renewable energies and cogeneration installations as well as conventional power plants to eliminate grid bottlenecks under a uniform regime, ensuring that the process runs more efficiently and cost-effectively in future. The advantage of the revised balancing compensation arrangements (amendments to the Energy Industry Act, Renewable Energy Sources Act and Electricity Grid Access Regulation) is that the balancing group risks arising as a result of the curtailment of renewable energy and cogeneration installations can be appropriately recompensed.

The **Act on Digitalisation of the Energy Transition** of 29 August 2016 (Federal Law Gazette I p. 2 034), provides the legal bases for the economically viable introduction of ‘smart measuring systems’. The previous power to issue statutory instruments under the Energy Industry Act was dropped in favour of a separate Act. The decentralised electricity supply system of the future is characterised by two-way flows of information and electricity, and passive consumers of electricity are increasingly becoming ‘prosumers’ who are actively participating in the design of the electricity supply system. Taken together, these changes have certain implications; in particular, they increase the demands imposed on the measuring and communication technologies and data processing systems to be employed. Smart measuring systems play an important role in this connection. Depending on the exact design, they can provide the consumption information required by end consumers, system operators and producers; they can be used to convey system status data and to support safe and reliable management measures, and they act as a kind of communication platform in the smart energy network. Cross-sectoral use of smart measuring systems is also envisaged, for example in the case of electricity, gas, district heat and heating or in the ‘smart home’ sector. This allows the benefit for consumers to be maximised. Smart measuring systems are however also an instrument for greater energy efficiency. End consumers obtain accurate information about their consumption behav-

iour. Smart measuring systems also enable the implementation of variable tariffs. Platform compatibility and (in particular) manufacturing in accordance with a privacy-by-design standard of the Federal Office for Information Security are the features that distinguish smart measuring systems from conventional systems (‘smart meters’).

For further details of the **Act modernising the network charges structure** (Network Charges Modernisation Act) of 17 July 2017, the **Landlord-to-Tenant Electricity Act** of 17 July 2017 and the **Act of 17 December 2018**[50]**,** see Section 2.b.1.

The **Act accelerating the expansion of power lines** (amendments to the Grid Expansion Acceleration Act, see 3.0.11 above) introduced further legislative measures into the Energy Industry Act aimed at accelerating approval procedures for grid expansion projects.

Sections 111e and 111f EnWG and the **Regulation on the Market Master Data Register**, which is based thereon and entered into force on 1 July 2017, form the bases for the **establishment of a Market Master Data Register**[51] by the Federal Network Agency. The aim is to improve the safeguarding and monitoring of security of supply, in particular the safe operation of energy supply networks and monitoring of security of supply, and to simplify the reporting obligations under energy law by bundling data notifications. This is intended to reduce the red tape associated with data collection and to ensure the availability and quality of historical energy data for a range of stakeholders. The Federal Network Agency operates the Market Master Data Register as an online database that has been fully ready for use since 31 January 2019.

3.0.13 Greenhouse gas quota under the Federal Immission Control Act

Up until the end of 2014, a key funding instrument for biofuels was the biofuel quota. The size and design of the quota system is regulated in the Federal Immission Control Act (Sections 37a to 37g).

Since 2015, this requirement has been changed to a reduction in greenhouse gases. The aim is to promote biofuels with a better GHG performance more heavily so that greater contributions can be made by these fuels to meeting the climate action commitments. From 2015 onwards, parties subject to the relevant obligations must accordingly ensure that the GHG emissions of the fuels that they place on the market (petrol, diesel and biofuels) are reduced in total by a fixed percentage with respect to the fossil reference value. For 2015 and 2016 this was 3.5%, and since 2017 it has been 4%. A further increase to 6% has been decided for 2020 onwards.

[50] Act amending the Renewable Energy Sources Act, the Combined Heat and Power Act, the Energy Management Act and other provisions of energy law of 17 December 2018, Federal Law Gazette I p. 2 549 (No 47).
[51] The Market Master Data Register can be accessed online at www.marktstammdatenregister.de.

Biofuels that have been placed on the market since January 2011 to meet the biofuel quota must continue to meet the sustainability requirements pursuant to the Biofuel Sustainability Regulation.

3.0.14 National Electromobility Platform, Government Electromobility Programme

Alongside the information on the use of renewable energies set out in the NREAP, the Federal Ministry for Economic Affairs and Technology, together with the Federal Ministry of Transport and Digital Infrastructure, the Federal Ministry of Education and Research [Bundesministerium für Bildung und Forschung, BMBF] and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety set up a Joint Unit for Electric Mobility on 1 February 2010, which continues to provide a single point of contact with the Federal Government. The National Electromobility Platform was also set up in 2010. Representatives from industry, research and politics work closely together in this forum. Concrete implementation steps are defined and proposed, with the aim of establishing Germany as the leading market for and the leading provider of electromobility. The National Electromobility Platform consists of a steering group and six working groups with some 20 members each.

Between 2010 and 2012, the National Electromobility Platform presented three important reports (taking stock of developments to date in electromobility in Germany/opportunities for German business and the efforts that the National Electromobility Platform considered necessary for the country to become both a leading market and a leading provider/importance of the showcase projects and the research and development needed in the market preparation phase).

The Government Electromobility Programme of May 2011 picked up on key recommendations from the National Electromobility Platform report and began working on their implementation. In 2014 the National Electromobility Platform published a progress report summing up the market preparation phase, and in 2018 it published a progress report on the market launch phase.

The National Electromobility Platform ended its work on 31 December 2018. The topics examined by the National Electromobility Platform have been transferred to the structures of the National Platform for the Future of Mobility.

3.0.15 Electromobility Act

The Electromobility Act, which entered into force on 12 June 2015, was intended to promote the widespread use of electromobility. It makes it possible to grant priority to electrically operated vehicles (passenger vehicles and light commercial vehicles) with regard to parking, the use of public roads or rights of way intended for specific purposes and the granting of exemptions from access restrictions or through-passage prohibitions by municipalities in local areas. The responsible local authorities can arrange the privileges at their own discretion.

3.0.16 Promotion of sales of electrically powered vehicles (environmental bonus)

With a view to promoting electromobility, since 2 July 2016 it has been possible to apply for a premium for new purchases of electric vehicles[52]. This amounts to EUR 2 000 for a battery-powered electric vehicle or fuel cell vehicle and EUR 1 500 for an externally charged hybrid electric vehicle. The manufacturer of the vehicle must give the buyer a discount of at least the same amount in order for the funding to be granted. Federal funds in the amount of EUR 600 million have been provided for the funding programme (up to June 2019 at the latest). With this level of funding, it should be possible for 300 000 vehicles to be funded. Up to the end of 2018, however, only 91 498 applications had been submitted. The funding guidelines on the environmental bonus were amended in early 2020 with a view to increasing the amounts of funding per vehicle and extending the term until the end of 2025.

3.0.17 Other measures to promote renewable energies

'Energy Networks' Working Groups

Stable system operation and a reliable supply of electricity can only be guaranteed with efficient and modern transmission and distribution systems. Working groups have been set up for the purpose of allowing system operators, institutions at Federal Government and federal state level and associations to work together on solutions relating to modernisation of the electricity grids.

- The System Security Working Group deals with safe grid operation, for example measures to ensure compliance with system balancing in high-wind and low-load situations, or the impacts of increasing transmission distances and quantities on grid stability.
- The Smart Grids and Meters Working Group supports the introduction of smart measuring systems and meters and the modernisation of distribution systems into an efficient and smart grid. Its activities include identifying technical, socio-economic, legal and political framework conditions and determining the areas where action must be taken in order to build a smart grid.

Energy Transition in Buildings Platform

The Federal Government aims to achieve a virtually climate-neutral building stock by 2050. With a view to achieving this goal, on 3 July 2014 the Energy Transition in Buildings Platform was founded (BMWi, 2017d), where relevant interest groups from industry, civil society and research meet with representatives of the federal and re-

[52] Guidelines on the promotion of sales of electrically powered vehicles (environmental bonus) by the Federal Ministry for Economic Affairs and Energy: http://www.bmwi.de/Redaktion/DE/Downloads/B/bekanntmachung-richtlinie-zur-foerderung-des- Abs.es-von-elektrisch-betriebenen-fahrzeugen.pdf.

gional authorities. Current developments are presented and discussed at the sessions. Under the aegis of the two platforms – Buildings and Energy Efficiency (see below) – joint working groups whose preliminary findings and conclusions have a bearing on the work of both platforms regularly convene to discuss the following subjects:

- innovative funding concepts,
- legal framework/EDL,
- competitive tendering,
- system issues,
- support programmes,
- advice and information.

Energy Efficiency Platform

Increasing energy efficiency is a cross-cutting problem that can only be solved by society as a whole. Efforts in this direction are also in the interest of energy consumers, since increasing energy efficiency helps to reduce energy costs to a significant extent. The Energy Efficiency Platform has the remit of developing and discussing joint solutions with relevant stakeholders from industry, civil society, research and the government departments concerned, as well as the federal states (BMWi, 2017a). It is composed of a plenary and various working groups (see above, 'Energy Transition in Buildings Platform') and sits at regular intervals. Among other things, it assists with the development of the National Energy Efficiency Action Plan (NEEAP).

Research and Innovation Platform

The *Energy Transition Research and Innovation Platform* (R&I Platform) brings together high-level stakeholders from the spheres of politics, research, industry and civil society, together with all the government departments concerned at Federal Government and federal state level. They jointly discuss and assess all current developments and research strategies. The *Energy Research Networks* form the technical basis for the Energy Transition Research and Innovation Platform. These open networks of experts have around 3 500 members, and deliver added value through networking that guarantees the quality of research outcomes and serves as a foundation for continuous advances in knowledge and the transfer of practical experience. The eight *Energy Research Networks* represent the broad research landscape, focusing on the topics of bioenergy, buildings and districts, energy efficiency in industry and commerce, energy system analysis, renewable energies, flexible energy conversion and electricity grids. A start-up network has been established with the aim of providing new companies with access to research partnerships and research funding. Another research network for hydrogen is currently at the preparatory stage. The members of the research networks can get involved in shaping energy research policy and lend fresh impetus to the process; for

example, they can help to identify new trends and areas where more research is needed, and the experts can contribute their input within the framework of the broad consultation process under the Seventh Energy Research Programme.

Onshore Wind Energy Agency [Fachagentur Windenergie an Land, FA Wind]

Since 2013, the Onshore Wind Energy Agency has supported the expansion of onshore wind energy use in Germany in a manner that is compatible with nature and the environment by developing cross-sectoral and highly practical analyses and guidance documents and organising information events. It serves as a non-partisan discussion forum for the municipalities, planning associations and representatives of the administration and political structures, as well as other stakeholders such as nature conservation bodies (both government bodies and those operating as associations). The Onshore Wind Energy Agency is organised as an association supported by the Federal Government, the federal states, municipal umbrella organisations, energy companies and civil society organisations.

Energy Transition Research Forum

The ‘Energy Transition Research Forum’ is a dialogue platform allowing representatives of the Federal Government, the federal states, universities and other academic bodies, business and society to discuss key issues relating to the energy transition. Options and proposals drawn up in the research sector are evaluated and used as a basis for developing recommendations and identifying further areas for research.

Energy research

The Federal Government’s planned reorganisation and decarbonisation of the German energy supply system by 2050 on the basis of high efficiency and extensive use of renewable energies can only be achieved through significant technological innovations. Energy research is therefore a strategic component of energy policy and economic policy in the shaping of the energy transition. The Federal Government adopted its Seventh Energy Research Programme in September 2018, which sets new priorities and defines areas of special importance for research funding and innovation policy over the years to come. It also focuses on the transfer of technologies and innovations. The Federal Ministry for Economic Affairs and Energy established real-life laboratories for the energy transition as a new funding pillar and a central measure for accelerating the transfer of innovations. In addition, the Seventh Energy Research Programme expands the scope of project funding to include society-wide and systemic issues, with a view to shifting the focus to major trends of overriding importance. These include sector coupling and hydrogen technologies, low-carbon industrial processes, resource efficiency and energy-relevant aspects of digitalisation. The programme represents the outcome of an extensive consultation process involving stakeholders from associations and companies, research and science organisations, members of research networks and representatives of the federal states.

In the priority area of renewable energies, the main focus is on funding measures for technologies that promote the production of electricity from wind and photovoltaic energy or that may help to increase the share of renewable energies in the heating sector. Consideration is also given to systemic issues relating to the integration of renewable energies into the supply system. In respect of wind energy, the Federal Ministry for Economic Affairs and Energy pursues the goal of increasing yield and reliability while simultaneously cutting costs. Larger and higher wind power installations pose significant demands in terms of mechanical loading capacity owing to their weight. Robust and environmentally friendly materials and composites, innovative designs, and drivetrains that are adapted to the increased masses and forces are therefore at the forefront of research and development efforts. Funding for research in the field of photovoltaics focuses on combinations involving silicon solar cell designs (which have already been developed to a high level) and other semiconductor materials. For example, perovskite solar modules have managed the leap from lab-based research to the first pilot production runs in just a few short years. Other key research topics include innovation production installations, extensions in useful life, recyclability and resource efficiency, as well as the integration of photovoltaic installations into buildings. Funding is also granted for application-oriented research and development projects relating to other topics: bioenergy, geothermal, solar thermal power plants, low-temperature solar thermal, hydropower and ocean energy.

The system integration of renewable energies constitutes one of the main challenges to be tackled over the next few years. To this end, the Federal Ministry for Economic Affairs and Energy is funding application-oriented energy research in the areas of electricity grids, electricity storage solutions and sector coupling. This also includes the funding of hydrogen technologies such as electrolysis procedures, as well as hydrogen-related logistics and transportation. As part of the cross-sectoral funding initiative ‘Energy transition in transport’, the Federal Ministry for Economic Affairs and Energy grants funding for projects involving the manufacture and use of alternative, electricity-based fuels and the incorporation of new technologies into the energy industry. Alongside research funding, one of the central tasks of the Federal Government’s energy research policy is research communication; this applies in particular to reporting on future trends and research agendas and promoting the transfer of research findings into real-life applications. The Federal Government has created a central web portal for this purpose (www.energieforschung.de). It also publishes an annual ‘Federal Energy Research Report’ to ensure an adequate level of transparency regarding the use of funding and the energy technologies that have been funded.

3.1. Please provide information on how supported electricity is allocated to final customers for the purposes of Article 3(9) of Directive 2009/72/EC.

(Article 22(1)(b) of Directive 2009/28/EC)

The electricity from renewable energies supported under the Renewable Energy Sources Act by means of the market premium, the feed-in payment and the landlord-to-tenant electricity supplement is marketed on the electricity power exchange by the TSOs or directly by the installation operators or third parties. The difference between the marketing revenues on the one hand and the feed-in payments and market premiums on the other, as well as the costs of promoting landlord-to-tenant electricity, is passed on in the form of the levy under the Renewable Energy Sources Act (Section 60(1) EEG 2017) in such a way that each electricity supply company bears the same costs per kilowatt-hour of electricity supplied to non-privileged end consumers. The question of whether electricity supply companies should pass the costs on to the end consumers, and if so in what amount, is regulated not by the Renewable Energy Sources Act, but by the individual contracts concluded under private law; these contracts generally stipulate that the costs should be passed on to the end consumers, however.

Section 78 EEG 2017 and Section 42(1) and (5) EnWG[53] outline how electricity supply companies can provide end consumers with information about the levy under the Renewable Energy Sources Act, and how the electricity funded under the Renewable Energy Sources Act must be identified on electricity bills, on the internet and in advertising material to end consumers. The electricity supply companies must inform end consumers that a share of their electricity comes from ‘renewable energies funded from the levy under the Renewable Energy Sources Act’ on their electricity bills, on the internet and in advertising material, according to the levy that they pay.

The electricity supply companies must also provide end consumers with information (on the electricity bill, on the internet and in advertising material) on the other components of the electricity mix and of the environmental impacts ‘in a consumer-friendly manner and in a graphic and visual format of an appropriate size’ (Section 42(2) EnWG[54]). The electricity supply companies must also specify the average values for the electricity mix and the environmental impacts in Germany. The electricity mix may include nuclear power, coal, natural gas, other fossil fuels, renewable energy sources funded from the levy under the Renewable Energy Sources Act, landlord-to-tenant

[53] Amended by Article 2 of the Act promoting landlord-to-tenant electricity and amending other provisions of the Renewable Energy Sources Act of 17 July 2017, Federal Law Gazette I p. 2 532, which entered into force on 25 July 2017.

[54] Amended by Article 6 of the Act introducing tendering procedures for electricity from renewable energies and further amendments to the law on renewable energies of 13 October 2016, Federal Law Gazette I p. 2 258, which entered into force on 1 January 2017.

electricity funded from the levy under the Renewable Energy Sources Act, and other renewable energies. In addition, since the start of 2019 it has been possible to display, under certain circumstances and in connection with the labelling of the share of electricity funded under the Renewable Energy Sources Act, the extent to which this electricity share was produced in the region in relation to electricity consumption (Section 42(5), sentence 2 EnWG), if the regional certificates have been redeemed by the competent authority pursuant to Section 79a(4) EEG 2017.

In the event that end consumers are supplied with landlord-to-tenant electricity for which a landlord-to-tenant electricity supplement is paid under the Renewable Energy Sources Act, the customers in question must be alerted to this fact in accordance with Section 78(7), first and third sentences EEG 2017 by labelling the relevant electricity share as ‘landlord-to-tenant electricity, funded under the Renewable Energy Sources Act’. If multiple end consumers participate in a landlord-to-tenant electricity project under the landlord-to-tenant electricity model, the landlord-to-tenant electricity consumed in a calendar year is, for the purposes of electricity labelling, to be distributed among the landlord-to-tenant electricity customers in question according to the ratio of their annual consumption and indicated to the landlord-to-tenant electricity customers accordingly (Section 78(7), sentence 2 EEG 2017).

4 PLEASE PROVIDE INFORMATION ON HOW, WHERE APPLICABLE, THE SUPPORT SCHEMES HAVE BEEN STRUCTURED TO TAKE INTO ACCOUNT RES APPLICATIONS THAT GIVE ADDITIONAL BENEFITS, BUT MAY ALSO HAVE HIGHER COSTS, INCLUDING BIOFUELS MADE FROM WASTE, RESIDUES, NON-FOOD CELLULOSIC MATERIAL, AND LIGNO-CELLULOSIC MATERIAL.

(Article 22(1)(c) of Directive 2009/28/EC)

4.1. Provisions of the Renewable Energy Sources Act

The Renewable Energy Sources Act 2017 and the Offshore Wind Energy Act contain provisions aimed at promoting certain technologies.

In addition to the pilot onshore wind power installations already described in the section on calls for tender (see above, Chapter 3.0.1), which may under certain circumstances be exempt from participation in calls for tender, special attention should be paid to the 'innovation auctions'. This special call for tender design takes a cross-technology rather than a cross-sectoral approach, and a regulation will be enacted containing all the relevant details. The aim of the innovation auctions is the promotion of innovative concepts for installations that benefit the system or grid (Section 39j(3) EEG 2017). Technology-neutral fixed market premiums and zero payments for negative prices are also to be trialled. Following an increase under the Omnibus Energy Act and the missed auction in 2020, the tender volume planned for innovative concepts for installations that benefit the system or grid is now 650 MW for 2020 and 500 MW for 2021 (Section 28(6) EEG 2017). The tender quantities for innovation auctions were deducted from the standard volumes under the relevant production column. The tender quantities in Section 28(1), sentence 1 and Section 28(2), sentence 1 EEG 2017 have been reduced accordingly.

In addition, pilot offshore wind power installations receive special support under Part 5, Section 68 et seqq. WindSeeG. Under Section 3(6), first clause WindSeeG, the term 'pilot offshore wind power installations' means the first three offshore wind power installations of a particular type for which there is evidence that a significant innovation going far beyond the prior art is being trialled. The status of 'pilot offshore wind power installation' must be awarded by the Federal Maritime and Hydrographic Agency, Section 68(1), sentence 2 WindSeeG. These pilot installations are in principle eligible for a funding entitlement pursuant to Section 19 EEG 2017 even if they have not participated in calls for tender (Section 69 WindSeeG), with the proviso that their total installed capacity must not exceed 50 MW per calendar year.

In addition, the Offshore Wind Energy Act[55] and the Offshore Installations Act [Seeanlagengesetz, SeeAnlG][56] have been amended to create a legal framework for the trialling of new concepts for offshore energy production. It will be possible to construct production installations other than wind power installations that are connected to the grid in specially designated energy production areas. The fact that these production installations are not connected to the grid is relevant for trials of the offshore production of hydrogen, for example. The facilitation of projects of this kind is encouraged under planning law through amendments to the purpose of the land development plan pursuant to Section 4(3) WindSeeG and the adoption of restricted access arrangements in respect of Section 5(2a) WindSeeG.

4.2. Cogeneration

Along with the provisions of the Renewable Energy Sources Act on the use of heat and the provisions of the MAP, support for cogeneration installations was again provided under the Combined Heat and Power Act of 19 March 2002, last amended on 17 December 2018, in the reporting years 2017 and 2018. In this respect a distinction must be made between the previous funding conditions that applied up to 31 December 2015 and the new funding conditions that applied from 1 January 2016 onwards, as well as the support provided to certain installations by means of calls for tender and the new provisions resulting from the Omnibus Energy Act[57].

The Combined Heat and Power Act 2012 promoted the construction of new high-efficiency cogeneration installations and the modernisation of existing installations of this kind with no limit as to size, initially regardless of whether they were based on renewable or other energy sources, with a graduated supplement paid for the electricity produced according to the size and age of the installation.

The construction of new heating networks and the expansion of existing heating networks was funded by means of an investment grant. The construction of cooling and heating storage facilities has also been funded with an investment grant since the last amendment to the Combined Heat and Power Act 2012. The expansion of cogeneration was supported under the Combined Heat and Power Act 2012 with funding totalling up to EUR 750 million per year; of this, up to EUR 150 million was earmarked for the expansion of heating networks. The amendments to the Combined

[55] Amended by Article 11 of the Act amending the Renewable Energy Sources Act, the Combined Heat and Power Act, the Energy Industry Act and other provisions of energy law of 17 December 2018, Federal Law Gazette I p. 2 549, which entered into force on 25 July 2017.

[56] Amended by Article 12 of the Act amending the Renewable Energy Sources Act, the Combined Heat and Power Act, the Energy Industry Act and other provisions of energy law of 17 December 2018, Federal Law Gazette I No., p. 2 549, which entered into force on 25 July 2017.

[57] Act amending the Renewable Energy Sources Act, the Combined Heat and Power Act, the Energy Industry Act and other provisions of energy law of 20 December 2018 (Federal Law Gazette I No 47, p. 2 522).

Heat and Power Act adopted in August 2012 built on the changes made in the summer of 2011 (extension of the funding period from 2016 to 2020 and removal of the previous dual cap with a limit of six years' operation, or four years for industrial cogeneration installations, plus a maximum of 30 000 hours at full capacity) to improve support still further. The payment for all installations was thus increased by 0.3 ct/kWh. Installations covered by emissions trading receive an extra 0.3 ct/kWh. An additional payment band (50 kW to 250 kW at 4 ct/kWh) was also introduced, and the funding eligibility requirements for installation modernisation projects were modified. Other changes include the addition of funding for heating and cooling storage facilities, cooling networks and cogeneration retrofitting in condensation plants, improved funding conditions for heating and cooling networks with small nominal ranges and simplified procedures for heating networks and small cogeneration installations.

The amendments to the Combined Heat and Power Act adopted in 2016 raised the funding cap to EUR 1.5 billion and introduced support for existing installations providing a public supply of district heat; the moderate increase in the funding rates (see Table 4.1) aims to facilitate further expansion of cogeneration installations under the challenging market conditions that currently prevail. The funding is specifically aimed at cogeneration electricity that is fed in to the public grid, mandatory direct marketing and further measures such as promotion of heat storage facilities, with a view to enabling cogeneration installations to react more flexibly to the fluctuating feed-in of renewable energies into the electricity system and into heating networks. Lastly, the amendments to the Combined Heat and Power Act in 2017 introduced funding rates determined by means of calls for tender for cogeneration installations with an electrical capacity between 1 MW and 50 MW. Moreover, a new funding category was created for 'innovative cogeneration systems', with the funding rates again determined by means of calls for tender. In this context, the term 'innovative cogeneration systems' refers to particularly energy-efficient and low-GHG systems within which cogeneration installations generate or convert cogenerated electricity and heat on a demand-oriented basis, in combination with high shares of heating from renewable energies. The flexibility created by electric heat generators in innovative cogeneration systems boosts the long-term system benefits of the electricity system.

To guarantee the consistency of the cogeneration expansion target with the other energy transition targets, the switch from the previous 25% target in relation to net electricity production to quantity-based targets of 110 TWh in 2020 and 120 TWh in 2025 was completed with the adoption of the Combined Heat and Power Act 2016.

Table 4.1: Funding for the operators of cogeneration installations for the construction of new installations or the modernisation or upgrading of existing installations (source: Section 7 KWKG 2016, in the version of 17 December 2018)

Electrical capacity		**Grid feed-in**		**Own supply**		
Up to and including 1 MW and > 50 MW	**Cogeneration capacity share (kW)/case (supplement in cent/kWh)**	**Section 7(1)**	**Section 7(2) Bonus payment for replacing a coal-fired cogeneration installation**	**Section 7(3), point 1**	**Section 7(3), point 2 Feed-in in customer installations or closed**	**Section 7(3), point 3 Heavy electricity consumers**
	up to 50	8.0	8.6	4.0	4.0	5.41
	between 50 and 100	6.0	6.6	3.0	3.0	4.0
	between 100 and 250	5.0	5.6	-	2.0	4.0
	between 250 and 2 000	4.4	5.0	-	1.5	2.4
	over 2 000	3.1	3.7	-	1.0	1.8
1 MW up to and including 50 MW		Determination of funding levels by means of calls for tender, plus coal replacement bonus of 0.6 cent when replacing a coal-fired cogeneration installation		No funding		

The supply by CHP plants in properties and districts up to 1 MW and > 50 MW is still funded by cogeneration supplements, the level of which is classified according to capacity. The levels of funding for new and modernised gas-fired CHP plants were considerably increased overall.

Through the introduction of a coal replacement bonus, the replacement of coal CHP plants by gas CHP installations is intended to be incentivised in a targeted manner. Existing gas CHP installations from 2 MW for public district heat supply that were threatened with closure received fixed-term support up to 2019. Along with the extension of the period of validity of the Combined Heat and Power Act until 2025 (in

connection with the amendments to the Combined Heat and Power Act adopted on 17 December 2018), the funding was also extended until 2025.

The Combined Heat and Power Act 2016 introduced mandatory direct marketing for the first time for cogeneration installations with a capacity of over 100 kW_{el}. This is intended to achieve greater alignment of the installations with the electricity market, so that the cogeneration installations can respond more effectively to the feed-in of renewable energies.

Under the Combined Heat and Power Act 2016, the modernisation of cogeneration installations was raised to a minimum age of 10 years, and the rating category was extended to over 50 kW_{el}. This meant that mini cogeneration installations were no longer eligible for funding in connection with modernisation projects. The retrofitting of installations up to 2 MW_{el} was extended to all installation sizes over 50 kW_{el}.

Under the Combined Heat and Power Act 2017, calls for tender were introduced as the standard procedure for determining funding levels in the case of installations with an electrical capacity of over 1 MW up to and including 50 MW. If an existing coal-fired cogeneration installation is replaced by an installation for which a successful bid was submitted in connection with a call for tender, the supplement payment (equivalent to the bid value) is increased by the coal replacement bonus. Only new installations and modernised installations with an investment level of 50% or more are funded under the tendering system. Own supply is excluded under the tendering system.

Funding for innovative cogeneration systems has also been introduced, whereby the level of funding is likewise determined on the basis of calls for tender. The term ‘innovative cogeneration systems’ refers to particularly energy-efficient and low-GHG systems within which cogeneration installations generate or convert cogenerated electricity and heat on a demand-oriented basis, in combination with high shares of heating from renewable energies. Innovative cogeneration systems incorporate electric heat generators for increased flexibility. The decarbonisation of grid-bound heat is addressed by the mandatory incorporation of renewable heat into innovative cogeneration systems.

Overall, by 2021 a total of 200 MW of cogeneration capacity will be put out to tender per year, in two bidding rounds per year, of which 150 MW will be allotted to conventional cogeneration installations and 50 MW to innovative cogeneration systems. Two bidding rounds have been conducted to date for the tendering segment of innovative cogeneration systems. Table 4.2 provides an overview of the tender outcomes for innovative cogeneration systems. Only three bids with a total volume of 13 MW were submitted in response to the call for tender of 12 December 2018. This fell a long way short of the figure of 29 MW put out to tender. The contract awards determined on the basis of the ‘pay-as-bid’ procedure are between 7.99 ct/kWh and 11.97 ct/kWh, and the average volume-weighted contract award value is

11.31 ct/kWh (10.27 ct/kWh in the previous round), which is close to the highest value of 12 ct/kWh.

Table 4.2: Outcomes of the bidding rounds for innovative cogeneration systems[58]

Tender contract awards	First round (June 2018)	Second round (December 2018)
Tender volume	25.0 MW	29.1 MW
Bids submitted	27 MW	13 MW
Successful bid volume	20.9 MW	13.0 MW
Number of bids submitted	7	3
Number of installations forming the subject of successful bids	5	3
Lowest contract award value	8.47 ct/kWh	7.99 ct/kWh
Highest contract award value	10.94 ct/kWh	11.97 ct/kWh
Average volume-weighted contract award value	10.3 ct/kWh	11.31 ct/kWh

The funding rates for heating storage facilities and heating networks pursuant to the Combined Heat and Power Act (Section 19) are shown in Table 4.3. Overall, the funding volume per project was increased from EUR 5 to 10 million (heating storage facilities) and from EUR 10 to 20 million (heating networks) between the Combined Heat and Power Act 2012 and the amendments adopted in 2016. By doing so, the Federal Government – taking into account the principle of mandatory direct marketing and the focused promotion of cogenerated electricity that is fed into the grid – responded to the challenges associated with the electricity market and provided an incentive for more flexible operation of cogeneration installations and their integration into a system for producing electricity from volatile and renewable energy sources.

Table 4.3: Support for networks and storage facilities (source: Combined Heat and Power Act 2012/2016, in the version of 17 December 2018)

Type		Investment grant	Combined Heat and Power Act 2012	Combined Heat and Power Act 2016
Heating and cooling	Small distribution	EUR 100/m line, max. 40% of costs	EUR 10 million/project	EUR 20 million/project

[58] https://www.bundesnetzagentur.de/DE/Sachgebiete/ElektrizitaetundGas/Unternehmen_Institutionen/Ausschreibungen/KWK/BeendeteAusschreibungen/BeendeteAusschreibungen_node.html.

networks	networks (DM < DN 100)			
	Large distribution networks (DM > DN 100)	30% of costs	EUR 10 million/project	EUR 20 million/project
Heating and cooling storage facilities	Small storage facilities (< 50 m^3 volume)	250 EUR/m^3 volume	EUR 5 million/project	EUR 10 million/project
	Large storage facilities (> 50 m^3 volume)	EUR 250/m^3 volume; max. 30% of costs	EUR 5 million/project	EUR 10 million/project

The last amendments to the Combined Heat and Power Act, adopted on 17 December 2018, resulted from the adoption of the Omnibus Energy Act (cf. Chapter 3.0.1). As well as extending the period of validity of the Combined Heat and Power Act until 31 December 2025, limits were placed on the funding of existing cogeneration installations. The funding rates for installations larger than 50MW_{el} will be gradually reduced, and the funding currently available for installations larger than 300 MW_{el} will be abolished. As a result, the cogeneration grant for existing cogeneration installations is 1.5 cents for an electrical cogeneration capacity of over 2 MW_{el} up to a capacity of 50 MW_{el}, 1.3 cents for cogeneration installations with an electrical capacity of over 50 MW_{el} up to 100 MW_{el}, 0.5 cents for installations with an electrical capacity of over 100 MW_{el} up to 200 MW_{el}, and finally 0.3 cents for cogeneration installations with an electrical capacity of over 200 MW_{el} up to and including 300 MW_{el}.

Table 4.4: Funding for existing installations under Section 13 KWKG (source: Combined Heat and Power Act 2016, in the version of 17 December 2018)

Electrical capacity	**(grant in cent/kWh)**
2-50 MW	1.5
50-100 MW	1.3
100-200 MW	0.5
200-300 MW	0.3
>300 MW	Not applicable

Under the National Climate Protection Initiative [Nationale Klimaschutzinitiative, NKI], the Combined Heat and Power Act is supplemented in respect of small installations

by the ‘Guidelines for the funding of cogeneration plants up to 20 kWel (Mini Cogeneration Guidelines)’ in the version of 15 December 2014.

The Market Incentive Programme for the promotion of renewable energies (KfW premium section) also supports biomass installations for combined heat and power (CHP) production that have an installed nominal heat capacity of over 100 kW and up to 2 000 kW and that use wood pellets, logs or wood chips, for example. Funding can also be applied for in connection with (among other things) the erection and expansion of installations for combined heat and power generation using deep geothermal energy (from a drilling depth of 400 m and a nominal heat capacity of at least 4 000 kW_{th}).

The Market Incentive Programme for the promotion of renewable energies (KfW premium section) also supports heating networks supplied by renewable sources of energy, provided that this heat comes almost exclusively from highly efficient cogeneration, waste heat or renewable energies, or combinations of these heat sources. Installations and networks that already receive support under the Renewable Energy Sources Act or the Combined Heat and Power Act are excluded.

The Mini Cogeneration Incentive Programme operated by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety is intended to accelerate the expansion of cogeneration installations with a capacity of less than 20 kW_{el} in the buildings sector. The Federal Government’s funding programme supports the decentralised production and supply of combined electricity and heat in single-family and multi-family dwellings and in the small-scale commercial sector. The Guidelines on the funding of cogeneration installations up to 20 kW_{el} entered into force for the first time in April 2008, and were last amended on 15 December 2014. The entry into force of the Guidelines on 1 January 2015 was intended not only to lend an additional boost to the broader use of small cogeneration installations, but also to implement a measure under the ‘Action Programme on Climate Protection 2020’ (BMUB, 2015).

In response to a drop in the number of applications, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety will discontinue the funding arrangement as of 31 December 2020.

4.3. Amendments to the Biomass Regulation

Within the scope of the payment rules under the Renewable Energy Sources Act, the Biomass Regulation governs which materials are recognised as biomass for the purpose of payments, which technical methods of electricity production from biomass fall within the scope of the Renewable Energy Sources Act, and which environmental requirements have to be met in the generation of electricity from biomass.

Installations subject to the provisions of the Renewable Energy Sources Act and commissioned up to 31 December 2011 are covered by the Biomass Regulation in the version in force from 18 August 2005 (for electricity generation from scrap wood

and the use of vegetable oil methyl ester in some existing installations, different transitional provisions apply under the Renewable Energy Sources Act 2012).

The Biomass Regulation was extensively amended with effect from 1 January 2012. In addition to the existing scope of regulation, it now also governed which materials qualify for an increased input-based payment under the Renewable Energy Sources Act 2012, which energy-related reference values should be used to calculate this payment and how the input-based payment should be calculated. Furthermore, following the adoption of these amendments, scrap wood (with the exception of industrial waste timber) was no longer a recognised biomass within the meaning of the Biomass Regulation.

The Biomass Regulation was amended again in the course of the comprehensive reform of the Renewable Energy Sources Act in 2014. The provisions on input-based payments and the corresponding energy-related reference values were deleted and not replaced. This marked an end to the increased support given to certain biomass inputs (e.g. maize, sugar beet and cereals in biogas installations).

The amendments to the Renewable Energy Sources Act 2017 resulted in only one change to the Biomass Regulation on 13 October 2016: waste liquors from cellulose pulp production ceased to be a recognised biomass within the meaning of the Biomass Regulation.

4.4. 37th Regulation implementing the Federal Immission Control Act (Regulation on the inclusion of electricity-based fuels and co-processed biogenic oils in the greenhouse gas quota)

The Regulation implementing the Federal Immission Control Act (Regulation on the inclusion of electricity-based fuels and co-processed biogenic oils in the greenhouse gas quota) enacted in the first half of 2017 resulted in the following amendments in particular:

- electricity-based fuels are to be included in the greenhouse gas quota in future provided that the electricity used to generate these fuels comes from renewable energies of non-biogenic origin,
- furthermore, up to the commitment year 2020, co-processed biogenic oils are also to be included in the greenhouse gas quota.

The Regulation was adopted for the specific purpose of transposing Directive (EU) 2015/652.

4.5. 38th Regulation implementing the Federal Immission Control Act (Regulation laying down further provisions for the reduction of greenhouse gases in fuels)

The 38th Regulation implementing the Federal Immission Control Act (Regulation laying down further provisions for the reduction of greenhouse gases in fuels) enacted by the Federal Cabinet in November 2017 transposes Directive (EU) 2015/652 (implementing provisions relating to the Fuel Quality Directive) and Directive (EU) 2015/1513 (relating to the avoidance of indirect land-use changes). In particular, the following amendments were made:

- In order to avoid indirect land-use changes, an upper limit for conventional biofuels of 6.5% will be introduced in future. Conventional biofuels above the upper limit will be treated as fossil fuels.
- A sub-quota will be introduced for advanced biofuels (from 0.05% in 2020, rising to 0.5% from 2025).
- The values for the greenhouse gas emissions of fossil fuels and the basic value are adjusted to the new targets.
- Electrical power used in electrically driven road vehicles can be included in the greenhouse gas quota in future.
- The definition of biofuels has been expanded.
- The scope of application of the greenhouse gas quota will in future be expanded to include other fossil fuels as well, in particular natural gas and liquefied petroleum gas. Moreover, biogenic liquefied petroleum gas will also be included in the quota in future.

4.6. Accompanying actions

Use of the measures mentioned above is also supported by ‘accompanying actions’ such as investment support for individual installations and the funding of know-how (studies, knowledge transfer).

Examples of investment support include funding for individual installations (‘beacon projects’) and regional funding all the way through to large-scale aid for research issues (BtL, wood gasification, PtG, PtL).

5 PLEASE PROVIDE INFORMATION ON THE FUNCTIONING OF THE SYSTEM OF GUARANTEES OF ORIGIN FOR ELECTRICITY AND HEATING AND COOLING FROM RES, AND THE MEASURES TAKEN TO ENSURE RELIABILITY AND PROTECTION AGAINST FRAUD OF THE SYSTEM.

(Article 22(1)(d) of Directive 2009/28/EC)

The provisions of Directive 2009/28/EC regarding guarantees of origin for electricity from renewable energy sources were transposed in Section 3 point 29 and Section 79 EEG 2017 and subsequent sub-statutory regulations based on that Act:

- the Renewable Energies Regulation of 17 February 2015, which establishes a framework for guarantees of origin,
- the Guarantees of Origin and Regional Certificates Implementing Regulation of 8 November 2018, which governs the details of the registration of electricity generation installations and members of the register, and the issue, transfer, recognition and redemption of guarantees of origin, and
- the Guarantees of Origin and Regional Certificates Charges Regulation of 8 November 2018.

These legal bases stipulate that the German Environment Agency should act as the central government office for the Guarantee of Origin Register for electricity from renewable energy sources in Germany. On the basis of these regulations, the German Environment Agency issues guarantees of origin upon application, redeems them, transfers them within Germany and abroad and recognises foreign guarantees of origin. For this purpose, the German Environment Agency has set up an electronic database (Guarantee of Origin Register), which records the issue, recognition, transfer and redemption of guarantees of origin. The Guarantee of Origin Register went live on 1 January 2013.

The Guarantee of Origin Register works like an online banking system; operators of installations that produce electricity from renewable energies can register themselves and their installations in the Guarantee of Origin Register. For every megawatt-hour of electricity, a guarantee of origin is placed in their account. The system operator, as an independent and expert third party, notifies the German Environment Agency of the volumes of electricity produced. The guarantees of origin are tradable. The German Environmental Agency is responsible for checking the data and the system. An electronic control system safeguards the reliability of the system.

The German Environment Agency issued a total of 17 million guarantees of origin for the 2017 production year and a total of 16.2 million[59] guarantees of origin for the 2018 production year so far.

Electricity supply companies that wish to identify electricity from other renewable energies (i.e. electricity from renewable energies not funded by the levy under the Renewable Energy Sources Act) as part of the electricity labelling scheme are required, under Section 42(5), sentence 1, point 1 EnWG, to redeem guarantees of origin for this electricity, provided that the case described in Section 42(5), sentence 1, point 3 EEG 2017 does not apply (application of ENTSO-E mix to electricity of unknown origin). Under Section 42(7) EnWG, the German Environment Agency is given access to the electricity supply companies' data on electricity labelling, so that it can compare this with the guarantees of origin issued and redeemed and thus monitor the trade in guarantees of origin to pick up any fraud or abuse. Only an electricity supply company can redeem guarantees of origin. A total of 91.7 million guarantees of origin[60] were redeemed in the Guarantee of Origin Register in 2017, and 99.9 million guarantees of origin were redeemed in 2018.

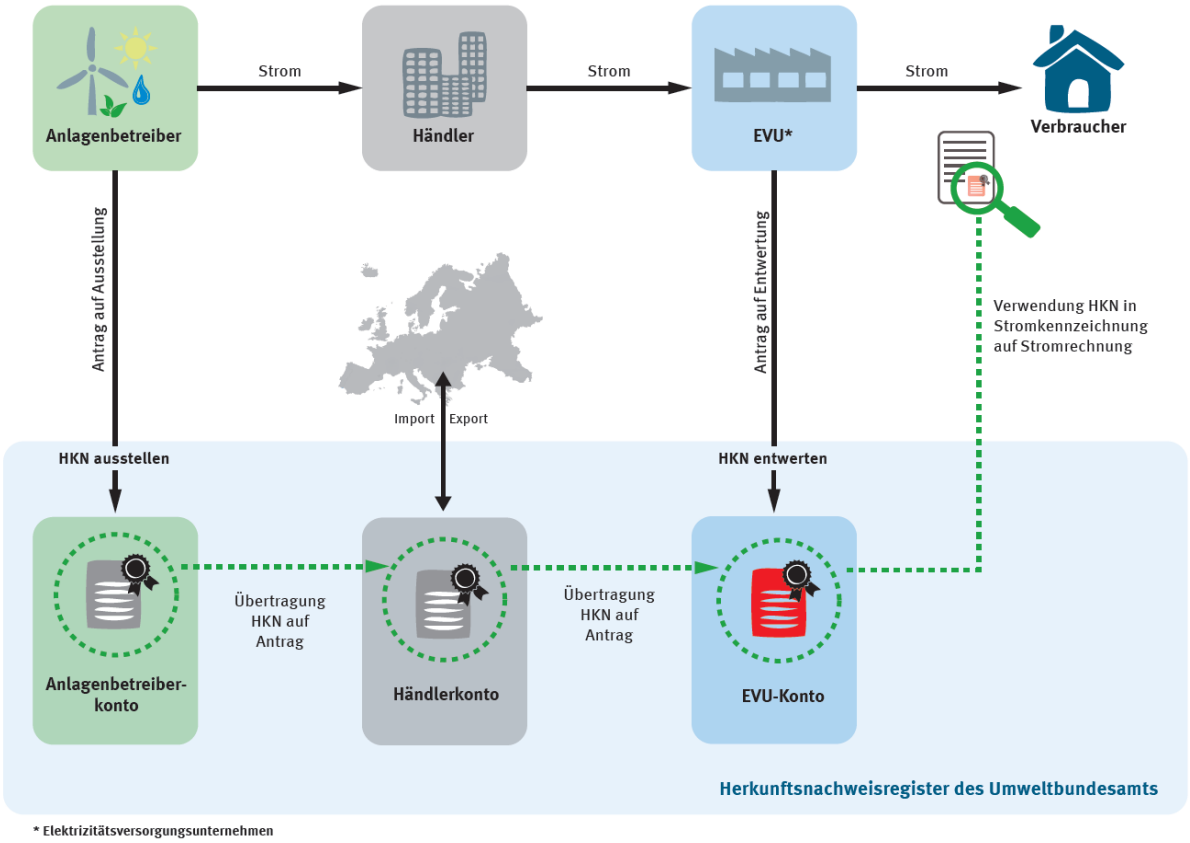
For international trade, the German Environment Agency uses the electronic interface of the Association of Issuing Bodies (AIB). This enhances the reliability of the German system and of the European market in guarantees of origin. In 2017, a total of 87.3 million guarantees of origin were imported and 7.8 million were exported. In 2018, a total of 92 million guarantees of origin were imported and 12.5 million were exported.

The German Environment Agency has established a number of rules to make the Guarantee of Origin Register system in Germany fraud-proof and reliable. These include: identity checks on the operators participating in the Guarantee of Origin Register by using the PostIdent process from Deutsche Post AG or by checking the IDs of foreign participants, checking the authorisation of registrants, issuing a user name and password and use of Captcha, entry of VAT identification number to assist in detecting possible VAT fraud, use of environmental experts to verify installation data and volumes of electricity.

In accordance with Section 31 KWKG, operators of highly efficient cogeneration installations can also apply for a guarantee of origin from the Federal Office of Economics and Export Control in respect of electricity produced in cogeneration.

[59] The final figures cannot be provided for 2016, since guarantees can still be issued up to the end of 2017. The latest information is from 30 June 2017.
[60] Rounded values in each case.

Figure 5.1: The system of guarantees of origin in Germany



Anlagenbetreiber	**Installation operator**
Strom	Electricity
Händler	**Trader**
EVU*	**Electricity supply company**
Verbraucher	**Consumer**
Antrag auf Ausstellung	Application for issue
Antrag auf Entwertung	Application for redemption
Verwendung HKN in Stromkennzeichnung auf Stromrechnung	Use of guarantee of origin in electricity labelling for electricity bills
HKN ausstellen	**Issue of guarantee of origin**
HKN entwerten	**Redemption of guarantee of origin**

Übertragung HKN auf Antrag	Transfer of guarantee of origin on application
Anlagenbetreiberkonto	**Installation operator account**
Händlerkonto	**Trader account**
EVU-Konto	**Electricity supply company account**
Herkunftsnachweisregister des Umweltbundesamts	**Register of Guarantees of Origin of the German Environment Agency**

6 PLEASE DESCRIBE THE DEVELOPMENTS IN THE PRECEDING TWO YEARS IN THE AVAILABILITY AND USE OF BIOMASS RESOURCES FOR ENERGY PURPOSES.

(Article 22(1)(g) of Directive 2009/28/EC)

The availability of biomass resources depends on the quantities that can be provided subject to ecological, technical and economic restrictions and the effect of competing demands for their use. Bottlenecks in availability and shortages may be statistically invisible if some market operators switch to other raw materials, leading to bottlenecks or displacement effects there, or if they shift use to other times. That is why estimates of the availability of biomass are fraught with uncertainty.

This section describes the use of biomass resources for energy purposes based on the categories defined in the progress report template document (Table 4) and, where possible, estimates availability.

The overall balance sheet of energy-related biomass use forms the principal basis for the official energy statistics and conclusions from surveys and special evaluations (including the survey on the use of wood fuel in households, the evaluation of data under the Renewable Energy Sources Act and the results of monitoring wood raw materials). These energy statistics allow only a limited breakdown or no breakdown at all by type (e.g. logs, wood chips, pellets, common arable crops, energy crops, residues, waste) and particularly by origin of the different biomass components (e.g. forestry and landscape conservation wood, domestic raw materials, imports). Reference will therefore be made below on a supplementary basis to the latest findings of the Thünen Institute (Thünen, 2019) in the context of the Joint Wood Energy Enquiry (UNECE/FAO 2019), data from the Federal Office for Agriculture and Food in connection with the annual evaluation and progress report (BLE, 2018; BLE, 2019) and the outcomes of regular operator surveys (DBFZ, 2019a). The use of biomass for energy purposes is extremely heterogeneous and decentralised, and recording of the use of biomass remains largely uncertain.

According to the outcomes of calculations, the total primary energy use from biomass, including the biogenic fraction of waste, was 25 657 ktoe in 2017 and 25 274 ktoe in 2018 (cf. Table 4). In the reporting period, approximately 7-8% of this was imported from other EU countries and approximately 5-6% from non-EU countries in the form of raw materials or fuels. Wood-based biomass used for heating and electricity made up the largest share (residues and co-products from the wood industry, scrap wood, wood biomass used directly for energy purposes), followed by common crops for biogas and biofuels and for use in the transport sector (see Table 4).

Table 4: Use of biomass for energy purposes

	Amount of domestic raw material (1 000 m³ for forestry; 1 000 t_{FM} for agriculture)		Primary energy in domestic raw material (ktoe)		Amount of imported raw material from EU (1 000 m³ for forestry; 1 000 t_{FM} for agriculture)		Primary energy in amount of imported raw material from EU (ktoe)		Amount of imported raw materials from non-EU (1 000 m³ for forestry; 1 000 t_{FM} for agriculture)		Primary energy in amount of imported raw material from non-EU (ktoe)	
	2017	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**
Use of biomass for heating and electricity:												
Wood biomass from forests and other wooded land used directly for energy purposes (fellings, etc.)[61]	28 439	27 417	6 165	5 947	528	506	108	104	857	798	161	152
Residues and co-products from wood industry etc.[62]		12 853	2 666	2 590	2 001	1 741	404	352	720	645	130	118
Common crops for biogas and biofuels (maize, grass, cereals, sugar beet, rapeseed, oil palm)[63]	61 193	61 428	4 855	4 876	58	84	20	28	239	0	79	83
Energy crops (grasses etc.) and short rotation trees (please specify)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Agricultural by-products/processed residues and fishery by-products:	70 240	61 285	1 160	1 013	0	0	0	0	0	0	0	0

[61] Calculations by the Thünen Institute of International Forestry and Forest Economics.
[62] Calculations by the Thünen Institute of International Forestry and Forest Economics.
[63] Calculation based on the liquid biomass and biogas used according to the Federal Ministry for Economic Affairs and Energy (2019) in 2017 and 2018, the substrate shares for liquid biomass according to the Federal Office for Agriculture and Food (2019) and for biogas according to the German Biomass Research Centre [Deutsches Biomasseforschungszentrum, DBFZ] (2019b), conversion factors according to BioGrace for liquid biomass and the NREAP for biogas, and energy and water contents according to BioGrace and the NREAP.

	Amount of domestic raw material (1 000 m³ for forestry; 1 000 t_{FM} for agriculture)		Primary energy in domestic raw material (ktoe)		Amount of imported raw material from EU (1 000 m³ for forestry; 1 000 t_{FM} for agriculture)		Primary energy in amount of imported raw material from EU (ktoe)		Amount of imported raw materials from non-EU (1 000 m³ for forestry; 1 000 t_{FM} for agriculture)		Primary energy in amount of imported raw material from non-EU (ktoe)	
	2017	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**
excreta and landscape conservation grass for biogas[64]												
Biomass from waste (municipal waste, industrial waste, sewage sludge etc.), including sewage treatment gas and landfill gas[65]	n/a	n/a	6 690	6 677	1 719	1 496	331	288	50	23	10	4
Others[66]	695	675	154	150	108	94	24	21	3	1	1	0

[64] Calculation based on the biogas used according to the Federal Ministry for Economic Affairs and Energy (2019) in 2017 and 2018, the substrate shares according to the German Biomass Research Centre (2019b) and the conversion factors and energy and water contents according to the NREAP.

[65] Landfill gas, sewage treatment gas, biogenic fraction of waste, other solid biomass (non-timber including sewage sludge) according to the Federal Ministry for Economic Affairs and Energy (2019), wood-based biomass from waste according to the Thünen Institute (2019) and waste-based proportion of biogas and liquid biomass; calculation of biogas proportion based on the biogas used according to the Federal Ministry for Economic Affairs and Energy (2019), the substrate shares according to the German Biomass Research Centre (2019b) and the conversion factors, energy and water contents according to the NREAP; calculation of liquid biomass proportion based on liquid biomass used according to the Federal Ministry for Economic Affairs and Energy (2019), the substrate shares according to the Federal Office for Agriculture and Food (2019), the conversion factors according to BioGrace and the energy and water contents according to BioGrace and the NREAP.

[66] The range of 'Other' materials used in biomass plants in accordance with the Joint Wood Energy Enquiry (Thünen 2019).

	Amount of domestic raw material (1 000 m³ for forestry; 1 000 t_{FM} for agriculture)		Primary energy in domestic raw material (ktoe)		Amount of imported raw material from EU (1 000 m³ for forestry; 1 000 t_{FM} for agriculture)		Primary energy in amount of imported raw material from EU (ktoe)		Amount of imported raw materials from non-EU (1 000 m³ for forestry; 1 000 t_{FM} for agriculture)		Primary energy in amount of imported raw material from non-EU (ktoe)	
	2017	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**
Use of biomass for transport:												
Common arable crops for biofuels (rapeseed, oil palm, soya, maize, cereals, sugar beet, sugar cane)[67]	1 736	1 434	482	398	3 217	3 068	772	712	2 458	2 722	652	732
Energy crops (grasses etc.) and short rotation trees for biofuels	0	0	0	0	0	0	0	0	0	0	0	0
Others (waste, residues, primarily UCO (used cooking oil))[68]	n/a	n/a	190	230	n/a	n/a	362	408	n/a	n/a	242	388

[67] Calculation based on the biofuels based on common arable crops placed on the market in Germany in 2017 and 2018 and certified as sustainable (BLE, 2019), conversion factors according to BioGrace and energy and water contents according to BioGrace and the NREAP.
[68] Calculation based on the biofuels based on waste placed on the market in Germany in 2017 and 2018 and certified as sustainable (BLE, 2019) and conversion factors according to BioGrace.

6.1. Biomass to generate heat and electricity

6.1.1 Wood biomass

Wood biomass, total. The information relating to the wood biomasses used by origin in 2017 (in Table 4) is based on the work of the Thünen Institute, *inter alia* under the aegis of the Joint Wood Energy Enquiry (JWEE) (UNECE/FAO, 2019); the information for 2018 was obtained by the Thünen Institute on the basis of the 2017 figures, taking into consideration the overall development in the various consumption sectors (Thünen Institute, 2019). Slight deviations from the volume structure outlined in Chapter 1 result in particular from differing data on the use of liquor. Harmonisation will be sought in future in this respect.

In the reporting years 2017 and 2018, a total of around 59.4 million m^3 and 57 million m^3, respectively, of wood biomass (including scrap wood) was used to provide electricity and heat. For comparison, the use of wood for energy purposes stood at 30.3 million m^3 in 2005, and increased to 65 million m^3 over the period up to 2009. Since then, the amount of wood used for energy purposes has remained relatively constant, at a level between 65 and 70 million m^3 per year. The fluctuations can be attributed to a number of different factors, for example the weather and changes in the prices of fossil fuels.

Imports and exports. The relationship between the use of domestic wood biomasses and wood imports was calculated in some cases on the basis of overall wood supply and trade, which may of course be significantly different from the wood used exclusively for energy purposes. The reason for this is that credible figures for foreign trade of wood segments used for energy purposes are only available to a very limited extent (only for wood pellets, for example), which is predominantly attributable to the fact that foreign trade statistics are not broken down by the type of use of the wood components.

The import of wood biomass (forest wood, industrial wood residues and scrap wood etc.) used for energy purposes as determined by JWEE was approximately 10% in 2017 and slightly lower in 2018, at around 9%. The volume of imports from non-EU countries was comparatively small, while imports from EU countries represented a substantial proportion of the raw material basis, particularly in the case of residues and by-products from the wood industry (especially sawmill by-products and wood pellets) and wood-based waste, with 13% each in 2017 and 11% and 12% respectively in 2018. Only around 5% of the wood biomass from forests and other wooded areas directly used for energy production was based on imports in 2017 and 2018. Exports also occur for a variety of wood fuels, according to industry data.

Use of direct supply of wood biomass for energy generation

The use of the direct supply of wood biomass for energy generation in 2017 and 2018 (forest wood, garden wood and landscape conservation wood) was on a par with the use of the indirect supply of wood biomass for energy generation (residues and co-products from the wood industry, wood-based biomass from waste and other wood-based biomass).

There was no accurate breakdown by types of wood on the basis of the JWEE. Mantau, Döring et al. (2018) undertook to create such a breakdown for 2014 and 2016 and identified the following as the most important types of wood for direct supply for energy purposes: merchantable wood [69] (approximately 55%; predominantly used for heating residential buildings), forest waste wood and bark[70] (approximately 30%;predominantly used for heating residential buildings and in biomass heating (power) plants) and residues from landscape design and conservation (10%;predominantly used in biomass heating (power) plants). Other types accounted for around 5%.

The estimates relating to the direct supply of wood used for energy purposes (merchantable wood, forest waste wood and bark, wood from landscape conservation) fluctuate to a very great extent and depend on the technical, economic and ecological restrictions considered. The volume of windfall and the options for its use must also be included in the evaluation.

Wood from short-rotation coppices (SRC) also only made a very small contribution to the provision of wood biomass for energy purposes in 2017 and 2018 and is not identified separately by the JWEE due to the low quantities involved.

Use of indirect supply of wood biomass

Under the JWEE system and in accordance with the EU Statistics Regulation, solid residues from the wood industry, which are used in particular in industry but also in the energy business and the private sector for the provision of electricity and heating, and liquor, which is used exclusively in industry for proportionate commercial energy supply, are subsumed under this biomass category. In 2017, black liquor accounted for around 30% of energy use from residues and co-products from the wood industry, bark and wood chips/shavings almost 25% each and waste wood a little over 20% (UNECE/FAO, 2019).

[69] Merchantable wood: essentially wood with a diameter of greater than 7 cm.
[70] Forest waste wood: essentially wood with a diameter of less than 7 cm, plus rejected merchantable wood.

Use of wood-based biomass from waste

The use of wood-based municipal and industrial waste for energy purposes amounted to approximately 2.5 million ktoe in 2017 and approximately 2.4 million ktoe in 2018 (Thünen, 2019). Imports of scrap wood accounted for a share of around 13%.

6.1.2 Biomass from agricultural land

In relation to the provision of heat and electricity, during the reporting period, 98% of biomass from agricultural land was used as a substrate for biogas production, approximately 2% for the production of vegetable oil and very minor amounts for the provision of solid fuels. The figures in Table 4 on the use of common crops for biogas and biofuels are derived from data published by the Working Group on Renewable Energies and Statistics for biogas and liquid biomass used in 2017 and 2018 (BMWi, 2019), where the data for biogas was set off against the shares of substrate input (DBFZ, 2019a) and the data for liquid biomass was set off against the shares of raw materials and imported raw materials that were used (BLE, 2018; BLE, 2019). The import of biogas substrate could not be identified on the basis of the available data; overall, however, a very low level of imports of maize silage (for example) is to be assumed close to the border (AFC, 2016).

For generation of biogas

Most energy production from biogas for heat and electricity is based on renewable raw materials. In terms of the energy content of substrate usage, a total of around 75-77% of biogas was obtained by fermenting common renewable raw materials in the reporting period (DBFZ, 2019a; DBFZ, 2017). In both 2017 and 2018, around 61 million tonnes of fresh mass (t_{FM}) of biomass from agricultural land was used for biogas production with subsequent use of this biogas for the production of heat and electricity (Table 4). The biggest energy-related contribution from renewable raw materials (approximately 72-75%) came from maize silage. This was followed, some way behind, by grass silage (approximately 10-12%) and grain and whole cereal plant silage (together approximately 9-10%) and sugar beet (approximately 4%) (DBFZ, 2019a). Other crops such as catch crops (approximately 1%) and special energy crops such as millet, Silphium perfoliatum and mixed wild plants (in total approximately 1%) also played a very minor role in the reporting period of 2017 and 2018.

For generation of liquid biofuels

Liquid biofuels are used almost exclusively in cogeneration units of various sizes for combined electricity and heating generation (DBFZ, 2015b). By way of contrast to previous reporting periods, biodiesel made a relevant contribution to liquid biofuels, with the share increasing to around 21% in 2017 (BLE, 2018). Vegetable oil however continued to account for the largest proportion of liquid biofuels used to produce electricity and heat, with a share of 79%; of this figure, palm oil accounted for the majority with 69% in 2017 and 71% in 2018, followed by rapeseed oil with 31% in 2017 and

24% in 2018 (BLE, 2018; BLE, 2019). The amount of vegetable oil used in stationary power installations is very low compared to its use in the fuel sector.

For provision of solid fuels

Crops which are used exclusively for the provision of heat and electricity have not so far been grown on a significant scale. In a few arable locations, willows and poplars have been cultivated in short rotation (cf. Chapter 6.1.1) and Miscanthus has been cultivated for the production of solid fuels. The proportion of hay and special energy grasses in the provision of heat and electricity is still very low and can also only be quantified with a high level of uncertainty. Thus it is not currently possible to report any figures in Table 4.

Estimating the supply of biomass from agricultural land for the production of heat and electricity is primarily a question of the available land area, changes in competing uses, in particular for foodstuff and feedstuff production, and its consequences for biodiversity – a question which cannot be answered in the context of this progress report.

6.1.3 Agricultural and fishery by-products and residues

The use of agricultural and fishery by-products and residues listed in Table 4 reflects their use as a biogas substrate. The calculation for this was performed by way of analogy to that described in Chapter 6.1.2. The use of agricultural and fishery by-products and residues as solid fuels could not be identified separately and is included in waste, but makes up less than 1% of that figure.

For production of biogas

Manure, which includes animal excreta in the form of slurry and solid manure, accounts for the most significant component in this segment. In both 2017 and 2018, approximately 16-18% of the total biogas produced was obtained from manure (DBFZ, 2019a). Cattle slurry accounted for almost half, followed by solid cattle manure, pig slurry, poultry manure, dry chicken manure and solid pig manure (DBFZ, 2017). Landscape conservation material contributed approximately 0.5% of the total heat and electricity provision on the basis of biogas (DBFZ, 2017). No detailed data are available in relation to the use of crop residues (straw, beet leaves, etc.) in biogas installations. At present, around one third of the manure generated is used for the production of biogas (Scholwin, Grope et al., 2018). The potential availability of manure for energy purposes should therefore be regarded as higher, but it is dependent on technical and economic restrictions and social developments as well as on the number and type of livestock farms.

For provision of solid fuels

As well as being used in biogas installations, straw is also used for the direct provision of electricity and, in particular, heat (DBFZ, 2015b), namely, in one large-scale

commercial installation and around a hundred smaller installations for heating with straw or straw pellets (FNR, 2015b). The overall extent of this use of straw is low and is only in part statistically quantified. In Table 4, straw is categorised under ‘Other waste and agricultural residues (solid biomass, non-timber)’. Straw is the biomass with the greatest relevance in terms of volume among the agricultural residues, but the supply of straw is highly dependent on the discovery of alternative ways of safeguarding the humus balance.

6.1.4 Biomass from waste

During the reporting period, waste biomass was fermented into biogas, recycled in combustion plants or used as a raw material for fuel production, among other things (cf. Chapter 6.2). The incineration of biogenic waste, both in pure form (e.g. scrap wood, cf. Chapter 6.1.1) and as a mixture (e.g. household waste) was by far the most important element. Table 4 shows the biomasses used for electricity and heat production (biogenic waste from households, industry, trade and agriculture, sewage slurry, sewage gas and landfill gas); the figures were calculated on the basis of data from the Working Group on Renewable Energies and Statistics (DBFZ, 2019a; BLE, 2018; BLE, 2019) and (Thünen, 2019).

Municipal biowaste and residues from industry, trade and agriculture accounted for around 3-4% of the ***generation of biogas*** for use in both electricity and heat production during the reporting period (DBFZ, 2019a).

In addition to vegetable oils, ***liquid waste biomass*** can also be used for electricity and heat production. In the reporting years 2017 and 2018, no used cooking oils (UCO) for which sustainability certificates had been issued were used as biofuels according to the Federal Office for Agriculture and Food (BLE, 2018; BLE, 2019).

Primary energy provision from the ***biogenic fraction of waste***, which was mainly used in waste incineration plants, totalled 3 217 ktoe in 2017 and approximately 3 102 ktoe in 2018.

The ***use of wood-based biomass from waste*** (scrap wood) is described in Chapter 6.1.1.

Biogenic waste that was deposited in landfill sites in the past produces ***landfill gas*** that can be used to produce energy, mainly in the form of electricity. On account of the prohibition on sending untreated residual waste to landfill that has been in force in Germany since 2005, the availability of landfill gas shows a continuing downward trend. The corresponding primary energy provision (electricity and heat) amounted to a total of 132 ktoe in 2017 and went down to 123 ktoe in 2018.

Primary energy provision for heat and electricity from ***sewage treatment gas*** was approximately 460 ktoe in 2017 and approximately 493 ktoe in 2018.

6.2. Biomass for the transport sector

The figures relating to the use of biomass for the transport sector in Table 4 were calculated using the data provided in the evaluation and progress report of the Federal Office for Agriculture and Food on the use of biofuels, the raw materials used and the origin of the raw materials (BLE, 2018; BLE, 2019) and conversion factors from the NREAP and BioGrace. In so doing it was assumed that no biofuels were used in Germany in 2017 and 2018 that had not been certified as complying with the sustainability criteria (see Chapter 13 in this connection). On account of the strongly intertwined international relationships in the biofuels sector, the supply situation has not been quantified.

6.2.1 Common arable crops

The dominant domestic raw material for biofuel production in Germany based on arable crops and counted against the GHG quota was rapeseed, with an estimated annual volume of around 1.0 million t_{FM} in 2017 and around 0.9 million t_{FM} in 2018. Other domestic raw materials included various types of cereals (combined total of approximately 603 kt_{FM} in 2017 and 490 kt_{FM} in 2018) and sugar beet (approximately 90 kt_{FM} in 2017 and 83 kt_{FM} in 2018) for bioethanol used in Germany.

Cereals (approximately 1 126 kt_{FM} in 2017 and approximately 1 227 kt_{FM} in 2018), maize (approximately 1 014 kt_{FM} in 2017 and approximately 950 kt_{FM} in 2018), rapeseed (approximately 930 kt_{FM} in 2017 and 700 kt_{FM} in 2018) and sugar beet (approximately 34 kt_{FM} in 2017 and approximately 64 kt_{FM} in 2018) accounted for the largest shares of raw materials in terms of imports from other EU countries. Palm oil (approximately 1 433 kt_{FM} in 2017 and approximately 1 376 kt_{FM} in 2018), maize (approximately 726 kt_{FM} in 2017 and approximately 904 kt_{FM} in 2018) and sugar cane (approximately 261 kt_{FM} in 2017 and approximately 124 kt_{FM} in 2018) made up the primary imports from non-EU countries. Biomethane used as fuel was produced solely on the basis of waste and residues during the reporting period (BLE, 2018; BLE, 2019). Waste and residues such as used cooking oils are analysed in 6.2.3.

6.2.2 Energy crops

No biofuels have so far been produced in Germany on a commercial scale from alternative, multiannual dedicated bioenergy crops such as grasses or short rotation trees.

6.2.3 Waste and residues

A breakdown of the waste and residues used to produce the biofuels placed on the market in Germany is provided in Chapter 8. In 2017 and 2018, used cooking oils accounted for around 81% of the raw material basis for biofuels from waste and residues, with relatively large amounts imported from other EU and non-EU countries

(BLE, 2018; BLE, 2019). The production of biomethane for use in transport during the reporting period was predominantly based on pulp from alcohol distillation and to a significantly lower extent on waste from sugar manufacture, organic waste collection bins, slurry and sewage slurry, and (in 2018, to a small extent) on silage maize. During the reporting period, the majority of the raw materials came from within Germany (BLE, 2018; BLE, 2019).

7 PLEASE PROVIDE INFORMATION ON ANY CHANGES IN COMMODITY PRICES AND LAND USE WITHIN YOUR MEMBER STATE IN THE PRECEDING TWO YEARS ASSOCIATED WITH INCREASED USE OF BIOMASS AND OTHER FORMS OF ENERGY FROM RENEWABLE SOURCES. PLEASE PROVIDE, WHERE AVAILABLE, REFERENCES TO RELEVANT DOCUMENTATION ON THESE IMPACTS IN YOUR COUNTRY.

(Article 22(1)(h) of Directive 2009/28/EC)

7.1. Land use for renewable energies

Land for the production of regenerative energy is mainly used to cultivate biomass for energy-related use and, to a much lesser extent, for wind power installations and ground-mounted photovoltaic installations. The amount of land used for geothermal energy and hydropower (other than storage facilities and dams) is insignificant.

7.1.1 Bioenergy

The figures relating to land taken up for bioenergy in Table 4a relate to the agricultural land in Germany that was used for the domestic production of bioenergy carriers. Figures relating to the use of woodlands for bioenergy cannot be provided on the basis of the currently available data.

Since, at the time of cultivation, the subsequent use is often not yet determined, there is no distinction in the official statistics between cultivation for food or fodder and that for energy purposes. As a result, the figures relating to land use for bioenergy are based on reasonable assumptions. The data from (FNR, 2019a) are used to this end; the latter calculates the land use for domestic production of the individual bioenergy carriers on the basis of the land used for the individual crops, net trade balance sheets and the raw material demand for the various applications (AFC, 2016). The areas of land calculated in this way should therefore be interpreted as computational variables that estimate the agricultural land required in Germany for the domestic production of (for example) biofuels. Discrepancies may accordingly be observed in relation to the size of the land areas associated with the domestic use of biofuels, as can be identified from the findings by the Federal Office for Agriculture and Food (BLE, 2018).

The land actually used in Germany for bioenergy applications both in Germany and abroad cannot be calculated accurately on the basis of the currently available data. The land use associated with imported bioenergy products and raw materials has also not been taken into consideration below, but may account for a considerable proportion in the case of certain applications.

The amount of land taken up for the cultivation of energy crops totalled around 2.2 million ha in the reporting period. The drop of around 9% compared to the previous reporting period can be attributed primarily to a reduction in the amount of land used to cultivate rapeseed for biofuel production. The cultivation of maize (grain for

bioethanol production and primarily silage maize for biogas extraction) continued to account for by far the greatest area used for the cultivation of energy crops.

Table 4a: Domestic agricultural land use for production of crops dedicated to energy production

Land use	Area (in hectares)					Area (in hectares)	
	2012	2013	2014	2015	2016	2017*	2018**
1. Land used for common arable crops	2 148 000	2 055 000	2 340 200	2 382 000	2 371 800	2 163 600	2 149 300
of which:							
Rapeseed for biodiesel and rapeseed oil	786 000	614 000	799 000	805 000	720 000	598 000	560 000
Plants for bioethanol	200 300	172 700	187 500	237 400	258 900	248 900	246 100
Plants for biogas	1 161 700	1 268 300	1 353 700	1 339 600	1 392 900	1 316 700	1 343 200
of which							
Maize (silage)	834 000	848 000	877 000	872 000	911 000	838 000	866 000
Whole crop (silage)	153 000	162 000	199 000	178 000	192 000	194 000	194 000
2. Land used for other energy crops	2 600	3 300	4 900	4 900	5 300	6 400	7 600
of which							
Silphium (for biogas)	100	300	400	400	800	1 900	3 000
Miscanthus (solid fuel)	2 500	3 000	4 500	4 500	4 500	4 500	4 600
3. Land used for short rotation trees (SRC)	5 000	6 000	6 000	6 630	6 630	6 630	6 630
Energy use, total	2 155 600	2 064 300	2 351 100	2 393 530	2 383 730	**2 176 630**	**2 163 530**

* preliminary values, ** estimated values

Source: (FNR, 2019a)

The significant drop in the amount of land used to cultivate rapeseed for the production of biofuels that is apparent from Table 4a corresponds to the overall downward trend that has been observed in the use of biofuels based on rapeseed (BLE, 2019). In addition, the land use data reflect the reduction in the use of sugar beet for bioethanol production; this is not apparent from Table 4a, however, since cereals dominate in terms of bioethanol production (according to Fachagentur Nachwachsende Rohstoffe e.V. (FNR, 2019a), 205 000 ha were used for cereals and 21 000 ha for sugar beet for bioethanol production in 2018). The amount of land used to cultivate cereals for bioethanol increased until 2016 and has remained relatively constant since then. The amount of land used to cultivate grain maize for bioethanol production has also remained constant over recent years. Further details of the nature and

origin of the biofuels used in Germany can be found in Chapter 14.2.1, and further details of the ecological impacts can be found in Chapter 9.

The land for the cultivation of substrates for biogas production remained relatively constant at 1.3 to 1.4 million ha following a sharp rise up until 2012 (with 530 000 ha in 2009 and 1 161 700 ha in 2012) and a moderate increase up until 2014 (1 354 100 ha) (AFC, 2016; FNR, 2019a). Of the biogas substrates, maize silage accounts for by far the greatest area (some 999 000 ha in 2018). To limit the use of maize as a biogas substrate, the permitted shares eligible for funding under the Renewable Energy Sources Act have been reduced since the Renewable Energy Sources Act 2012 ('maize cap'). According to this mechanism, the permitted proportion used per biogas installation (applies to grain and whole crop maize, corn cob mix, corn maize and ground ear maize) will be gradually reduced from 50% in 2017 to 44% in 2021. The amount of land used for cultivation of Silphium increased eightfold to 3 000 ha between 2015 and 2018, but continues to make only a minor contribution to the production of biogas substrates.

No changes were recorded in respect of the area under other 'dedicated bioenergy crops' (alternative multiannual energy crops), such as short-rotation trees in short-rotation coppices (SRC) or Miscanthus for use as solid fuel. Overall, 'dedicated bioenergy crops' in the form of SRC, Miscanthus and Silphium thus only accounted for around 0.7% of the total area under cultivation with crops for energy purposes in 2018, despite a sharp rise in the area used for the cultivation of Silphium.

Environmental impacts. In regions where high livestock numbers coincide with a high incidence of biogas installations, there is often a problem of particularly high levels of nutrient excess due to the heavy application of organic fertilisers (manure and fermentation residues from renewable raw materials). This increases the risk of gaseous nutrient losses and nitrate leaching. It also increases the risk of erosion by the late stand density in the case of maize. In practice, a high proportion of maize in the crop rotation cycle is often associated with high levels of ammonia in the air and nitrates in the groundwater, a negative humus balance and an increased risk of attack by pests (particularly corn borer and corn rootworm), an impoverishment of agricultural biodiversity and an adverse effect on the look of the landscape (BfN, 2010b; TAB, 2010; KLU, 2013; MLNiedersachsen, 2014). In certain areas of Lower Saxony with a high density of biogas installations and livestock, the large-scale cultivation of maize for biogas production and animal husbandry has meant that maize takes up well over 50% of arable land in some municipalities (MLNiedersachsen, 2014; DMK, 2018).

Loss of grassland and intensification of use. With the increasing demand for biomass for energy-related use, grassland has grown in importance as a supplier of biogas substrate. Intensification of use may compromise the quality of the grassland affected in Germany and reduce its value in terms of biodiversity. Since ploughing up grassland produces high CO_2 emissions because of the breakdown of humus, the

competent authorities at federal state level have imposed a restrictive authorisation requirement for potential grassland ploughing measures (which may involve the payment of compensation). There is a complete ban on ploughing up ecologically sensitive permanent grassland in FFH areas. An area covering approximately 4.62 million ha was used as permanent grassland in Germany in 2013 (Destatis 2015). In relation to the overall figure for agricultural land, grassland accounted for a share of just under 28%. In response to an increase in the ploughing up of grassland, and within the framework of the common agricultural policy, an increasing number of bans were imposed on grassland ploughing, meaning that the area of permanent grassland as a share of agricultural land remained relatively constant, and was still around 28% in 2018 (Destatis, 2018a). Nevertheless, the development trends for grassland habitats suggest that the area of intensively used grassland as a proportion of permanent grassland is increasing (BfN, 2017). Cutting frequencies, use of fertiliser and crop size also indicate a trend towards intensification. (In the period between 2010 and 2014, crop sizes for permanent grassland increased from 28.5 million tonnes to 32.4 million tonnes (+14%) (Destatis 2015).)

Biodiversity. Negative impacts on biodiversity may come from intensification of use and the loss of agricultural micro-structures such as hedges, uncultivated field edges and other border areas. In turn, these impacts also affect participation in agri-environmental measures and make it harder to assign and maintain nature conservation areas because of the increased pressure on the land. The funding conditions for agri-environmental measures under the Community objective ‘improvement of the agrarian structures and coastal protection’ were therefore designed to be as attractive as possible; nevertheless, the success of these measures depends to a large extent on how they are used by farmers, i.e. selected from a range of measures. This in turn depends not only on adequate funding as a basic condition, but also on other conditions, e.g. potential restrictions/penalties in the event that the measure is not implemented properly.

Water volume. There is as yet no indication that the availability of water in Germany is being adversely affected by the cultivation of energy crops. However, there are significant differences between crops in terms of the amount of water they require. Poplar and willow in short-rotation coppices have been reported as potentially leading to locally reduced levels of groundwater regeneration (Richter, Jansen et al., 2014).

Water quality. Only around 7% of bodies of flowing water and 26% of lakes in Germany met the targets of the Water Framework Directive in 2015 and achieved a ‘good status’ (UBA, 2017). Nitrogen and phosphorus inputs and far-reaching changes

in hydromorphology make agriculture one of the main reasons why a ‘good status’ cannot be achieved. Agriculture is also one of the main reasons why the nitrate limit value of 50 mg/l in upper groundwater is exceeded at 28% of measuring points in the impact measuring network[71] (BMUB and BMEL, 2017). Additional nutrient inputs from the fermentation residues of renewable raw materials exacerbate the problem yet further.

Soil quality. The impacts on soil quality of the cultivation of renewable raw materials used (among other things) for bioenergy production may include the following:

- alteration in the level of organic soil content as a result of changes in crop rotation cycles, land use and intensity of farming,
- increased risk of erosion by wind and water,
- increased risk of soil compaction.

There has been no nationwide study of changes in the ecological state of the soil in agriculturally used areas in Germany, so no definitive conclusions can be drawn regarding the impacts of bioenergy production on soil quality.

7.1.2 Photovoltaic

The amount of land taken up per MW of newly commissioned ground-mounted photovoltaic installations has steadily decreased in recent years as a result of efficiency improvements in modular technology and space-saving installation designs. The amount of land taken up by installations commissioned up to and including 2010 was on average around 3.56 ha/MW (ZSW, IWES et al., 2014). Ground-mounted installations commissioned in 2011 required approximately 2.5 ha/MW, while an average value of 1.34 ha/MW had ultimately been achieved by 2018 (ZSW, bosch&partner, 2019).

In total, around 23 900 ha was taken up by ground-mounted photovoltaic installations commissioned up to and in 2018. Of this area, approximately 17 940 ha was in conversion areas/on sealed soils or in industrial areas, approximately 3 840 ha on the verges of roads and railways and approximately 7 470 ha on arable land. Since the verges of roads and railways are typically located on former arable land, the total area of agricultural land covered by ground-mounted photovoltaic installations is around 11 000 ha. The share of total agricultural area in Germany (18.2 million ha) accounted for by ground-mounted photovoltaic installations is 0.07% (ZSW, bosch&partner, 2019) .

[71] Source of data (reporting period 2012 to 2014): 697 measuring points in the ‘specialised agriculture monitoring network’ [Teilmessnetz Landwirtschaft] within the newly designed EU Nitrate Measuring Network; within the catchment area of these latter, the groundwater measuring points are dominated by the influence of uses involving farmland, grassland and special crops.

In accordance with the Renewable Energy Sources Act 2017, the federal states are able to stipulate individually, by means of a regulation, whether and to what extent arable land and/or grassland in less-favoured regions should be considered for calls for tender for ground-mounted photovoltaic installations (clause enabling the federal states to take action under Section 37c EEG 2017). Regulations of this kind on the opening up of land are currently in force in Bavaria (up to 70 installations/year), Baden-Württemberg (up to 100 MW/year, evaluation by the end of 2022), Hessen (up to 35 MW/year until the end of 2025), Rheinland-Palatinate (up to 50 MW/year), exclusively on grassland areas in less-favoured regions, until the end of 2021) and Saarland (up to 100 MW until the end of 2022) (ZSW, bosch&partner 2019).

7.1.3 Onshore wind energy

On account of the comparatively low significance of the land taken up by wind power installations, this value has thus far not been recorded in Germany. Based on a rough estimate of around 0.2 ha[72] of sealed soil per wind power installation, it can be assumed that around 5 580 ha[73] of soil was sealed as a result of wind power installations at the end of 2018. In addition, due account should be taken of the land used for the construction of additional infrastructure, such as access routes and car parking areas. This applies in particular to the use of wooded areas for wind power installations. The total area of land permanently withdrawn from other uses through the construction of wind power installations is comparatively small.

7.2. Price trends

The following subsections outline the rents and land prices and the trends in prices of the relevant raw materials used to produce bioenergy in Germany, which are only partly attributable to bioenergy use.

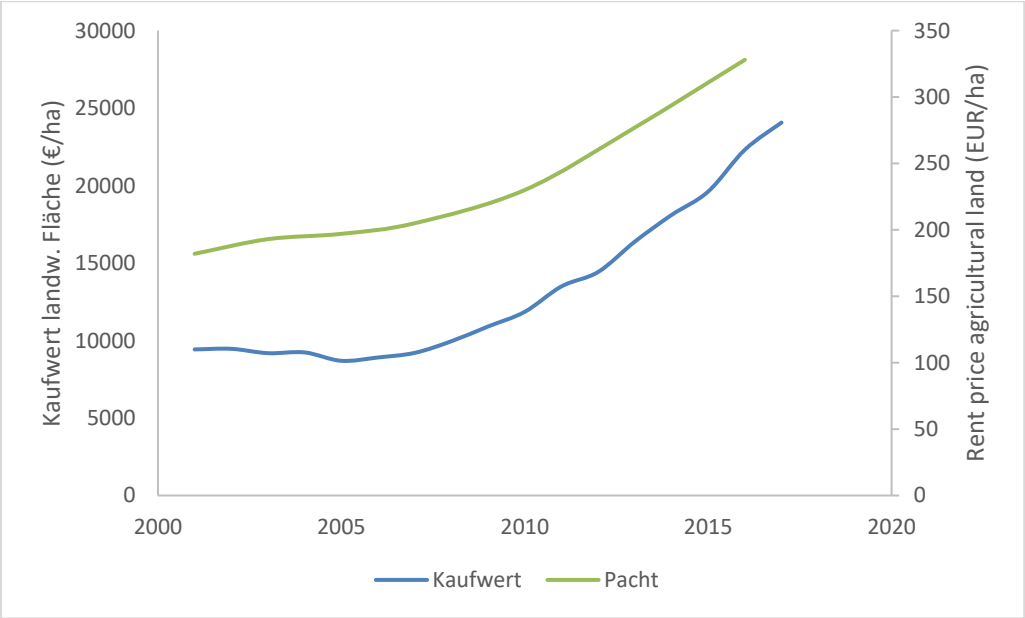
7.2.1 Rents and land prices

For some years, a sharp increase in the purchase and rent prices for land used for agriculture has been observed. The purchase value rose by around 160% from 2007 to 2017, and rents by 60% to 2016 (Destatis, 2017; Destatis, 2018b).

[72] The calculation of 0.2 ha/wind power installation applies to modern wind power installations and takes account of the soil sealed for crane footprints and foundations permanently required during the operating period of wind power installations. Data were evaluated for the four types of wind power installations that obtained the most approvals in 2016. The values for the total soil sealed for these installations were between 0.13 and 0.19 ha/wind power installation.

[73] The total sealed soil used for wind power installations corresponds to the total stock of installations, i.e. including older existing installations with smaller foundations and crane footprints. Since the estimated value of 0.2 ha was however used for all wind power installations, the sealed soil figure calculated for the end of 2018 should be regarded as conservative.

Figure 7.1: Development of purchase values and rents for agricultural land



Source: (Destatis 2017, Destatis 2018b)

Kaufwert landw. Fläche (€/ha)	Purchase price for agricultural land (EUR/ha)
Kaufwert	Purchase value
Pacht	Rent

Once again, impacts are observed not only in connection with bioenergy use, but also with non-agricultural factors. Reports have however been received from some regions with a high density of biogas installations that the increased demand for land is affecting rents. In some regions with a high density of biogas installations, the associated increased demand for land can cause a considerable increase in the price level for new leases (MLNiedersachsen, 2014). This affects livestock-rearing regions in the west of Lower Saxony, for instance, where rents are already above average (MLNiedersachsen, 2012; MLNiedersachsen, 2014). In these extreme cases, the high rents are mainly attributable to the combination of a high density of refineries (especially pig fattening) and biogas installations which, with their demand for land for silage and energy maize, but also for the spreading of the accumulating manure and fermentation residues, trigger regional competition over land use, which contributes to a rise in land prices (LSN, 2014; Garvert, 2017).

7.2.2 Wood-like biomass

Demand for wood as a material experienced an economic downturn in 2009, but subsequently stabilised. Since 2010, demand for wood as a material and demand for energy-related use have been roughly equivalent in terms of volume. In 2016, around 65-70 million m³ of wood were used in both cases (including forest wood, industrial wood residues and scrap wood) (Mantau, Döring et al., 2018), whereby significant differences were observed in terms of wood types and momentum, for example as a result of winter temperatures.

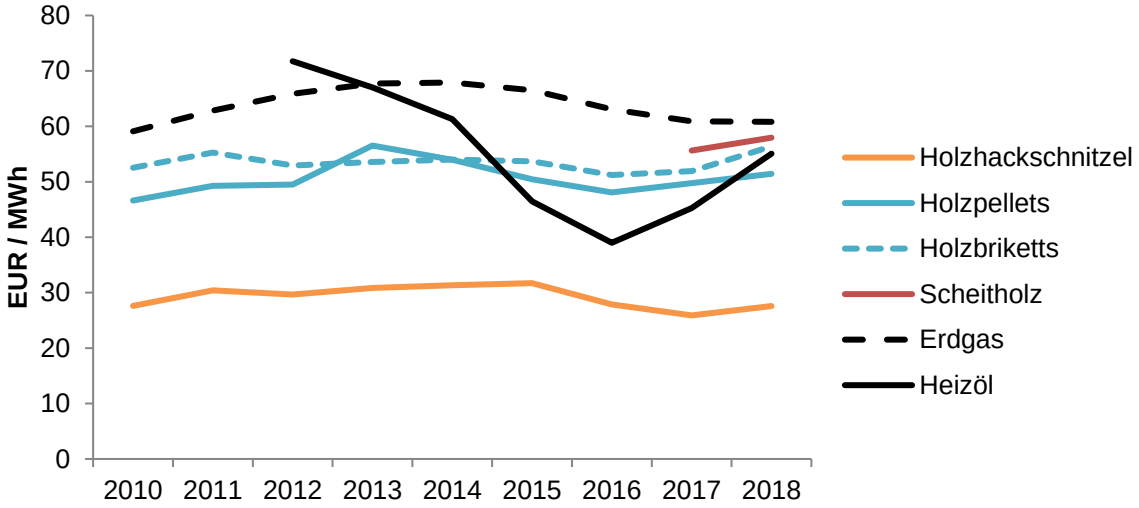
Wood chips. The price of forest wood chips doubled between 2003 and 2013 and continued to increase at a slower pace until 2015, when it reached the previous high of around EUR 32/MWh. The price of these chips fell to around EUR 26/MWh by 2017 and then increased again slightly in 2018 to around EUR 28/MWh (CARMEN, 2019c).

Wood pellets. The prices for wood pellets have been influenced strongly by heating oil prices. After the prices rose up to the start of 2014 (FNR, 2017), which reflected the growing demand for pellets as a result of the clear growth in pellet-fired installations in Germany (Mantau, 2012; DEPI, 2015), the average price for wood pellets fell by approximately 10% from 2014 to 2016 (CARMEN, 2017) and increased again from 2016 to 2018 by around 7% to approximately EUR 52/MWh (CARMEN, 2019a).

Wood briquettes. The price for wood briquettes was around EUR 52/MWh in 2017. A renewed increase in prices for wood briquettes was observed as well during the reporting period after a drop in prices between 2014 and 2016. The rate of increase between 2016 and 2018 (around 10%) was however somewhat higher than that for wood pellets, meaning that in 2018, wood briquettes cost around EUR 56/MWh (CARMEN, 2019b).

Logs. Overall, prices saw an upward trend between 2011 and 2014 (CARMEN, 2015). Nevertheless, log prices are only relevant for the small number of users who purchase logs from fuel traders. More important methods of procuring logs remain direct purchase from forest owners, forestry services, farmers or acquaintances, self-promotion or trees felled in privately owned forests (Mantau, Döring et al. 2018). The dependence of log prices on oil and gas prices is not so marked as that observed for wood pellets, for example. Accordingly, there was no reduction in prices as a result of the drop in heating oil prices; instead, log prices continued to rise steadily even after 2014, reaching around EUR 58/MWh at the end of 2018 (FNR, 2019b).

Figure 7.2: Evolution of fuel prices



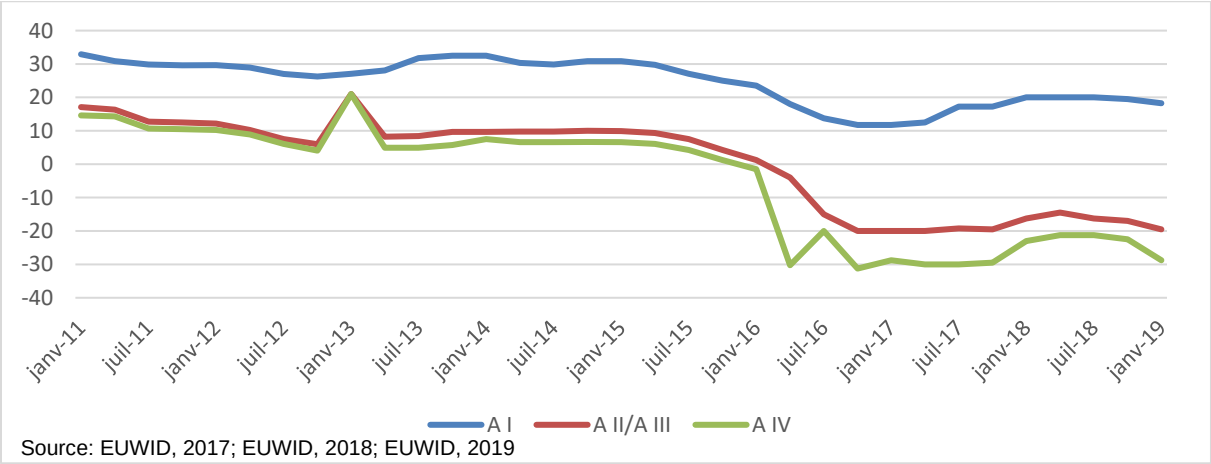
Quelle: Holzhackschnitzel Holzpellets, Holzbrikkets: Carmen e.V.: Scheitholz: FNR; Heizöl, Erdgas: Destatis

Holzhackschnitzel	Wood chips
Holzpellets	Wood pellets
Holzbriketts	Wood briquettes
Scheitholz	Logs
Erdgas	Natural gas
Heizöl	Heating oil
Euro / MWh	**EUR/MWh**
Quelle	Source

Scrap wood. The volume of scrap wood, and accordingly also the price thereof, is linked to construction activity and plywood volumes, whereas the use of scrap wood is linked to the price level of waste for waste incinerators, the operation of scrap wood power plants and weather conditions. After a sharp drop in scrap wood prices in 2015 and 2016, prices stabilised during the reporting years of 2017 and 2018 and started to rise again at a low to moderate pace depending on the category and region. In early 2017, cold weather conditions resulting in lower occurrence of scrap wood and higher demand for district heat marked an end to the over-supply of scrap wood observed since 2016 (EUWID 2017a). Although concerns were raised about the scarcity of scrap wood at certain power plants, the prices barely increased. The volume of scrap wood was again lower than expected during 2017, which is attributable *inter alia* to a slight drop in imports and increase in exports. Nevertheless, the

prices for scrap wood in the categories A II to A IV remained largely constant in 2017, since the scrap wood market was balanced and stable in large areas of Germany (EUWID 2017c, EUWID 2017b). The prices for these wood types only started to increase in 2018. Prices had dropped by the end of 2018, however, particularly in the south of the country, owing to a very healthy supply situation resulting from an economic boom and low demand for scrap wood in the dry summer of 2018 (EUWID, 2018). The price of wood in the A I category started to increase again in 2017 in step with demand for material qualities (EUWID 2017c, EUWID 2017a, EUWID 2017b). The scrap wood industry continued to be affected by rising transport costs and scarce transport capacities in both 2017 and 2018. Since the costs were typically passed on at the location where the scrap wood was generated, however, it is probable that the impacts on scrap wood prices were low (EUWID, 2017c).

Figure 7.3: Evolution of prices for scrap wood types

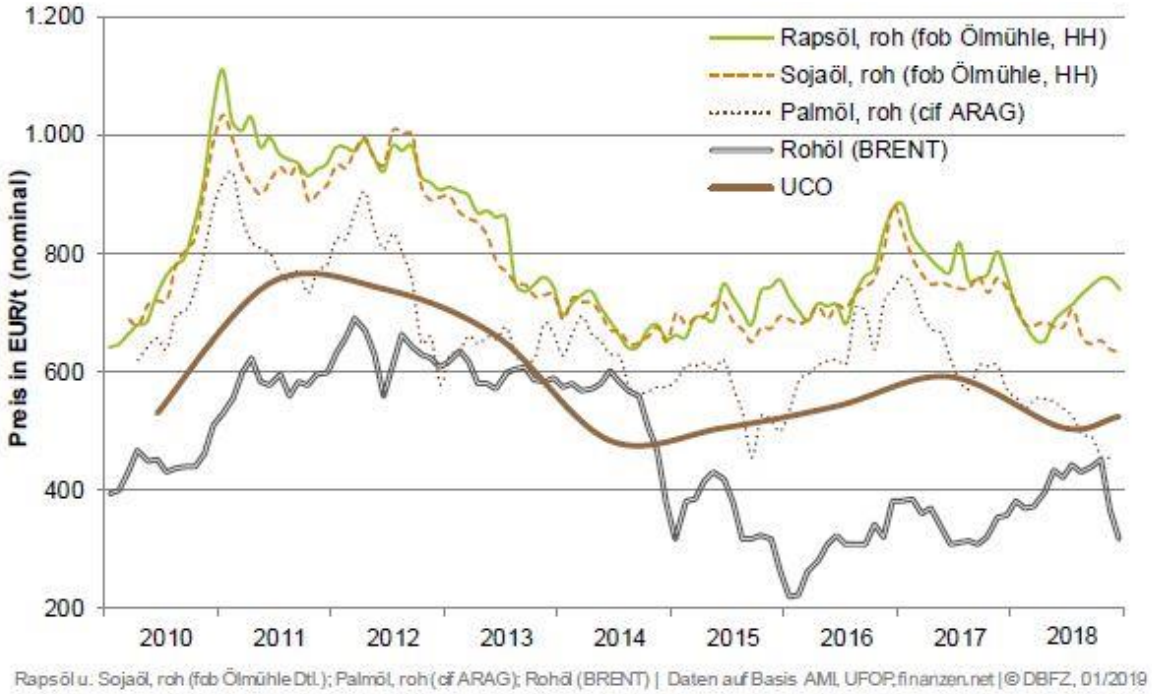


Source: EUWID, 2017; EUWID, 2018; EUWID, 2019

7.2.3 Vegetable oils

Oilseeds and vegetable oils obtained from them are used as energy sources both in the transport sector and in cogeneration units. Their prices are largely determined by the situation on the world market, which in turn depends on fluctuating supply (e.g. based on the respective harvest) and demand in all usage sectors (FNR, 2015a; DBFZ 2019b). Prices for vegetable oils fell between 2011 and 2015, but began to rise again in 2016. The price of crude palm oil fell by 44% during the reporting period. In December 2018, a tonne of palm oil cost only EUR 423, instead of EUR 751 as in December 2016 (UFOP, 2017b; UFOP, 2018b). Reasons include an abundant supply of raw materials thanks to record levels of production in Indonesia and Malaysia, and restrained demand on the world market. The price of soybean oil also fell significantly during the reporting period, since high production outpaced low global demand; the latter was due (among other things) to the trade war between China and the USA. The slump in palm oil prices also had an impact on the price of other vegetable oils. The price of rapeseed oil nevertheless rose again between mid-2018 and the end of the year, since the drought in Europe and Australia resulted in poor harvests (UFOP 2017a, UFOP 2018a).

Figure 7.4: Evolution of vegetable oil prices



Source: (DBFZ, 2019)

Preis in EUR/t (nominal)	**Cost in EUR/t (nominal)**
Rapsöl, roh	Rapeseed oil, crude
Ölmühle	Oil mill
Sojaöl, roh	Soybean oil, crude
Palmöl, roh	Palm oil, crude
Rohöl	Crude oil
u.	And
Daten auf Basis	Data based on

7.2.4 Substrates for biogas generation

The prices for the majority of substrates used to produce biogas exhibit a very low level of dependence on the world market, since their high water content means that they are only transported short distances. The range of substrate costs is therefore relatively wide, and the costs differ to a considerable extent from region to region. In spite of significant regional differences, the averaged substrate costs calculated on the basis of a survey by the German Biogas Association [Fachverband Biogas] reflect

a significant rise in costs owing to the drought in 2018. In comparison to 2016, the price of silage maize (ex-silo collection) rose by approximately 6.5% to EUR 98.7/t_{TM} (or EUR 35.3/t_{FM}), and the price of grass silage rose by as much as around 13% to EUR 93.7/t_{TM} (or EUR 33.5/t_{FM}). Only the price of sugar beet continued to fall to EUR 109.7/t_{TM} (fieldside collection), which is probably attributable to falling sugar prices (Rauh, 2019). In terms of the methane yield, silage maize thus remained the most cost-effective biogas substrate (at around EUR 0.32/m^3CH_4), apart from waste and residues, and grass silage the second most cost-effective biogas substrate (at EUR 0.36/m^3CH_4). At the same time, however, the maize yield in certain federal states was around 40% of the (low) country-wide average (Destatis, 2019b), meaning that significant regional differences in conditions are likely.

7.2.5 Producer prices for agricultural and forestry products

Agricultural products. The producer price index for agricultural products is measured against the base year of 2010. In 2017, the index rose by 15.5% compared to 2010. The increase in the index for plant products (+15.0%) and animal products (+15.8%) was roughly similar (Destatis, 2018c). In 2018, price levels were 15.2% higher in relation to 2010, primarily as a result of the increase in the price of plant products (price index +23.6% compared to 2010, +9.9% for animal products) (Destatis, 2019c).

Forestry products. Wood products for energy production are also reported in the producer price index for forestry products for information purposes. The prices of wood products for energy production dropped by 3.5% in 2017 (Destatis, 2018c) compared to the base year of 2010. The drop in prices was largely due to reduced prices for wooden discs and chips (-9.2%) and industrial wood (-6.2%), which can undoubtedly be attributed to the very high availability of scrap wood. Compared to 2017, the price of wood products for energy production recovered in 2018, with the result that the index was at a similar level to that in 2010 (-0.9%) (Destatis, 2019c). Whilst the prices for fuel wood (beech) fell by 7.2% in 2017 compared to the previous year, they rose again by 2.1% in 2018 to a price index of 152.7, which was 52.7% higher than in 2010 (Destatis, 2019c).

8 PLEASE DESCRIBE THE DEVELOPMENT AND SHARE OF BIOFUELS MADE FROM WASTES, RESIDUES, NON-FOOD CELLULOSIC MATERIAL, AND LIGNO-CELLULOSIC MATERIAL.

(Article 22(1)(i) of Directive 2009/28/EC)

Statistical information on the production of biofuels on the basis of the feedstocks listed in Annex IX Parts A and B to Directive 2009/28/EC is not available for Germany, but figures can be provided in relation to the feedstocks for the volumes of biofuels counted against the GHG quota in Germany on the basis of the data supplied by the Federal Office for Agriculture and Food for both reporting years (cf. Table 5).

The total use (transport sector and other types of traffic[74]) of biofuels in accordance with Annex IX Part A to Directive 2009/28/EC to meet the GHG quota was almost 6 ktoe overall in 2017. This corresponds to a share of around 0.01% of total fuel consumption. Biofuels based on biowaste collected separately in private households were particularly significant, as well as fuels based on industrial waste and effluent from palm oil mills and empty palm fruit bunches. Biofuels based on used cooking oil were counted against the biofuel quota in the amount of 646 ktoe in 2017.

In 2018, the pattern for biofuels pursuant to Annex IX, Part A to Directive 2009/28/EC was similar to that in the previous year; overall use was around 8 kt RÖE, which in turn corresponded to 0.01% of total fuel consumption. This overall total is again dominated by biofuels based on biowaste collected separately in private households, as well as by fuels based on industrial waste and effluent from palm oil mills and empty palm fruit bundles. The amount of biofuels based on used cooking oil that were counted against the GHG quota rose significantly in 2018 compared to the previous year, to 840 ktoe.

[74] Transport in agriculture, forestry, the construction industry and the military. The use of fuel in this field (including biogenic content) is recorded, under the 'heating and cooling' sector rather than the transport sector. The values in Chapter 1 (transport sector) therefore differ from those in Chapter 8.

Table 5: Development of biofuels produced from the feedstocks listed in Annex IX to Directive 2009/28/EC (ktoe)[75]

Feedstock as listed in Annex IX Part A to Directive 2009/28/EC	**2017**	**2018**
(a) Algae if cultivated on land in ponds or photobioreactors,		
(b) Biomass fraction of mixed municipal waste, but not separated household waste subject to recycling targets under point (a) of Article 11(2) of Directive 2008/98/EC,		
(c) Biowaste as defined in Article 3(4) of Directive 2008/98/EC from private households subject to separate collection as defined in Article 3(11) of that Directive,	2.1	4.6
(d) Biomass fraction of industrial waste not fit for use in the food or feed chain, including material from retail and wholesale and the agro-food and fish and aquaculture industry, and excluding feedstocks listed in Part B of this Annex,	1.4	1.3
(e) Straw,	0.0	
(f) Animal manure and sewage sludge,	0.1	
(g) Palm oil mill effluent and empty palm fruit bunches,	1.9	1.2
(h) Tall oil pitch,	0.1	
(i) Crude glycerine,		0.0
(j) Bagasse,		
(k) Grape marcs and wine lees,	0.1	0.0
(l) Nutshells,		
(m) Husks,		
(n) Cobs cleaned of kernels of corn,		
(o) Biomass fraction of wastes and residues from forestry and forest-based industries, i.e. bark, branches, pre-commercial thinnings, leaves, needles, tree tops, saw dust, cutter shavings, black liquor, brown liquor, fibre sludge, lignin and tall oil,		
(p) Other non-food cellulosic material as defined in point (s) of the second paragraph of Article 2,		1.3
(q) Other ligno-cellulosic material as defined in point (r) of the second paragraph of Article 2 except saw logs and veneer logs.		
Feedstock as listed in Annex IX Part B to Directive 2009/28/EC	**2017**	**2018**
(a) Used cooking oil,	646.0	840.5
(b) Animal fats classified as Categories 1 and 2 in accordance with Regulation (EC) No 1069/2009 of the European Parliament and of the Council.		

[75] Evaluation of the Nabisy database operated by the Federal Office for Agriculture and Food, as at October 2019.

9 PLEASE PROVIDE INFORMATION ON THE ESTIMATED IMPACTS OF THE PRODUCTION OF BIOFUELS AND BIOLIQUIDS ON BIODIVERSITY, WATER RESOURCES, WATER QUALITY AND SOIL QUALITY WITHIN YOUR COUNTRY IN THE PRECEDING TWO YEARS. PLEASE PROVIDE INFORMATION ON HOW THESE IMPACTS WERE ASSESSED, WITH REFERENCES TO RELEVANT DOCUMENTATION ON THESE IMPACTS WITHIN YOUR COUNTRY.

(Article 22(1)(j) of Directive 2009/28/EC)

The amount of data available regarding the impacts of biofuel and liquid biofuel production on the aforesaid environmental indicators over the preceding two years is limited, and the following is therefore a general description of agricultural production and the cultivation of renewable raw materials used (among other things) for bioenergy production.

The development of agricultural production is influenced by various factors. These include not only global population growth, rising incomes and resource-intensive consumption patterns in industrialised countries, but also changing consumption patterns (including rising consumption of animal products) in developing and emerging economies. These factors increase the demand for agricultural goods (WBGU, 2009). Increasingly unpredictable crop failures are likely to intensify competition between different parties wishing to use the scarce supply. The cultivation and marketing of feedstocks for biofuel production is another factor influencing the demand for agricultural products and agricultural production. The range of different influencing factors involved meant that it is difficult to quantify empirically the direct effects of biofuel production on the agricultural production system as a whole. This is particularly true given that the German agricultural market is closely tied to the global markets.

It is generally the case that pressure on agricultural land is increasing as a result of the aforesaid influencing factors. A study by Weishaupt et al. (2020) identifies a link between rising animal production and an increase in the ratio of livestock to land, since land is required not only for pasture grazing but also to grow fodder crops for the animals. These activities account for around 70% of agricultural land in the EU. Based on past land-use changes in the EU and using modelling techniques, Schulp et al. (2019) posit that not only urbanisation, but also intensification or neglect of agricultural land results in a drop in cultivated landscapes.

The area under cultivation for energy crops has remained at a similar level in recent years: the AUC was 2 280 000 ha in 2017, 2 426 000 ha in 2018 and 2 371 000 ha in 2019 according to estimates by the Federal Ministry of Food and Agriculture [Bundesministerium für Ernährung und Landwirtschaft, BMEL] (BMEL, 2020). In 2019, this corresponded to around 14% of Germany's agricultural land (FNR, 2019). The area of land used for bioethanol and biodiesel crops was 846 000 ha in 2017 and 806 000 ha in 2018; there are no figures currently available for 2019 (FNR, 2019).

Intensified farming of agricultural land, *inter alia* for the purpose of producing feedstocks for biofuels, has an adverse impact on protected ecological resources. As a basic principle, more intensive farming of agricultural land in Germany is linked to risks in relation to biodiversity, water resources, water and soil quality and the state of terrestrial ecosystems (BfN, 2010b; BfN, 2015; UBA, 2015; BfN, 2017). For example, the constriction of crop rotation cycles, the restriction to a few particularly high-yield varieties and the high use of fertilisers and plant protection products have a negative effect on agricultural biodiversity. An analysis of the most important primary sectors reveals that agriculture-related causes are responsible for 70% of the projected reduction in terrestrial biodiversity (Diversity, 2014). The loss of agriculturally/ecologically significant structures and forms of land use such as extensively used grassland, wastelands, borders and unused marginal areas of parcels as a result of a general increase in the pressure on use of agricultural land (BfN, 2010b) also has a negative impact on biodiversity. The decrease in numbers of representative bird species in agricultural land is a key indicator of deficiencies in terms of sustainability (UBA, 2017; UBA, 2018). The most significant consequences of intensive agriculture in respect of water and soil quality include nitrogen inputs into groundwater, nutrient inputs into surface waters and eutrophication, loss of humus, soil erosion, soil compaction and biodiversity loss. Nitrogen emissions into the air can lead to eutrophication and acidification of terrestrial ecosystems. The individual crops differ in terms of their impacts on biodiversity, water resources and water and soil quality (KBU, 2008a; KLU, 2013).

Despite its significance in crop rotations and as a supplier of protein feed, rapeseed has often been shown to be less cost-effective in direct comparison with other crops such as sunflower or winter cereal (SRU, 2007; BfN, 2010b). For instance, the cultivation of rapeseed frequently leads to excess nitrogen in the land and thus to an increased risk of waterbodies being polluted by nitrogen losses. Due to the susceptibility of this crop to insect damage and fungal attack, rapeseed is moreover associated with a relatively high use of plant protection products (EEA, 2007; vTI, 2010). The humus balance in the case of rapeseed is crucially dependent on whether the rapeseed straw remains on the field.

By way of contrast, the cultivation of sugar beet always exhibits a marked humus consumption (EEA, 2007; TAB, 2010). The risk of erosion and the risk of soil compaction are also very high in sugar beet cultivation owing to the use of heavy harvesting technology.

The erosion risk of grain maize is increased by its late harvesting. Likewise, the cultivation of grain maize is associated with increased risks of nitrate leaching and, on account of its self-compatibility, the risk of narrow crop rotation cycles and thus negative impacts on agricultural biodiversity (although the use of plant protection products is typically lower than with the cultivation of rape, for example).

Looking to the future, the use of straw to produce BtL fuel represents a significant risk to the target of a balanced humus level, unless the removal of straw is effectively tied to the locally specific soil conditions.

10 PLEASE ESTIMATE THE NET GREENHOUSE GAS EMISSION SAVINGS DUE TO THE USE OF ENERGY FROM RENEWABLE SOURCES.

(Article 22(1)(k) of Directive 2009/28/EC)

In 2017, the use of renewable energy sources produced a net saving on greenhouse gas emissions of approximately 181.6 million tonnes of CO_2 equivalent. The vast bulk of this (around 139 million tonnes of CO_2 equivalent) was achieved by generating electricity from renewable energy sources. The consumption of renewable energy sources to provide heating and cooling produced greenhouse gas emissions that were 35.2 million tonnes of CO_2 equivalent lower than the substituted mix of fossil energy sources. The consumption of biofuels led to 7.4 million tonnes of CO_2 equivalent fewer greenhouse gas emissions (without taking into account indirect land-use changes and based on the fossil reference value from Directive 2009/28/EC of 83.8 g CO_2 equivalent/MJ).

The total net emissions avoided through the use of renewable energies were 186.9 million tonnes of CO_2 equivalent in 2018, reflecting the fact that use was slightly higher in 2018 than in 2017. The electricity sector contributed 144 million tonnes of CO_2 equivalent, the 'heating and cooling' sector 35.1 million tonnes of CO_2 equivalent, and the consumption of biofuels in the transport sector (again without taking into account indirect land-use changes and based on the fossil reference value from Directive 2009/28/EC of 83.8 g CO2 equivalent/MJ) 7.7 million tonnes of CO_2 equivalent to the total GHG reduction.

This calculation of greenhouse gas emissions avoided is based on the actual, non-normalised energy supply from renewable energy sources[76]. The detailed methodology and the data sources used in the emission balance for renewable energy sources are explained in UBA (2019).

Table 6: Estimated GHG emission savings through the use of renewable energy (million tonnes of CO_2 equivalent)

Environmental aspects	2017	2018

[76] The energy supply from renewable sources in the electricity, heating and transport sector (in the latter case only biofuels that are used solely in the transport sector, without other transport) was used to estimate the savings in greenhouse gas emissions in 2017 and 2018: Unlike the tables in Chapter 1, the actual electricity production from wind energy and hydropower and the total final consumption of energy from liquid biomass to provide electricity and heating were used. This only has a minor impact on the results of the greenhouse gas audit, however.

Total estimated net GHG emission savings through the use of renewable energy[77]	***181.6***	***186.9***
- Estimated net GHG saving from the use of renewable electricity	139.0	144.0
- Estimated net GHG saving from the use of renewable energy in heating and cooling	35.2	35.1
- Estimated net GHG saving from the use of renewable energy in transport[78]	7.4	7.7

[77] The contribution of electricity, hydrogen and gas from renewable energy sources should be reported depending on the final use (electricity, heating and cooling or transport) and only be counted once towards the total estimated net GHG emissions savings.

[78] Only through the use of biofuels in the transport sector (without other transport). Greenhouse gas avoidance through the use of renewable electricity in transport is included under the electricity sector. The figures are consistent with those reported by the Federal Office for Agriculture and Food (2019), except that other transport (order of magnitude of the GHG reduction: 0.4 million tonnes of CO_2 equivalent/year) was subtracted.

11 PLEASE REPORT ON (FOR THE PRECEDING TWO YEARS) AND ESTIMATE (FOR THE FOLLOWING YEARS UP TO 2020) THE EXCESS/DEFICIT PRODUCTION OF ENERGY FROM RENEWABLE SOURCES COMPARED TO THE INDICATIVE TRAJECTORY WHICH COULD BE TRANSFERRED TO/IMPORTED FROM OTHER MEMBER STATES AND/OR THIRD COUNTRIES, AS WELL AS ESTIMATED POTENTIAL FOR JOINT PROJECTS UNTIL 2020.

(Article 22(1)(l) and (m) of Directive 2009/28/EC)

For the current 2017/2018 reporting period, the indicative trajectory for Germany according to Directive 2009/28/EC provides for a minimum share of renewable energy in gross final consumption of energy of 13.7%. As shown in Table 1, the actual share of renewable energy in gross final consumption of energy was 15.5% in 2017 and 16.5% in 2018, and hence well above the indicative trajectory in both reporting years.

The values for gross final consumption of energy in the reporting period given in Table A (2017: 226 410 ktoe, 2018: 224 000 ktoe) produce a minimum consumption of energy from renewable sources needed to achieve the trajectory of 31 086 ktoe for 2017 and 30 666 ktoe for 2018. The actual consumption of 31 086 ktoe in 2017 and 30 755 ktoe in 2018, as shown in Table 1a, thus results in a surplus of 3 945 ktoe for 2017 and 6 141 ktoe for 2018 (Table 7).

At 14.8%, the proportion of renewable energy in Germany in 2016 was already well above the minimum values for the 2017/2018 reporting period (13.73%), as was the case in previous years. With a share of renewable energy in gross final consumption of energy of 15.5% in 2017 and 16.5% in 2018, Germany is still on track to meet its binding target of 18% in 2020. Based on the initial data for 2019 and forecasts for 2020, increasing the share by a further 1.5 percentage points and achieving the target of 18% by 2020 appears to be a realistic target.

The tender procedure introduced under the Renewable Energy Sources Act 2017 serves as a reliable tool for steering the implementation of the expansion corridor. Annual tender volumes are defined in this connection for onshore and offshore wind energy, photovoltaic energy and biomass installations.

***Table 7: Actual and estimated excess and/or deficit (-) production of renewable energy compared to the indicative trajectory which could be transferred to/from other Member States and/or third countries (ktoe)*[79][80]**

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Actual/estimated excess or deficit production[81]			9 236	11 831	9 816	10 666	7 967	8 069	3 945	6 141		*3 065* [82]

Table 7 compares actual and estimated surpluses for the production of renewable energy compared to the indicative trajectory. For the reporting period, this results in surpluses of 3 945 ktoe in 2017 and 6 141 ktoe in 2018.

On this basis, the corresponding estimated value from Table 9 of the NREAP is shown in italics for the target year 2020. This value is based on the 'scenario with further efficiency measures' under the 2010 NREAP. At present, however, the actual development of the gross final consumption of energy is closer to the 'reference scenario' of the NREAP. Using this as a basis results in a lower surplus for 2020 (423 ktoe). Initial estimates for the continued use of renewable energies and changes in gross final energy consumption indicate that small surpluses will also be recorded for the remaining years of 2019 and 2020.

11.1. Please provide details of statistical transfers, joint projects and joint support scheme decision rules.

The Renewable Energy Sources Act 2017 that entered into force on 1 January 2017 provides for 5% of the annual capacity to be installed to remain open to participation by installations in other Member States, provided that a corresponding cooperation agreement exists with the partner countries concerned, that the opening of the tenders to cross-border participation is consistent with the principle of reciprocity, and that the 'physical import' of electricity to Germany, or a comparable effect on the German electricity market, can be demonstrated.

In summer 2017, to clarify the provisions of the Renewable Energy Sources Act 2017, the Cross-Border Renewable Energies Regulation [Grenzüberschreitende-Erneuerbare-Energien-Verordnung, GEEV], which previously only applied to photovoltaic installations, was revised and expanded to include cross-border tenders for onshore wind power installations.

[79] Please use actual figures to report on the excess production in the two years preceding submission of the report, and estimates for the following years up to 2020. In each report Member States may correct the data of the previous reports.
[80] When filling in the table, for deficit production please mark the shortage of production using negative numbers (e.g. –x ktoe).
[81] (please distinguish per type of renewable energy and per origin/destination of import/export).
[82] The figures in italics are based on the 'scenario with further efficiency measures' under the 2010 NREAP.

In the fourth quarter of 2016, Denmark and Germany held pilot calls for tender in respect of ground-mounted photovoltaic installations that were open to participation by both countries. Overall, this means that an additional electricity quantity of 2.7169 ktoe must be offset against Germany’s achievement of targets for 2018.

During the reporting period, the Federal Government continued to hold talks with other Member States with a view to concluding further cooperation agreements as a basis for the opening up envisaged under the Renewable Energy Sources Act. Since summer 2017, the possibility of cross-border calls for tender has been discussed with France and Luxembourg, among other Member States.

12 PLEASE PROVIDE INFORMATION ON HOW THE SHARE OF BIODEGRADABLE WASTE IN WASTE USED FOR PRODUCING ENERGY HAS BEEN ESTIMATED, AND WHAT STEPS HAVE BEEN TAKEN TO IMPROVE AND VERIFY SUCH ESTIMATES.

(Article 22(1)(n) of Directive 2009/28/EC)

To determine the contribution of biodegradable waste to electricity and heat production, it is generally assumed that 50% of the waste processed in waste incineration plants is biodegradable. This value comes from a study (UBA, 2011) which examined the waste flows from selected treatment methods in detail. Municipal waste (residual waste, bulky waste, biowaste, cardboard, paper, paperboard, light packaging, scrap wood and sewage sludge) and industrial waste similar to household waste were examined. The proportion of biodegradable material for each waste category was determined. The quantities for the different waste categories can be used to calculate the average energy-related biogenic fraction of all the waste used for incineration. The methods of determining the biogenic fraction are constantly being improved and tested for their practical viability (e.g. C14 method).

13 PLEASE PROVIDE THE AMOUNTS OF BIOFUELS AND BIOLIQUIDS IN ENERGY UNITS (KTOE) CORRESPONDING TO EACH CATEGORY OF FEEDSTOCK GROUP LISTED IN PART A OF ANNEX VIII TAKEN INTO ACCOUNT BY THAT MEMBER STATE FOR THE PURPOSE OF COMPLYING WITH THE TARGETS SET OUT IN ARTICLE 3(1) AND (2), AND IN THE FIRST SUBPARAGRAPH OF ARTICLE 3(4).

Of the feedstocks listed in Part A of Annex VIII to Directive 2009/28/EC, during the reporting period it was oil crops (rapeseed, oil palm, sunflower, soya, Brassica carinata, shea) – which in accordance with Annex VIII are associated with by far the greatest estimated emissions as a result of indirect land-use changes – that represented the predominant share of biofuels and bioliquids based on common arable crops (64% in 2017 and 62% in 2018). In 2017 approximately 34% and in 2018 approximately 36% came from the category of 'Cereals and other starch-rich crops', which includes maize, wheat, triticale, rye and barley, among others. In 2017 and 2018 only around 2% of biofuels and bioliquids came from sugars (sugar beet and sugar cane).

Table 13: Amounts of biofuel and bioliquids in energy units (ktoe[83]) corresponding to the categories of feedstock groups listed in Annex VIII Part A

Feedstock group	2017	2018
Cereals and other starch-rich crops[84]	669	690
Sugars[85]	46	37
Oil crops[86]	1 265	1 196

[84] Biofuels and bioliquids based on maize, wheat, triticale, rye and barley that were placed on the market in Germany in 2017 and 2018 and certified as sustainable according to the Federal Office for Agriculture and Food (2019).
[85] Biofuels and bioliquids based on sugar beet and sugar cane that were placed on the market in Germany in 2017 and 2018 and certified as sustainable according to the Federal Office for Agriculture and Food (2019).
[86] Biofuels and bioliquids based on rapeseed, oil palm, sunflower, soya and Brassica carinata that were placed on the market in Germany in 2017 and 2018 and certified as sustainable according to the Federal Office for Agriculture and Food (2019).

Reporting outside the progress report template

14 Report pursuant to the Biomass Electricity Sustainability Regulation and Biofuel Sustainability Regulation (Biomass Sustainability Regulations))

In Section 64 of its Biofuel Sustainability Regulation, Germany has stipulated that the progress report pursuant to Article 22 of Directive 2009/28/EC to the European Commission should report on the fulfilment of the requirements laid down in the Biofuel Sustainability Regulation and the impact on sustainability of producing the biofuels placed on the market in the Federal Republic of Germany. The report must assess whether the use of biofuels is socially acceptable. Since liquid biomass is treated in the same way in terms of content, sustainability aspects relating to the biofuels counted against the GHG quota and bioliquids used to generate electricity in Germany will be reported on jointly below. The report is based partly on the evaluation and progress reports from the Federal Office for Agriculture and Food for the reporting years 2017 (BLE, 2018) and 2018 (BLE, 2019).

14.1. Fulfilment of the requirements of the Biomass Sustainability Regulations

The Biomass Sustainability Regulations entered into force at the end of 2009 and have been applicable without any restrictions since 1 January 2011.

The Biomass Sustainability Regulations stipulate that evidence of compliance with the sustainability requirements (sustainability certificates) must be provided with the aid of private certification systems and certifying bodies. The provisions of the Biomass Sustainability Regulations are mainly implemented by the Federal Office for Agriculture and Food. The Federal Office for Agriculture and Food recognised two certification systems (ISCC DE and REDcert DE) as early as 2010, so economic operators could join these certification systems at an early date in order to be able to produce the sustainability certificate that was mandatory in Germany from 1 January 2011. In 2010, a total of four applications for recognition of certification systems had been filed with the Federal Office for Agriculture and Food; this number of applications had not changed by the end of 2018. Of these applications, the two systems mentioned above were recognised, one application for recognition of a certification system was rejected and the recognition of one system was withdrawn (BLE, 2019). In addition to these national systems in Germany (German systems), European Commission Directive 2009/28/EC also leaves open the possibility for approval of voluntary national or international schemes for sustainability certification, which according to the German Biomass Sustainability Regulations are likewise recognised in Germany as proof of sustainability (‘voluntary schemes’). A total of 14 of these voluntary schemes had been approved by the European Commission by the end of 2018. The approval of the voluntary schemes is in each case valid for five years; in eight

cases the approval has been granted again, and in six other cases the approval had expired by the end of 2018 without being granted again (BLE, 2019). In addition, the EU Member States can introduce national systems (equivalent to the German system of sustainability certificates) that meet the requirements of Directive 2009/28/EC with respect to evidence of compliance with the sustainability criteria. National systems of this type have been set up in Hungary, Slovenia, Slovakia and Austria as of the end of 2018. An interface with the Austrian database eINa is incorporated into the web-based national 'Sustainable Biomass Systems' database (Nabisy), and the sustainability certificates issued by that system can also be transferred to the German system. The other national systems referred to are stored in Nabisy by way of analogy to the procedure for the voluntary schemes.

For a certain volume of biomass, certifying bodies perform the task of certifying sustainable origin in keeping with the requirements of the Sustainability Regulations. The Federal Office for Agriculture and Food had recognised 23 certifying bodies on a permanent basis and 45 on a provisional basis as at 31 December 2018. A total of 51 applications for recognition were submitted, of which six were rejected, and 22 permits were withdrawn or cancelled because the certifying bodies ceased to operate (BLE, 2019). As a basic principle, the Federal Office for Agriculture and Food carries out an annual 'office audit' at the premises of each certifying body. During this process, a sample of cases handled by the certifying body is checked. Depending on the results, office audits may take place at shorter intervals. In addition, depending on the risk classification of the certifying body, the Federal Office for Agriculture and Food carries out 'witness audits', during which it accompanies the auditors to the various interface points and observes their procedure ('checking the checkers'). However, these witness audits can only be carried out by the Federal Office for Agriculture and Food if the countries have agreed to the accompanying assessment on their territory. Once a year, the certifying bodies are obliged to report to the Federal Office for Agriculture and Food on their experience with the certification systems that they use.[87]

Worldwide, in 2017 a total of 134 companies and in 2018 97 companies were certified for the first time or recertified by the certification bodies accredited by the Federal Office for Agriculture and Food in accordance with the requirements of the German systems, and the majority of these certificates (102 certificates in 2017) were issued to companies in Germany. In 2017, a further 24 companies were certified in other EU Member States, and eight companies in third countries. In 2018, the 'majority' of certificates were issued to companies in Germany (BLE 2018, BLE 2019). Compared to 2014, the number of companies certified in accordance with the requirements of

[87] Along with comments on the feasibility of the system specifications, this report also contains facts relevant to an assessment as to whether the certification systems are suitable for meeting the legal requirements.

German systems in 2015 fell by 65%, and in 2016 decreased by a further 18% as compared to 2015; in 2018, the number dropped by 28% compared to the previous year. The downwards trend in certifications in accordance with the systems recognised by the Federal Office for Agriculture and Food is thus continuing. In parallel to the decrease in certifications in Germany, there has been an increase in the number of companies certified in accordance with the requirements of voluntary schemes (BLE, 2018; BLE, 2019). If the certifying body providing certifications in accordance with the requirements of voluntary schemes has its headquarters or place of business in Germany and the certification decision was made in Germany, the certificates also have to be sent to the Federal Office for Agriculture and Food. In 2017, 3 116 of these initial certifications and recertifications were reported to the Federal Office for Agriculture and Food (BLE, 2018), and 2 919 in 2018 (BLE, 2018; BLE, 2019). Thus, only 4% of companies in 2017 were certified by certifying bodies recognised by the Federal Office for Agriculture and Food in accordance with the requirements of German systems, and 96% were certified in accordance with the requirements of voluntary schemes.

The Federal Office for Agriculture and Food is responsible for managing data on the sustainability of biofuels and bioliquids through Nabisy. The figures[88] for the sustainability of biofuels and bioliquids that are relevant to the German market have to be entered into Nabisy by the economic operators concerned. They are then documented and validated by Nabisy. The German main customs offices and the biofuel quota office have direct access to Nabisy, along with the relevant competent authorities in other Member States of the EU. The main customs offices can use the data from Nabisy to perform their tasks of fiscal supervision under the Energy Tax Act [Energiesteuergesetz] and the biofuel quota office their task of monitoring the biofuel quota obligation under the Federal Immission Control Act. The exchange of sustainability-related data between the competent authorities in the Member States is necessary to prevent the economic operators from claiming unlawful relief in multiple Member States for the same goods. Nabisy provides the necessary institutional basis for this exchange of data, and the Federal Office for Agriculture and Food is in contact with authorities in other Member States in order to ensure the required synchronisation of data.

A possible exclusion or the non-recognition of certificates is the only indication that the requirements of the sustainability system have not been met for a given raw material in the cases reviewed, and this is subsequently penalised through exclusion from the system. It is not currently possible to provide details about the reasons lead-

[88] The data include the type of raw materials used, the quantity, the energy content, the country of cultivation, classification as waste or residue, the supplier chain and the potential GHG reduction.

ing to an exclusion or the geographic breakdown on the basis of the information regularly published. Following its audit of the EU system for certification of sustainable biofuels in 2015, the European Court of Auditors (ECA) reported a lack of transparency and lack of checks of voluntary schemes (ECA, 2016). For example, it was pointed out in this connection that even after the publication of guidelines on the transparency of voluntary schemes in March 2015 (European Commission, 2015c), certain gaps in information regarding the functioning of these schemes continued to exist, the management structures of some schemes concealed the risk of conflicts of interest and the functioning of recognised voluntary schemes and compliance with sustainability criteria (the EU environmental requirements, for example) were not monitored by the Commission. Increasing the transparency of the overall certification and evidence system is nevertheless essential in order to boost its credibility and increase its acceptance by market participants. With the aim of increasing transparency and improving supervision of voluntary schemes by the Commission, Directive (EU) 2015/1513 accordingly requires regular reporting on activities in the context of voluntary schemes. None of these reports have as yet been published.

14.2. Impact on sustainability of the production of bioliquids used in Germany to generate electricity and of biofuels placed on the market

In transposition of Directive 2009/28/EC, the Biomass Sustainability Regulations cover aspects of sustainable biomass production in the form of minimum ecological criteria that have to be met (14.2.2). Other sustainability aspects are not covered by the Regulations (14.2.3).

14.2.1 Origin of bioliquids used in Germany to generate electricity and of biofuels counted against the quota obligation

Biofuels

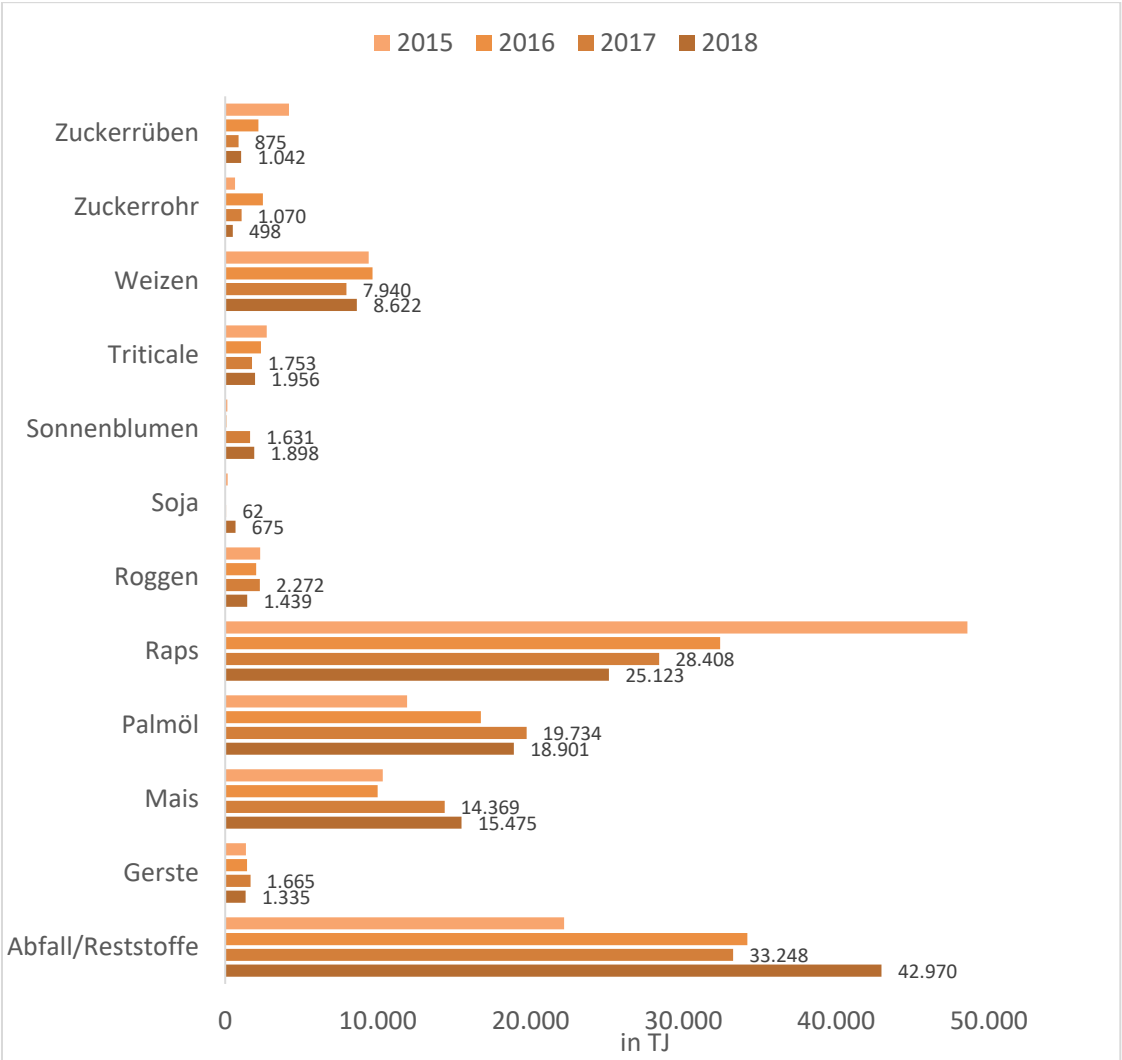
The amount of biofuels recorded for inclusion under the quota obligation or tax relief by the Federal Office for Agriculture and Food decreased again slightly in 2017 as compared with the previous two years, and in 2017 reached 113 029 TJ; in 2018, however, the figure rose somewhat to 120 066 TJ (BLE, 2019) (see also Chapters 1 and 8). One significant reason for the continuation of the downward trend up to and including 2017 can be found in the change to the greenhouse gas quota[89] and achievement of the target by means of biofuels with a particularly high potential for GHG savings (BLE, 2019). Changes in the raw material basis used for biofuels can

[89] Up to the end of 2014, the biofuel quota was the main funding instrument for biofuels. Since 2015, a GHG reduction target ('GHG quota') has applied instead of this quantity-based target, in accordance with Section 37a BImSchG. Since 2015, the parties in question have been obliged pursuant to this latter to ensure that the GHG emissions from the fuels that they place on the market (petrol, diesel and biofuels) are reduced in total by 3.5% with respect to the fossil reference value, and since 2017 by 4%.

accordingly also be observed. For example, the use of wastes and residues remained at a similar level in 2017 after a considerable increase in 2016, but then continued to rise again in 2018. The share of wastes and residues in the biofuels counted against Germany's GHG quota increased from 29.4% in 2017 to 35.8% in 2018, while that of rapeseed and sugar beet continued to drop in Germany. In 2018, as in 2017, the use of palm oil expanded again after many years of falling values (since 2015), which reflected the EU-wide trend for increased use of palm oil as a feedstock for the production of biodiesel (Silhvonen, 2019).

In Germany, the share of palm oil as a feedstock for all types of biofuel rose from 10.5% in 2015 to 17.5% in 2017. This trend did not continue in 2018, when the figure dropped to 15.7%.

Figure 14.1: Feedstocks used for biofuels



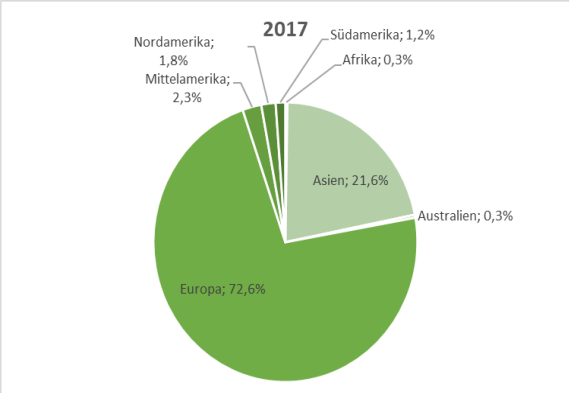
Zuckerrüben	Sugar beet
Zukkerohr	Sugar cane

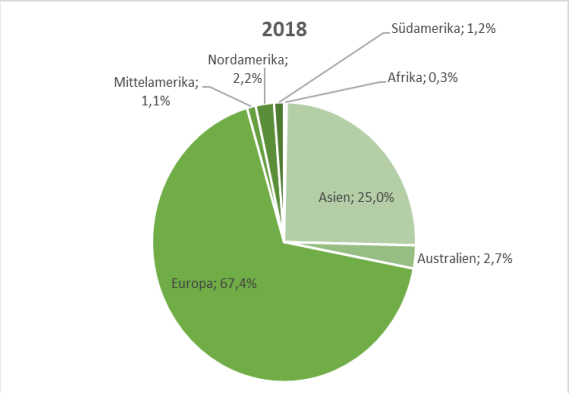
Weizen	Wheat
Triticale	Triticale
Sonnenblumen	Sunflower
Soja	Soya
Roggen	Rye
Raps	Rapeseed
Palmöl	Palm oil
Mais	Maize
Gerste	Barley
Abfall/Reststoffe	Waste/Residues
in TJ	in TJ

Since 2013, it has been necessary for sustainability certificates also to include information relating to the producer country. After a transitional period, during which (partial) sustainability certificates[90] were still validated in Nabisy without reference to the origin, since 2015 it has been possible to indicate the assigned origin of all sustainability certificates so that the biomass cultivated in accordance with the requirements of the sustainability systems can be assigned to the relevant countries of origin without any gaps.

Figure 14.2: Origin by continents

[90] Partial sustainability certificates may arise in the course of the biofuel supply chain if the quantities of sustainable biofuels being traded are split or pooled based on demand. Sustainability certificates may be split or grouped together with others in order to document this process.





Mittelamerika	Central America
Nordamerika	North America
Südamerika	South America
Afrika	Africa
Asien	Asia
Australien	Australia
Europa	Europe

The largest proportion of raw materials again came from Europe in 2017 (73%) and 2018 (67%), primarily from the EU (67% and 64%). The share and the absolute quantity of the biofuels placed on the market in Germany on the basis of biomass from Europe remained relatively constant in comparison to 2016, after a significant drop in the previous years (82 027 TJ in 2017, 80 954 TJ in 2018). The downward trend in feedstocks originating from Germany continued in 2017, however (28 144 TJ or -21% compared to 2016), and in 2018 (26 392 TJ or -6% compared to 2017). By way of contrast, a marked increase was observed in the contribution of feedstocks from European third countries, which rose more than fourfold in 2017 compared to 2016 (6 415 TJ in 2017). This was primarily attributable to maize-based bioethanol from Ukraine. In 2018, the contribution of feedstocks from European third countries rose again to 7 831 TJ (+22% compared to 2017).

Feedstocks from Asia also made a significant contribution to the supply of biofuels counted against the GHG quota in Germany, with a share of 22% in 2017 and 25% in 2018. Compared to 2016, the quantity of biofuels manufactured from feedstocks originating from Asia (palm oil and waste for biodiesel production, rapeseed) increased

by 6% in 2016; it increased again by 23% in 2018 compared to 2017. This increase is primarily attributable to a rise of 75% in the quantity of biofuels based on waste and residues. The quantity of feedstocks for the provision of biofuels counted against the GHG quota in Germany and originating from Central America increased significantly (2 606 TJ in 2017). This is mainly due to the fact that the quantity of Central American palm oil used in Germany increased more than sevenfold in 2017 compared to 2016. In 2018, however, the quantity of Central American palm oil dropped to 1 029 TJ. The amounts of biofuels placed on the market in Germany that were based on feedstocks from North and South America decreased in 2017 compared to 2016 (1 983 TJ from North America and 1 335 TJ from South America in 2017), but increased in 2018 to 2 682 TJ from North America (+35.2% compared to the previous year) and 1 477 TJ from South America (+10.6%). There was a significant increase in biofuels whose feedstocks originated from Australia (3 198 TJ in 2018 compared to 379 TJ in 2017). As in previous years, a further slight increase was observed for feedstocks from Africa, but this again made up only a very small proportion of the total amount in 2017 and 2018 (approximately 0.3% in 2017 and 0.3% in 2018) (BLE, 2019).

As already noted, the steep upward trend in palm oil use observed in 2016 continued in 2017 (increase of 17.9% in 2017 compared to 2016); the figures then stabilised at around the same level in 2018. This meant that the share of feedstocks originating from Asia continued to rise, with Asia contributing approximately 88% of palm oil in 2017, even though Central America also became an important supplier of palm oil for the biofuels placed on the market in Germany, with Honduras supplying approximately 12% of palm oil in the same year. The palm oil originating from Asia in 2017 was supplied by Indonesia (92%) and Malaysia (8%); in 2018, Indonesia supplied 96.2% and Malaysia 3.8%. Indonesia therefore contributes the largest proportion of palm oil for energy purposes, with the associated known ecological and social problems relating to palm oil cultivation (Knoke and Inkermann, 2015). In 2017, use for biofuels accounted for around 52% of the amount of palm oil consumed in Germany (Hawighorst, 2018), and imports of palm oil to Germany for a range of purposes (fuel and food sectors, chemical industry and technical use) dropped from 1.3 million tonnes in 2016 to 0.9 million tonnes in 2018 according to OVID (2019). The share of palm oil used in other sectors in Germany and certified as sustainable is slowly increasing (26-85% in 2017), but was again still only around one quarter of the global production of palm oil certified as sustainable in 2017 (Hawighorst, 2018). Furthermore, since the estimated proportion of oil used for energy purposes in the main producer countries is only in single figures, the question must be raised as to whether the fluctuating demand in the fuel sector for palm oil that is certified as sustainable has a significant effect on the sustainable development of overall production. It is logical to assume that the companies that are endeavouring to obtain certificates are those that are in any case able to comply with the requirements of the Sustainability Regulation.

There was another slight increase in the amount of soya used in 2017, but soya still only accounts for around 0.05% of all the feedstocks used for biofuels placed on the market in Germany. In addition to South America (646 TJ, which represents a steep rise compared to 27 TJ in 2017), Europe also contributed to the supply of soya in 2018 again (19 TJ compared to 35 TJ in 2017). Following a sharp rise in the use of South American sugar cane in 2016, the use of this sugar cane dropped again significantly by around 63% in 2017. There was a further reduction of 66.4% in 2018 (from 746 TJ in 2017 to 251 TJ in 2018). A clear majority of this sugar cane came from Peru (95% of South American sugar cane and 66% of all sugar cane; no data available regarding the origin of sugar cane in 2018). The amount of sugar cane originating from Central America used as a feedstock for biofuels dropped to 247 TJ in 2018 (324 TJ in 2017). Brassica carinata is a newcomer to the group of feedstocks for biofuels, and originates from South America (52 TJ in 2018).

The use of rapeseed-based biofuels continued to drop again in 2018. Rapeseed accounted for 20.9% of the total quantity of feedstocks used in Germany; the same figure in the previous year was 25.1%. Rapeseed accounted for around 34% (in 2017) or 27.2% (in 2018) of all feedstocks originating from Europe; 55% of this rapeseed (in 2018) or 53% (in 2017) originated from Germany, followed by France, Poland, Hungary, Romania and Bulgaria. In 2017, around 99% of the rapeseed used in biofuels in Germany originated from Europe (including Germany).

Following another significant drop in the use of sugar beet as a feedstock for biofuels in 2017 (-60% compared to 2016, -89% compared to 2013), the share of sugar beet in 2018 was similar to the previous year; it accounted for approximately 3.3% of feedstocks for biofuels in 2018, and 2.9% in 2017. The proportion of sugar beet in feedstocks originating from Europe represented only around 1% of the total in both 2018 and 2017. As was the case for sugar beet, all of the maize used by the German biofuel market in the reporting year of 2018 originated from Europe. The use of maize increased significantly in 2017 compared to 2016 (+44%), which was primarily attributable to maize-based bioethanol from Ukraine (which accounted for 42% of all maize-based biofuel in 2017). In 2018, the quantity of maize originating from Europe and used for the production of maize-based bioethanol increased again slightly from 14 369 TJ in 2017 to 15 475 TJ. The contribution of cereal to the biofuels placed on the market in Germany in 2018 remained relatively constant, even if the proportions of the various cereal types changed somewhat (more triticale and wheat, less rye and barley than in 2017). In addition, relevant quantities of biodiesel were again produced using sunflower oil in 2017 for the first time (around 1.5% of all biofuels); this trend continued in 2018 (1.5% again). In 2018, the proportion of sunflower oil in biodiesel increased by 16.4%.

Following a significant increase in the use of waste and residues for biofuels in Germany, the use sank slightly in 2017 to a total of 33 249 TJ, but rose again in 2018 to 42 971 TJ. In 2017, around 30% of biofuels were based on waste and residues, with

the same figure rising to over one third in 2018. The place of origin of waste and residues has shifted slightly towards Asia, with around 63% originating from Europe and around 28% from Asia. The quantity of waste and residues from Germany was 7 962 TJ in 2017, and increased to 9 626 TJ in 2018 (+20.9%). Used cooking oil accounted for 98% and 99.4% of waste and residues originating from Asia (in particular China and Indonesia) in 2017 and 2018 respectively. Overall, 95% (in 2017) and 85% (in 2018) of waste and residues originating from Germany were processed into biodiesel. During the reporting period, the second most frequent biofuel based on waste and residues was biomethane, the feedstocks for which originated exclusively from Germany. Further information on the nature of the waste and residues used to manufacture the biofuels placed on the market in Germany and certified as sustainable is provided in Chapter 8. The secondary role of the feedstocks listed in Part A of Annex IX to Directive 2009/28/EC in comparison with used cooking oil is once again striking.

Combustible biofuels

According to the Federal Office for Agriculture and Food, a similar volume of biofuels for the generation of electricity and feed-in was registered under the Renewable Energy Sources Act in 2017 and 2018 as in the previous years (31 287 TJ in 2017 and 30 388 TJ in 2018). The most important type of biofuel in 2017 and 2018 remained biofuel from the pulp industry (thick waste liquor[91]) (87% and 85% respectively), followed by vegetable oil (10% and 11% respectively). As far as vegetable oils are concerned, rapeseed oil gained somewhat on palm oil compared to the situation in 2016. Whereas palm oil accounted for around 85% of the vegetable oils used as biofuel in 2016, by 2017 palm oil accounted for around 69% and rapeseed oil for around 31%. The ratio was similar in 2018 (71% for palm oil and 24% for rapeseed oil); in addition, shea started to be used as a biofuel (around 5%). The volume of fatty acid methyl esters (FAME) used as biofuels increased sharply in 2017. Starting from a share of around 0.1% in previous years, FAME accounted for around 2.6% of biofuels in 2017. This trend continued in 2018, with a share of around 4.1%.

14.2.2 Sustainability aspects addressed by the Biomass Sustainability Regulations

Greenhouse gas emissions Directive 2009/28/EC provides a defined method for calculating the GHG savings achieved through the use of biofuels promoted by quotas and tax breaks (see Chapter 10) rather than fossil fuels; this method is included in the Biomass Sustainability Regulations. It incorporates direct greenhouse gas emissions from the cultivation of raw materials and from transport and processing. Emissions resulting from land-use changes are also factored in using this method insofar

[91] In energy statistics (and also in Chapter 1), thick waste liquor falls under the category of solid biomass.

as they are the direct result of the cultivation of crops for the production of biofuels (or liquid energy sources). As inadmissibly high GHG emissions resulting from direct land-use changes mean that relevant areas are ineligible for certification from the outset, no information is available about the corresponding changes in land use. Emissions that are due to global, regional and local relocation effects (indirect effects) are not included in the calculation methodology that serves as a basis for authorising a biofuel to be counted against the quota or for the payment of feed-in tariffs in the case of bioliquids (see 14.2.3). The effects in terms of climate protection cannot therefore be definitively assessed.

Through the switch from the quantity-based quota to the minimum GHG reduction quota in 2015, the significance of the method for calculating the GHG reduction has increased greatly, because since then not only compliance with the minimum reduction, but also the calculated reduction as such has been relevant. Reference has already been made to the shift in the feedstock basis towards higher GHG reduction potentials that has taken place since then (see 14.2.1).

On account of the GHG quota, which only exists in Germany, there is an above-average incentive to prioritise use of biofuels that were produced in particularly energy-efficient installations (often installations with reduced consumption of electricity and heat, optimised flow of materials, and in part using electricity and heat from biomass cogeneration installations) and based on feedstocks associated with low GHG emissions (cf. also in this respect 14.2.1). Consequently, the GHG reductions documented for Germany are by no means typical of the biofuels produced and used in Europe or around the world. Since the introduction of the GHG quota, the calculated GHG savings as a result of the biofuels counted against the quota in Germany have increased sharply, although it cannot be assumed that there is an equivalent significant change in production facilities. For example, the average saving of biodiesel (based on the fossil reference value of 83.8 g CO_2 equivalent enshrined in the Biomass Regulations) was 80.8% in 2017 and 80.6% in 2018 and the average saving of bioethanol was 82.6% in 2017 and 84.9% in 2018, or in other words considerably higher than in 2014, the last year with the energy quota (50.7% and 54.6% respectively), or even in 2016 (78.7% and 75.4% respectively). The average values for 2017 and 2018 are thus clearly higher than the minimum requirement of 50% GHG savings that has existed since 1 January 2017.

The high GHG saving in the case of bioethanol is in many cases also the result of CO_2 credits for the external use of biogenic CO_2 that is formed during processes. As there are no clear accounting rules in this respect (European Commission, 2017b), it cannot be ruled out that the substitution of conventional CO_2 will prove excessive.

The cultivation of substrates for the production of biofuels that takes place in EU countries is typically not accounted itself, but is usually accounted on the basis of the NUTS2 values in accordance with Article 19(2) of the Renewable Energies Directive. These are based on input values for the years 2006-2010 and thus do not corre-

spond to the state of the art. At present, the extent to which an update of the underlying data and an alternative method of calculating the nitrous oxide emissions may lead to deviating results cannot be definitively estimated and requires more detailed analysis.

It is also clear that the quantities of goods that were booked in 2017 and 2018 to the accounts of other Member States had significantly lower emissions savings (BLE, 2018; BLE, 2019), which also raises the issue of distribution effects or the actual change in the overall emissions reduction in the use of biofuels in Europe and worldwide.

Conservation areas. The Biomass Sustainability Regulations contain requirements to protect areas of great importance to biodiversity[92], to protect areas with high stocks of carbon[93] and to protect peat bogs. If the certification is applied effectively and the areas are properly defined, it will largely prevent the direct conversion of recognised conservation areas to be used to produce biofuels and bioliquids. Highly biodiverse grassland was first defined by the Commission in December 2014, and this definition applied from 1 October 2015[94]. In the meantime, three voluntary certification schemes have been granted 'partial recognition' which expressly excluded the protection of highly biodiverse grassland (ECA, 2016). Even though there is no longer any reason to grant partial recognitions since a definition of highly biodiverse grassland is now available, the assessment of grassland status still presents a challenge for auditors. In a letter to the voluntary schemes, the Commission states that independent experts must carry out such assessments (European Commission, 2015a). However, this letter does not impose a legally binding requirement. The verification of properly defined areas remains an important condition for compliance with this sustainability criterion for all conservation areas.

Agricultural operations within the EU. To address any negative environmental impacts from agricultural activities on arable land, particularly more intensive cultivation, the Biomass Sustainability Regulations reference the rules on direct payments under the common agricultural policy and the minimum requirements for good agricultural and ecological conditions for land in the Member States of the European Union (cross-compliance). Evidence of compliance must be provided through the documentation of agricultural aid received. Other requirements or extra checks in addition to

[92] Areas of great importance to biodiversity within the meaning of the Regulations include (a) primary forests and undisturbed forests, (b) nature conservation areas, and c) highly biodiverse grassland.

[93] Areas with high stocks of carbon within the meaning of the Regulation include (a) wetlands and (b) continuously forested areas (> 1 ha and with trees over 5 m high).

[94] Commission Regulation (EU) No 1307/2014 of 8 December 2014 on defining the criteria and geographic ranges of highly biodiverse grassland for the purposes of Article 7b(3)(c) of Directive 98/70/EC of the European Parliament and of the Council relating to the quality of petrol and diesel fuels and Article 17(3)(c) of Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources.

the on-the-spot controls performed each year on approximately 1% of applications (BMEL, 2019) are not covered by the Biomass Sustainability Regulations.

14.2.3 Sustainability aspects not addressed by the Biomass Sustainability Regulations

Indirect effects. The production of biofuels and bioliquids does not only have a direct effect on the land cultivated for the relevant feedstocks. Instead, this concrete quota of demand is a significant factor that influences global land use as a whole. This means that even if the sustainability requirements are met, the production of biofuels and bioliquids may still lead indirectly to land-use changes through displacement effects and the associated emissions, ploughing-up of conservation areas, drainage of marshland etc. The risks of indirect land-use changes (iLUC) have been widely discussed among large sections of the professional public and at different political levels for a number of years. The delegated Regulation C(2019)2055/1013409 supplementing Directive (EU) 2018/2001 was adopted in 2019. High iLUC-risk feedstocks are to be determined and may no longer be counted against renewable targets. The amendments to Directives 98/70/EC and 2009/28/EC introduced various reporting obligations in relation to iLUC. In future, when reporting (among other things) the GHG emissions per energy unit, fuel providers will also take into consideration the average preliminary estimates for emissions as a consequence of iLUC. In its most recent 'Renewable Energy Progress Report', within the framework of reporting on the targeted GHG emissions savings, the European Commission also referred to the average preliminary estimates in relation to iLUC in Annex VIII to Directive 2009/28/EC. In summary, the GHG savings caused by biofuels as reported by the Member States for 2015 decreased by between 40% and 80% (European Commission, 2017a). In order to limit the indirect effects overall, an amendment to the Fuel Quality Directive and the Renewable Energy Directive was adopted at EU level in the form of Directive (EU) 2015/1513. The relevant provisions are to be transposed into German law by means of the 38th Federal Immission Control Regulation[95], a draft of which was published in September 2016. For the purpose of limiting iLUC, Directive (EU) 2018/2001 of the European Parliament and of the Council stipulates an upper limit for conventional biofuels (at most one percentage point higher than their share in the final consumption of energy in the road and rail transport sectors in 2020 in that Member State, with a maximum of 7% of final consumption of energy in the road and rail transport sectors in that Member State[96]; from 2020, a minimum share of advanced

[95] Draft bill of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety on the Thirty-Eighth Regulation implementing the Federal Immission Control Act (Regulation laying down further provisions for the reduction of greenhouse gases in fuels – 38th Federal Immission Control Regulation).

[96] Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources. OJ L 328, 21.12.2018, p. 82-209.

biofuels (0.2% in 2022, at least 1% in 2025 and at least 3.5% by 2030). However, consideration should be given to the fact that even advanced biofuels are only free from indirect effects if the materials are waste in the proper sense of the term and their use for biofuel production does not displace other uses, which in turn switch to raw materials with higher environmental costs (Searle, Pavlenko et al., 2017, Malins, 2017). These kinds of indirect effects are also not addressed by the Biomass Sustainability Regulations. According to the last evaluation report by the Federal Office for Agriculture and Food (2019), the quantity of residual/waste substances originating from Asia that form the basis for biofuels has doubled. These residual/waste substances consist almost exclusively of used cooking oil (UCO). It has not been definitively established whether UCO imports from Asia have an impact on local usage, since UCO is already used locally as a feedstock for biofuels in place of palm oil (Kharina et al., 2018). Further research is required in this area.

Effects on food prices. Fluctuations in global and local food prices are caused by a complex set of factors. This high degree of complexity makes it hard to quantify exactly the effect of producing the biofuels and bioliquids used in Germany on global and local food prices and hence on food security. According to estimates by the EU Commission in respect of the impacts on foodstuff prices, demand for biofuels in the EU had a global price effect of 1-2% for cereals (bioethanol) in the period 2010/2011 and 4% for rapeseed, soya and palm oil (biodiesel) in 2008 and 2010 (European Commission, 2013; European Commission (2015b). A meta-study of a range of research on this subject clearly shows that there is a demonstrable effect on food prices through the cultivation of feedstocks for the production of biofuels, even though it is difficult to quantify the effect and a relatively high level of uncertainty remains (European Commission, 2014; Bentivoglio and Rasetti 2015).

Respect for land use rights. Various publications make a connection between the growing need for biomass, some of it for energy-related purposes, and ‘land grabbing’. Ethical concerns are raised by the oft-documented expulsion of the rural population who have been cultivating the land previously but do not possess any rights of use (Goeser, 2011). The huge socio-economic risk associated with such transactions, particularly in developing countries, thus lies in the withdrawal of access to land, water and other natural resources from the local population, which in turn increases the risk of famine and poverty (Ecofys, ISI et al., 2012; Colchester, Chao et al. 2013). Social aspects such as safety and involvement that are similarly lost during land grabbing are also associated with land ownership and property (Rao, 2018). Based on the current state of the data, direct and quantifiable connections between the global phenomenon of land grabbing and the promotion of biofuels and bioliquids in Germany and in the EU are hard to identify, but there are numerous references to land grabbing in connection with the production of feedstocks for biofuels (Nolte, Ostermeier et al., 2014; Oxfam 2016). According to data from the Land Matrix Global Observatory, by 2016 at least 21% of all recorded international land acquisitions were made in the context of biofuel projects, primarily in Brazil, Indonesia and Africa

(Nolte, Ostermeier et al. 2014). Problems can also arise in connection with failed biofuel projects. According to Nolte, Ostermeier et al. (2014), around 38% of biofuel-only projects for which contracts had been signed were abandoned in 2014, but the newly partitioned land rights were nevertheless retained. This can have a damaging impact on local communities, since they ultimately lose their access to the land. Data from the Land Matrix Observatory for 2019 indicate that 50 projects involving the cultivation of feedstocks for biofuels were abandoned (out of 295 contracts that were concluded). The European Commission regularly commissions studies to investigate the socio-economic problems of biofuel production in the countries where cultivation takes place. On the issue of illegal land grabbing, the study refers to the considerable difficulties involved in providing consistently reliable evidence of this issue. The methodological problems involved in assigning and conferring a legal status to land are a factor here, as well as the availability of reliable data and uncertainties when it comes to identifying the land affected. The study concludes that between 60 000 and 600 000 ha of land grabs may be linked to the promotion of biofuel in the EU (Ecofys, 2014). Another study from 2013 identified a total area of 180 000 ha worldwide which might have been subject to illegal land grabbing under European biofuel policy (Ecofys, 2013). It should be noted, however, that these are just the areas acquired directly for the production of biofuels and bioliquids for the European market. The effect triggered by the additional pressure on the land is not included. As large-scale land grabs are a real and relevant problem fraught with serious consequences and high socio-economic risk, and given the lack of transparency, unsatisfactory data and numerous documented cases of displacement, there would appear to be a need for further research.

Labour rights and child labour. Based on the available data, it is impossible to make any specific statement on the impact of the demand for feedstocks to satisfy Germany's need for biofuels and bioliquids on the situation in the countries that provide these feedstocks. A report on compliance with the eight fundamental Conventions adopted by the International Labour Organization (ILO)[97] in the main exporting countries (Ecofys, International et al., 2013) found that there had been no significant change with regard to ratification of the Conventions on workers' rights in the main exporting countries in the last few years. According to this report, the vast majority of the countries that export biofuels and bioliquids to the EU have ratified the fundamental Conventions, but enforcement is weak, especially in developing and emerging countries. Although the European Commission's most recent study on the sustainability of bioenergy (European Commission, 2016) does refer to the fact that use of

[97] These are as follows: Forced Labour Convention (No 29), Freedom of Association and Protection of the Right to Organise Convention (No 87), Right to Organise and Collective Bargaining Convention (No 98), Equal Remuneration Convention (No 100), Abolition of Forced Labour Convention (No 105), Discrimination (Employment and Occupation) Convention (No 111), Minimum Age Convention (No 138), Worst Forms of Child Labour Convention (No 182).

voluntary systems could also have indirect positive social effects, such as protection of workers, only one of the four systems audited by the European Court of Auditors included a review of socio-economic effects, such as respect for labour rights (European Commission, 2016).

Agricultural operations outside the EU. Imports of biofuels and bioliquids from outside Europe are not covered by the requirements of European agricultural policy. This applied to around 16% of raw materials in 2015 and 24% in 2016; in 2018, 36% of feedstocks came from outside the EU, and the majority were raw materials whose cultivation was associated with high ecological risks, such as palm oil, sugar cane, soya and maize. The environmental acceptability of cultivating these raw materials therefore depends mainly on the farming rules and agricultural practices in place in the exporting country and on the specific requirements of the relevant certification system for the agricultural cultivation systems.[98]

The Federal Government is involved in various international bodies addressing known sustainability problems with biofuels and bioenergy as a whole. This particularly includes the Global Bioenergy Partnership (GBEP). Germany's contribution focuses in particular on developing skills and applying a set of sustainability indicators developed by the GBEP[99] in the individual countries. Through its 23 member countries, 15 international partner organisations and 43 observers (countries and organisations) (figures last updated in 2019), the Global Bioenergy Partnership mainly addresses the level of country-specific political planning for sustainable bioenergy production.

14.2.4 Is the use of bioliquids to generate electricity and the use of biofuels socially acceptable?

Crucial to determining whether the use of biofuels and bioliquids is defensible from a socioethical standpoint is a judgement of the risks and benefits for present and future generations that are associated with this use. If biofuels and bioliquids are manufactured from raw materials produced in the EU, it must be assumed that the social requirements for those directly concerned have been met. Other benefits and risks to be considered here include in particular the effects on food and water supplies in endangered countries or vulnerable regions, poverty reduction through the generation of additional income, rural development, jobs, displacement of traditional uses of the land (e.g. by expanding areas under cultivation) and the external effects of more intensive production.

---

[98] As most EU certification systems recognise sustainability certificates from participants in other EU certification systems, all or part of the upstream chain may be certified by different systems than the end product.

[99] Eight indicators for each of the three pillars – environmental, social and economic – with descriptors and a full account of the methods used; see http://www.globalbioenergy.org/programmeofwork/task-force-on-sustainability/gbep-report-on-sustainability-indicators-for-bioenergy/en/.

The nature, scale and likelihood of the risks and benefits associated with the use of such fuels are heavily dependent on the raw materials used, the scale on which they are used and the context surrounding this use. In effective implementation scenarios, this includes the regulations applicable to land use and the protection of traditional rights to the land in the countries of origin, for example, as well as changes in per capita resource usage and interactions with other sectors of demand (see 14.2). Where biomass is grown for energy-related use, particularly in some third countries, the sustainability certification systems established in the EU cannot currently prevent the potential social risks from occurring. Similarly, the EU provisions do not guarantee that the benefits will be delivered. In particular, indirect effects pose diverse and potentially high risks from the use of biofuels and bioliquids based on an increase in biomass from agricultural production. These arguments support the increased use of residues and waste materials to generate biofuels as envisaged in the amended Renewable Energy Directive 2009/28/EC and the Fuel Quality Directive 98/70/EC, in particular through the introduction of an upper limit for ‘conventional’ biofuels.

15 ANNEX

15.1 List of abbreviations

ACER: Agency for the Cooperation of Energy Regulators

AIB: Association of Issuing Bodies

APEE: Anreizprogramm Energieeffizienz [Energy Efficiency Incentive Programme]

EEZ: Exclusive Economic Zone

BAFA: Bundesamt für Wirtschaft und Ausfuhrkontrolle [Federal Office of Economics and Export Control]

BauGB: Baugesetzbuch [Federal Building Code]

BauNVO: Baunutzungsverordnung [Land Use Regulation]

BBPIG: Bundesbedarfsplangesetz [Federal Requirements Plan Act]

BImSchG: Bundesimmissionsschutzgesetz [Federal Immission Control Act]

BImSchV: Bundesimmissionsschutzverordnung [Federal Immission Control Regulation]

Biokraft-NachV: Biokraftstoff-Nachhaltigkeitsverordnung [Biofuel Sustainability Regulation]

BiokraftQuG: Biokraftstoffquotengesetz [Biofuel Quota Act]

BiomasseV: Biomasseverordnung [Biomass Regulation]

BioSt-NachV: Biomassestrom-Nachhaltigkeitsverordnung [Biomass Electricity Sustainability Regulation]

BMU: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit [Federal Ministry for the Environment, Nature Conservation and Nuclear Safety]

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]

BNetzA: Bundesnetzagentur [Federal Network Agency]

BtL: Biomass-to-Liquid

EAG-EE: Gesetz zur Umsetzung der Richtlinie 2009/28/EG zur Förderung der Nutzung von Energie aus erneuerbaren Quellen [Act transposing Directive 2009/28/EC on the promotion of the use of energy from renewable sources]

EE: Erneuerbare Energie [renewable energies]

EEG: Erneuerbare-Energien-Gesetz [Renewable Energy Sources Act]

EEV: Endenergieverbrauch [final energy consumption]

EEWärmeG: Erneuerbare-Energien-Wärmegesetz [Renewable Energies Heat Act]

EKFG-AndG: Gesetz (zur Änderung des Gesetzes) zur Errichtung eines Sondervermögens „Energie- und Klimafonds“) [Act (amending the Act) on the establishment of a special ‘Energy and Climate Fund’]

EmoG: Elektromobilitätsgesetz [Electromobility Act]

EnEV: Energieeinsparverordnung [Energy Savings Regulation]

EnLAG: Energieleitungsbaugesetz [Electricity Grid Expansion Act]

EnLBRÄndG: Gesetz zur Änderung von Bestimmungen des Rechts des Energieleitungsbaus [Act amending provisions of the law on electricity grid expansion]

ENTSO-E: European Network of Transmission System Operators for Electricity

EnVKG: Energieverbrauchskennzeichnungsgesetz [Energy Consumption Labelling Act]

EnWG: Energiewirtschaftsgesetz [Energy Industry Act]

ESG: Energieeffizienzstrategie Gebäude [Energy Efficiency Strategy for Buildings]

R&D: Research and development

F&I: Forschung und Innovation [research and innovation]

FA Wind: Fachagentur Windenergie [Onshore Wind Energy Agency]

GasNZV: Gasnetzzugangsverordnung [Gas Grid Access Regulation]

GEEV: Grenzüberschreitende-Erneuerbare-Energien-Verordnung [Cross-Border Renewable Energies Regulation]

GGEMO: Gemeinsame Gesellschaftsstelle Elektromobilität [Joint Unit for Electric Mobility]

HGÜ: Hochspannungs-Gleichstrom-Übertragung [high-voltage direct current transmission]

HKNR: Herkunftsnachweisregister [register of guarantees of origin]

KfW: Kreditanstalt für Wiederaufbau

kW_{el}: electrical power in kilowatts

CHP: Combined heat and power

KWKG: Kraft-Wärme-Kopplungs-Gesetz [Combined Heat and Power Act]

kW_{th}: thermal power in kilowatts

MAP: Marktanreizprogramm zur Förderung erneuerbarer Energien im Wärmemarkt [market incentive programme for the promotion of renewable energies in the heating market]

MaStR: Marktstammdatenregister [market master data register]

MaStRV: Marktstammdatenregisterverordnung [Market Master Data Register Regulation]

NABEG: Netzausbaubeschleunigungsgesetz [Grid Expansion Acceleration Act]

NEEAP: National Energy Efficiency Action Plan

NawaRo: nachwachsende Rohstoffe [renewable raw materials]

NEP: Netzentwicklungsplan [Network Development Plan]

NOVA: Netz-Optimierung vor Verstärkung vor Ausbau [grid optimisation before grid reinforcement before grid expansion]

NPE: nationale Plattform Elektromobilität [National Electromobility Platform]

NREAP: National Renewable Energy Action Plan

O-NEP: Netzentwicklungsplan Offshore [Offshore Network Development Plan]

OWP: Offshore wind park

PCI: Projects of Common Interest

PV: Photovoltaic

RÖE: Rohöleinheit [oil equivalent]

SysStabV: Systemstabilitätsverordnung [System Stability Regulation]

StromNZV: Stromnetzzugangsverordnung [Electricity Grid Access Regulation]

t_{FM}: Tonnen Frischmasse [tonnes of fresh mass]

GHG: Greenhouse gas

TYNDP: Ten-Year Network Development Plan

UBA: Umweltbundesamt [German Environment Agency]

UCO: used cooking oil

TSO: Transmission system operators

WindSeeG: Windenergie-auf-See-Gesetz [Offshore Wind Energy Act]

15.2 List of figures and tables

List of figures

List of tables

Tables based on the template provided by the European Commission:

Supplementary tables:

15.3 References

AFC (2016). Erhebung und Aufbereitung sowie Analyse der Validität und Reliabilität statistischer Daten zu NawaRo – Projektendbericht [Collection and preparation of statistical data on renewable raw materials and analysis of their validity and reliability – final project report]. Gülzow, AFC Consulting Group AG.

Aha, B. and J. Z. Ayity (2017). Biofuels and the hazards of land grabbing: Tenure (in)security and indigenous farmers' investment decisions in Ghana. Land Use Policy 60.

Alexander, P., M. D. A. Rounsevell, C. Dislich, J. R. Dodson, K. Engström and D. Moran (2015). 'Drivers for global agricultural land use change: The nexus of diet, population, yield and bioenergy.' Global Environmental Change 35: 138-147.

Amnesty International (2016): The great palm oil scandal – Labour abuses behind big brand names.

Deutsches Pelletinstitut, BAFA (2015). Zuschuss für Mini-KWK-Anlagen, Bundesamt für Wirtschaft und Ausfuhrkontrolle [Subsidy for mini CHP installations, Federal Office of Economics and Export Control].

Bentivoglio, D. and M. Rasetti (2015). Biofuel sustainability: review of implications for land use and food price. Germany, Europe, Firenze University Press.

Federal Agency for Nature Conservation [Bundesamt für Naturschutz, BfN] (2010a). Bioenergie und Naturschutz. Synergien fördern, Risiken vermeiden, Bundesamt für Naturschutz [Bioenergy and nature conservation. Promoting synergies, avoiding risks, Federal Agency for Nature Conservation].

BfN (2010b). Flächeneffektive Bioenergienutzung aus Naturschutzsicht, Bundesamt für Naturschutz [Land-efficient use of bioenergy from the perspective of nature conservation, Federal Agency for Nature Conservation].

BfN (2015). Tiere und Pflanzen in Deutschland. Artenschutz-Report, Bundesamt für Naturschutz [Animals and plants in Germany. Species protection report, Federal Agency for Nature Conservation].

BfN (2017). Agrar-Report 2017 – Biologische Vielfalt in der Agrarlandschaft [Agricultural report 2017 – Biological diversity in the agricultural landscape]. H. v. d. Decker, B. Jessel, A. Krug, B. Schuster and U. Stratmann. Bonn – Bad Godesberg, Federal Agency for Nature Conservation.

Federal Office for Agriculture and Food [Bundesanstalt für Landwirtschaft und Ernährung, BLE] (2016). Evaluations- und Erfahrungsbericht für das Jahr 2015. Bonn, Bundesanstalt für Landwirtschaft und Ernährung [Evaluation and experience report for 2015. Bonn, Federal Office for Agriculture and Food]

Federal Office for Agriculture and Food [Bundesanstalt für Landwirtschaft und Ernährung, BLE] (2017). Evaluations- und Erfahrungsbericht für das Jahr 2016. Bonn, Bundesanstalt für Landwirtschaft und Ernährung [Evaluation and experience report for 2015. Bonn, Federal Office for Agriculture and Food]

Federal Office for Agriculture and Food [Bundesanstalt für Landwirtschaft und Ernährung, BLE] (2018). Evaluations- und Erfahrungsbericht für das Jahr 2017. Bonn, Bundesanstalt für Landwirtschaft und Ernährung [Evaluation and experience report for 2015. Bonn, Federal Office for Agriculture and Food]

Federal Ministry of Food and Agriculture [Bundesministerium für Ernährung und Landwirtschaft, BLE] (2019). Evaluations- und Erfahrungsbericht für das Jahr 2018. Bonn, Bundesanstalt für Landwirtschaft und Ernährung [Evaluation and experience report for 2015. Bonn, Federal Office for Agriculture and Food]

Federal Ministry of Food and Agriculture [Bundesministerium für Ernährung und Landwirtschaft, BMEL] (2019). 'Cross-Compliance.' Retrieved on 04.12.19., from https://www.bmel.de/DE/Landwirtschaft/Foerderung-Agrarsozialpolitik/_Texte/Cross-Compliance.html.

BMU (2012). Erfahrungsbericht zum Erneuerbare-Energien-Wärmegesetz (EEWärmeG-Erfahrungsbericht), Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit [Experience report on the Renewable Energies Heat Act, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety].

Deutsches Pelletinstitut, BMUB (2015). Projektionsbericht 2015 gemäß Verordnung 525/2013/EU [Projection report 2015 pursuant to Regulation 525/2013/EU].

BMUB and BMEL (2017). Nitratbericht 2016 – Gemeinsamer Bericht der Bundesministerien für Umwelt, Naturschutz, Bau und Reaktorsicherheit sowie für Ernährung und Landwirtschaft [Nitrate report 2016 – Joint report by the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety and the Ministry of Food and Agriculture].

BMWi (2015). Zweiter Erfahrungsbericht zum Erneuerbare-Energien-Wärmegesetz – Die Entwicklung des Wärme- und Kältemarktes in Deutschland. Die Energiewende – Ein gutes Stück Arbeit [Second experience report on the Renewable Energies Heat Act – Development of the heating and cooling market in Germany. The energy transition – a great deal remains to be done, Federal Ministry for Economic Affairs and Energy].

BMWi (2017a). 'Bundesministerium für Wirtschaft und Energie: Energiewende-Plattform Energieeffizienz.' ['Federal Ministry for Economic Affairs and Energy: Energy Transition Platform Energy Efficiency']. 27.09.2017, from https://www.bmwi.de/Redaktion/DE/Textsammlungen/Energie/energiewende-plattform-energieeffizienz.html

BMWi (2017b). 'Bundesministerium für Wirtschaft und Energie: Energiewende-Plattform Energienetze.' ['Federal Ministry for Economic Affairs and Energy: Energy Transition Platform Energy Grids'] from https://www.bmwi.de/Redaktion/DE/Artikel/Energie/energiewende-plattform-energienetze.html

BMWi (2017c). 'Bundesministerium für Wirtschaft und Energie: Energiewende-Plattform Forschung und Innovation.' ['Federal Ministry for Economic Affairs and Energy: Energy Transition Platform Research and Innovation'] Retrieved on 27.09.2017, from https://www.bmwi.de/Redaktion/DE/Artikel/Energie/Energieforschung/energieforschung-energiewende-plattform-forschung-und-innovation.html

https://www.bmwi.de/Redaktion/DE/Artikel/Energie/energiewende-plattform-energienetze.html

BMWi (2019). Zeitreihen zur Entwicklung der erneuerbaren Energien in Deutschland – unter Verwendung von Daten der Arbeitsgruppe Erneuerbare Energien-Statistik (AGEE-Stat) [Time series concerning the development of renewable

energies in Germany – using data from the Working Group on Renewable Energy Statistics] . As at: December 2019 Berlin.

BMWi (2017d). 'Bundesministerium für Wirtschaft und Energie: Energiewende-Plattform Gebäude.' ['Federal Ministry for Economic Affairs and Energy: Energy Transition in Buildings Platform']. Retrieved on 27.09.2017, from https://www.bmwi.de/Redaktion/DE/Textsammlungen/Energie/energiewende-plattform-gebaeude.html

Deutsches Pelletinstitut, CARMEN (2015). Logs.

CARMEN (2017). Der Holzpellet-Preis-Index, Jahresmittelwerte [The wood pellet price index, annual average values].

CARMEN (2019a). Der Holzpellet-Preis-Index, Jahresmittelwerte [The wood pellet price index, annual average values].

CARMEN (2019b). Preisentwicklung bei Holzbriketts [Price trends for wood briquettes].

CARMEN (2019c). Preisindex für KUP-Hackschnitzel [Price index for short rotation plantation wood chips].

Colchester, M., S. Chao, J. Dallinger, S. M. Toh, C. Kiev, I. Saptaningrum, M. A. Ramirez and J. Pulhin (2013). Agribusiness large-scale land acquisitions and human rights in southeast Asia – Updates from Indonesia, Thailand, Philippines, Malaysia, Cambodia, Timor-Leste and Burma. S. Chao.

German Biomass Research Centre [Deutsches Biomasseforschungszentrum, DBFZ] (2015a). Biomassepotenziale von Rest- und Abfallstoffen – Status quo in Deutschland. Schriftenreihe Nachwachsende Rohstoffe [Biomass potential of residual and waste substances – status quo in Germany. Series of publications on renewable raw materials].

DBFZ (2015b). Stromerzeugung aus Biomasse [Generation of power from biomass].

DBFZ (2017). Optionen für Biogasbestandsanlagen bis 2030 aus ökonomischer und energiewirtschaftlicher Sicht – Zwischenbericht (Status Quo), Forschungsvorhaben für das Umweltbundesamt [Options for existing biogas installations between now and 2030 from an economic and energy industry perspective – interim report (status quo), research project for the German Environment Agency].

DBFZ (2019a). Auswertung der Befragung der Biogasanlagenbetreiber für die Jahre 2017 und 2018 [Evaluation of the 2017 and 2018 surveys of biogas installation operators].

DBFZ (2019b). Monitoring Biokraftstoffsektor – 4. Auflage [Monitoring of the biofuel sector – 4th edition]. DBFZ report. Leipzig. 11.

Deutsches Pelletinstitut, DEPI (2015). Verteilung Pelletheizungen in Deutschland, Deutsches Pelletinstitut [Distribution of pellet heating systems in Germany, Deutsches Pelletinstitut].

Destatis (2015). Feldfrüchte und Grünland. Dauergrünland nach Art der Nutzung im Zeitvergleich [Arable crops and grassland. Permanent grassland depending on usage type over time]. See Federal Office.

Destatis (2017). Land- und Forstwirtschaft, Fischerei – Eigentums- und Pachtverhältnisse, Agrarstrukturerhebung, Fachserie 3, Reihe 2.1.6 [Agriculture and

forestry, fishery, ownership and leasing structures, Farm Structure Survey, Technical Series 3, Series 2.1.6].

Destatis (2018a). Fachserie 3 Reihe 3.1.2 Land- und Forstwirtschaft, Fischerei – Bodennutzung der Betriebe (Landwirtschaftlich genutzte Flächen) [Technical Series 3 Series 3.1.2 Agriculture and forestry, fisheries, land use by undertakings (agricultural land)].

Destatis (2018b). Land- und Forstwirtschaft, Fischerei; Kaufwerte für landwirtschaftliche Grundstücke; Fachserie 3 Reihe 2.4 [Agriculture and forestry, fisheries; purchase values for agricultural parcels; Technical Series 3, Series 2.4].

Destatis (2018c). Preisindizes für die Land- und Forstwirtschaft [Price indices for agriculture and forestry]. See Federal Office. Wiesbaden.

Destatis (2019a). Feldfrüchte und Grünland – Anbaufläche ausgewählter Anbaukulturen im Zeitvergleich. [Arable crops and grassland – area under cultivation of selected crops over time]

Destatis (2019b). Land- und Forstwirtschaft, Fischerei – Wachstum und Ernte – Feldfrüchte – Fachserie 3, Reihe 3.2.1 [Agriculture and forestry, fisheries – growth and harvest – arable crops – Technical Series 3, Series 3.2.1].

Destatis (2019c). Preisindizes für die Land- und Forstwirtschaft [Price indices for agriculture and forestry]. See Federal Office. Wiesbaden.

Diversity, S. o. t. C. o. B. (2014). Global Biodiversity Outlook 4. Montréal: 155.

German Institute for Economic Research [Deutsches Institut für Wirtschaftsforschung, DIW], German Aerospace Centre [Deutsches Zentrum für Luft- und Raumfahrt, DLR] (2019): Ökonomische Indikatoren der Energiebereitstellung: Methode, Abgrenzung und Ergebnisse für den Zeitraum 2000 – 2017 [Economic indicators of energy supply: method, definition and outcomes for the period 2000-2017]. Politikberatung kompakt No 135.

Deutsches Maiskomitee e.V. (DMK) (2018). %ualer Anteil des Maisanbaus an der Ackerfläche für Deutschland auf Kreisebene 2016. [Percentage share of arable land in Germany used for maize cultivation at district level 2016]

Ecofys (2013). Land grabs for biofuels driven by EU biofuels policies. Project number: BIENL13469.

Ecofys (2014). Renewable Energy Progress and Biofuels Sustainability. 3813991.

Ecofys, F. ISI, B. B. Held, E. E. Group and W. International (2012). Renewable energy progress and biofuels sustainability. Report for the European Commission.

Ecofys, W. International and IEEP (2013). Mandatory requirements in relation to air, soil, or water protection: analysis of need and feasibility. Utrecht.

Advisory Council on the Environment [Sachverständigenrat für Umweltfragen, EEA] (2007). Estimating the environmentally compatible bioenergy potential from agriculture. EEA Technical report, European Environment Agency. 12/2007.

European Commission (EC) (2013). Renewable energy progress report. Report from the Commission to the European Parliament and the Council, European Commission. 175.

European Commission (EC) (2014). Renewable Energy Progress and Biofuels Sustainability. 3813991.

European Commission (2015a). Implementation of the recently adopted criteria and geographic ranges of highly biodiverse grassland. Brussels, European Commission. 359294.

European Commission (2015b). Renewable energy progress report. Report from the Commission to the European Parliament and the Council, European Commission. 293.

European Commission (2015c). Update of Commission website, notifications and transparency measures. Brussels, European Commission 1094930.

European Commission (EC) (2016). Sustainability of Bioenergy. Brussels, European Commission. 418.

European Commission (2017a). Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Brussels, European Commission.

European Commission (2017b). Note on conducting and verifying actual calculations of GHG emission savings, Version 2.0. Brussels, European Commission. 2122195.

European Commission (EC) (2019). Renewable energy progress report. Report from the Commission to the European Parliament and the Council, European Commission. 225.

European Court of Auditors (2016). The EU system for the certification of sustainable biofuels. Special report. Luxembourg, European Court of Auditors.

European Parliament (2014). Palm oil and deforestation of rainforests. Resolution of the European Parliament of 4 April 2017 on 'Palm oil and deforestation of rainforests' (2016/2222(INI)), European Parliament.

EUWID (2017a). 'EUWID-Marktbericht für Altholz – "Der große Druck ist raus".' ['EUWID market report for scrap wood – "The pressure is (mostly) off"']. EUWID Neue Energie [New Energy] 2017 (06): 18-19.

EUWID (2017b). 'EUWID-Marktbericht für Altholz – Ausgeglichener Altholz-Markt: "Kein Überhang, aber auch keine Unterdeckung".' ['EUWID market report for scrap wood – "Balanced scrap wood market: no surplus, but also no deficit"']. EUWID Neue Energie 2017 (18): 17-18.

EUWID (2017c). 'EUWID-Marktbericht für Altholz – Der Markt für Altholz zeigt sich derzeit weigehend stabil und ausgeglichen.' ['EUWID market report for scrap wood – The market for scrap wood continues to be largely stable and balanced']. EUWID Neue Energie 2017 (32): 18-19.

EUWID (2018). 'EUWID-Marktbericht für Altholz – Altholzbranche sieht dem Winter entspannt entgegen.' ['EUWID market report for scrap wood – the scrap wood sector faces the winter calmly']. EUWID Neue Energie 2018 (45): 18-19.

Fehrenbach, H., Giegrich, J., Köppen, S., Wern, B., Pertagnol, J., Baur, F., Hünecke, K., Dehoust, G., Bulach, W., Wiegmann, K. (2019). BioRest: Verfügbarkeit und Nutzungsoptionen biogener Abfall- und Reststoffe im Energiesystem (Strom-, Wärme- und Verkehrssektor) [Bioresidues: availability and usage options for biogenic waste and residual substances in the energy system (electricity, heating and transport sector)]. Retrieved on 10.12.2019 from https://www.umweltbundesamt.de/publikationen/biorest-verfuegbarkeit-nutzungsoptionen-biogener

Fachagentur Nachwachsende Rohstoffe e.V. (FNR) (2015a). Erhebung statistischer Daten zu Preisen Nachwachsender Rohstoffe [Collection of statistical data on the prices for renewable raw materials]. FNR.

FNR (2017). Energiepreisentwicklung. [Trends in energy prices] A. 67.

FNR (2019a). Anbau und Verwendung nachwachsender Rohstoffe in Deutschland [Cultivation and use of renewable raw materials in Germany]. 15.

FNR (2019b). Energiepreisentwicklung. [Trends in energy prices] A. 67.

FNR (2015b). 'Heizen mit Stroh – Wertschöpfung für Landwirtschaft und Kommunen.' ['Heating with straw – value creation for agriculture and municipalities']. Retrieved on 12.09.2017, from https://veranstaltungen.fnr.de/strohheizung2015/.

Garvert, H. (2017). Determinanten der Pachtpreise in Deutschland – Biogasförderung und Direktzahlungen im Fokus [Determinants of lease prices in Germany – biogas promotion and direct payments in focus]. Dr. agr. inaugural dissertation, Justus-Liebig University Gießen.

Goeser (2011). Land Grabbing. Ursachen, Wirkungen, Handlungsbedarf [Land grabbing. Causes, impacts, need for action]. Infobrief des Wissenschaftlichen Dienstes des Bundestages [Information letter by the Scientific Services of the Bundestag]. File ref. WD 5 – 3010 – 204/11.

Hawighorst, P. (2018). Der Palmölmarkt in Deutschland im Jahr 2017 [The palm oil market in Germany in 2017]. Cologne, Meo Carbon Solutions.

Kommission Bodenschutz beim Umweltbundesamt [Soil Protection Commission within the German Environment Agency, KBU] (2008a). Bodenschutz beim Anbau nachwachsender Rohstoffe – Empfehlungen der "Kommission Bodenschutz beim Umweltbundesamt" [Soil protection in connection with the cultivation of sustainable raw materials – recommendations by the Soil Protection Commission within the German Environment Agency].

KBU (2008b). Empfehlungen der Kommission Bodenschutz am Umweltbundesamt „Bodenschutz beim Anbau nachwachsender Rohstoffe" [Recommendations by the Soil Protection Commission within the German Environment Agency 'Soil Protection in connection with the cultivation of sustainable raw materials'].

Kharina, A., Searle, S., Rachmadini, D., Kurniawan, D.D. and A. Prionggo (2018): Potential economic, health, and greenhouse gas benefits of incorporating used cooking oil into Indonesia's biodiesel. ICC White Paper, Washington.

Agricultural Expert Panel at the German Environment Agency [Kommission Landwirtschaft beim Umweltbundesamt, KLU] (2013). Biogaserzeugung und -nutzung: Ökologische Leitplanken für die Zukunft. Vorschläge der Kommission Landwirtschaft beim Umweltbundesamt [Biogas production and use: ecological guidelines for the future. Proposals by the Agricultural Expert Panel at the German Environment Agency]. Dessau-Roßlau, Agricultural Expert Panel at the Germany Environment Agency.

Knoke, I. and H. Inkermann (2015). Palmöl – der perfekte Rohstoff? eine Industrie mit verheerenden Folgen, Bonn [Palm oil – the perfect raw material?: an industry with devastating consequences, Bonn].

Lower Saxony State Office for Statistics [Landesamt für Statistik Niedersachsen, LSN] (2014). Pachtpreise für landwirtschaftlich genutzte Flächen sind deutlich

gestiegen, Landesamt für Statistik Niedersachsen [Lease prices for agricultural land have risen sharply, Lower Saxony State Office for Statistics].

Mantau (2012). Holzrohstoffbilanz Deutschland – Entwicklungen und Szenarien des Holzaufkommens und der Holzverwendung 1987 bis 2015 [Wood product balance for Germany – developments and scenarios for wood supply and wood use 1987 to 2015]. Hamburg, University of Hamburg.

Mantau, U., P. Döring, H. Weimar and S. Glasenapp (2018). Rohstoffmonitoring Holz – Mengenmäßige Erfassung und Bilanzierung der Holzverwendung in Deutschland. Schriftenreihe Nachwachsende Rohstoffe [Raw material monitoring for wood – quantitative recording and balancing of wood use in Germany. Series of publications on renewable raw materials]. Gülzow, Fachagentur Nachwachsende Rohstoffe e.V.

Marlins, C. (2017): Waste not want not. Cerulogy and the International Council on Clean Transportation, London.

Lower Saxony Ministry of Food, Agriculture and Consumer Protection [Niedersächsisches Ministerium für Ernährung, Landwirtschaft und Verbraucherschutz, MLNiedersachsen] (2012). Biogas in Niedersachsen. Entwicklung, Stand und Perspektiven. L. Niedersächsisches Ministerium für Ernährung, Verbraucherschutz und Landesentwicklung and E. u. K. Niedersächsisches Ministerium für Umwelt [Biogas in Lower Saxony. Development, status and prospects. L. Lower Saxony Ministry of Food, Consumer Protection and Rural Development and E and K Lower Saxony Ministry of the Environment].

MLNiedersachsen (2014). Biogas in Niedersachsen. Inventur 2014. L. Niedersächsisches Ministerium für Ernährung, Verbraucherschutz und Landesentwicklung and E. u. K. Niedersächsisches Ministerium für Umwelt [Biogas in Lower Saxony. Inventory 2014. L. Lower Saxony Ministry of Food, Consumer Protection and Rural Development and E and K Lower Saxony Ministry of the Environment].

Nolte, K., A. Ostermeier and K. Schultze (2014). ‘Food or fuel – the role of agrofuels in the rush for land.’ GIGA Focus International Edition English 05: 8.

OVID (2019). Importe von Ölsaaten, Verband der Ölsaatenverarbeitenden Industrie in Deutschland. [Imports of oilseeds, OVID]

Oxfam (2016). Burning land, burning the climate – The biofuel industry’s capture of EU bioenergy policy. M.-O. Herman and J. Mayrhofer. Oxford.

Rao, J. (2018). Fundamental Functionings of Landowners: Understanding the relationship between land ownership and wellbeing through the lens of ‘capability’. Land Use Policy 72.

Rauh, S. (2019). "2018er Dürre wirkt preistreibend." [‘2018 drought drives up prices’]. Biogas Journal 2019 (2): 40-43.

Richter, F., M. Jansen and N. Lamersdorf (2014). Reduced groundwater recharge under short rotation coppice plantations – may agroforestry help to lessen enhanced water consumption ? Portugal, Europe, EURAF.

Scholwin, F., J. Grope, A. Clinkscales, J. Daniel-Gromke, N. Rensberg, V. Denysenko, W. Stinner, F. Richter, T. Raussen, M. Kern, T. Turk and G. Reinhold (2018). Aktuelle Entwicklung und Perspektiven der Biogasproduktion aus Bioabfall und Gülle. EVUPlan des Bundesministeriums für Wirtschaft und Energie, Umweltbundesamt [Current developments and perspectives for biogas

production from biological waste and slurry. EVUPlan of the Federal Ministry for Economic Affairs and Energy, German Environment Agency].

Searle, S., N. Pavlenko, S. E. Takriti and K. Bitnere (2017). Potential greenhouse gas savings from a 2030 greenhouse gas reduction target with indirect emissions accounting for the European Union. icct.

Silhvonen, J. (2019). The trend worsens: More palm oil for energy, less for food – Drivers burn more than half of palm oil imported into the EU – 2018 data, Transport & Environment.

Advisory Council on the Environment [Sachverständigenrat für Umweltfragen, SRU] (2007). Klimaschutz durch Biomasse. Sondergutachten, Sachverständigenrat für Umweltfragen. [Climate protection through biomass. Special expert opinion, Advisory Council on the Environment]

Office of Technology Assessment at the German Bundestag [Büro für Technikfolgenabschätzung beim Deutschen Bundestag, TAB] (2010). Chancen und Herausforderungen neuer Energiepflanzen. Endbericht, Büro für Technikfolgenabschätzung beim Deutschen Bundestag. [Opportunities and challenges associated with new energy crops. Final report, TAB]

Johann Heinrich von Thünen Institute (2019). Thünen-Institut auf Basis JWEE, Thünen-Institut für Internationale Waldwirtschaft und Forstökonomie. [Johann Heinrich von Thünen Institute on the basis of the Joint Wood Energy Enquiry (JWEE), Johann Heinrich von Thünen Institute for International Forestry and Forest Economics]

Office of Technology Assessment at the German Bundestag [Büro für Technikfolgenabschätzung beim Deutschen Bundestag, UBA] (2010). Energieziel 2050: 100% Strom aus erneuerbaren Quellen [Energy target 2050: 100% electricity from renewable sources]. Dessau-Roßlau, UBA.

UBA (2011). Nutzung des Potenzials des biogenen Anteils im Abfall zur Energieerzeugung [Using the potential of the biogenic share of waste for energy generation], Institute for the Waste Economy and Contaminated Sites, Technical University of Dresden [Institut für Abfallwirtschaft und Altlasten, Technische Universität Dresden, IAA TU Dresden].

Deutsches Pelletinstitut, UBA (2015). Reaktiver Stickstoff in Deutschland. [Reactive nitrogen in Germany]

UBA (2017). Daten zur Umwelt 2017 – Indikatorbericht [Environmental data 2017 – indicator report].

UBA (2018). Daten zur Umwelt – Umwelt und Landwirtschaft, Umweltbundesamt. [Environment data – environment and agriculture, German Environment Agency].

Federal Ministry of Food and Agriculture [Bundesministerium für Ernährung und Landwirtschaft, UBA] (2019). Umweltbundesamt: Emissionsbilanz erneuerbarer Energieträger – Bestimmung der vermiedenen Emissionen im Jahr 2018. [German Environment Agency: emissions balance for renewable energy carriers – calculation of emissions avoided in 2018] UBA Climate Change. Dessau-Roßlau. No 37/2019.

UFOP (2017a). ‘Grafik der Woche 2017.’ [Chart of the week 2017] Retrieved on 06.09.2019, from https://www.ufop.de/biodiesel-und-co/biodiesel/grafik-der-woche/archiv-grafiken-der-woche/

UFOP (2017b). UFOP – Marktinformation Ölsaaten und Biokraftstoffe Januar 2017. [UFOP – Market information for oilseeds and biofuels, January 2017] Berlin, UFOP.

UFOP (2018b). UFOP – Marktinformation Ölsaaten und Biokraftstoffe Dezember 2018 [UFOP – Market information for oilseeds and biofuels, December 2018] Berlin, UFOP.

UFOP. (2018a). 'Grafik der Woche 2018.' [Chart of the week 2018] Retrieved on 06.09.2019, from https://www.ufop.de/biodiesel-und-co/biodiesel/grafik-der-woche/archiv-grafiken-der-woche/.

UNECE/FAO (2019). Joint Wood Energy Enquiry (JWEE). United Nations. Geneva.

Johann Heinrich von Thünen Institute (2009). Auswertung von Daten des Integrierten Verwaltungs- und Kontrollsystems zur Abschätzung von Wirkungen der EU-Agrarreform auf Umwelt und Landschaft. Arbeitsberichte aus der vTI-Agrarökonomie [Evaluation of data from the integrated administration and control system for estimating the impacts of EU agricultural reform on the environment and agriculture. Working reports from the Agricultural Economy Department of the Johann Heinrich von Thünen Institute]. Braunschweig. 07/2009.

Johann Heinrich von Thünen Institute (2010). Aspekte des Gewässerschutzes und der Gewässernutzung beim Anbau von Energiepflanzen. Arbeitsbericht aus der vTI-Agrarökonomie [Aspects of water protection and water use in connection with the cultivation of energy crops. Working report from the Agricultural Economy Department of the Johann Heinrich von Thünen Institute]. 03/2008.

German Advisory Council on Global Change [Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen, WBGU] (2009). Welt im Wandel: Zukunftsfähige Bioenergie und nachhaltige Landnutzung, Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen [World in transition: future bioenergy and sustainable land use, German Advisory Council on Global Change].

Centre for Solar Energy and Hydrogen Research Baden-Württemberg [Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg, ZSW], bosch&partner (2019). Vorbereitung und Begleitung bei der Erstellung eines Erfahrungsberichts gemäß § 97 EEG. Vorhaben IIc – Solare Strahlungsenergie [Preparatory and support measures in connection with the drafting of an experience report pursuant to Section 97 of the Renewable Energy Sources Act. Project IIc – solar energy].

ZSW, Fraunhofer Institute for Wind Energy and Energy System Technology [Fraunhofer-Institut für Windenergiesysteme, F. IWES], bosch&partner and GfK (2014). Vorbereitung und Begleitung der Erstellung des Erfahrungsberichts 2014 gemäß § 65 EEG. Vorhaben IIc – Solare Strahlungsenergie [Preparatory and support measures in connection with the drafting of a 2014 experience report pursuant to Section 65 of the Renewable Energy Sources Act. Project IIc – solar energy].