Germany´s Fourth Biennial Report on Climate Change under the United Nations Framework Convention on Climate Change 2020

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Abbreviations

BAFA	Federal Office for Economic Affairs and Export Control
BGBl	Federal Law Gazette
BIMSchV	Secondary legislation under the Act on the Prevention of Harmful Effects on the Environment Caused by Air Pollution, Noise, Vibration and Similar Phenomena
BMBF	Federal Ministry of Education and Research
BMEL	Federal Ministry for Food, Agriculture and Consumer Protection
BMU	Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety
BMWi	Federal Ministry for Economic Affairs and Energy
BMZ	Federal Ministry for Economic Cooperation and Development
CTF	Common tabular format (standardised reporting format under the United Nations Framework Convention on Climate Change used in the annexed tables in the Biennial Report)
DEG	Deutsche Investitions- und Entwicklungsgesellschaft mbH
Destatis	Federal Statistical Office, Wiesbaden
ESD / ESR	Effort sharing d (Decision No 406/2009/EC and Regulation (EU) 2018/842)
EU	European Union
GDP	Gross domestic product
GVA	Gross value added
HGV	Heavy goods vehicles
ESD	Effort sharing decisions (Decision No 406/2009/EC and Regulation (EU) 2018/842)
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
KfW	Kreditanstalt für Wiederaufbau
LULUCF	Land use, land use change and forestry
MMR	Monitoring Mechanism Regulation
NIR	National inventory report
OECD	Organization for Economic Co-operation and Development
PaM	Policies and measures
REDD+	Reducing emissions from deforestation and forest degradation
UBA	Federal Environment Agency, Dessau
UNFCCC	United Nations Framework Convention on Climate Change
WAMS	With-additional-measures scenario in the Projections Report pursuant to EU Regulation 525/2013
WMS	With-measures scenario in the Projections Report pursuant to EU Regulation 525/2013

Executive summary

The emissions situation in 2017

By 2017, Germany had succeeded in cutting its emissions by 27.5 % from 1990 levels. The release of carbon dioxide is still the main contributor to greenhouse gas emissions, accounting for 88.0 %. The relative share of CO_2 emissions in total greenhouse gas emissions has actually risen slightly since the base year, due to the disproportionate reduction in emissions of other greenhouse gases. Methane (CH_4) emissions' share in total emissions was 6.1 %, nitrous oxide's (N_2O) share was 4.2 % and that of fluorinated greenhouse gases (known as F-gases) was approximately 1.7 %. Nitrogen trifluoride (NF_3), a greenhouse gas which has been included in the reporting since the 2015 due to the Revised UNFCCC Reporting Guidelines (Decision 24/CP.19), contributes a negligible share of 0.001 %. The distribution of greenhouse gas emissions in Germany is typical of a highly developed, industrialised country. When considered by category, reductions are seen in all sectors – with the exception of transport, where emissions are once more at the same level as in the 1990 base year – with the most marked reductions being in the waste management sector.

Reduction targets

In its Climate Action Plan 2050, the German government reaffirmed and further defined its ambitious national climate targets: Germany intends to be largely greenhouse gas neutral by 2050. The government has also reaffirmed the intermediate targets of reducing its greenhouse gas emissions by at least 55 % by 2030 and by at least 70 % by 2040 compared with 1990. In addition, the Climate Action Plan 2050 spells out the government's 2030 climate target for the individual sectors, describes the development pathways needed in those sectors, lists initial implementation measures and sets up a process for monitoring and refining the policies and measures. This is the means by which Germany will play its part in achieving the Paris Agreement's overall aim to limit global warming to well below 2 degrees Celsius and, if possible, to 1.5 degrees Celsius.

At the time of writing this report, specific instruments and measures were being prepared in what is known as the German government's climate cabinet. The ministries are working towards an agreement on how they intend to achieve the 2030 sector targets and at the same time contribute to complying with the emission budgets set by the EU Effort Sharing Regulation. On 25 September 2019, the government passed a resolution on the key elements of Germany's climate policy for the next decade.

Emission trends

Overall, climate action measures and the energy transition have resulted in considerable progress towards the 2020 target. However, current projections indicate that they are not sufficient to achieve Germany's ambitious climate target for 2020. According to the latest estimates (2019 Projections Report), which the German government does not fully endorse but will take into account in its future considerations, the measures adopted in 2018 will make it possible to reduce greenhouse gases by up to 34.3 % by 2020.

Overall, the fact remains that Germany has made significant progress in climate change mitigation since the beginning of the 1990s. Examples of this include the fact that it has decoupled economic growth from greenhouse gas emissions and surpassed the reduction targets it set under the first commitment period of the Kyoto Protocol (2008-2012). Germany is also making good progress with regard to the target for the second commitment period of the Kyoto Protocol (2013-2020) in terms of the overall budget. In particular, the expansion of renewable energy has led to increasing reductions in energy-related greenhouse gas emissions. Renewable energy's share in gross electricity consumption rose to 37.8 % in 2018, with its share

in final gross energy consumption across all sectors that year rising to 16.7 %. Its share in total heat and cooling consumption in 2018 was 14.2 % and in the transport sector it was 5.7 %.[1] In 2018, a total of 187.3 million tonnes of CO_2 equivalents were avoided as a result of renewable energy.[2]

Climate finance

The German government contributes its fair share to international climate finance and is one of the world's largest donors. In this context, it set itself the goal of doubling its contribution by 2020, from the 2014 target value of EUR 2 billion to EUR 4 billion (from budgetary sources and grant equivalents of development loans). This will implement Chancellor Merkel's 2015 pledge. In the period from 2005 to 2018, the German government's climate finance from budgetary sources increased almost sevenfold to a total of approximately EUR 3.3 billion (USD 3.895 billion).[3] Since 2017 this includes grant equivalents in KfW development loans; see also Section 5.1.3.1.1.[4] In addition to the public climate finance from budget funds, Germany has also since 2013 reported mobilised public climate finance, i.e. climate-related credit financing provided by KfW Entwicklungsbank and the Deutsche Investitions- und Entwicklungsgesellschaft mbH (DEG), which uses market funds. Since 2015, this reporting has been project-specific. In addition to the deployed budgetary funds, EUR 3.246 billion (USD 3.831 billion) were pledged by KfW and DEG from capital market funds in 2018. The German government's aim is to be even-handed in providing climate finance for emission reduction and climate change adaptation. Of the budgetary funds provided from the federal budget, 53 % was used for mitigation measures and 47 % for adaptation measures in 2018. The German government uses a broad range of instruments and institutions for its international cooperation activities in the field of climate and development.

Background

As a Party to the United Nations Framework Convention on Climate Change (UNFCCC), Germany is obliged to submit regular reports. In addition to the annual National Inventory Report and the National Communication to be submitted every four years, Biennial Reports have also been a requirement since 2014.[5] In this Fourth Biennial Report, Germany reports – in compliance with the biennial reporting guidelines[6] – on trends in greenhouse gas emissions, its national reduction target, measures taken to achieve the target and progress made, projections of future emissions trends and provision of financial, technological and capacity-building support to developing countries. Comprehensive information in table form is given in the common tabular format[7] in the Annex to this report.

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[1] BMWi (2019): Zeitreihen zur Entwicklung der erneuerbaren Energien in Deutschland, as at: 08/2019. Some figures are still provisional.

[2] Federal Environment Agency, AG Erneuerbare Energien-Statistik (2019), https://www.umweltbundesamt.de/daten/energie/erneuerbare-energien-vermiedene-treibhausgase: 27 September 2019

[3] Conversion using the official OECD exchange rates for 2017 and 2018. https://data.oecd.org/conversion/exchange-rates.htm

[4] In addition, funds in the amount of EUR 23 million (USD 26 million) were made available in 2017 for the Annex I countries Ukraine, Turkey and Belarus, and EUR 66 million (USD 78 million) in 2018 for the Annex I countries Ukraine, Turkey, Russia and Belarus.

[5] UNFCCC Decision 1/CP.16

[6] UNFCCC biennial reporting guidelines for developed country Parties. Annex I to UNFCCC Decision 2/CP.17

[7] Common tabular format for UNFCCC biennial reporting guidelines for developed country Parties. UNFCCC Decision 19/CP.18

1 Information on greenhouse gas emissions and trends, Greenhouse Gas Inventories including information on the National System of Emissions Inventories

The descriptions in this chapter are based on the National Inventory Report 2019 (NIR 2019). In accordance with decision 3/CP.5, Germany submitted its Report on 12 April 2019 along with the Greenhouse Gas Inventories covering the period from 1990-2017. The Report describes the methods and data sources on which the calculations of German greenhouse gas emissions are based.

Please refer to NIR 2019 for a detailed description of methodology and for information on the determination and calculation of emission inventories.[8] The data used in this report correspond to the emission data in NIR 2019.[9] Detailed information on emissions can be found in the inventories published annually in the common reporting format (CRF).[10]

1.1 Summary of information from the Greenhouse Gas Inventories

Since 1994, the countries listed in Annex I of the UN Framework Convention on Climate Change – including Germany – have been committed to submit al Greenhouse Gas Inventory to the UNFCCC Secretariat by 15 April each year. The Revised UNFCCC Reporting Guidelines, which were adopted by the 19th session of the Conference of the Parties,[11] require details of emissions by sources and removals by sinks in the base year (1990 for CO_2, N_2O, CH_4; 1995 for HFCs, PFCs, SF_6, NF_3) and for each year up to two years before the report year to be provided.

Under the Kyoto Protocol, mitigation targets for aggregate emissions of a basket of six greenhouse gases – carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) – were agreed for two commitment periods (2008 to 2012 and 2013 to 2020). In the second commitment period, further greenhouse gases were added to the original six: nitrogen trifluoride (NF_3), six hydrofluorocarbons (HFC-152, HFC-161, HFC 236cb, HFC 236ea, HFC-245fa, HFC-365mfc) and two perfluorocarbons (C-C_3F_6, $C_{10}F_{18}$).

1.2 Greenhouse gas emissions and trends

In 2017 the overall emissions of greenhouse gases were 27.5 % below 1990 levels.[12] A closer look at the individual components reaffirms this trend in its varying degrees for the different gases. The changes in emissions of the principal greenhouse gases in terms of quantity amounted to minus 24.2 % for carbon dioxide (CO_2), minus 54.3 % for methane (CH_4) and minus 41.3 % for nitrous oxide (N_2O). By contrast, the trend for F-gases, which account for about 1.7 % of greenhouse gas emissions, is not quite so uniform. As a result of the introduction of new technologies and the use of these substances as substitutes, emissions of SF_6 fell by 7.23 % and of PFCs by 91.81 % compared with 1990, whereas emissions of HFCs rose by 100.9 %. Emissions of NF_3, a greenhouse gas which is included in the report for the first time, have risen very

[8] https://www.umweltbundesamt.de/themen/klima-energie/treibhausgas-emissionen

[9] https://unfccc.int/sites/default/files/resource/deu-2019-nir-15apr19.zip

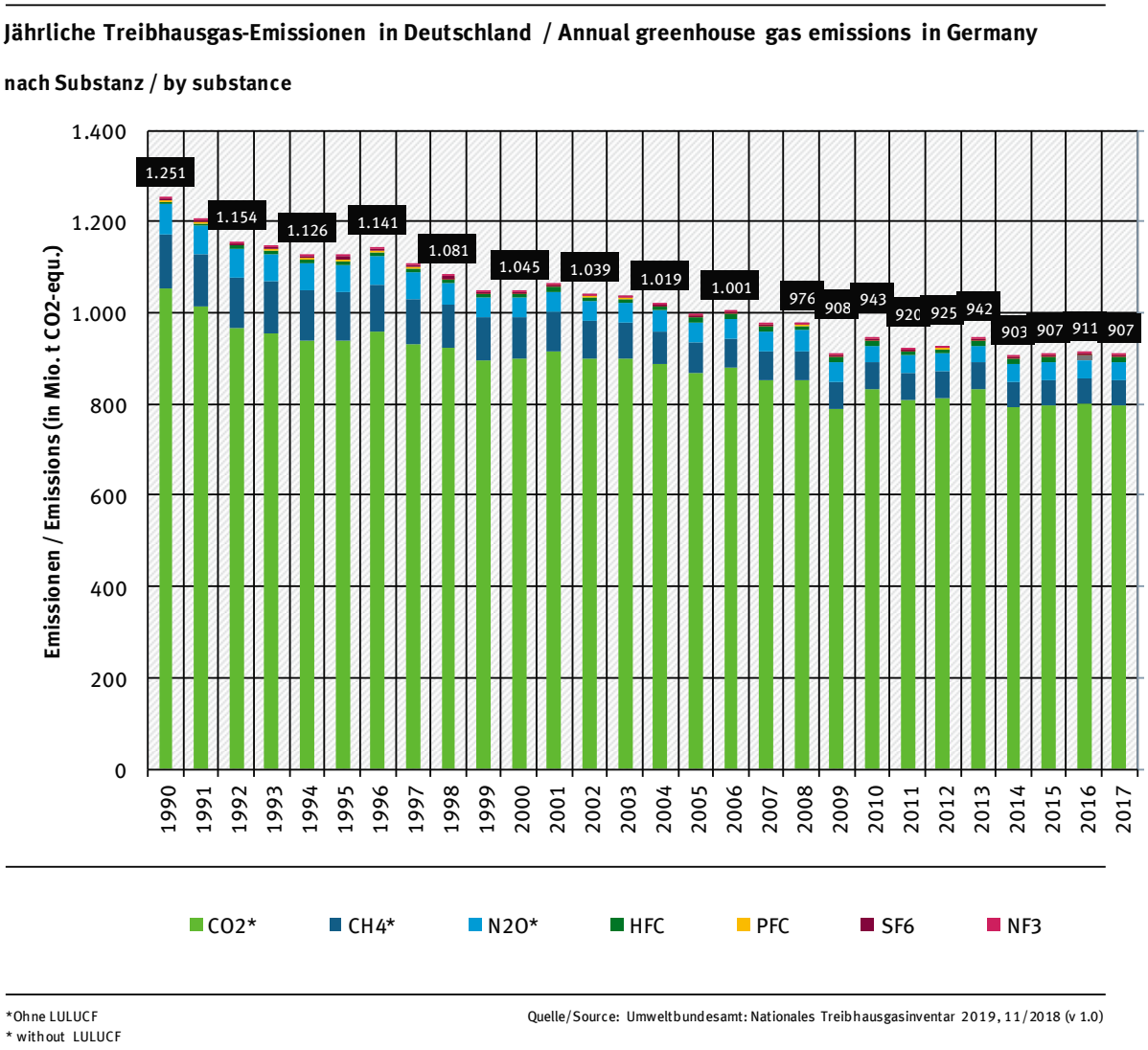
[10] https://unfccc.int/sites/default/files/resource/deu-2019-crf-12apr19.zip

[11] Revised UNFCCC guidelines: http://unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf#page=2

[12] The above figures do not take account of emissions from the land use, land use change and forestry (LULUCF) category.

markedly since 1990 – by 32,5 % – but their contribution to overall emissions, at approximately 0.001 %, is extremely small[13].

Figure 1: Emission trends in Germany since 1990 by greenhouse gas



Source: Federal Environment Agency: 2019 National Greenhouse Gas Inventory.

The distribution of greenhouse gas emissions in Germany is typical of a highly developed, industrialised country. In 2017, release of carbon dioxide was once again the main contributor to greenhouse gas emissions, accounting for 88.0 %. Most of them came from stationary and mobile combustion of fossil fuels. The relative share of CO_2 emissions in total greenhouse gas emissions has risen by about 3.9 percentage points since the base year, due to the disproportionate reduction in emissions of other greenhouse gases. Methane (CH_4) emissions, most of which are caused by livestock raising, fuel distribution and landfills, accounted for a 6.1 % share. Most emissions of nitrous oxide (N_2O) came from agriculture, industrial processes

[13] Due to confidentiality reasons and the use of "unspecified mix" categories in table 1(d)s3 the changes from the base year (1990) differ from the numbers in table 1(d)s3. The changes mentioned here are the correct changes from the base year.

and the combustion of fossil fuels, contributing 4.2 % to greenhouse gas emissions. Fluorinated greenhouse gases (known as F-gases) contributed about 1.7 % to total emissions.

1.2.1 Trends for aggregate greenhouse gas emissions between 1990 and 2017

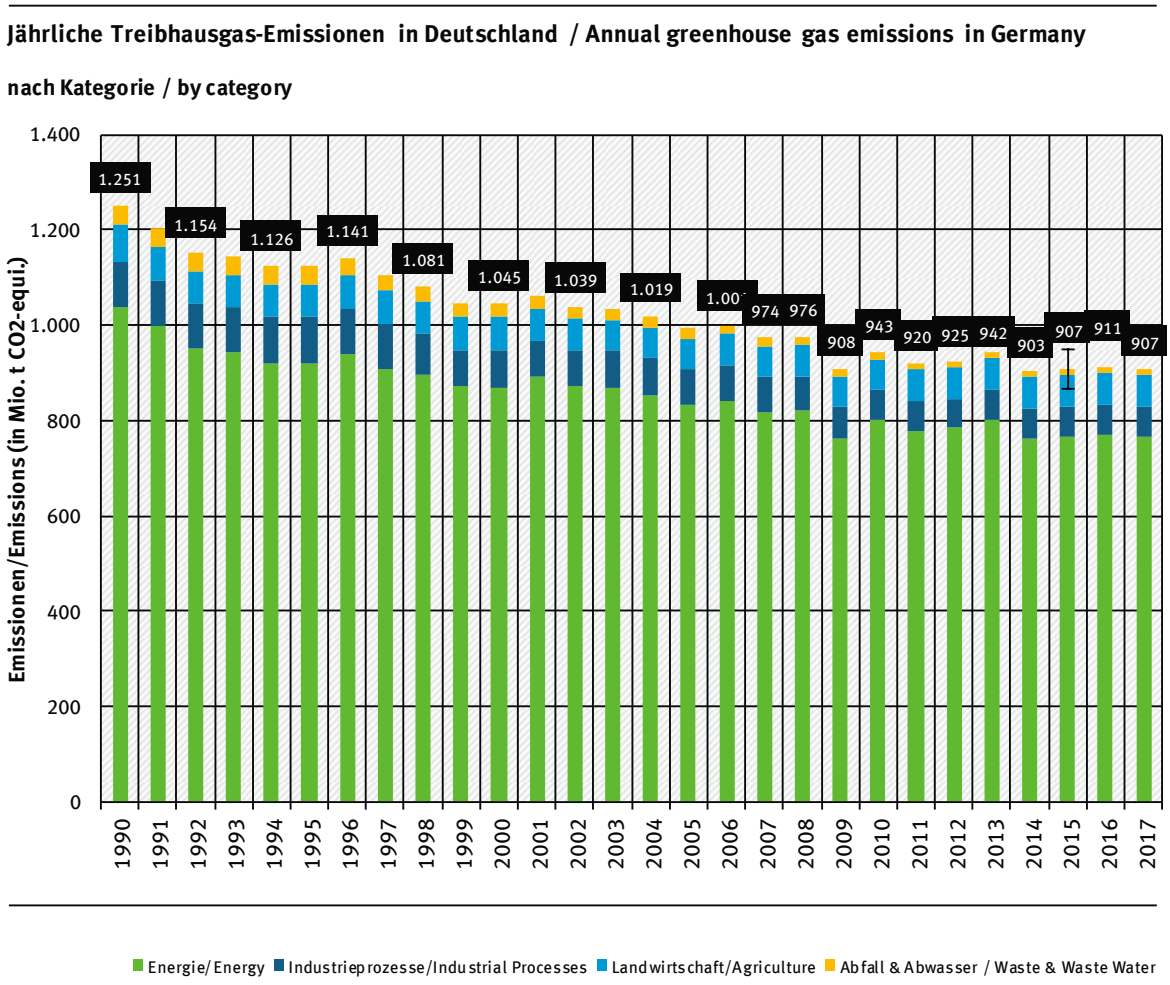
There was a marked 27.5 % reduction in greenhouse gas emissions between 1990 and 2017. The individual greenhouse gases contributed to the change in different ways (see Figure 2).

Emissions of the direct greenhouse gases that dominate in terms of quantity, primarily methane, were reduced considerably. The main reasons for this are as follows:

- Change from the use of solid fuels to lower-emission liquid and gaseous fuels since 1990
- Increased use of renewable energy sources and the associated substitution for fossil fuels
- More efficient plants and facilities
- Changes in livestock raising conditions and reduction in livestock populations
- Compliance with statutory provisions on waste management

Figure 2 shows the contribution of the individual groups of sources and sinks to total greenhouse gas emissions. It clearly illustrates the absolute dominance of energy-related emissions and the fact that the relative contributions of the individual groups of sources and sinks remain largely constant. Over time, energy-related emissions have steadily decreased. The majority of deviations from the trend are temperature-related. Differences in temperature trends – especially in winter – influence heating behaviour and thus the energy consumed to produce space heating. This has a major impact on the annual trend in energy-related GHG emissions.

Figure 2: Emission trends in Germany since 1990, by category

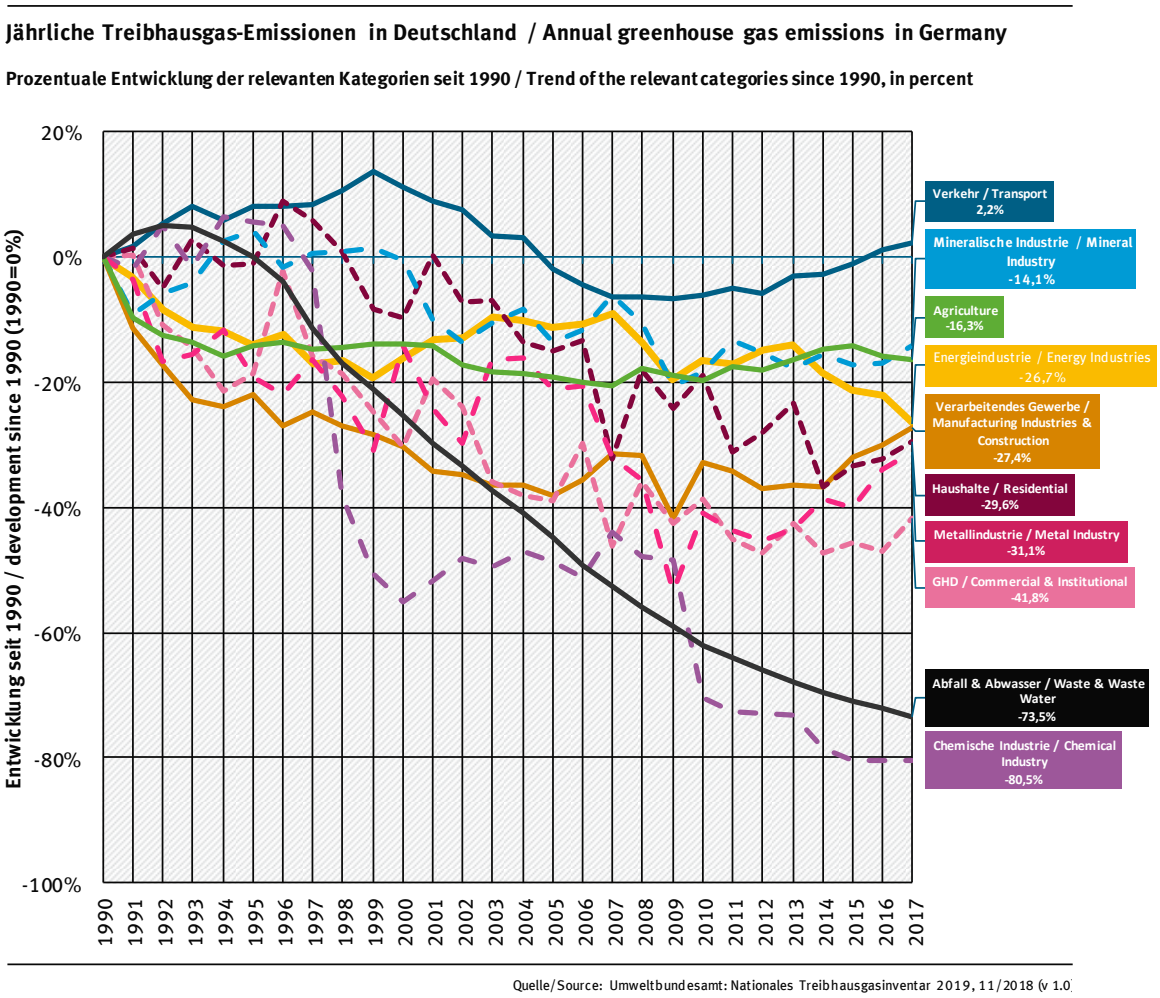


Ohne LULUCF
Without LULUCF
Fehlerindikator 2015: +/- 2 Standardabweichungen

Quelle/Source: Umweltbundesamt: Nationales Treibhausgasinventar 2019, 11/2018 (v 1.0)

The above figures do not take account of emissions from the land use, land-use change and forestry (LULUCF) category.
Source: Federal Environment Agency: 2019 National Greenhouse Gas Inventory.

Figure 3: Relative trends in greenhouse gas emissions since 1990 by category



Source: Federal Environment Agency: 2019 National Greenhouse Gas Inventory.

Figure 3 shows the relative trends in greenhouse gas emissions for the different categories since 1990. The most marked reduction here was in emissions in the waste management sector, where regulations introduced to increase recycling of reusable materials (packaging legislation) and composting (legislation on organic waste) have resulted in a steep decline in the amount of waste being landfilled and therefore in a steady reduction in landfill emissions. As far as emissions from industrial processes are concerned, emission-reduction measures – especially in the area of adipic acid production from 1997 to 2009 – had a major impact. Emissions from solvent and product use fell significantly as a result of N_2O being used less frequently as an anaesthetic. Trends in emissions from agriculture essentially reflect the trends in livestock populations.

1.2.2 Emissions trends by greenhouse gas

The individual greenhouse gases contributed to the trends in greenhouse gas emissions to differing degrees. The reasons for that will be explained in greater detail in the discussion of trends below. The global economic crisis, which began to impact on Germany at the end of 2008, had a major influence on emissions; some of the annual variations between 2008-2017 were caused by economic fluctuations in specific sectors.

The release of carbon dioxide – the vast majority of which was caused by stationary and mobile combustion processes – dominates the overall picture regarding aggregate greenhouse gas emissions. Due to the above-average decrease in emissions of the other greenhouse gases, CO_2's share in overall greenhouse gas emissions has risen since 1990. All other greenhouse gases together are responsible for only about one tenth of total greenhouse gas emissions.

1.2.2.1 Carbon dioxide (CO_2)

The reduction in CO_2 emissions is closely linked to trends in the energy sector. The sharp emissions reduction in this area seen in the early 1990s was primarily the result of restructuring in the new German Länder (former East Germany), including switching to cleaner fuels and decommissioning obsolete facilities. The changes in the fuel mix have continued, to a somewhat lesser degree, up to the current report year.

Use of gases, primarily natural gas, as substitutes for solid and liquid fuels is also reflected in emissions trends for stationary combustion systems. While CO_2 emissions from liquid fuels decreased by about 41 % from their 1990 levels, and emissions from solid fuels by as much as about 47 %, emissions from gaseous fuels increased by roughly 51 %.

When these emissions trends are viewed at the level of individual categories, a highly consistent picture emerges. In comparison to 1990 levels, CO_2 emissions in all sub-categories of energy-related emissions decreased by a total of nearly 239 million tonnes.

Trends in the transport sector, which is dominated by road transport, are somewhat different: CO_2 emissions in this sector increased to over 184 million tonnes in1999, then fell slightly as a result of lower consumption, consumers purchasing fuel in other countries,[14] diesel being used instead of petrol,[15] and blending biodiesel. The steady rise in average engine power is one of the reasons for the fact that the trend has stagnated since about 2007; however, it began to rise once more when transport volumes and mileage increased again and the use of biofuels decreased from 2013 onwards. CO_2 emissions from the transport sector were approximately 166 million tonnes in 2017, which is once more higher than the 1990 baseline level of 162 million tonnes.

CO_2 emissions were slightly lower than the previous year with reductions in the energy industry being partially offset by increases in emissions from the manufacturing industry and higher heating demand in the household sector.

1.2.2.2 Nitrous oxide (N_2O)

Since 1990, N_2O emissions have decreased by about 41 %. Most emissions of nitrous oxide (N_2O) came from agriculture and the combustion of fossil fuels, contributing 4.2 % to greenhouse gas emissions. Smaller amounts of emissions are caused by wastewater treatment, the chemical industry and the use of N_2O in products (for example as an anaesthetic). Industry has had the greatest influence on emissions reductions, especially in the area of adipic acid production as a consequence of abatement systems being fitted in 1997 and 2009. As a result of technological reduction measures, emissions from the chemical industry have been cut by about 97 % with respect to 1990. Since 1999, emissions trends have been strongly influenced by economic trends in the chemical industry.

Total emissions decreased slightly compared with the Third Biennial Report, mainly as a result of a decline in emissions from agriculture.

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[14] Emissions were calculated on the basis of domestic fuel sales. The volume of fuel obtained outside Germany is therefore not reflected in the German emission inventory.

[15] Diesel fuel's share in total fuel consumption for road transport increased sharply throughout the entire period in question. Whereas in1990 nearly two-thirds of all road traffic emissions were still being caused by petrol consumption, the ratio is now virtually the opposite.

1.2.2.3 Methane (CH_4)

Methane emissions are caused mainly by livestock husbandry, landfilling waste and the distribution of liquid and gaseous fuels. On the other hand, energy-related and process-related emissions are almost negligible. Methane emissions have been cut by over 54.3 % since 1990. This key driver of this trend has been the decline in the amount of organic waste sent to landfill; this has been banned since 1 June 2005. Other environmental policy measures (waste separation with intensified recycling and increasing energy recovery from waste) are also responsible for this trend. A second important factor is that energy recovery from coal mine gas has increased, while overall production of such gas has decreased (due to the closure of coal mines). Emissions in this area have fallen by nearly 78 % since 1990. Yet another reason for the emissions reductions is that livestock populations in the former East Germany have been reduced, with reductions occurring especially in the first half of the 1990s. Repairs and modernisation of outdated gas distribution networks in that part of Germany, along with improvements in fuel distribution, have brought about further reductions in total emissions.

1.2.2.4 Fluorinated gases

Emissions of **HFCs** rose, primarily as a result of their increased use as refrigerants in commercial and mobile refrigeration and air-conditioning systems and of increasing disposal of those systems. This more than offset emissions reductions resulting from their reduced use in PUR installation foams.

The emissions reductions for **PFCs** were achieved primarily through the efforts of primary aluminium producers and semiconductor manufacturers.

The **SF_6** emissions reduction up to 2003 is due primarily to use of the gas in automobile tyres being phased out since the mid-1990s. The EU-wide ban in force since 2007 and efforts to increase environmental awareness have been successful here, resulting in emissions reductions of over 100 tonnes and greenhouse gas reductions of 2.5 million tonnes of CO_2e. Similar success has been achieved with soundproof windows, for which production use of SF_6 has been reduced to zero. The majority of current and future emissions of SF_6 will result from open disposal of old windows. Emissions from electricity transmission facilities have also decreased considerably. Important emissions sources remaining include welding and production of glass fibre optics.

Since 2015, the only use of **NF_3** has been in the production of semiconductors. Since their relevance to overall greenhouse gas emissions is so minor, no separate trend analysis is provided here.

1.3 Description of the National System of Emissions Inventories

Germany's National System of Emissions Inventories under Article 5.1 of the Kyoto Protocol fulfils all UNFCCC, KP and EU requirements.[16] All reviews to date have reaffirmed this.

1.3.1 Institutional, legal and procedural aspects of the National System

The National System was essentially institutionalised on three levels in Germany. It was established at ministerial level with the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) as lead agency, based on an agreement between the undersecretaries of the participating ministries in 2007. The system now incorporates the Federal Ministry of Food and Agriculture (BMEL), Federal Ministry for Economic Affairs and Energy (BMWi), Federal Ministry of Transport and Digital Infrastructure (BMVI), Federal

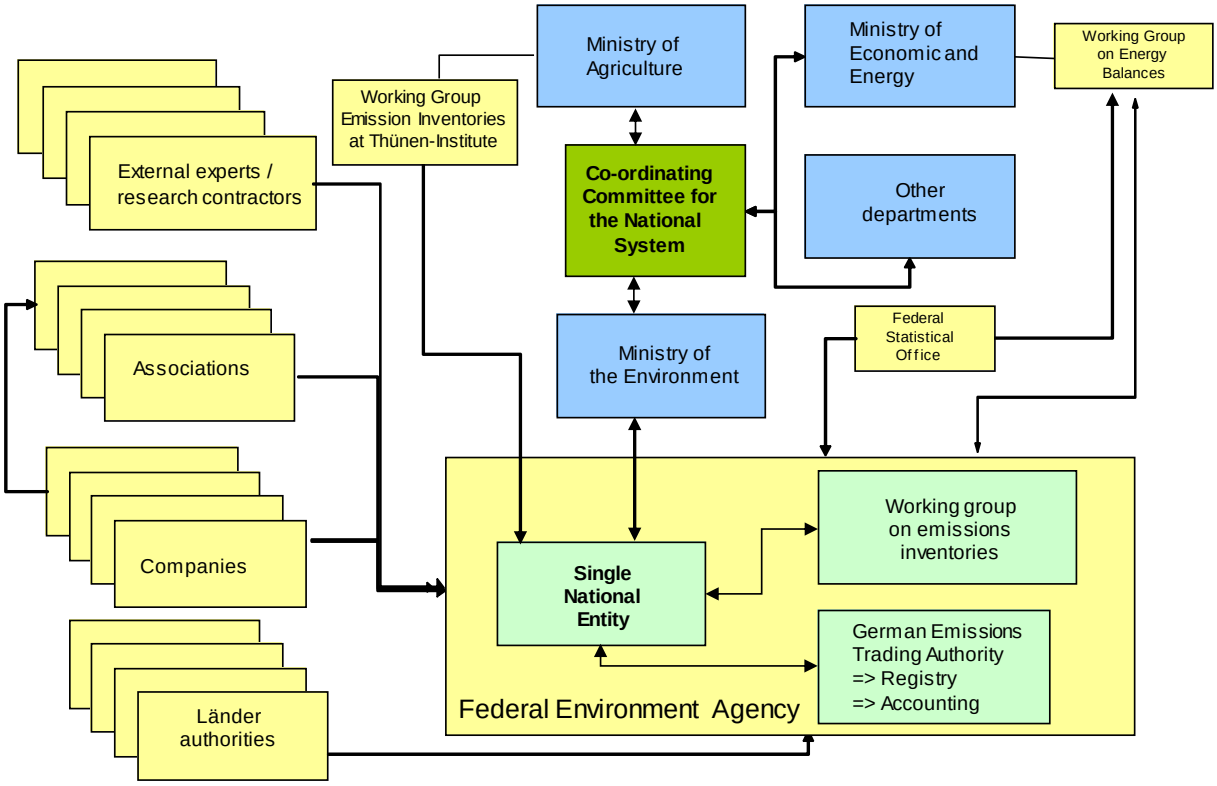
[16] Guidelines for National Systems under Article 5, paragraph 1, of the Kyoto Protocol. UNFCCC Decision 19/CMP.1; online at: http://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf#page=14 and Decision 24/CP.19: http://unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf#page=2 and Decision280/2004/EC.

Ministry of the Interior (BMI), Federal Ministry of Finance (BMF) and Federal Ministry of Defence (BMVg), so that all of the key institutions that are in a position to make high-quality specialised contributions are now involved.

Similarly in 2007, the tasks involved in serving as the Single National Entity for Germany were assigned to the German Environment Agency. The Single National Entity integrates other specialised units at the level of the German Environment Agency into the National System and coordinates the input of all the other institutions and organisations involved in emissions reporting.

The chart below provides an overview of the structure of the three levels of the National System of Emissions in Germany.

Figure 4: Information on changes to the National System



Source: Federal Environment Agency's own chart

Following the 2016 in-country review of the greenhouse gas inventory, the institutional consolidation of the National System to meet the requirements for the second Commitment Period of the Kyoto Protocol pursuant to the revised UNFCCC reporting guidelines and the 2006 IPCC Guidelines for National Greenhouse Gas Inventories can now be regarded as having been completed. The emphasis in this reporting period was thus on safeguarding existing data streams and on closing any occurring data gaps. More detailed information can be found in Chapter 13 of the 2019 National Inventory Report.

1.3.2 Information on quality management

The national system in Germany serves to ensure that preparation of the inventories conforms to the principles of transparency, consistency, comparability, completeness and accuracy. This is achieved through ongoing quality management and continuous inventory improvement, for example.

A Quality System for Emissions Inventories (QSE) creates the necessary framework for complying with good inventory practice and carrying out routine quality assurance both within and beyond the Federal Environment Agency. It was set up at the Federal Environment Agency in 2005 on the basis of an in-house directive (Hausanordnung 11/2005) and covers all the processes necessary for ongoing improvements to the quality of the Greenhouse Gas Inventories. This includes defining responsibilities and quality targets relating to choice of method, data collection, calculation of emissions, determining uncertainties and recording the quality tests carried out and their results (confirming that targets have been achieved and, if they were not achieved, listing proposed measures for remedying that in the future). A database ensures ongoing quality improvement within the Quality System for Emissions Inventories (QSE). It contains all the tabular documents on national quality control (QC)/quality assurance (QA) (QC/QA plan, checklists, lists detailing responsibilities etc.).

Since 2008, further government agencies, institutions and inventory experts have been incorporated into the quality management system and minimum requirements of data documentation, quality control/quality assurance and archiving have been specified so that the Quality System for Emissions has been extended to cover the entire national system. The procedure makes it possible for other organisations to develop their own quality assurance systems that are tailored to their specific needs and to build on their existing structures.

Chapters 1.3 and 1.6 of the 2019 National Inventory Report have more detailed information on the quality assurance and control system in Germany.

2 Description of the quantified economy-wide emissions target for greenhouse gases

2.1 National targets

Germany is pursuing ambitious climate change mitigation goals.

The German government established its goal of achieving extensive greenhouse gas neutrality by 2050 in its Climate Action Plan 2050. To this end, it plans to gradually reduce greenhouse gas emissions: by at least 55 % by 2030 and by at least 70 % by 2040 compared with 1990. The Climate Action Plan 2050 broke down the emissions reduction target for 2030 into specific sector targets for the energy industry, buildings, transport, industry and agriculture.

The German government has committed to a short-term target of reducing greenhouse gas emissions by 40 % by 2020 compared with 1990. It is not likely that the target will be achieved by this deadline. Nevertheless, with its 2030 programme of measures, the government intends to get back on course to reduce greenhouse gas emissions and to achieve its reduction targets for 2030 on time.

Under the Effort Sharing agreements (Effort Sharing Decision and Effort Sharing Regulation) designed to achieve the EU reduction targets (see below), Germany is to reduce the greenhouse gas emissions that are not regulated by the emissions trading scheme by 14 % by 2020 and by 38 % by 2030 (compared with 2005). In the case of emissions that are subject to the European Emissions Trading System, a European cap on emissions allowances is applicable.

The official National Inventory data is used to measure progress towards achieving the national greenhouse gas (GHG) reduction targets. The national targets thus apply to emissions of all the greenhouse gases covered by the Kyoto Protocol. They apply to domestic emissions in all sectors and do not take into consideration credits from land use, land-use change and forestry (LULUCF) nor credits from what are known as flexible mechanisms such as the Clean Development Mechanism (CDM) and Joint Implementation (JI).

2.2 European target

In 2010, the European Union made the commitment to reduce its greenhouse gas emissions by 20 % from 1990 levels by 2020.

The 28 EU Member States agreed to this target as a common goal under the UN Framework Convention on Climate Change.

Table 1: Description of the European Union's quantified emission reduction target

Parameter	Description
Base year	1990
Target year	2020
Emissions reduction target	-20 %
Target includes these greenhouse gases	CO_2, CH_4, N_2O, HFCs, SF_6
GWP (global warming potential)	AR4

Parameter	Description
Sectors	All sources and sectors as defined by IPCC (Intergovernmental Panel on Climate Change); international aviation partially included.
LULUCF	Not included
Counting flexible mechanisms	Possible under certain conditions under the ESD and in the ETS (Emissions Trading System)

With the adoption of the 2020 climate and energy package in April 2009,[17] the EU approved a series of measures to implement this target agreement. The Renewable Energy Directive, new agreements on EU emissions trading, and the Effort Sharing Decision are intended to ensure that the agreed reduction target is met. The overall target of a 20 % reduction from 1990 levels corresponds to a 14 % reduction from 2005 levels. Two thirds of the 14 % reduction are accounted for by the sector covered by the Emissions Trading System and one third by the sector not covered by the system.[18]

All EU Member States and the non-Member States Norway, Iceland and Liechtenstein, which also participate in the EU Emission Trading System, agreed to a common emissions cap under the amended Emissions Trading Directive.[19] This means there are no longer any specific national caps. However, the annual caps specified for allocations for the 2013-2020 period are being reduced by 1.74 % annually, based on the average level of allocations by the Member States over the previous second phase (2008-2012). The annual emission caps can be viewed as intermediate targets. The EU's Biennial Report contains additional information on the EU Emissions Trading System (ETS).

Emissions outside of the ETS are governed by the Effort Sharing Decision.[20] Emissions from international maritime traffic, national and international aviation (covered by emissions trading within the EEA since 1 January 2012) and from land use, land-use change and forestry (LULUCF) are exempt. Many smaller emissions sources in different sectors are covered: transport (cars and heavy goods vehicles), households, services, small industrial installations, fugitive emissions in the energy sector, F-gas emissions from appliances and other sources, agriculture and waste. These emissions account for some 60 % of total greenhouse gas emissions in the EU.

While the reduction target within the EU Emissions Trading System is to be jointly fulfilled, the reduction target for areas not covered by the ETS is divided into national targets for each Member State. The Effort Sharing Decision initially specified a percentage reduction target for the 2005 to 2020 period. That reduction target was then translated into binding annual emission budgets[21] for the 2013-2020 period.[22] Accordingly, Germany must reduce its emissions in the areas not covered by the ETS by 14 % from 2005 levels by 2020 pursuant to the Effort Sharing

[17] Including Decision 406/2009/EC, Decision 2009/29/EC and Decision 406/2009/EC

[18] Directive 2009/29/EC

[19] Directive 2009/29/EC of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community

[20] Decision No 406/2009/EC

[21] Annual emission allocations (AEAs)

[22] Commission decision of 26 March 2013 on determining Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council (2013/162/EU) and Commission Implementing Decision of 31 October 2013 on the adjustments to Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/ EC of the European Parliament and of the Council (2013/634/EU).

Decision. The annual emission budget was 472 Mt CO_2e for 2013 and will be reduced to 425 million tonnes by 2020.

A uniform monitoring and review process for those agreements is specified for all EU Member States in the Monitoring Mechanism Regulation.[23]

The ETS and ESD allow for the use of flexible mechanisms. Article 11a (8) of the amended Emissions Trading Directive 2009/29/EC specifies that credits may not exceed 50 % of the Community-wide reductions below the 2005 levels over the period from 2008 to 2020. That value is further restricted by limits for individual installations specified in Commission Regulation No 1123/2013 on international credit entitlements.[24]

Under certain circumstances, credits from project-based mechanisms can also be used for emissions not covered by the ETS, as specified in Article 5 of the ESD. The annual cap for each Member State is 3 % of the emissions in 2005. Unused credits may be banked forward or transferred to other Member States up to 2020.

[23] Monitoring Mechanism Regulation (MMR): Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC.

[24] Commission Regulation (EU), RICE, Commission Regulation on International Credit Entitlements: No 1123/2013 of 8 November 2013 on determining international credit entitlements pursuant to Directive 2003/87/EC of the European Parliament and of the Council.

3 Progress towards meeting the national emissions reduction target

3.1 Reduction measures and their effect

The most important strategies and measures under German climate policy include the Climate Action Programme 2020, which was adopted in December 2014, and the Climate Action Plan 2050, which was approved in 2016.[25] Both the Climate Action Programme and the Climate Action Plan are described at length in the Seventh National Communication. They contain information on the most important climate action measures.

In this section, we present selected measures that entered into force or were amended during the 2016-2017 reporting period. CTF Table 3 in the annex provides information on the reduction contributions made by key climate action measures. The measures listed are an integral part of the with-measures scenario in the Projections Report,[26] in which the reported effects of measures on greenhouse gases are also determined. The German government has developed a programme of measures intended to guarantee achievement of the 2030 targets that were agreed in the Climate Action Plan 2050.

3.1.1 Cross-sectoral strategies and measures

The 2019 Projections Report updated the calculated reduction effect of the 1999 environmental tax reform; the new value is recorded in CTF Table 3 under PaM 1.

3.1.1.1 EU Emissions Trading System (PaM 2)

The amendments to the Emissions Trading Directive for the phase 2021-2030 entered into force on 8 April 2018. The amended directive contains important new provisions to strengthen the EU Emissions Trading System and its pricing signal. The overall number of auctioned and freely allocated emissions allowances will decrease by 2.2 % per annum from 2021 (compared with the 2010 reference value). Under the market stability reserve (MSR), 24 % instead of 12 % of surplus allowances will be withdrawn from the market each year. From 2023 onwards, the maximum size of the market stability reserve will be limited to the number of allowances auctioned the previous year. Surplus allowances over and above that will be cancelled. Member States also have the option of reducing the number of allowances if additional national climate action measures lead to fossil fuel power plants being decommissioned.

Reduction effect

The complex interactions at European level make it impossible for us to carry out our own calculation of the price for emission allowances (CO_2 price) using an endogenous model. For that reason, the CO_2 price modelled for the different sectors is specified as an exogenous parameter. According to calculations in the Projections Report, emissions trading in 2020 will reduce greenhouse gas emissions by 5.6 Mt CO_2e more than under a without-measures scenario that does not include emissions trading; in 2030 that figure will be 10 Mt (see PaM 2a and 2b (policy and measure) in CTF Table 3).

[25] English version available online at: http://www.bmub.bund.de/fileadmin/Daten_BMU/Pools/Broschueren/klimaschutzplan_2050_en_bf.pdf .

[26] http://cdr.eionet.europa.eu/de/eu/mmr/art04-13-14_lcds_pams_projections/projections/envwqc4_g/170426_PB_2017_-_final.pdf .

3.1.2 Sectoral strategies and measures

3.1.2.1 Energy industry

3.1.2.1.1 Renewable Energy Sources Act (EEG) (PaM 3)

Since the decisions on the energy transition were taken, the Act has undergone constant development and been adapted to the new requirements and framework for the expansion of renewable energy sources. The amendment to the Act, which entered into force in 2017, defined expansion paths for the most important renewable energy sources. Most of them are to be achieved by tendering procedures for funding. The expansion path for onshore wind, which also corresponds to the tendering volume, is 2,900 MW p.a. in 2020 and beyond (gross). The installed capacity of offshore wind turbines is scheduled to rise to 15,000 MW in 2030. The planned annual gross increase in solar systems will remain at 2,500 MW. The annual gross increase in biomass systems, which also corresponds to the tendering volume, will be 200 MW from 2020 to 2022. A detailed study of the expansion of renewable energy sources is contained in the Renewable Energy Progress Report[27] and the annual national monitoring report on the energy transition.[28]

Reduction effect

The installed capacity expected for 2020 is calculated on the basis of historical increase figures and the tendering procedures still outstanding. Installed capacity is calculated on the basis of the above-mentioned gross capacity in the following reference years. The aim is that, under the with-measures scenario (WMS), renewable energy will account for between roughly 40 and 45 % of gross electricity consumption in 2025 and between 55 and 60 % in 2035. The target of a 65 % share for renewable energy in 2030, which was part of the coalition agreement, is not achieved under the WMS because its legal implementation would require an amendment to the Renewable Energy Sources Act. For the same reason, the special tendering procedures for 2020 under the WMS, which were included in the coalition agreement, have not been taken into account. The German government's 2019 Projections Report showed a greenhouse gas reduction effect for the Renewable Energy Sources Act of 113 Mt CO_2e in 2020 and 148 Mt CO_2e in 2030 (see CTF Table 3, PaM 3).

3.1.2.1.2 Funding for combined heat and power generation (PaM 4)

The Combined Heat and Power Act was last amended in July 2017. In recent years, funding for combined heat and power generation (CHP) as a contribution to achieving national climate goals focused on highly efficient plants commissioned by 31 December 2022. Natural-gas CHP plants that replace a coal-fired plant receive a bonus. Furthermore, tendering procedures for funding support for innovative CHP systems (e.g. solar thermal plants or heat pumps) have been issued for the first time through the "innovation pilot." The CHP expansion target has been adjusted: of the annual net electricity generation, a minimum of 110 TWh is to be generated by CHP plants by 2020 and 120 TWh by 2025. In addition to the CHP Act, promotion of micro-CHP also makes a contribution to achieving the goal of expanding CHP.

Reduction effect

The list of CHP plants detailing the increase in capacity is to be reviewed for the 2019 Projections Report's WMS and updated to include new projects. The WMS assumes the current version of the CHP Act (no funding for new plants commissioned after 2022). This enables 1 Mt

[27] The EU Commission publishes an online English version of the progress reports of each EU Member State: http://ec.europa.eu/energy/en/topics/renewable-energy/progress-reports .

[28] Federal Ministry for Economic Affairs and Energy (2019): Second Monitoring Report on Energy of the Future, https://www.bmwi.de/Redaktion/DE/Publikationen/Energie/fortschrittsbericht-monitoring-energiewende.pdf?__blob=publicationFile&v=26

CO_2e to be avoided in 2020 and 2 Mt in 2030. By contrast, current legislation includes funding for new installations that are commissioned up to 2025. Funding beyond that time is the subject of current deliberations. A greater reduction effect can therefore be assumed.

3.1.2.1.3 Placing lignite-fired power plants on standby for reserve capacity only (PaM 5)

There were no changes to this measure during the reporting period; it was described on p. 28 of the Third Biennial Report.

Reduction effect

The early decommissioning of lignite-fired power plants reduces CO_2 emissions by 11.8 to 15 Mt CO_2e in 2020 (see CTF Table 3, PaM 5).

3.1.2.2 Energy: electricity consumption in private households

3.1.2.2.1 EU Ecodesign Directive (PaM 6)

The Ecodesign Directive 2009/125/EC (formerly Directive 2005/32/EC) is the legal framework that specifies minimum efficiency standards for energy-related products in the European single market. Directive 2009/125/EC was transposed into German law by the 25 November 2011 version of the Energy-Related Products Act. For further details, please refer to the description of the Ecodesign Directive in the Sixth National Communication.

Reduction effect

The Ecodesign Directive has the greatest effect on electricity consumption in private households, the trade, commerce and services sector, and industry. The corresponding emission reductions are accounted for in the energy sector. The 2019 Projections Report puts the emission reduction resulting directly from this measure at 0.1 Mt CO_2e both in 2020 and in 2030 (see CTF Table 3, PaM 6).

3.1.2.2.2 Energy Labelling Regulation (PaM 7)

Regulation (EU) 2017/1369 setting a framework for energy labelling and repealing Energy Labelling Directive 2010/30/EU entered into force on 1 August 2017. This EU framework regulation is directly applicable in each EU Member State and, unlike directives, does not have to be transposed into national law. The existing regulations on the different product groups take the form of the individual pieces of delegated legislation regulating the labelling requirements. They will remain in force for the time being, but will gradually be replaced by specific regulations for each product group. In particular, there will be a return to the A-G label (plus signs such as A+++ will no longer be allowed), a reassessment of the energy efficiency classes (rescaling) for these product groups and the establishment of a product database.

Reduction effect

The with-measures scenario includes all appliance groups for which labelling is mandatory under this regulation as of 31 August 2018. Quantification is done in the sector to which the product group is allocated. Currently, most of the delegated regulations apply to the household sector. The measure reduces electricity consumption and thus results in emission reductions in the energy sector. The emission reduction effect for this measure is therefore not reported separately in the policy scenarios.

3.1.2.3 Energy: Consumption in industry and the trade, commerce and services sector – electricity and process heat/steam

In addition to the measures outlined below, the EU Ecodesign Directive, with its minimum efficiency standards for various product groups, makes a substantial contribution to improving energy efficiency and hence to the avoidance of greenhouse gas emissions in industry and trade (PaM 6).

Other PaMs with a reduction effect reported in CTF Table 3 that remain unchanged are:

- Electricity tax capping conditional on energy efficiency targets being met (see p. 87 of the Seventh National Communication, PaM 8 in the current CTF Table)
- Energy efficiency networks (see pp. 88 f. of the Seventh National Communication, PaM 11)

3.1.2.3.1 Energy audits for SMEs (PaM 9)

Under a programme run by the Federal Ministry of Economic Affairs and Energy, small and medium-sized enterprises are offered financial support to obtain qualified energy advice. Qualified energy consultants identify potential for energy conservation and prepare specific proposals on measures to be taken for the individual company. These proposals can be used to develop action plans for using waste heat, for example. The funding guideline meets the EU requirements for energy audits as set out in its Energy Efficiency Directive (2012/27/EU). The programme is administered by the Federal Office for Economic Affairs and Export Control (BAFA). The pool of eligible energy consultants was expanded in December 2017. The funding can now be applied for by all trades businesses, heating inspectors and energy providers such as public utilities that have the appropriate qualifications. The maximum funding is EUR 6,000 per action plan.

Reduction effect

In 2020, a total of 1.7 Mt of CO_2e will be avoided as a result of energy advice to SMEs. The reduction in 2030 is estimated at 0.7 Mt CO_2e.

3.1.2.3.2 Energy audits for enterprises that are not SMEs (PaM 10)

The obligation resulting from Article 8 (4-7) of the EU Energy Efficiency Directive (2012/27/EU (EED)) to carry out energy audits for enterprises that are not SMEs is under consideration here. The energy audits in the companies in question are to be carried out by qualified and accredited experts. The directive requires the first energy audit to have been carried out by 5 December 2015 at the latest. To implement this requirement, the Energy Services Act was amended accordingly with effect from 22 April 2015. Under this amendment, large companies (enterprises that are not SMEs as defined by the European Commission (<250 employees, turnover < EUR 50 million, or annual balance sheet total <EUR 43 million)) are obliged to have carried out an energy audit in accordance with DIN EN 16247-1 by 5 December 2015 and to carry out further audits at maximum intervals of four years. Companies that have an energy management system certified under DIN EN ISO 50001 or an EMAS environmental management system are exempted from the obligation to carry out energy audits.

Reduction effect

The measure avoids 1.4 Mt CO_2e in 2020 and 2.0 Mt CO_2e in 2030 in the form of direct emissions of greenhouse gases from large companies.

3.1.2.3.3 Funding guideline for promoting the prevention and utilisation of waste heat (PaM 12)

This guideline, which is an element of the Waste Heat Prevention Campaign, entered into force in 2016. The guideline which was amended on 25 August 2017, covers financial support for measures to avoid or use industrial waste heat. The funding takes the form of an investment grant or repayment grant for up to 40 % of the eligible costs. The programme will fund capital investments in different kinds of technology to encourage modernisation or expansion of existing plants and build new plants if that avoids the production of waste heat or makes it possible to utilise previously unused waste heat more efficiently. This includes internal and external capital investments as well as measures to use waste heat to generate electricity. It is assumed that the annual funding will rise to EUR 100 million per annum by 2020.

Reduction effect

As a result of fuel savings, this measure avoids 2.1 Mt CO_2e in 2020 and 3.8 Mt CO_2e in 2030.

3.1.2.4 Industrial processes and use of products (fluorinated greenhouse gases)

The following measures continue to apply without change. Their greenhouse gas reduction effect has been updated:

- MAC Directive 2006/40/EC (PaM 14)
- Including PFC emissions from primary aluminium production in the EU Emissions Trading System (PaM 15)

3.1.2.4.1 Transposition of EU Regulation 517/2014 on fluorinated greenhouse gases (PaM 16)

The measure continues to apply as described in the Seventh National Communication (see p. 99) and in the Third Biennial Report (see p. 30).

The policy scenarios calculated an overall greenhouse gas reduction effect for this measure of 3.3 Mt CO_2e in 2020 and 9.3 Mt CO_2e in 2030 (see CTF Table 3, PaM 16a and b).

3.1.2.5 Transport

In addition to the measures set out below, the German government uses budget funds to promote public transport, rail infrastructure and electric mobility. The funding programmes are described in detail in the Seventh National Communication.

3.1.2.5.1 HGV toll (PaM 17)

Directive 2013/22/EU, last amended by Directive 2013/22/EU, sets the framework for charging heavy goods vehicles to use roads in the Member States. A toll has been charged for heavy goods vehicles with a maximum permissible gross laden weight greater than 12 tonnes using the Autobahn motorway system in Germany since 2005. In 2012 and 2015, the HGV toll was gradually extended to some federal highways (a total of approximately 2,300 km). In October 2015, it was also extended to apply to HGVs with a maximum permissible gross laden weight of 7.5 tonnes or more. The Fourth Act Amending the Federal Trunk Road Toll Act of 27 March 2017 (Federal Law Gazette I, p. 564), which regulates the extension of the HGV toll to all federal highways as of 1 July 2018, entered into force on 31 March 2017. On 15 May 2018, the federal cabinet also adopted a draft act which provides for the toll charges to be adjusted as of 1 January 2019 in line with the latest report on transport infrastructure costs. As a result, the toll charges for HGVs, which were last changed in January 2015, will be adjusted. For most vehicles, this will mean an increase in the toll charges; under the draft act, electric HGVs are exempt from tolls.

There is no change to the fact that the tolls do not apply to long-distance buses and HGVs with a maximum permissible gross laden weight <7.5 tonnes.

Reduction effect

The 2019 Projections Report calculated the direct emission reductions as being 0.7 Mt CO_2e in 2020 and 0.8 Mt CO_2e in 2030 (see CTF Table 3, PaM 17).

3.1.2.5.2 Adjustment of GHG quota (PaM 18)

Two pieces of secondary legislation under the Act on the Prevention of Harmful Effects on the Environment Caused by Air Pollution, Noise, Vibration and Similar Phenomena – Regulation on counting electricity-based fuels and processed biogenic oils towards greenhouse gas targets (37th BIMSchV.) and the Regulation to establish further provisions for reducing vehicle-fuel-related greenhouse gases (38th BIMSchV.) – and the Regulation on Crediting Reductions in Upstream Emissions brought the regulations on GHG reduction quotas into line with EU law dating from 2015. In particular, this includes the following changes:

- Electricity-based fuels (hydrogen and methane) that are produced entirely using non-biogenic renewable electricity can be credited to the GHG reduction quota.
- Renewable electricity used in electric-drive road vehicles can be credited to the GHG reduction quota on the basis of the average GHG emissions in the electricity mix in Germany. The Federal Environment Agency publishes the value for the electricity mix annually in the Federal Gazette (Bundesanzeiger).
- To avoid indirect changes in land use, the share of conventional biofuels in road transport is capped at 5 % (based on energy content). Conventional biofuels above that cap are treated as fossil fuels.
- For advanced fuels (i.e. fuels from renewable electricity or from certain waste materials or residues or lignocellulose) a sub-target will be introduced, starting in 2020 and rising to a 0.5-% share in road transport's final energy demand from 2025 onwards.
- The baseline value, which is crucial for calculating the necessary greenhouse gas reduction was increased in line with EU requirements from 83.3 to 94.1 kg CO_2e per gigajoule.

The policy scenarios did not determine a reduction effect for this measure.

3.1.2.5.3 Funding for of electric mobility (PaM 19)

Various measures put in place by the German government to promote electric mobility are described in the Seventh National Communication (see pp. 96 f.) and in the Third Biennial Report (see pp. 30 f.). They are unchanged.

Reduction effect

The 2019 Projections Report calculated a GHG reduction of 0.3 Mt CO_2e for 2020 and 0.1 Mt CO_2e in 2030 for various measures promoting electric mobility.

3.1.2.5.4 Strengthening public transport (PaM 20)

The Länder and local authorities are responsible for planning, design, organisation and financing of public transport. Nevertheless, the federal government provides the Länder and local authorities with financial support for this task. The federal government provides over half the public funding for public transport from regionalisation funds, from funds from the

Decentralisation Act and from the Local Authority Transport Infrastructure Financing Act programme. Based on the agreement by the government and the Länder to increase regionalisation funds to EUR 8.2 billion in 2016 and to raise the rate at which funding will increase each year to 1.8 % up to and including 2031, the federal government will have provided by 2031 a total of EUR 15.6 billion more than was previously available. The Local Authority Transport Infrastructure Financing Act programme will continue beyond 2019. The coalition agreement contains a priority measure which provides for these funds to be increased to EUR 1 billion by 2021. To implement this, both Article 125c of the Basic Law and the Local Authority Transport Infrastructure Financing Act will need to be amended. The draft for the necessary amendment to the Basic Law (Article 125c) was adopted by the federal cabinet on 2 May 2018 and is now progressing through the parliamentary procedures. Under the Decentralisation Act, the Länder also receive annual compensation payments of about EUR 1.336 billion to improve transport conditions (public transport and also municipal roads) in the local authorities. The Länder decide how to use the funds, with the proviso that they must be invested. According to the transitional provision of Article 143c of the Basic Law, funding from the Decentralisation Act ceases on 31 December 2019. From 2020, the Länder will instead receive shares in the revenue from value added tax. Finally, the federal government also supports public transport through tax breaks (e.g. lower rates of value added tax) and through compensation (e.g. for the transport of severely disabled persons). Furthermore, a regulation was introduced in the Electricity Tax Act on 1 January 2018 under which electricity for electric vehicles used in public transport is subject to tax relief. The tax relief is 9.08 euros per megawatt hour of electricity on a normal tax rate of 20.50 euros per megawatt hour.

Reduction effect

The 2019 Projections Report estimates the greenhouse gases avoided by increasing public transport's share to be 0.1 Mt CO_2e for 2020 and 0.2 Mt CO_2e for 2030.

3.1.2.5.5 Strengthening cycle and pedestrian transport (PaM 21)

Currently, EUR 5 million a year are being spent on innovative, non-investment projects as part of the 2020 National Cycle Paths Plan. EUR 98 million are available each year to build and maintain cycle paths along federal highways and EUR 1.3 million for cycle paths along federal waterways. The Seventh Act Amending the Federal Trunk Roads Act of 27 June 2017 authorised the federal government to grant financial assistance up to 2030 to build cycle superhighways (delegating responsibility to the Länder, local authorities and local authority associations). Since 2017, EUR 25 million per year have been allocated for this in the budget. Investments in electric cargo bikes and trailers with electric drive support systems for cargo bikes are eligible for funding under BMU's small production guidelines, provided they have a minimum of 1 m^3 capacity and a payload of at least 150 kg. 30 % of the purchase costs are funded, up to a maximum of EUR 2,500. Private and municipal enterprises and local authorities (cities, towns, counties), universities, research institutions and hospitals are eligible to apply for funding. BMU also promotes cycling in local authorities through a national cycling for the climate competition, which is part of its National Climate Initiative (NKI), and through its Local Authorities Guideline.

The Projections Report does not show the reduction effect of this measure separately.

3.1.2.5.6 Corporate mobility management (PaM 22)

The aim of promoting corporate mobility management is to make commuter journeys and journeys to work considerably more sustainable. The Federal Ministry of Transport and Digital Infrastructure published its funding guideline on corporate mobility management on 2 May 2018. In the first phase, the 26 winners of prizes in the "mobil gewinnt" competition, which were awarded on 13 December 2017, are eligible to apply. Investment costs and additional investment costs for corporate mobility management (e.g. installing showers, purchasing

vehicles with alternative drive systems, building bike stands) are funded. Funding totalling EUR 8 million is planned.

The Projections Report does not show the reduction effect of this measure separately.

3.1.2.5.7 Car Sharing Act (PaM 23)

The Car Sharing Act entered into force on 1 September 2017. The provisions conferring power to make statutory instruments entered into force the day after the Act was promulgated. A post was created in the Federal Ministry of Transport and Digital Infrastructure in order to ensure legal supervision of the Car Sharing Act, to create the changes needed for appropriate regulations and administrative rules and to evaluate the Act as required under Section 6. With this Act, the federal government passed a piece of model legislation allowing reserved parking spaces to be allocated for particular companies and their station-based car-sharing schemes. The 16 Länder then have to use the model act to create their own legislation allowing them to designate space for car sharing companies' pick-up and return points on public roads, which they and local authorities have responsibility for building and maintaining. As a result of the Act, the visibility of car sharing vehicles – especially station-based ones – can be increased because the legislation makes it possible for the stations to be located on the street instead of in backyards. This in turn makes it possible to create broader access to car sharing and also to attract new users. In addition to this, car sharing companies can be given preferential treatment with regard to charges for parking on public roads and paths, provided the Länder design their charging regulations accordingly. The Act also stipulates eligibility criteria for car sharing providers. One of the aims underlying this is to reduce private motor transport and air pollution, in particular by promoting the use of electric vehicles. It also raises the issue of promoting intermodality.

The Projections Report does not show the reduction effect of this measure separately.

3.1.2.6 Agriculture

The Projections Report recalculated the reduction effect of the following PaMs, which remain unchanged:

- More farm manure in biogas plants (p. 103 of the Seventh National Report; PaM 24 in CTF Table 3)
- Expansion of organic farming (p. 102 of the Seventh National Report; PaM 25 in CTF Table 3)

3.1.2.6.1 Fertiliser Application Regulation (PaM 26)

The amendment to the Fertiliser Application Regulation entered into force at the end of May 2017, thus putting key provisions of the EU Nitrates Directive into effect in Germany. Many aspects of the Fertiliser Application Regulation influence the management of nutrients, particularly farm manure. The new regulations now also include manure of plant origin (digestion residues from biogas plants) in the permitted field application limit for organic fertilisers of 170 kg N/ha. Mandatory fertiliser planning according to specific instructions has also been introduced. In addition, for the first time provisions have also been included to reduce atmospheric nitrogen losses (obligation to incorporate manure and urea on uncultivated arable land within four hours), and from 2020 the permissible gross nitrogen balance surplus will be reduced from previously 60 to 50 kg N/ha on a three-year average. In order to target regional pollution situations more specifically, the Länder now have the option of introducing further measures such as shorter incorporation times, longer closed periods for applying fertiliser and lower permissible nutrient surpluses in areas with high nitrate inputs and high phosphorus loads in surface waters.

This measure is projected to reduce GHG emissions by 2.7 Mt CO_2e in 2020 and by 2.5 Mt CO_2e in 2030 (see CTF Table 3, PaM 26).

3.1.2.6.2 NEC Directive and National Air Pollution Control Programme (PaM 27)

The new NEC Directive (EU) 2016/2284 on national obligations to reduce emissions of certain atmospheric pollutants, which was passed in December 2016, stipulates a 29 % reduction in NH_3 emissions by 2030, compared with 2005 levels.

This reduction can be achieved by implementing a series of measures to avoid and reduce NH_3 emissions from agriculture. They include covering liquid manure storage units, incorporating or injecting farm manure without delay, the use of urease inhibitors in urea-based fertilisers, and greater use of exhaust air filters in pig and poultry houses. Some of these measures are already required by law, firstly under the current Fertiliser Application Regulation (low-emission application of manure, use of urease inhibitors) and also under air-quality control legislation (built-in covers on liquid manure and digestion residue storage units in installations subject to licensing, and decrees at Land level on exhaust air scrubbers in large-scale pig-fattening units. Certain plant and machinery to reduce emissions can still be funded through investment aid. Furthermore, implementation of the other measures cited in the National Air Pollution Control Programme is required in order to comply with the reduction obligation for ammonia under the new NEC Directive. These measures to reduce ammonia also indirectly bring about a reduction in N_2O.

Calculations indicate that the NEC Directive results in GHG emissions being 0.2 Mt CO_2e lower in 2020 and 0.7 Mt CO_2e lower in 2030 (see CTF Table 3, PaM 27).

3.1.2.7 Land use and land-use changes

3.1.2.7.1 Maintaining permanent grassland (PaM 28)

Germany is taking a particularly ambitious approach to maintaining grassland as required by the CAP. According to the provision that applies up to 2020, farms that receive direct payments and are subject to greening requirements must acquire an official authorisation before converting permanent grassland into arable land and must also provide evidence of a replacement piece of land of the same size on which new permanent grassland must be established. The conservation of permanent grassland is also supported by provisions in several Länder. As land use statistics show, the decline in permanent grassland came to a standstill after 2010. For the period after 2020, it is assumed that grassland conservation will continue until 2035, which is beyond the period to which the current EU agricultural policy applies.

If the areas of permanent grassland are maintained at the level of 2014, greenhouse gas emissions will be almost 0.8 Mt CO_2e lower in 2020 and over 2.5 Mt CO_2e lower in 2030 (see CTF Table 3, PaM 28).

3.1.2.7.2 Reduced land take for settlement and transport (PaM 29)

The models assume that Germany achieves the target it set in its national Sustainable Development Strategy of limiting the land converted for settlement and transport purposes to less than 30 hectares per day up to 2030.

Reduction effect

This measure is projected to reduce GHG emissions by 0.1 Mt CO_2e in 2020 and by 0.6 Mt CO_2e in 2030 (see CTF Table 3, PaM 29).

3.1.2.7.3 Conservation of peatlands (PaM 30)

The Climate Action Programme 2020 also includes conservation of peatlands. All the countries that are rich in peatlands have developed peatland conservation programmes and are supporting peatland conservation projects with money from the European Agricultural Fund for Rural Development (EAFRD) and the European Fund for Regional Development (EFRD), to some extent linked to specific area-related targets. The implementation of peatland conservation projects by the Länder is therefore shown as a measure under the with-measures scenario (WMS). The impacts are estimated on the basis of an update to the budgets made available for peatland conservation in the current financing period and the costs and size of area involved in projects that have already been completed. It is assumed that by 2030 16,000 hectares of arable land on peatlands will have been converted to grassland, 53,700 hectares of grassland will have been wetted (converted to wetland) and 17,900 hectares of drained wetland areas will have been re-wetted.

Reduction effect

Overall this measure will bring about a reduction in greenhouse gas emissions of 0.6 Mt CO_2e in 2030. The reduction effect will not be noticeable in 2020 since it is very soon after the launch of the funding programme.

3.1.2.8 The waste management sector

3.1.2.8.1 Strengthening recycling through the Packaging Act (PaM 31)

The provisions of the 2017 Packaging Act, which entered into force in January 2019, have increased the rate of recovery of secondary raw materials from waste, with recycling them or otherwise using them to generate energy being prioritised. The Act replaces the 1998 Packaging Regulation. It contains a two-stage procedure in which the recovery rates for packaging are set at a considerably higher level. The first increase took place when the Act entered into force in January 2019; the second increase will follow in January 2022.

3.1.2.8.2 Commercial Waste Regulation (PaM 32)

The new Commercial Waste Regulation came into force on 1 August 2017. In particular it implements the requirements of the five-stage hierarchy of waste in the area of commercial municipal waste and certain types of construction and demolition waste. In addition to a restrictive obligation to separate waste, a further requirement to pre-treat mixed commercial waste and specifications for the pre-treatment plants are stipulated. The aim is to achieve increased recycling rates for commercial waste.

Reduction effect

The reductions in emissions resulting from an increase in the share of waste recycled (3.1.2.8.1 and 3.1.2.8.2) do not impact on greenhouse gas emissions from the waste sector but on those of the energy and industry sectors when, for example, less waste is incinerated because more is recycled and fewer primary raw materials are used. The reductions are therefore not shown separately for these measures (see CTF Table 3, PaM 31 and 32).

3.1.2.8.3 Funding for landfill aeration (PaM 33)

Since 2013, landfill aeration to reduce the potential of methane generation has been promoted under the Local Authorities Guideline, which is part of the National Climate Initiative. This measure has been continued and stepped up as described in the Climate Action Programme 2020. This, in conjunction with more intense efforts to provide information and motivate the relevant stakeholders, and also because the maximum funding available has been increased, has resulted in 43 projects being approved, many of which have already begun. In the programme

period under the current NKI Local Authorities Guideline, funding for landfill aeration was guaranteed until the end of 2019. A decision has now been taken to continue it.

Reduction effect

Within the with-measures scenario, the last aeration measures will be approved in 2022 and will begin in 2024. The associated savings will be achieved in the next 10 years. It is assumed that the measures will be completed by 2034. A reduction of 0.4 Mt CO_2e in greenhouse gas emissions as a result of this measure is shown for 2030 (see CTF Table 3, PaM 33).

In future, projects to aerate larger landfills or landfill sections will also be implemented as part of the funding opportunities offered by local authority model climate action projects. This will permit a considerably higher total funding amount compared to that available under the NKI. The aim here is to support aeration of landfills with a savings potential of about 50,000 CO_2e per year. The aeration of four additional landfills of this kind per year between 2021 and 2026 seems realistic, which could then result in an additional annual reduction of 1.2 Mt CO_2e from 2025. The greater the potential for emissions reduction of the individual projects funded, the greater the possibility of achieving the savings more easily and with greater certainty.

These measures are supported by a voluntary commitment on the part of the Association of German Landfill Operators INWESD to save at least 1 Mt CO_2e by 2030 as a result of the measures described and to introduce the first measures as early as 2019.

3.1.2.9 Buildings

The policies and measures in CTF Table 3 that continue to apply without change are described in the Seventh National Communication (see pp. 89 ff.) and in the Third Biennial Report (see pp. 33 ff.). They are also listed in CTF Table 3 with updated calculations of the greenhouse gas reduction effect.

- Energy Efficiency Incentive Programme (PaM 35)
- Energy Conservation Regulation (PaM 36)

3.1.2.9.1 CO_2 Building Rehabilitation Programme (PaM 37)

EUR 2 billion a year were available in 2017 and 2018 to fund new measures for the following sub-programmes: Energy-Efficient Refurbishment and Energy-Efficient Construction (private consumers), Energy-Efficient Construction and Refurbishment (commercial buildings) and Energy-Efficient Construction and Refurbishment (municipal and social infrastructure). The funding programme is described in more detail in the Seventh National Communication (see pp. 89 f.) and in the Third Biennial Report (see p. 33).

The 2019 Projections Report determined that direct emission reductions as a result of fuel savings in the buildings sector will be 1.5 Mt CO_2e in 2020 (see CTF Table 3, PaM 37). Emissions in 2030 are reduced by 6.7 Mt CO_2e.

3.1.2.9.2 Market Incentive Programme for renewable energy (MAP) (PaM 38)

The Market Incentive Programme is described in more detail in the Seventh National Communication (see pp. 92 f.) and in the Third Biennial Report (see p. 33). The details of funding available under this programme are given in the guidelines as last amended on 21 December 2018. Funding under the programme is divided into two parts. The Federal Office for Economic Affairs and Export Control (BAFA) offers investment grants for smaller-scale systems. Solar collector systems, biomass systems and efficient heat pumps, mostly in one- or two-unit houses, are eligible for the grants. For larger systems, KfW awards low-interest loans with repayment grants under its Renewable Energies programme, premium option. Large solar thermal systems,

biomass heating (and power) plants, large, efficient heat pumps, biogas piping, deep geothermal systems, local heating networks for heat from renewable energy sources and large heat storage facilities for renewable heat are all eligible under this part of the programme. Since 1 February 2018, systems that are eligible under the Renewable Energy Sources Act have also been funded again. This applies to biomass systems and deep geothermal systems for combined heat and power generation in the output classes that the MAP guidelines specify are eligible for KfW funding but also to biogas piping that supplies CHP plants. Funds from the federal budget and from the Special Energy and Climate Fund of about EUR 320 million and an additional EUR 98 million were available for the Market Incentive Programme in 2018.

Reduction effect

This funding of approximately EUR 320 million per annum is updated for the entire scenario period used in the WMS. The emissions reductions in the policy scenarios were determined by comparison with a without-measures scenario as described in section 4.3.5.2 of the Seventh National Communication. The model calculates direct GHG reductions from fuel savings amounting to 2.3 Mt CO_2e. Reduction effects amounting to 10 Mt CO_2e are shown for 2030 (see CTF Table 3, PaM 38).

3.1.2.9.3 Model projects on heating network systems 4.0 (PaM 39)

Under its heating network systems 4.0 funding programme, the federal government has supported the construction of highly innovative heating networks since 1 July 2017. These are 4th generation heating networks designed to sustainably supply residential and non-residential buildings, as well as industrial processes, with low-temperature heat up to a maximum of 95°C. The low temperature level makes it easier to integrate renewable energy, especially solar thermal and ambient heat. The funding is in two stages: in Module I, the Federal Office for Economic Affairs and Export Control (BAFA) funds a feasibility study to examine the cost effectiveness and technical feasibility of the project. The actual construction of the heating network is funded under Module II. In addition to the basic funding, premiums are awarded for high shares of renewable energy and waste heat and for particularly cost-efficient heat networks. This replaces the programme's funding to date (2017/2018) under the Special Energy and Climate Fund's energy efficiency fund.

The Projections Report calculated that this measure reduces GHG emissions by 0.05 Mt CO_2e in 2020 and by 1 Mt CO_2e in 2030 (see CTF Table 3, PaM 36).

3.1.3 Information on changes to institutional climate change mitigation arrangements

3.1.3.1 Regulations in the European context

The regulations in the European context are part of the EU's Biennial Report.

3.1.3.2 Regulations in the national context

3.1.3.2.1 Interministerial Working Group on CO_2 Reduction

The German government set up the Interministerial Working Group on CO_2 Reduction in 1990, with the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) as the lead agency. The working group's remit is to draft guidelines for climate action, identify areas where action is needed, identify potential for reducing greenhouse gases and propose comprehensive packages of measures to reduce greenhouse gas emissions in Germany and submit them to the federal cabinet.

3.1.3.2.2 Other institutional arrangements

The Second Biennial Report described other institutions that participate in implementing agreements under the Kyoto Protocol. There have been no changes in the institutions concerned, nor in their portfolio of activities in the meantime.

3.1.3.3 Monitoring and evaluation of climate change mitigation activities

The monitoring and evaluation of EU targets are described in the European Union's Biennial Report.

Important developments and indicators related to national climate targets are regularly discussed in the German government's climate action report[29] (published annually since 2015), the annual monitoring report[30] and the progress report entitled Energy of the Future,[31] which is published every four years. The reports are available online. Progress in implementation of the 2050 Climate Action Plan will also be reported on a regular basis starting in 2020.

3.1.4 Evaluating the effects of reduction measures

To date there has been selective ex-post evaluation of climate change mitigation measures in Germany both in terms of their effect on the climate and the economy. For example, each year the Federal Environment Agency analyses more precisely what contribution the expansion of renewable energy makes to avoiding greenhouse gases as part of the work of the Working Group on Renewable Energies – Statistics (AGEE-Stat). Below are the findings for the 2018 reporting year. A study was done to determine the economic impacts of the Climate Action Programme 2020 for the German government's 2016 climate action report. The results can be found on pp. 36 ff. of the Third Biennial Report. During the reporting period, an impact assessment was carried out on the targets set in the Climate Action Plan 2050.

3.1.4.1 Effects of policies and measures on trends in greenhouse gas emissions

3.1.4.1.1 Trends in emissions avoided by using renewable energy

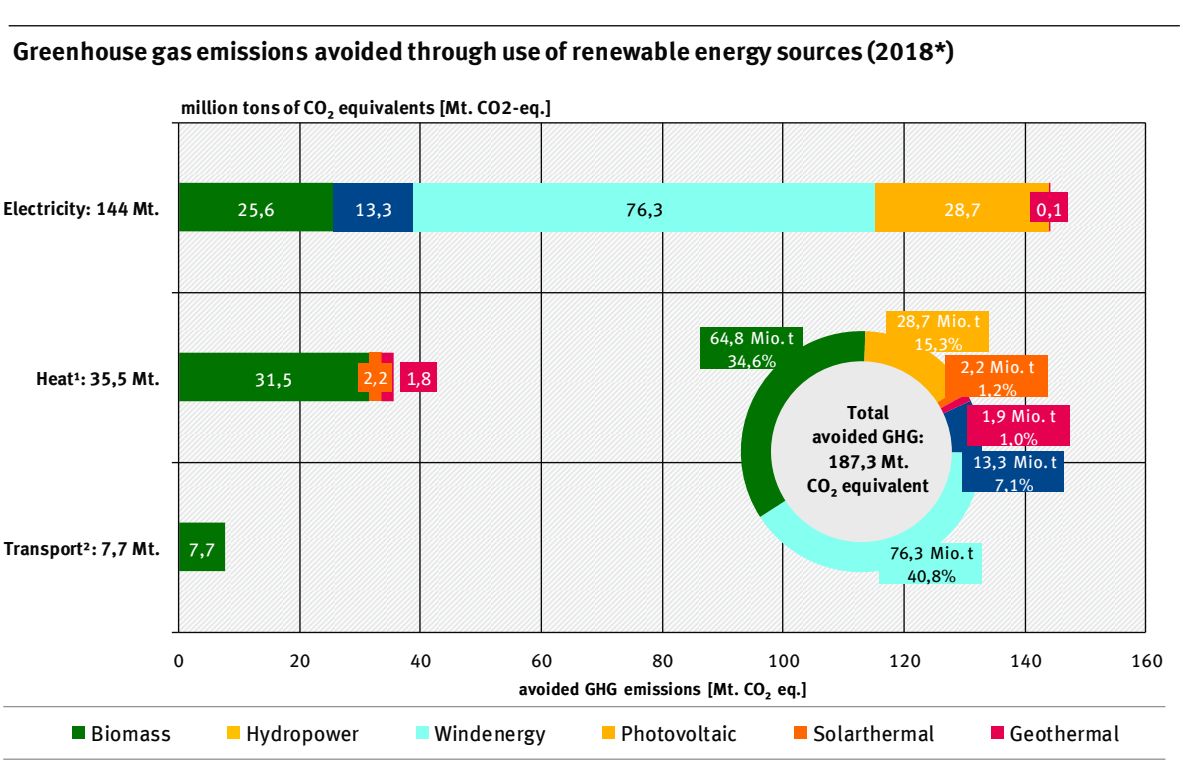
Replacing fossil fuels with renewable energy sources makes an important contribution to meeting climate targets. Emissions totalling about 187.3 Mt CO_2e were avoided in 2018, compared with a reference system under which renewable energy sources were not used and energy demand remained the same as in 2018. Almost 144 Mt CO_2e were avoided in the electricity sector. Emissions were 35.5 Mt CO_2e lower in the heating sector and 7.7 Mt CO_2e lower in the transport sector. Across all sectors, wind energy contributed around 41 % to the total GHG reduction, followed by biomass at around 35 % and photovoltaics at around 15 % (see Figure 5).

29 The 2018 climate action report is available online at: https://www.bmu.de/fileadmin/Daten_BMU/Download_PDF/Klimaschutz/klimaschutzbericht_2018_bf.pdf .

30 https://www.bmwi.de/Redaktion/DE/Publikationen/Energie/sechster-monitoring-bericht-zur-energiewende.pdf?__blob=publicationFile&v=37

31 https://www.bmwi.de/Redaktion/DE/Publikationen/Energie/fortschrittsbericht-monitoring-energiewende.pdf?__blob=publicationFile&v=19

Figure 5: Net balance of greenhouse gas emissions avoided due to the use of renewable energy sources in 2018



* preliminary values
¹ without charcoal
² Only biogenic fuels in the transport sector (excluding use in agriculture, forestry, construction or military and excluding electricity consumption by the transport sector) based on preliminary data from the Federal Ministry of Food and Agriculture for 2018 and on the applicable fossil fuel comparator (83.8 g CO_2e/TJ) as set out in Directive 2009/28/EC. By contrast, the basic value used in the 38th BimSchV § a 3 is 94.1 g CO_2e/TJ).

Source: German Environment Agency (UBA), 'Emissionbalance of renewable energy sources' based on data from AGEE-Stat 08/2019

The avoidance of emissions as a result of using renewable energy sources is calculated on a net basis. The emissions caused by the provision of final energy from renewables are offset against the gross emissions avoided by replacing fossil fuels and/or nuclear energy. This takes into account all upstream process chains involved in extracting and supplying energy sources and manufacturing and operating plant and equipment (not including dismantling); it thus differs from the internationally binding rules used to determine GHG emissions in the GHG inventories.

3.1.4.1.2 Socio-economic effects of the targets set in the Climate Action Plan 2050

The Climate Action Plan 2050 includes the decision to carry out a comprehensive impact assessment.[32] One of the underlying aims of this is to develop sound policies and measures with which to achieve the targets set for 2030. The methodology used is to compare a reference scenario with two different paths to reach the targets. Path A reaches the targets primarily as a result of better energy efficiency, whereas path B relies chiefly on expanding the use of renewable energy. Below is a description of selected findings of the impact assessment.

The different environmental impacts of the two paths, such as air pollutant and heavy metal emissions, nutrient input and biodiversity, are evaluated. The required investment and resulting savings, along with macroeconomic effects such as impact on GDP and GVA, employment and competitiveness, are investigated.

The analysis of the environmental impact of particulate emissions indicated marked differences between the two paths: whereas particulate emissions decreased as a result of efficiency-

[32] Published at: https://www.oeko.de/fileadmin/oekodoc/Folgenabschaetzung-Klimaschutzplan-2050-Endbericht.pdf

oriented path A, path B led to an increase. The reason for this is that more solid biomass is incinerated under path B. In the case of the other environmental impacts investigated, both paths bring about improvements and there are mostly only differences in degree.

Investment in climate action and efficiency technologies is needed to achieve the sector targets.

In path A with its emphasis on energy efficiency, additional investment is needed in the area of building refurbishment in particular (a cumulative total of about EUR 160 billion in the period up to 2030). Achieving the targets for renewables in the energy sector involves differential investment of almost EUR 80 billion (cumulative up to 2030) in path A. In the two reference years 2025 and 2030 investment stimuli are just under and just over EUR 14 billion, respectively, in the building sector; and EUR 7.5 and 7.8 billion billion in the energy sector.

In path B, with its emphasis on electricity-based technologies in most fields of action, investment in other renewable electricity generation technologies continues in order to meet the electricity demand in other fields of action. This results in the need for cumulative additional investment of about EUR 110 billion up to 2030 and with regard to the reference years 2025 and 2030 for additional investment of EUR 12.5 billion and just under EUR 10 billion respectively. In the buildings sector, the greater emphasis on electricity-based heat generators means that investment in refurbishment is lower with the result that the cumulative additional investment in path B (compared with the reference) is about EUR 100 billion (with roughly EUR 7.8 and 7.5 billion in the reference years).

The analysis of the savings shows that for path A savings clearly exceed the additional annuity investment in both reference years 2025 and 2030. The bottom line is that the additional investment is cost-effective; the cost to industry and investors is offset by the savings made, so that the net result is that the investment is profitable. A more in-depth review shows that this is also true for the individual fields of action. The net savings in 2030 are even more marked than in 2025. At the same time, it must be stressed that the total investment volume in 2030 is higher in path A than in path B. In path B the additional investment and savings do not balance out – neither in the short term nor by 2030. The savings are lower than the investment-related costs. In summary, it can be noted that, from the micro-perspective, path A looks economically positive. However, it must also be stressed that initially there is a need for additional investment and that it takes time for the resulting savings to produce a return.

The social consequences were also considered for the buildings sector in particular. A comparison between the two paths and the reference case clearly shows that what people would have to pay for their homes – per square metre and per month – would be slightly higher than the reference case for both paths. Whereas in path A there is a greater drop in energy costs than in path B, rent increases for tenants or interest on loans for homeowners result in an overall rise in accommodation costs. In path B the accommodation costs are slightly higher than the reference case and the energy costs almost identical. This is due to the fact that in path B investment in the efficiency of the building envelope is lower whereas investment in converting the heating systems is higher. Heating will continue to incur expenditure (especially electricity from heat pump systems).

3.1.4.1.3 Information on minimisation of adverse impacts in accordance with Article 3, paragraph 14 of the Kyoto Protocol

Most measures in Germany are not expected to have direct effects on developing countries; in other cases, the expected effects, such as those resulting from the development of technical and administrative structures for climate change mitigation, are considered to be very positive.

The potential indirect effects are almost all consistently positive, particularly as a result of beneficial effects on the energy supply and energy prices in the cooperation countries. NIR 2016

contained a detailed description of the individual measures. They related to areas including promotion of biofuels, elimination of coal subsidies, policies and measures at EU level, particularly emissions trading, and supporting developing countries in diversifying their energy supplies. There have been no changes since those measures were reported.

3.1.5 Use of credits from market mechanisms to achieve national reduction targets

Up to and including 2018, Germany did not use any credits from market mechanisms to achieve its climate targets. It is expected that a small number of emission allowances will have to be purchased from other EU Member States under the EU Effort-Sharing Directive in order to meet the national targets.

3.2 Evaluation of emissions reduction, recognising market-based instruments and LULUCF

3.2.1 National targets

In its Climate Action Plan 2050 of November 2016,[33] the German government confirmed and further defined its ambitious national climate targets. In the Climate Action Plan 2050, the government also reaffirms the targets of reducing its greenhouse gas emissions by at least 55 % by 2030, 70 % by 2040, and 80 to 95 % by 2050 compared with base year 1990. The Climate Action Plan clearly states: Germany intends to be largely greenhouse gas neutral by 2050. Germany is not likely to meet its emissions reduction target for 2020 on schedule. By implementing the recommendations of the Commission on Growth, Structural Change and Employment, the government will continue to work towards achieving its target of reducing greenhouse gas emissions by 40 % as soon as possible.

In addition, the Climate Action Plan spelled out the government's 2030 climate target for the individual sectors, described the necessary development pathways, agreed initial implementation measures and set up a process for monitoring and refining the policies and measures. This is the means by which Germany will play its part in achieving the Paris Agreement's aim to limit global warming to well below 2 degrees Celsius and to pursue efforts to limit the temperature increase to 1.5 degrees Celsius.

The German government adopted the Climate Action Programme 2020 back in December 2014. It did so in response to the 2013 Projections Report, which stated that the national emission reduction target of minus 40 % by 2020 would probably not be achieved with the measures that had been put in place at that time. In order to reach the 40 % target, therefore, additional efforts needed to be made. The German government did this with the most comprehensive action programme up to that time, which included measures in all sectors. When it became clear that, despite the action programme, the target would not be achieved on schedule, the federal government responded by mandating the Commission on Growth, Structural Change and Employment to make recommendations on how to meet the 40 % target as quickly as possible.

Germany has made significant progress in climate change mitigation since the beginning of the 1990s. Examples of this include the fact that it has decoupled economic growth from greenhouse gas emissions and surpassed the reduction targets it set itself during the first commitment period of the Kyoto Protocol. To achieve the German government's ambitious national target of cutting the country's greenhouse gas emissions by at least 40 % by 2020 compared with 1990, emissions need to be cut from the 1990 level of about 1,250 Mt CO_2e to a maximum of 750 Mt CO_2e in 2020.

According to the 2019 National Inventory Report, some 907 million tonnes of greenhouse gases were emitted in Germany in 2017. That equates to a 27.3 % reduction in comparison to 1990. According to the latest estimates by the Federal Environment Agency, 865 million tonnes of greenhouse gases were emitted in 2018, a reduction of about 30.8 % since 1990. The 2019 Projections Report concludes that, as a result of the measures that have already been adopted and implemented, a reduction in greenhouse gases of 33.4 % can be achieved by 2020 and a reduction of 41.8 % by 2030. When uncertainties regarding population trends, economic trends and energy prices are taken into account, a range of about 33.2 to 33.7 % in the projected emissions reduction results. The sensitivity range for the 2030 reduction is between 41.4 % and 43.6 % (see section 4 on projections). The German government does not fully endorse the

[33] The Climate Action Plan 2050 is available in German and English at: http://unfccc.int/focus/long-term_strategies/items/9971.php and http://www.bmub.bund.de/themen/klima-energie/klimaschutz/klima-klimaschutz-download/artikel/klimaschutzplan-2050-1/?tx_ttnews%5BbackPid%5D=3915 .

scenarios of the 2019 Projections Report for the period 2005 to 2035, because they are not official statistical data, but the result of modelling carried out by independent research institutes that are not connected to government institutions. However, it will ensure that the research findings are taken into account in its future deliberations.

3.2.2 Germany's contribution to the EU reduction targets

The EU has made a commitment for all its Member States jointly to the Secretariat of the UNFCCC, undertaking to cut greenhouse gas emissions by 20 % compared with 1990 levels by 2020.[34] The EU contribution is ascertained by adding together the emissions of all 28 Member States. Emissions from land use, land-use change and forestry (LULUCF) do not count towards the EU target and are therefore not included in CTF Tables 4 and 4a.

A portion of the total emissions is regulated under the EU-wide Emissions Trading System (ETS). Installations and processes that fall under the Emissions Trading System in all 28 EU Member States are allocated allowances from an EU emissions budget (cap). Norway, Iceland and Liechtenstein, which are not members of the EU but do participate in the ETS, also receive allowances in this way. The aim is cut these emissions by 21 % by 2020compared with 2005 levels. According to the European Environment Agency, emissions from stationary installations that are covered by the Emissions Trading System (not including aviation), decreased by 22 % between 2005 and 2017.[35]

Table 2 shows the trends in emissions from stationary installations in Germany covered by the Emissions Trading System and trends up to 2035 ascertained in the Projections Report. Between 2005 and 2016 there was an actual decrease of 12.7 %. In principle, this downward trend continues in the projections for the 2020 to 2035 period. Credits obtained from flexible mechanisms under the Kyoto Protocol can to a certain extent be used in the ETS, provided the mitigation projects meet certain quality criteria.[36]

Table 2: Trends in emissions trading for stationary installations and in emissions in the ESD sectors under the WMS of the 2019 Projections Report.

($Mt CO_2e$)	2005	2010	2016	2020	2025	2030	2035
Emissions from stationary installations within the ETS[a]	518.9	478.9	452.9	396.6	394.0	354.1	343.4
Emissions covered by the ESD[b]	470.4	459.5	454.1	436.6	404.1	373.4	351.9
Total emissions covered by the ESD and from stationary installations within the ETS[c]	989.3	938.4	907.0	833.2	798.1	727.7	695.4
Trends in emissions from stationary installations within the ETS compared with 2005	22.5 %	-7.7 %	-12.7 %	-23.6 %	-24.1 %	-31.8 %	-33.8 %
Trends in emissions covered by the ESD compared with 2005	22.5 %	-2.3 %	-3.7 %	-7.4 %	-14.3 %	-20.8 %	-25.4 %
NF_3 (outside the scope of the ESD and ETS)[c]	0.0	0.1	0.0	0.0	0.0	0.0	0.0

[a] Emissions covered by the ETS in line with the 2013 definition.

34 FCCC/SB/2011/INF.1/Rev.1.

35 EEA Briefing 12/2018: Recent trends and projections in EU Greenhouse Gas Emissions.

36 Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community

[b] For reasons of consistency (i.e. to permit comparison with data for 2020-2035), emissions between 2005 and 2016 have been calculated using CRF categories; in line with the 2013 ETS definition. Does *not* correspond to the base value for the reduction target under the ESD.

[c] This sum is lower than the total national emissions because CO_2 emissions from domestic aviation and all NF_3 emissions are not covered by the ETS or the ESD.

Source: Federal Environment Agency: 2018 National Inventory Report, Central System for Emissions, European Environment Agency EU ETS Data Viewer, calculations by Öko-Institut.

The EU Member States have agreed national reduction targets for the greenhouse gas emissions that are not regulated by the EU Emissions Trading System. Under this agreement, Germany has committed to reducing emissions by 14 % from 2005 levels by 2020.[37] This percentage reduction target was translated into an annual emissions budget for each Member State. In 2013, the emission budgets were adapted to ensure compliance with IPCC requirements.[38] Furthermore, a decision was taken in 2017 to distribute the additional reductions required across the emissions budgets for 2017 to 2020 only.[39] This means that Germany has to comply with considerably tighter emission limits during this period.

Current estimates indicate that Germany will not be able to fully comply with its emission budgets throughout the entire period of validity of the ESD: emissions under the ESD totalled 464.73 Mt CO_2e in 2017, whereas the budget was only 432.3 Mt CO_2e. In 2016 the budget was 452.4 Mt CO_2e and actual emissions totalled 454.16 Mt CO_2e. Up to and including 2015, compliance with the annual emission budget was achieved and surplus emission allowances were accumulated. As things stand at present, there are enough of these accumulated emission allowances to compensate for the shortfall between 2016 and 2018. Current estimates indicate that in 2019 and 2020 Germany will most likely have to purchase emission allowances for about 50 Mt CO_2e from other EU Member States.[40]

[37] Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020

[38] 2013/634/EU: Commission Implementing Decision of 31 October 2013 on the adjustments to Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council

[39] Commission Decision (EU) 2017/1471 of 10 August 2017 amending Decision 2013/162/EU to revise Member States' annual emission allocations for the period from 2017 to 2020

[40] European Environment Agency, Greenhouse Gas Emissions covered under the Effort Sharing Decision, https://www.eea.europa.eu/data-and-maps/data/esd-1

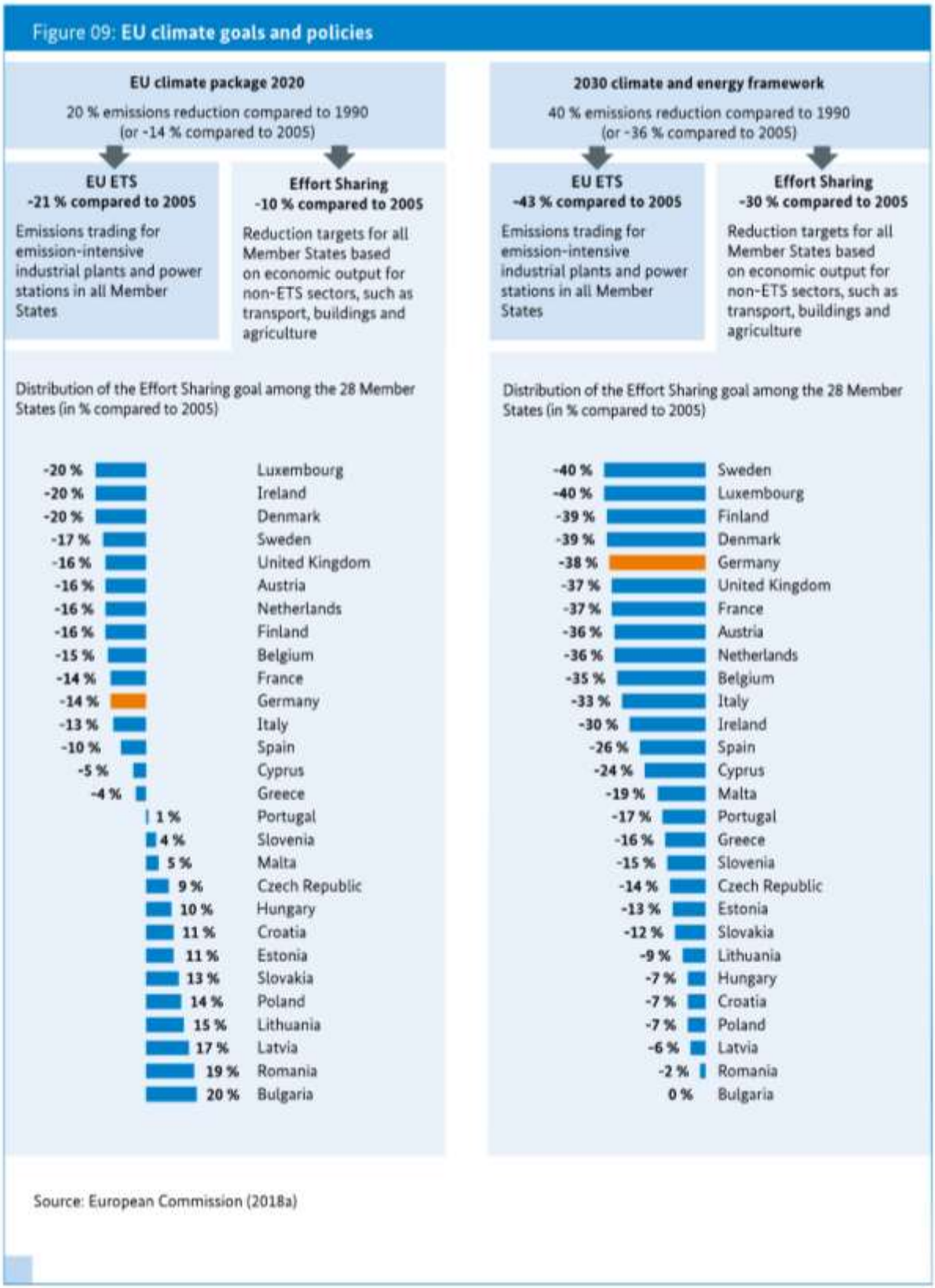


Figure 6: EU climate targets and instruments

Source: BMU – Klimaschutz in zahlen 2019, Section 2.2, p. 22

4 Projections

The projections described here are based on calculations from 2018 and have already been used in the 2019 Projections Report.

The German government does not fully endorse the results of the scenarios for the trend in greenhouse gas emissions in Germany for the period from 2005 to 2035. Any scenario that looks as far ahead as 2035 is bound to be fraught with major uncertainties. The trends estimated differ, depending on the assumptions made and methodology used.

4.1 Description of the methodology used

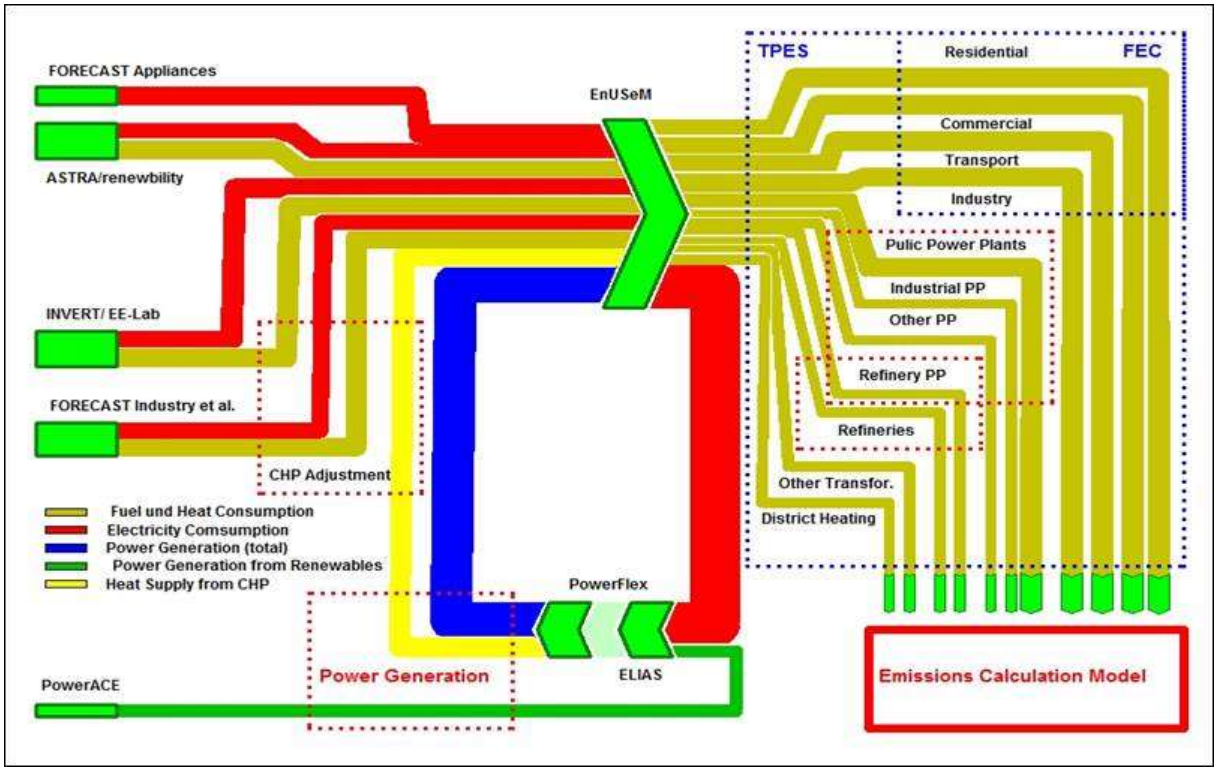
The methodology is based on past projections. A more detailed description can be found in the Seventh National Communication.[41] Underlying data such as population growth and GDP have been updated. The 2019 projection of population trends differs from that in the 2017 Projections Report: based on the latest figures and on the Federal Statistical Office's population forecasts, an increase by 2020 is assumed instead of a decline. A slight decline is assumed by 2035. The 2019 Projections Report, by contrast with the 2017 report, assumes markedly higher growth rates in GDP, based on federal government data (spring projection) and on the trend (with a time lag) given in the EU Guidance (2018). Energy prices (oil, gas, coal) and prices of greenhouse gas emission allowances are slightly higher than in the last Projections Report.

An energy system model and an emissions calculation model were used to develop the scenarios by consolidating the results of detailed sectoral analyses, some based on models, into consistent and exhaustive figures for energy demand and greenhouse gas emissions.

The process of analysing and evaluating the different measures, calculating greenhouse gas emissions by source category and ascertaining the background information and indicators needed for this report is based on different methodological approaches and sets of models for the different sectors which permit an adequate analysis based on the data and information available for those sectors. For energy-related greenhouse gas emissions from combustion processes, the analyses are based on a complex system of different models (Figure 7):

[41] https://unfccc.int/sites/default/files/resource/26795831_Germany-NC7-1-171220_7 %20NatCom%20to%20UNFCCC.pdf

Figure 7: Calculation models used for projections of emissions arising from the combustion of fossil fuels



Greenhouse gas emissions from combustion processes were ascertained using the Öko-Institut's emissions model, which evaluates emissions aspects of the energy demand projections aggregated in EnUSEM for the various end-use and conversion sectors within the national greenhouse gas emissions system. For fugitive emissions in the energy sector, source category-specific modelling was used. It is based on energy demand and supply volumes and the methods used in the National Greenhouse Gas Inventory. Three different approaches are used for emissions from industrial processes.

a) For process-related emissions connected with the energy sector, emissions are ascertained on the basis of the energy demand and supply volumes in the Öko-Institut's emissions model, using the methods employed in the National Greenhouse Gas Inventory.

b) For process-related emissions that are not connected with the energy sector, emissions are ascertained on the basis of production estimates in Öko-Institut's emissions model, based on the methods employed in the National Greenhouse Gas Inventory.

c) For HFC, PFC, SF_6 and NF_3 emissions, existing projections were updated and adjusted. Projections of greenhouse gas emissions by agriculture and by land use, land use change and forestry (LULUCF) are prepared by the Johann Heinrich von Thünen-Institute. The Öko-Institut's multi-phase waste model used to prepare the National Greenhouse Gas Inventories has been expanded to create the projection for greenhouse gas emissions from the waste management sector. To analyse energy-related greenhouse gas emissions, a principal component analysis is also used, with which a singular value decomposition analysis can then be performed to describe emissions trends on the basis of trends in population growth, economic growth, the energy productivity of the economy as a whole, the share of fossil fuels in the total primary energy supply and the greenhouse gas intensity of the fossil energy sources used.

As a Member State of the European Union, Germany has a commitment to report its greenhouse gas projections by 15 March every two years. The last report was the 2019 Projections Report, which had to be submitted by 15 March 2019. The projections in that report have been used to prepare this report. Since the complex modelling work was therefore carried out during 2018, the 2018 Greenhouse Gas Inventory, which was the most up-to-date at the time, was used. It contains inventory data up to 2016. This data was compiled following the 2006 IPCC Guidelines for National Greenhouse Gas Inventories using global warming potentials (GWP) from the Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC).

Specific studies were done for space heating and hot water, electrical appliances, industry, the trade, commerce and services sector, transport, electricity generation from renewable energies and fossil electricity generation, as well as for fugitive emissions in the energy sectors and process-related CO_2, CH_4 and N_2O emissions. The results of other studies were used or adapted for other source categories (HFCs, PFCs and SF_6 emissions and agriculture, land use, land-use change and forestry (LULUCF)).

First, all the measures in the with-measures scenario were modelled together for the different sectors. This ensures that the measures can overlap and complement each other producing synergistic effects. In the second step, the policy measures were modelled individually in sector-specific models. By comparing the effect of the individual measures with the effect of all the measures together, it is possible to adjust the effects to take account of possible overlaps.

A with-measures scenario was calculated overall and for each sector review. The 2019 Projections Report did not include a separate without-measures scenario. However, in studying the effects of individual measures in the sectors, assumptions were on occasion made about how, in a fictional world, that sector would have developed without the policies in question. However, since these policies and measures have already been in place for a long time, it is difficult to produce a projection of a development without their influence.

The 2019 Projections Report, which contains a more detailed description of the methodology and a fact sheet for the models used, can be found on the EEA data server.[42]

4.2 Projection results

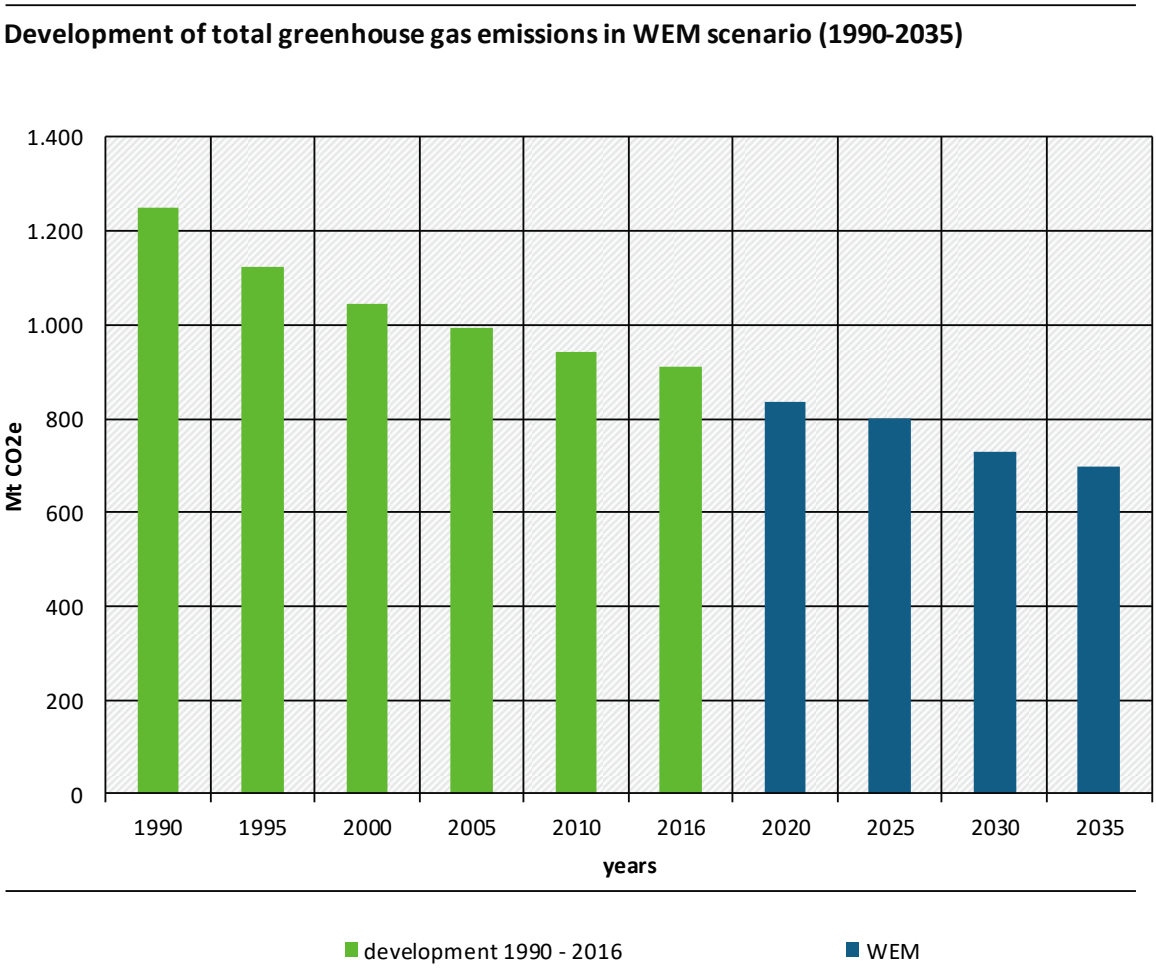
4.2.1 Cross-cutting trends

The trends in total greenhouse gas emissions are calculated from energy-related greenhouse gas emissions and those from industrial processes, product use, agriculture, waste management, and land use, land-use change and forestry (LULUCF). This kind of estimate of emissions trends – even for short periods of time – is fraught with serious uncertainties. Economic trends, energy prices and other underlying conditions can have a strong influence on actual trends. The results must therefore be evaluated in light of the assumptions made about the underlying data as described in the Projections Report. Sensitivity analyses carried out for the scenario within the 2019 Projections Report show the potential order of magnitude of the uncertainties.

Figure 8 summarises the main projection results for trends in total greenhouse gas emissions. It shows the raw inventory data for the historical reference years 1990 to 2016. Projections for the with-measures scenario are given from 2020 onwards.

[42] http://cdr.eionet.europa.eu/de/eu/mmr/art04-13-14_lcds_pams_projections/projections/ .

Figure 8: Trends in total greenhouse gases under the WMS (1990-2035)



Quelle: historic data from national GHG inventory; projection by Öko-Institut/Fraunhofer-ISI

Source: Öko-Institut.

For total greenhouse gas emissions (excluding land use, land-use change and forestry and international aviation and maritime transport), the WMS shows a reduction of 158 Mt CO_2e or 16 % for the 2005 to 2020 period. By 2030, the reduction compared with 2005 is about 263 Mt CO_2e or 26 % and by 2035 it is 296 Mt CO_2e or 30 %. Compared with 1990, this equates to a reduction of 33 % by 2020, 42 % by 2030, and over 44 % by 2035. If the sensitivities analysed in the report are also considered, there is a reduction in emissions in 2020 (2030) of up to 34.3 % (43.6 %) by comparison with 1990 (in the calculation assuming weaker economic growth).

However, it must also be pointed out that the emissions trends described do not include developments in international aviation (and to a lesser extent deep-sea shipping). In particular, the very dynamic trend in international aviation causes the relevant greenhouse gas emissions to increase by almost 7 (11) Mt CO_2e between 2005 and 2020 (2030), which equates to an increase of roughly 23 % (37) %.

4.2.2 Electricity generation

Under the WMS, electricity consumption falls by approximately 11 % during the scenario horizon starting with 2008. However, as a result of the sometimes extremely strong electricity exports (between 47 and 78 TWh), net electricity generation remains at around 610 TWh until

2020 and then, after a slight decline, reaches this level again in 2035. It would fall considerably more if it were not for a marked rise in electricity consumption in the road transport sector caused by electric vehicles.

Electricity generation from renewable energy sources increases considerably under the WMS (from roughly 186 TWh in 2016 to about 344 TWh in 2035). This trend is primarily driven by a considerable increase in the capacity of both onshore and offshore wind energy. Taken together, onshore and offshore wind power generation rises by almost 160 % compared to the baseline year. Generation from photovoltaics (PV) also rises (increasing by about 87 % by 2035). Conversely, electricity generation from nuclear energy, lignite, hard coal, oil and natural gas declines up to 2035.

4.2.2.1 Emission trends

In the with-measures scenario, greenhouse gas emissions in the electricity sector (including emissions from CHP plants generating electricity and heat) fall from 348 Mt CO_2e in 2016 to 261 Mt CO_2e in 2035. About 50 Mt CO_2e of the reduction occurred in the period up to 2020; from 2020 to 2035, emissions decreased by a further 36 Mt CO_2e.

4.2.3 Other energy conversion sectors

Other sectors of the energy industry include district heating plants, oil and other refineries, other installations in the conversion sector (lignite mines, coal mines, briquette factories, coking plants, other conversion and processing installations, and the energy consumption of biogas plants) and natural gas compressor stations in pipeline networks.

Greenhouse gas emissions from other sectors of the energy industry decreased by about 15 % between 1990 and 2016 and by 2035 fall to a level that is 25 % lower than in 1990. However, emissions from public heating plants rise as a result of increased use of natural gas. However, emissions from refineries and other installations in the conversion sector fall, so that overall there is a decline in emissions. CO_2 emissions dominate the total emissions from the remaining sectors of the energy industry, accounting for 99 % of all emissions.

4.2.4 Fugitive emissions from fuels

Fugitive emissions from coal mining and the oil and gas industries decrease by 61 % from 2005 to 2035. This trend is primarily the result of coal mining being phased out in Germany. The total reduction in energy-related greenhouse gas emissions (combustion-related emissions, including international transport and fugitive emissions from fuels) is 246 Mt CO_2e or 30 % in the period from 2005 to 2035.

4.2.5 Transport

Compared with 2005, the final energy consumption for domestic transport rises by about 7.2 % by 2020. The reason the decrease is small is the higher transport volume, which is not fully offset by the increase in efficiency. A slight decrease of 1.9 % in final energy consumption for the domestic transport sector by comparison with 2005 is achieved by 2035.

Final energy consumption from international transport also continues to rise up to 2020 under the WMS, with the final energy consumption of transport as a whole rising by 9.7 % by 2020 compared with 2005. This trend continues until 2030, only then beginning to decline slightly, so that by 2035 final energy consumption of transport as a whole is only 3.4 % higher than 2005.

4.2.5.1 Emission trends

By comparison with the baseline year 2016, total greenhouse gas emissions under the WMS fall by 2035 to about 191 Mt CO_2e. This equates to a reduction of almost 5 % compared to 1990. The level of emissions in 2020 exceeds that of 2016; emissions decrease slightly after 2020.

If the individual gases are considered, it can be seen that, relatively speaking, the emission reduction measures have the greatest impact on methane emissions. There is a reduction in these emissions of over 90 % between 1990 and 2035. In the case of CO_2, emissions are higher in 2035 than in 1990 under the WMS. Nitrous oxide emissions also increase; CO_2 remains by far the most predominant gas, accounting for 99 % of total emissions from the transport sector in both 1990 and 2035.

4.2.6 Private households – heating and cooling, appliances

Up to 2035, emissions from heating, cooling and appliances in private households decline to about 49 Mt CO_2e under the WMS. This equates to a reduction of almost 63 % compared to 1990. It is a reduction of about 56 % compared with 2005. Emissions in 2020 are about 79 Mt CO_2e, a decrease of about 40 % compared with 1990. The decline in heating oil demand is the driver behind the emission reduction.

If the individual gases are considered, it will be seen that the emission reduction measures impact mainly on CO_2 and N_2O emissions. Compared with 1990, the reduction in N_2O emissions is the highest at 75 %, followed by the reduction in CH_4 emissions, which fall by 68 %, and in CO_2 emissions which fall by 62 %. CO_2 remains by far the most predominant gas, accounting for 98 % of the total emissions from the household sector both in 1990 and in 2035.

4.2.7 Private households – electricity consumption

Private households experience a continual decrease in electricity consumption under the WMS – from roughly 112 TWh in 2016 to about 104 TWh in 2035.

A relatively consistent number of appliances is assumed for white goods. The increase in consumption brought about by additional appliances resulting from the rise in the number of households is more than offset by the anticipated decrease in electricity consumption as a result of greater efficiency. The opposite is the case with ICT devices: despite the sometimes considerable decrease in energy consumption by most ICT devices, the markedly higher number of appliances brings about a significant increase in energy consumption. In the area of lighting, the change to LED technology brings about markedly lower specific consumption. Their level of usage remains roughly the same, which means that electricity consumption drops continuously. By contrast, both a marked rise in numbers of appliances and higher power ratings is assumed for air-conditioning. As a result, the power consumption for air conditioning systems will rise significantly up to 2035.

4.2.8 Trade, commerce and services – heating and cooling, appliances and processes

CO_2, CH_4 and N_2O emissions in the trade, commerce and services sector (heating and cooling, appliances and processes) fall to about 27 Mt CO_2e under the WMS. This equates to a reduction of about 70 % compared to 1990. Emissions in 2020 under both scenarios are about 44 Mt CO_2e, a decrease of roughly 50 % compared with 1990.

When the individual gases are considered, it is noticeable that the greatest reduction in emissions for CH_4 occurred after 1990 and that there was an increase after 2005. These emissions stay at a comparable level from 2016 to 2035 but are still around 80 % below the 1990 level. CO_2 emissions fall by 69 % by 2035 compared to 1990, N_2O emissions by 60 %.

4.2.9 Industry

CO_2, CH_4 and N_2O emissions in industry (not including industrial power plants, but including construction transport) fall to about 57 Mt CO_2e under the WMS. This equates to a reduction of almost 51 % compared to 1990 under the WMS. By 2035, emissions are 22 % down on 2005 under the WMS. The main drivers for the trend in industrial emissions are industrial production, the switch to recycling-based production routes, the use of different energy sources and the use of energy-efficient technologies.

CO_2 remains by far the most predominant gas, accounting for 99 % of total emissions by industry in both 1990 and 2035.

4.2.10 Industrial processes and use of products (CO_2, CH_4 and N_2O emissions)

CO_2, CH_4 and N_2O emissions in the industrial processes and product use sector fall to about 39 Mt CO_2e under the WMS. This equates to a reduction of 53 % compared to 1990. Emissions in this sector had already fallen by 46 % in the past, from 83.6 Mt CO_2e in 1990 to 45.7 Mt CO_2e in 2016.

Most of the historical reduction in CO_2, CH_4 and N_2O emissions from industrial processes was achieved in the chemical industry, followed by metal production. By comparison, considerably lower changes in emissions are projected for the future. CO_2 is by far the dominant gas in 2035, accounting for 96 % of total emissions. Emissions of N_2O and CH_4 remain at a low level between 2016 and 2035.

4.2.11 Industrial processes and use of products (fluorinated greenhouse gases)

Emissions of fluorinated greenhouse gases from industrial processes and product use fall to less than 5 Mt CO_2e by 2035 under the WMS. This corresponds to a reduction of almost 72 % compared to 1995, which is the base year for German F-gas emissions under the Kyoto Protocol. It is a reduction of about 66 % compared with 2005. Emissions in 2020 under the WMS are about 14 Mt CO_2, a decrease of roughly17 % compared with 1995.

If the individual groups of gases are considered, it can be seen that the emissions in 2035 are lower than in 1995 in the case of PFCs, SF_6 and the unspecified mix only. The period between 1995 and 2015 was characterised by a steep increase in HFC use and HFC emissions, and a decline in PFC and SF_6 emissions. Marked reductions in emissions of HFCs and SF_6 primarily can be expected by 2035. NF_3 emissions are not significant in quantitative terms by comparison with the other fluorinated greenhouse gases. HFC emissions have accounted for the largest share of total emissions since 2005; their share was 72 % in 2016 and in 2035 it is 71 % under the WMS.

4.2.12 Agriculture

By 2016, emissions from agriculture were almost 18 % lower than in 1990, but they were 3 % higher than in 2005. By 2020, emissions under the WMS fall by 20 % compared with 1990 to over 63 Mt CO_2e. Emissions are expected to fall by almost 23 % by 2035 compared to 1990 to 61.5 Mt CO_2e. The changes in emissions apply relatively evenly to all greenhouse gases so that there are only slight shifts in the percentage shares in emissions from agriculture accounted for by CO_2, CH_4 and N_2O.

4.2.13 LULUCF

Changes in the use of wood and a shift in the distribution of age classes of trees with the resulting reduction in tree growth cause the forests' sink effect to be reduced, falling from its

original level of about 75 Mt CO_2e in 1990 to a minimum of about 12 Mt CO_2e in 2020, after which there is a slight increase once more. In 2035, the forests' sink effect is over 21 Mt CO_2e.

Overall, the LULUCF sector changes from being a sink to being a source of greenhouse gases in the period between 2016 (-14 Mt CO_2e) and 2020 (+30 Mt CO_2e). Based on the assumption that there will be no more relevant conversion of grassland to arable land from 2016 onwards, emissions from arable land decrease considerably up to 2035. There are only minor changes in emissions from other land-use sectors. The changes in greenhouse gas emissions resulting from the expected changes in forest carbon stocks surpass all changes connected to measures in other land-use sectors under the scenario examined. In 2035, the cumulative greenhouse gas emissions forecast for the LULUCF sector are also positive at approximately 19 Mt CO_2e.

When assessing forestry's contribution to climate change mitigation, it must be kept in mind that emissions that are avoided by producing materials from wood that is directly related to the raw material supplied by the forestry sector are not classified under the LULUCF source category. Instead, the reduced emissions are reflected in other sectors or source categories. However, these lower emissions are directly linked to a negative impact on the balance in the LULUCF sector.

4.2.14 Waste management

Residual methane emissions from landfills are the predominant component of greenhouse gas emissions from the waste management and wastewater sector. Because landfilling untreated waste was phased out in 2005 – a measure that was publicised a long time in advance – these emissions have been steadily decreasing since 1990. Since 2005, the volumes of waste that are still sent to landfill are for the most part pre-treated (incineration, biological-mechanical treatment) household waste, commercial waste similar to household waste, and waste from industry, consisting predominantly of the inert fractions. The methane and nitrous oxide emissions from other sources, especially composting, biological-mechanical waste treatment and municipal wastewater differ only marginally from these emissions.

By 2016, emissions from the waste management sector had already fallen by 73 % compared to 1990 (28 Mt CO_2e) to 10.5 Mt CO_2e. By 2020, emissions fall by between 77.5 % compared with 1990 to about 8.6 Mt CO_2e. By 2035, reductions of 86 % compared with 1990 are achieved, with emissions falling to approximately 5 Mt CO_2e. Future reductions are in methane emissions, which are almost 2 Mt CO_2e lower in 2020 than in 2016. Under the WMS, methane emissions are reduced by 5 Mt CO_2e by 2035 compared with 2016 .

4.3 Estimate of the aggregate impact of strategies and measures

4.3.1 Impact of the individual measures in the with-measures scenario

Table 3 shows the reduction effects of the quantified instruments in the with-measures scenario. It should be noted that some of the instruments in the demand sectors do not lead to a reduction in direct emissions – at least not exclusively – but reduce electricity consumption (especially in households). The overall impact of this reduction is quantified in the energy industry sector (electricity savings resulting from measures in other sectors).

Table 3: Direct emissions reduction achieved through climate policy instruments under the WMS, summarised by sector

Direct emissions reductions by all measures under the WMS in each sector

(Mt CO_2e)	2020	2025	2030	2035
Energy industry	130.8	140.0	157.0	169.0
Industry	9.8	14.9	16.4	14.7
Buildings (households and trade, commerce and services)	6.1	16.5	26.4	34.8
Households	0	0	0	0
Transport	1.1	1.2	1.1	1.2
Fugitive emissions from fuels	0	0	0	0
Industrial processes (including F-gases)	16.6	20.9	26.4	27.7
Agriculture	3.1	4.2	4.6	4.6
Waste management	0.0	0.3	0.4	0.4
Total	**167.5**	**198.0**	**232.3**	**252.4**
LULUCF	-0.9	-2.5	-3.9	-4.9
Total with LULUCF	**166.6**	**195.5**	**228.4**	**247.5**

4.4 Trends in total greenhouse gas emissions and their components

Trends in greenhouse gas emissions are aggregated below in two different ways. On the one hand, the contributions made by the different greenhouse gases are depicted and, on the other, the contributions made by the individual source categories are shown. Each of these depictions shows the total greenhouse gas emissions defined in two different ways: with and without emissions from deep-sea shipping and international aviation, and with and without release or sequestration of greenhouse gases in the land use, land-use change and forestry sector (LULUCF). The two types of international transport are included in the national Greenhouse Gas Inventories, but only for information. As a rule, emissions from international fuel bunkers (deep-sea shipping and international aviation) and LULUCF do not count towards meeting climate targets in Germany; this report follows this convention.

Figure 8 (Section 4.2.1) summarises the main projection results for trends in total greenhouse gas emissions. It shows the raw inventory data for the historical reference years 1990 to 2016. From 2020 onwards it shows the projections.

4.4.1 Results of the projection under the with-measures scenario

4.4.1.1 Trends in greenhouse gas emissions by type of gas

CTF Table 6(a) shows a summary of trends in emissions of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3). This summary does not include greenhouse gas emissions from international fuel bunkers (deep-sea shipping and international aviation) and LULUCF.

By 2016, domestic greenhouse gas emissions were already just less than 27 % down on 1990 and over 8 % down on 2005 in the national balance. Compared with the 1990 reference year, total greenhouse gas emissions fall by just under 33 % (almost -16 % compared with 2005) from 1,252 to 836 Mt CO_2e up to 2020 and by almost 42 % (-26 % compared with 2005) to 730 Mt CO_2e up to 2030. The German government's goal to reduce greenhouse gas emissions by 40 % by 2020 and by 55 % by 2030 compared with 1990 is thus not achieved under the with-measures scenario.

Between 1990 and 2016, annual emissions of carbon dioxide[43] were cut by almost 24 %. CO_2 emissions are 42 % lower in 2035 than in 1990. Both historically and in the projection, CO_2 is the gas with the largest share in Germany's total greenhouse gas emissions.

The greatest reductions in methane emissions have already been achieved in the past: CH_4 was, after CO_2, the most important greenhouse gas in 1990, with a share in total emissions of almost 10 %. However, since a 55 % cut in CH_4 emissions had been achieved by 2016, their share in total emissions fell to only slightly more than 6 %. By 2035, CH_4 emissions are a good 62 % down on 1990. However, since the emissions reductions here are disproportionately low, especially from 2020, their percentage rises again slightly to just below 7 % up to 2035.

Nitrous oxide's share in total greenhouse gas emissions was over 5 % in 1990. Here too an approximately 42 % cut was achieved by 2016, so that its share in total emissions fell from 5 % to 4 %. However, by contrast with methane, there have been no further reductions in emissions for nitrous oxide. In 2035, N_2O emissions are only slightly lower than in 2016. Their percentage share therefore rises once more to just under 5 % in 2035.

In 1990, fluorinated gases accounted for 1.1 % of total greenhouse gas emissions; by 2016, this figure had risen to 1.7 %. By 2035, their share will fall to 0.7 %.[44]

The reductions compared with Kyoto Protocol base year emissions (1990 for CO_2, CH_4 and N_2O and 1995 for fluorinated gases) are in each case slighter higher than emissions reductions from 1990 levels.

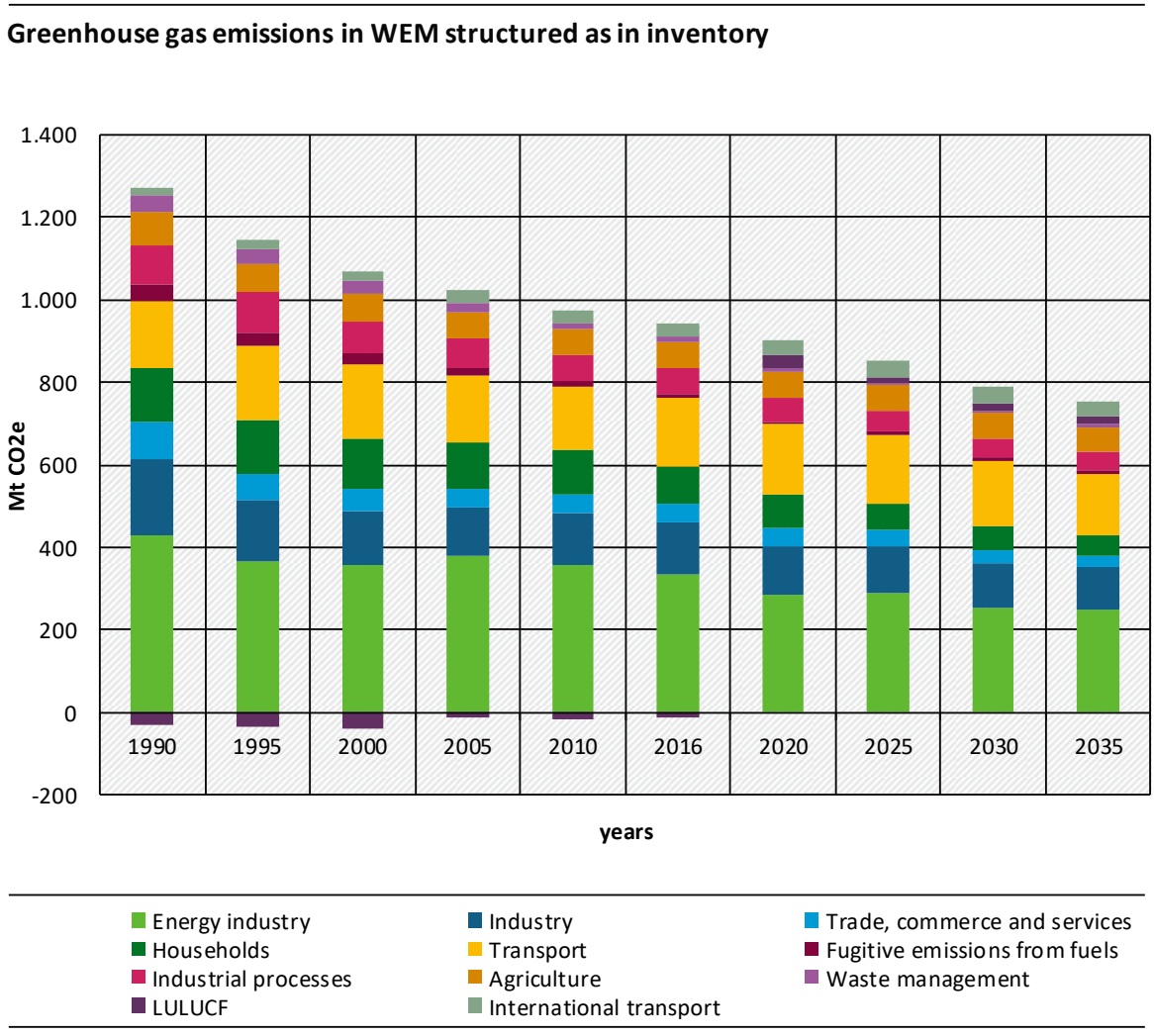
4.4.1.2 Trends in greenhouse gas emissions by category

Table 4, Figure 9 and CTF Table 6a provide an overview of emission trends under the with-measures scenario, broken down by category. Considering domestic emissions, but not including international aviation and maritime transport and LULUCF, greenhouse gas emissions fell by about 27 % up to 2016 compared with 1990 and by over 8 % compared with 2005. By 2020, emissions fall by about 33 % compared with 1990 (16 % down on 2005) and by 2035 they fall by over 44 % compared with 1990 (30 % down on 2005) to 698 Mt CO_2e.

[43] CO_2 emissions from combustion of biomass are not included here or in any of the CO_2 emissions discussed in this report.

[44] Hydrofluorocarbons (HFCs) were the major group within the fluorinated greenhouse gases in 2016. HFC emissions more than quadrupled between 1995 (the reference year for fluorinated greenhouse gases) and 2016. However, since HFC emissions will fall again considerably in the future, emissions of 69 % below 2016 levels will be achieved in 2035, which is nevertheless still higher than 1995 levels. Emissions of perfluorocarbons (PFCs) had already been cut by 88 % by 2016 compared with 1995 levels; only slight reductions are expected in the future. By 2016, sulphur hexafluoride (SF_6) emissions had been cut by about 40 % from their 1995 level. However, since an initial increase in SF_6 emissions is projected, their 2020 level will be only 31 % below their 1995 level. On the other hand, a very marked decline is expected from 2020, so that by 2035 SF_6 emissions may be 85 % lower than in 1995. By 2016, there had already been a reduction of over 97 % compared to 1995 in the unspecified mix of HFCs and PFCs. These emissions will remain at roughly this level. Emissions of nitrogen trifluoride (NF_3) reached their highest level in 2010, but in 2016 they were still several times higher than in 1995. However, NF_3 will continue to be of negligible importance in the future.

Figure 9: Trends in total greenhouse gas emissions by source category under the WMS (1990-2035)



Quelle: historic data from national GHG inventory; projection by Öko-Institut/Fraunhofer-ISI

Source: 2019 Projections Report for Germany in accordance with Regulation (EU) No 525/201345

Table 4: Trends in total greenhouse gas emissions by source category under the WMS, 1990-2035

By category

(Mt CO_2-Äquivalente)	1990	2005	2010	2014	2020	2025	2030	2035
Energiewirtschaft	427.4	379.4	356.9	332.2	286.1	290.3	255.1	247.8
Industrie	186.7	115.3	125.1	126.4	118.0	112.0	107.1	103.4
GHD	88.4	47.8	47.6	45.1	44.0	38.3	32.5	27.0
Haushalte	131.9	112.0	107.0	91.5	78.9	65.0	55.9	49.4
Verkehr	164.4	161.4	154.2	166.8	171.2	166.5	160.3	152.1

[45] Online: http://cdr.eionet.europa.eu/de/eu/mmr/art04-13-14_lcds_pams_projections/projections/envwqc4_g/170426_PB_2017_-_final.pdf/manage_document .

(Mt CO_2-Äquivalente)	1990	2005	2010	2014	2020	2025	2030	2035
Diffuse Emissionen aus Brennstoffen	38.0	16.4	11.3	10.0	7.3	7.0	6.7	6.4
Industrieprozesse	97.1	76.3	63.4	61.8	58.2	52.4	45.4	44.5
Landwirtschaft	79.4	63.3	62.6	65.2	63.2	62.0	61.5	61.5
Abfallwirtschaft	38.4	21.2	14.6	10.5	8.6	6.8	5.5	5.4
Gesamt	**1,251.6**	**993.1**	**942.8**	**909.4**	**835.6**	**800.4**	**730.0**	**697.6**
ggü. 2005	**26.0 %**	**0.0 %**	**-5.1 %**	**-8.4 %**	**-15.9 %**	**-19.4 %**	**-26.5 %**	**-29.8 %**
ggü. 1990	**0.0 %**	**-20.7 %**	**-24.7 %**	**-27.3 %**	**-33.2 %**	**-36.0 %**	**-41.7 %**	**-44.3 %**
ggü. Basisjahr[a]	**-0.3 %**	**-20.9 %**	**-24.9 %**	**-27.6 %**	**-33.4 %**	**-36.2 %**	**-41.8 %**	**-44.4 %**
Nachrichtlich:								
LULUCF	-31.3	-12.1	-16.4	-14.5	29.5	11.3	19.0	18.8
Internationaler Luft- und Seeverkehr	18.6	30.1	32.5	34.7	36.9	39.5	41.1	39.3
Gesamt inklusive nachrichtlich	**1,238.9**	**1,011.2**	**958.9**	**929.7**	**902.1**	**851.2**	**790.1**	**755.6**
ggü. 2005	**22.5 %**	**0.0 %**	**-5.2 %**	**-8.1 %**	**-10.8 %**	**-15.8 %**	**-21.9 %**	**-25.3 %**
ggü. 1990	**0.0 %**	**-18.4 %**	**-22.6 %**	**-25.0 %**	**-27.2 %**	**-31.3 %**	**-36.2 %**	**-39.0 %**
ggü. Basisjahr[a]	**-0.3 %**	**-18.6 %**	**-22.8 %**	**-25.2 %**	**-27.4 %**	**-31.5 %**	**-36.4 %**	**-39.2 %**

Source: 2019 Projections Report for Germany in accordance with Regulation (EU) No 525/2013[46]

The energy industry accounted for the largest share of emission reductions achieved between 2016 and 2035. In this sector, emissions fall in absolute terms by 46 Mt CO_2e by 2020 compared with 2016 and by 84 Mt CO_2e by 2035. That equates to a 14 % reduction in 2020 compared with 2016 (-33 % compared with 1990) and represents a 25 % reduction in 2035 (-42 % compared with in 1990). Whereas the energy industry's share in total emissions (not counting international transport and LULUCF) rose from just over 34 % in 1990 to almost 37 % in 2016, it falls to just under 36 % by 2035.

Energy-related industrial emissions fall by 8 Mt CO_2e or 7 % between 2016 and 2020 (37 % below their 1990 level), and then fall by 23 Mt CO_2e or 18 % from their 2016 level by 2035 (45 % down on 1990). Overall, industrial emissions' share rises from over 14 % in 2016 to almost 15 % in 2035.

Greenhouse gas emissions from the trade, commerce and services sector fall by about 1 Mt CO_2e or 2 % up to 2020 compared with 2016 (-49 % compared with 1990) and then decline by 18 Mt CO_2e or 40 % up to 2035 compared with 2016 (-69 % compared with 1990). The trade, commerce and services sector's share in total emissions remains at about 4 %.

Private households make the second largest contribution to the projected reduction in emissions: they reduce their emissions by 14 % or 13 Mt CO_2e between 2016 and 2020 (40 %

[46] Online: http://cdr.eionet.europa.eu/de/eu/mmr/art04-13-14_lcds_pams_projections/projections/envwqc4_g/170426_PB_2017_-_final.pdf/manage_document .

down on 1990) and by 46 % or 42 Mt CO_2e up to 2035 (63 % below 1990 levels). Furthermore, private households' share falls from 10 % in 2016 to 7 % in 2035.

Only minor emissions reductions are achieved in the transport sector. Up to 2020, emissions continue to rise; after that there is a reduction up to 2035 of 15 Mt CO_2e or 9 % compared with 2016 (-7 % compared with 1990). Nevertheless the historical trend in transport emissions – i.e. an increase in their share in overall emissions – continues: whereas in 1990 transport's share in total emissions was just over 13 %, by 2016 it had risen to almost 18 % and is just under 22 % in 2035. It must also be noted that, due to the expansion of electric mobility, some of the emissions from the transport sector are shifted to the energy industry, because public electricity generation is accounted for in the latter.

In absolute terms, reductions in fugitive emissions from the energy sector are low, but they are high in relative terms. Emissions reductions of 3 Mt CO_2e between 2016 and 2020 and of 4 Mt CO_2e up to 2035 equate to decreases from 2016 levels of 27 % in 2020 (81 % down on 1990) and 35 % in 2035 (83 % down on 1990). The relative percentage remains the same at around 1 %.

Emissions from industrial processes were the most important of all the non-energy-related emissions in 1990, accounting for almost 8 % of total emissions; in 2016 their share had fallen to just under 7 %. This percentage falls to just over 6 % by 2035. Overall, emissions from industrial processes fall by almost 4 Mt CO_2e or 6 % between 2016 and 2020 (40 % down on 1990) and by 17 Mt CO_2e or 28 % by 2035 (54 % down on 1990).

Although emissions from agriculture decreased between 1990 and 2016, it has nevertheless become the most important source of greenhouse gases apart from the energy sector. Furthermore, agriculture is the sector with the lowest projected emissions reduction: 2 Mt CO_2e or 3 % by 2020 compared with 2016 (20 % down on 1990) and just over 4 Mt CO_2e or 6 % by 2035 compared with 2016 (23 % down on 1990). This also means that agriculture's share in total emissions rose from over 6 % in 1990 to 7 % in 2016 and reaches almost 9 % in 2035.

Waste management is the sector with the historically highest emissions reductions in relative terms, experiencing an almost 73 % decline in emissions between 1990 and 2016. Nevertheless, emissions from the waste management sector are reduced by a further 2 Mt CO_2e or 18 % between 2016 and 2020 and by 5 Mt CO_2e or 48 % by 2035 compared with 2016. This means that waste management continues to be the sector with the greatest emissions reductions in relative terms – 77 % in 2020 and 87 % in 2035 (compared with 1990 levels).

The rise in agricultural emissions and only slight decrease in emissions from the waste management sector explain the below-average decrease in methane and nitrous oxide emissions described in section 1.

Whereas in the past the LULUCF sector was an overall sink, in the projection it is a source of emissions. For more information on this please refer to section 1.

Emissions from the proportion of international aviation and maritime transport that is attributable to Germany rose by 87 % between 1990 and 2016. These emissions rise by a further 2 Mt CO_2 or 6 % up to 2020 and by 7 Mt CO_2e or 25 % up to 2035 compared with 2016. This means that emissions from international aviation and maritime transport will be 87 % higher in 2020 than in 1990 and in 2035 they will even be more than twice as high as in 1990.

Taking international maritime transport and aviation into account, emissions in 2016 were 25 % and 8 % lower than in 1990 and 2005 respectively and fall by 27 % by 2020 compared with 1990 (-11 % compared with 2005) and by 39 % by 2035 (-25 % compared with 2005).

5 Financial and technical support and capacity-building in developing countries

5.1 Climate finance

5.1.1 General principles and assumptions

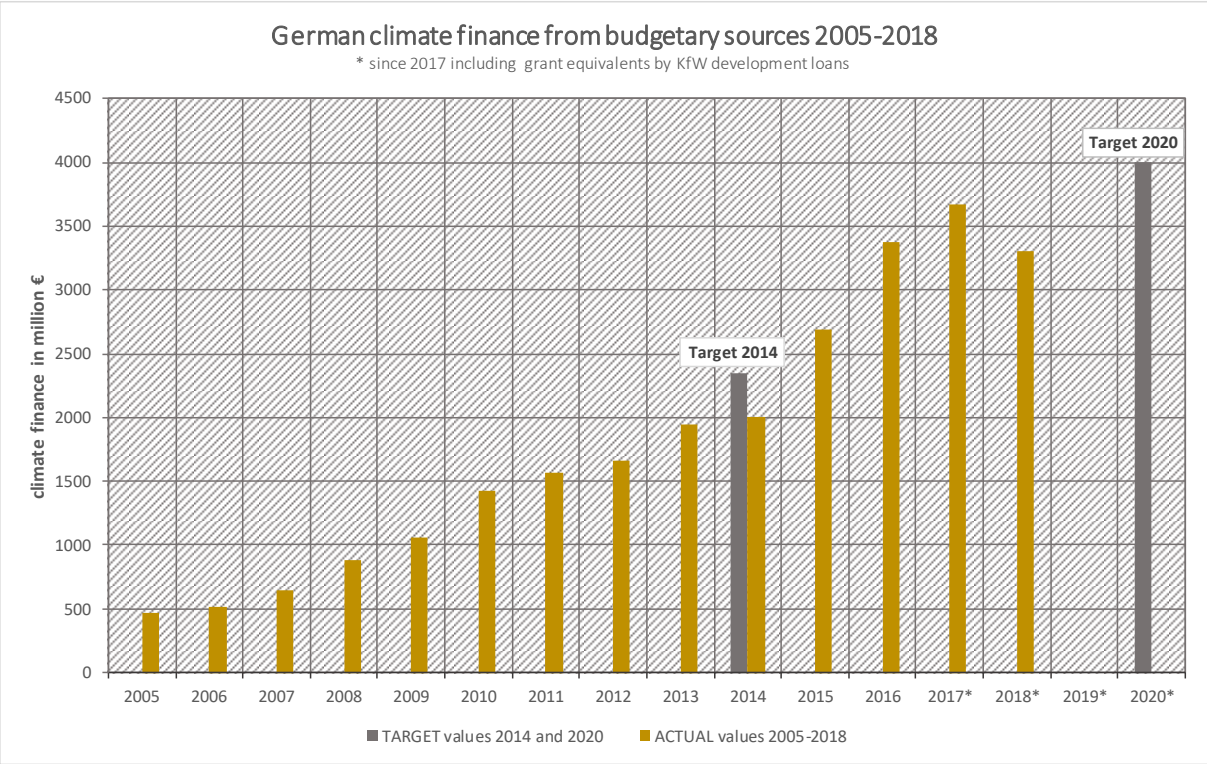
A commitment to climate action and to development go hand in hand. Germany regards supporting developing countries, emerging economies and transition countries with climate change adaptation and mitigation to be closely linked to implementing the Paris Agreement and Agenda 2030. The impacts of increasingly severe climate change directly affect everyone's living conditions and their development opportunities. It is imperative that growth and development strategies aim to achieve greenhouse gas neutrality and decarbonisation of the economy.

5.1.2 Overview of climate finance 2017–2018

The German government remains committed to its financial pledges and since 2005 has markedly increased its financial support for developing countries, emerging economies and transition countries to reduce greenhouse gas emissions (GHGs), adapt to the impacts of climate change and protect forests and biodiversity, including sustainable management of forests as a contribution to mitigating climate change (REDD+).[47] 2018 was the first time since 2005 that there was a slight reduction in contributions from budgetary funds compared with the previous year. This is due to the development of the country programmes that BMZ has agreed in partnership with the partner countries. Germany remains committed to Chancellor Merkel's 2015 pledge to double Germany's contribution to international climate finance by 2020 – from the 2014 target value of EUR 2 billion to EUR 4 billion (budgetary sources and grant equivalents from development loans).

[47] Full English title: Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries.

Figure 10: German climate finance from budgetary sources 2005-2018 (in EUR millions)



Source: BMZ graphic.

In 2017, Germany provided budgetary resources amounting to EUR 3.627 billion (USD 4.089 billion[48]) for international climate finance. Grant equivalents of development loans were recorded and reported for the first time in 2017. They totalled EUR 556 million (USD 626 million) in 2017. In addition, it pledged EUR 3.079 billion (USD 3.471 billion) in mobilised public finance from capital resources (c.f. explanations section 5.1.3.1.1) through KfW Development Bank and Deutsche Investitions- und Entwicklungsgesellschaft mbH (DEG). Thus, public climate finance totalled around EUR 6.706 billion (USD 7.559 billion). In addition, the use of public funds enabled climate finance to be mobilised through KfW and DEG totalling EUR 486 million (USD 548 million) in 2017 (calculated using the OECD DAC methodology).

Germany's international climate finance from budgetary funds was EUR 3.3 billion (USD 3.895 billion) in 2018. In addition, funds in the amount of EUR 23 million (USD 26 million) were made available in 2017 for the Annex I countries Ukraine, Turkey and Belarus, and EUR 66 million (USD 78 million) in 2018 for the Annex I countries Ukraine, Turkey, Russia and Belarus.

The grant equivalent share was EUR 319 million (USD 377 million) in 2018.

In addition, the public climate finance mobilised through KfW Development Bank and DEG totalled EUR 3.246 billion or USD 3.831. Private climate finance mobilised through the use of public funds through KfW and DEG totalled EUR 468 million (USD 552 million) in 2018.

Germany has increased its contribution to climate finance from budgetary sources almost sevenfold since 2005. This also reflects the successful mainstreaming of climate-related issues in its development cooperation efforts.

[48] Conversion using the official OECD exchange rates for 2017 and 2018: https://data.oecd.org/conversion/exchange-rates.htm. In the case of contributions to multilateral funds (e.g. the GCF or GEF), the official exchange rate for the replenishment round in question was used.

5.1.3 German climate finance instruments, institutions and initiatives

The German government uses a broad range of instruments and institutions for its international cooperation activities in the field of climate and development:

- Bilateral financial, technical and academic cooperation: German climate finance focuses on bilateral cooperation. From 2017 to 2018, an average of 85 % of the budgetary resources allocated to climate finance were spent for this purpose.
- Multilateral cooperation, such as the Green Climate Fund (GCF), the Climate Investment Funds (CIFs), the Adaptation Fund (AF), the Global Environment Facility (GEF) and the Forest Carbon Partnership Facility (FCPF) as cooperation with multilateral development banks and United Nations organisations.

During the reporting period for the Biennial Report, Germany set important priorities by instigating and/or providing comprehensive support for international initiatives designed to drive forward the rapid and ambitious implementation of the Paris Climate Agreement. Particularly worthy of highlighting here are the effectiveness of the NDC (Nationally Determined Contributions) Partnership (see Section b)), the InsuResilience Global Partnership, which is a G20/V20 initiative on financing and insurance for climate risk (see Section 5.1.5.2), the Africa Renewable Energy Initiative (AREI), the NAMA Facility and the AFR100 initiative (see Section 5.1.6.6).

5.1.3.1.1 Methodology used to measure German climate finance

Germany attaches great importance to measuring and communicating its climate finance transparently and comprehensively. For this reason, it has reported its bilateral climate finance in Table 7b on a project-specific basis in order to depict the individual projects in as much detail as possible. In addition, supplementary information on the individual projects can be found on the BMZ,[49] BMU[50] and BMBF[51] websites.

The climate finance calculated consists exclusively of new commitments and resources disbursed in the reporting year. New and additional means all funds newly pledged ordisbursed in the reporting year. Thus, all the climate finance reported in Tables 7, 7a and 7b is new and additional.

Since 2013, Germany has reported on its total public climate finance, including mobilised climate finance. Since 2015, it has presented the mobilised public climate finance on a project-specific basis.

Germany distinguishes between two sub-categories of public climate finance:

a) Public financing from budgetary funds, including grant equivalents in KfW development loans. Climate finance provided from the public budget is recorded in this category. Grant equivalents in development loans have been recorded and reported since 2017. The term grant equivalent refers to the difference between the nominal value of a loan and the present value of the debt service (repayment of principal and interest payments discounted at rates set by the Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC)). Thus, a grant equivalent is a notional value which is used to quantify the value of a concessionary loan. To prevent double counting, the grant equivalents are deducted from KfW's development loans (see category b). Since the

[49] www.bmz.de/climatefinance

[50] www.international-climate-initiative.com/en/projects

[51] https://www.fona.de/en/

interest rate subsidies from budgetary funds, which are used to leverage KfW's development loans, are reported in a form that is aggregated by region,[52] they are deducted from the grant equivalents. Furthermore, since the 2014 report, the imputed climate-relevant contributions to the funds of the multilateral development banks (MDBs) were recorded for the first time using the methodology developed by the OECD Joint ENVIRONET and WP-STAT Task Team to Improve Rio Markers, Environment and Development Finance Statistics.

b) Mobilised public finance is the climate-related loan finance from KfW Development Bank's market funds and DEG's own resources generated from public budgetary funds. It takes the form of finance streams that count as Overseas Development Assistance (ODA), usually as concessional loans.

A third category consists of private climate finance mobilised by public funds. The private climate finance mobilised by the German government currently consists predominantly of revolving credit lines to local (development) banks, investments in structured funds and public-private partnerships.

Germany currently reports on mobilised private climate finance only in those areas and for those finance instruments for which there are reporting methods that have already been agreed with OECD. Both DEG and KfW use such methods to calculate mobilised private finance.

To ensure transparent records of climate finance, Germany has used OECD climate markers, also known as Rio markers, since the 2011 reporting year. They are presented with a differentiation between different areas: reduction of greenhouse gases, adaptation to climate change and forest and biodiversity conservation, including REDD+. So far there are no separate international markers for REDD+.

Technology transfer and capacity building are components of virtually all of the German government's bilateral cooperation projects and cannot be categorised separately. Beacon projects with a special focus on technology transfer and capacity building can be found in CTF Tables 8 and 9.

The statistical data in CTF Tables 7, 7a and 7b in the Annex to this document include the funds allocated from public budgetary sources for all climate-related bilateral development cooperation projects that were approved in the year in question. Multilateral contributions to climate finance are treated as disbursements. Mobilised public finance is the climate-related loan finance from KfW Development Bank's market funds and DEG's own resources generated from public budgetary funds. It takes the form of finance streams that count as ODA, usually as concessional loans.

5.1.3.2 Support for Nationally Determined Contributions and the NDC Partnership

Through numerous measures from various ministries, the German government supports the implementation of NDCs, to which the Parties to the Paris Agreement committed. NDCs were a central reference point for Germany's climate-related development cooperation with regard to new pledges.

In order to quickly and effectively commence implementation of the NDCs and contribute to raising climate ambition, BMZ and BMU, in conjunction with Morocco, other industrialised countries and developing countries, and various international organisations, launched a global partnership to promote the implementation of NDCs at the end of 2016 (the NDC Partnership or

[52] Consolidated based on the regions funded as part of BMZ's bilateral cooperation in Asia, Southeast Europe/Caucasus, Latin America and the Caribbean, the Middle East and Africa.

NDCP).[53] The aim of the partnership is to support developing countries in bringing together their NDCs and Sustainable Development Goals (SDGs) and to help achieve more coordinated implementation of the various bilateral and multilateral donor programmes. The NDC Partnership is in principle open to all countries and international organisations that support its objectives and principles.[54]

Until the end of 2018, in the partnership's start-up phase, Germany and Morocco co-chaired the steering committee, passing this role on to the Netherlands and Costa Rica at COP24. The multilateral partnership continues to develop very dynamically: a total of 91 countries, 21 international organisations and development banks and 10 associated members have joined the partnership.[55]

Work at national level within the NDC Partnership[56] got off the ground in over 40 member countries and three regional initiatives during the reporting period. The objective is to draw up national partnership plans, which compare what a given country needs in support to implement its NDCs with the contributions made by donor-funded projects. The plans and their development offer an opportunity of improving both the cooperation between national actors to prioritise national climate targets and donor coordination. By the end of 2018 partnership plans that operationalise NDC implementation and address the partners' priority needs had been drawn up.

To support it in organisational terms, Germany finances a support unit for the NDC partnership in conjunction with Denmark, the United Kingdom, France and Australia. In addition to the ongoing orientation of the International Climate Initiative (IKI) and the climate-relevant bilateral development cooperation towards the NDC partnership plans, the German government has also made funding contributions available to directly support the partnership. BMZ provides a total of EUR 104 million (USD 123 million) in funding to World Bank, GIZ, WRI, UNDP and UNFCCC in order to achieve fast and flexible technical assistance at country level in the context of the NDCP. In the reporting period, BMU made EUR 96 million (USD 113 million) available to the NDC Partnership through a consortium of 11 implementing organisations with different expertise.

5.1.4 Allocation channels for delivering German climate finance

Germany provides a large part of its climate finance contributions – an average of about 84.5 % based on 2017 und 2018 figures – in the form of bilateral cooperation (see Figure 11**Fehler! Verweisquelle konnte nicht gefunden werden.**). In 2017, bilateral climate finance accounted for EUR 3.146 billion (USD 3.547 billion) and multilateral climate finance for EUR 480 million (USD 541 million). In 2018, a total of EUR 2.714 billion (USD 3.204 billion) went into bilateral climate finance and EUR 586 million (USD 692 million) into multilateral climate finance.

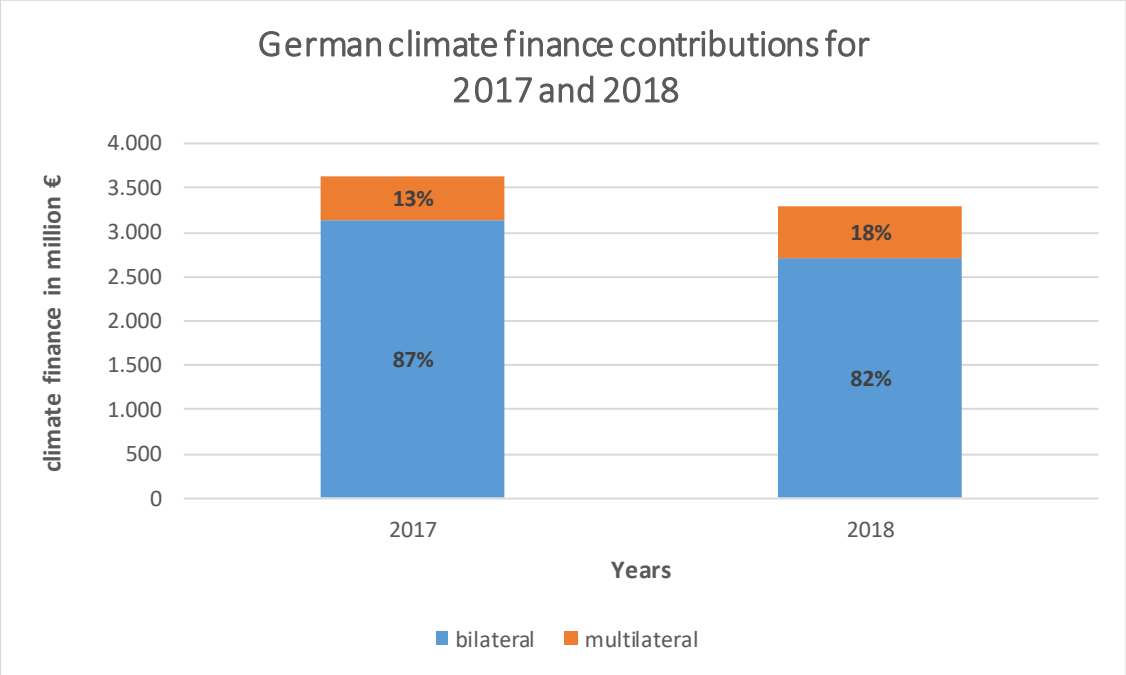
[53] http://www.ndcpartnership.org/ .

[54] These include: support country-driven processes, promote long-term climate action, enhance efficiency and responsiveness, build in-country capacity, improve coordination, enhance integration into national planning, advance adaptation and mitigation, align development and climate change, support multi-stakeholder engagement.

[55] http://www.ndcpartnership.org/partners - As at: 10 August 2017.

[56] Information on the country process and NDCP's country engagement strategy: https://ndcpartnership.org/country-engagement

Figure 11: German climate finance contributions from budgetary sources for 2017-2018 divided into bilateral and multilateral (in EUR millions and as a percentage)



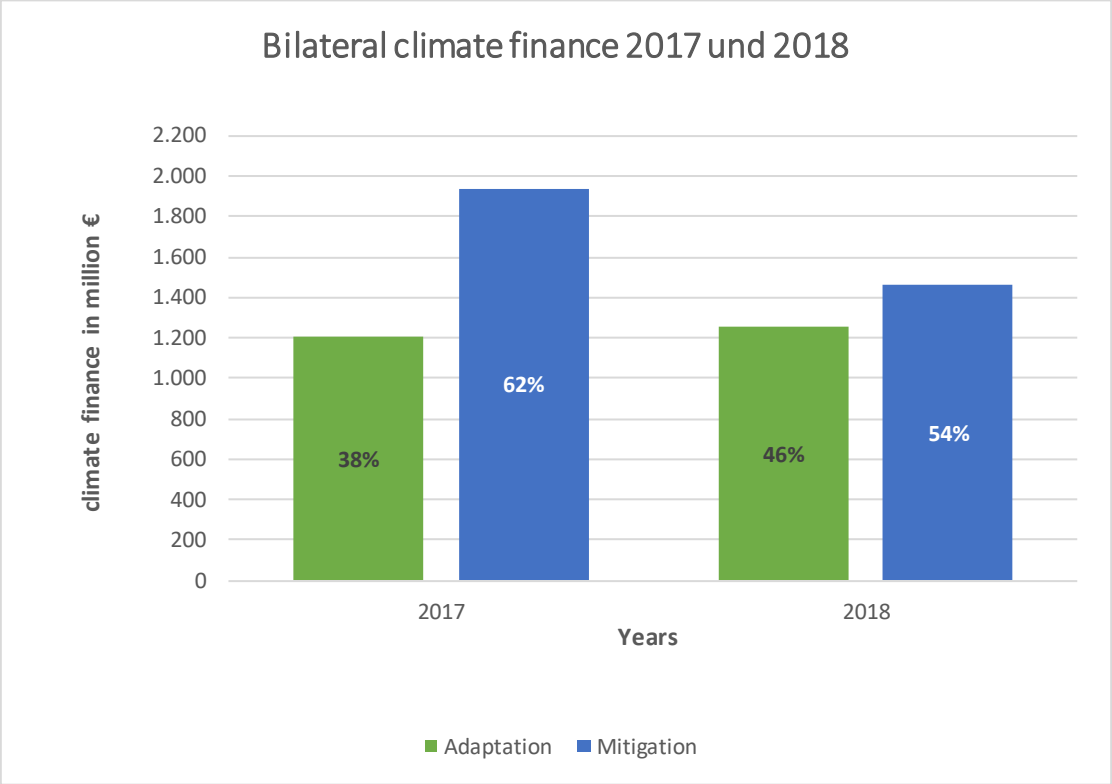
Source: BMZ graph

5.1.4.1 Bilateral cooperation

The German government has been even-handed in providing bilateral climate finance for emission reduction and climate change adaptation (Figure 12). About 38 % of bilateral climate finance was invested in adaptation measures and roughly 62 % in mitigation measures in 2017. In 2018, 46 % of the budgetary funds made available went into adaptation projects and 54 % into mitigation projects.

Figure 12: German bilateral climate finance from budgetary sources for 2017-2018, divided into adaptation and mitigation (in EUR millions and as a percentage)

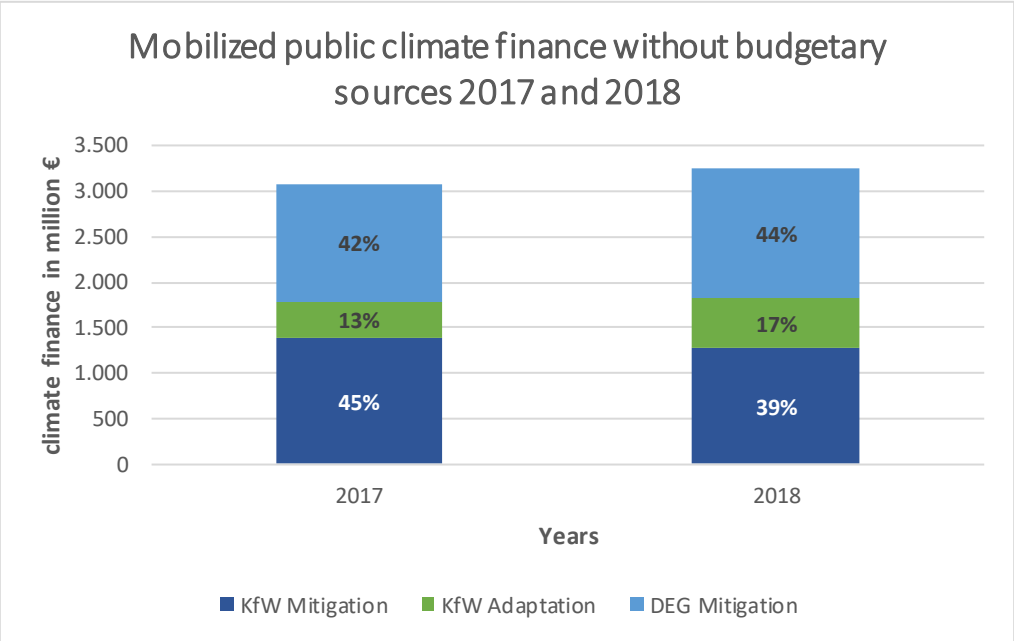
(as a percentage)



Source: BMZ graph

In addition to public climate finance from budgetary sources, Germany has since 2013 also reported on mobilised public climate finance, i.e. climate-related credit financed by KfW Development Bank and DEG that uses market funds. As can be seen in Figure 13, in addition to the budgetary funds deployed, a further EUR 3.079 billion (USD 3.471 billion) were pledged by KfW and DEG from capital market funds in 2017. In 2018, the public finance mobilised through KfW and DEG totalled EUR 3.246 billion or USD 3.831 billion.

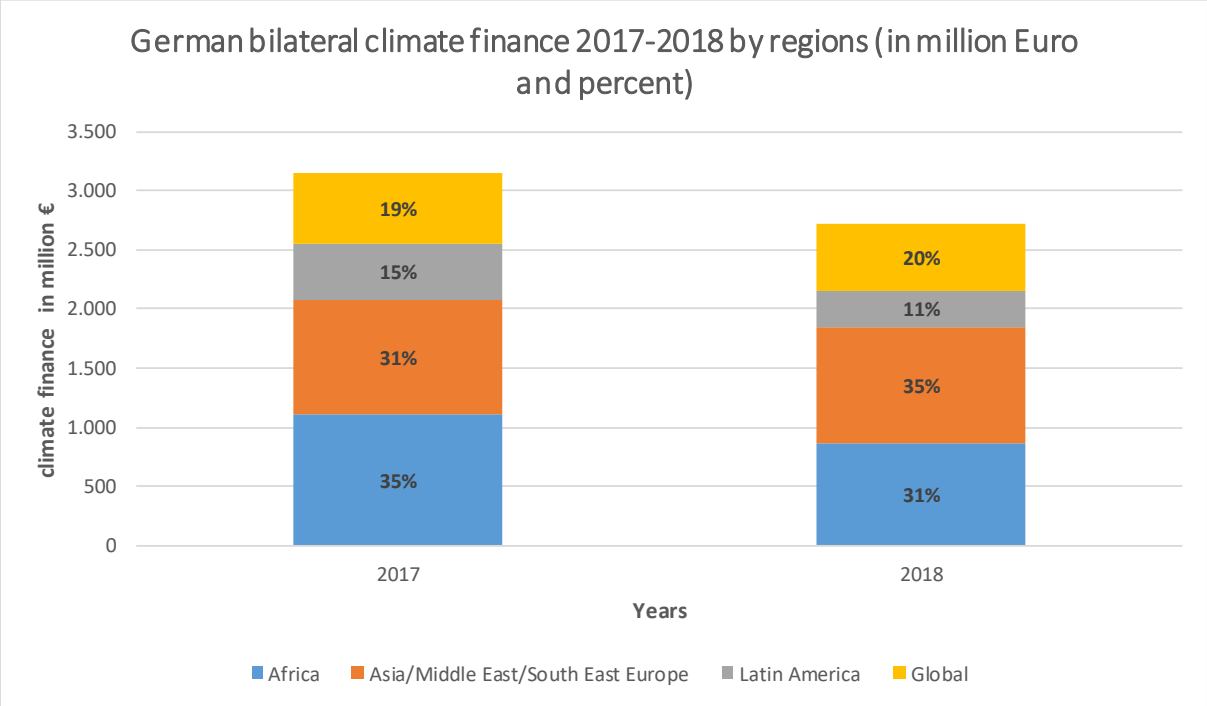
Figure 13: German finance sourced from mobilised public market funds for 2018 (as a percentage and in EUR millions)



Source: BMZ graphic.

The breakdown of the total bilateral climate finance of EUR 2.714 billion (USD 3.204) in 2018 is as follows: Germany supported partner governments in Africa with EUR 864 million (USD 1.019 billion), in the Asian, Middle East and South-East European regions with EUR 986 million (USD 1.164 billion), in Latin America and the Caribbean region with EUR 310 million (USD 366 million) and through global projects with EUR 554 million (USD 654 million). See Figure 14. Of the bilateral climate finance, which totalled EUR 3.146 billion (USD 3.547 billion) in 2017, Germany spent EUR 1.102 billion (USD 1.242 billion) on cooperation with African partner governments, EUR 979 million (USD 1.104 billion) in the Asian, Middle East and South-East European regions, EUR 469 million (USD 529 million) in Latin America and the Caribbean and EUR 596 million (USD 672million) for global projects. Again, see Figure 14.

Figure 14: Climate finance 2017-2018 from budgetary sources by region (as a percentage and in EUR millions)



Source: BMZ graphic.

5.1.4.2 Multilateral cooperation

Germany provides part of its climate financing through multilateral institutions as contributions to international climate funds and multilateral organisations. In addition to its role as donor, Germany also supports funds and multilateral development banks with regard to their strategic orientation and operational implementation in order to optimise their contribution to making the climate finance efficient and effective.

The funds supported by Germany that were directly set up under the United Nations Framework Convention on Climate Change and now also operate under the Paris Agreement include the GCF, AF; the GEF; the Least Developed Countries Fund (LDCF); and the Special Climate Change Fund (SCCF).

Germany also supports climate funds that exist independently of the Framework Convention on Climate Change. Among them are the World Bank CIFs, including the Pilot Programme for Climate Resilience (PPCR) and the FCPF. Germany also participates in the following funds of MDBs through its regular contributions: the International Development Association (IDA) of the World Bank, the African Development Fund (AfDF), the Asian Development Fund (AsDF) and various funds of the Caribbean Development Bank.

These contributions, as well as its contributions to the GEF, are included in German climate finance in accordance with the imputed climate-relevant shares established by these institutions. In addition, Germany supports United Nations programmes in implementing the global climate agenda through annual contributions and special initiatives.

Germany has announced it will double its original contribution to EUR 1.500 billion (USD 1.689) for the replenishment of the GCF. With its pledge of EUR 750 million (USD 1.003 billion), Germany was already one of the largest contributors to the fund in the phase that has been completed. As a member of the Board, it also participates actively in discussions on the institutional set-up and operational implementation of the Fund.

Germany pledged EUR 420 million (USD 496 million) for the Seventh Replenishment (2018–2022) and is thus the second-largest donor to the GEF after Japan. Ever since the GEF began publishing its imputed climate relevant share (2015), Germany has used it as a basis for calculating the GEF climate contribution. Germany serves as a member of the GEF Council, where it focuses particularly on harnessing synergies between the conventions dealt with in the GEF and the expansion of the effective results monitoring at project and programme level.

The German commitments to the LDCF total EUR 315 million (USD 372 million) (as at October 2019). In the reporting period, it paid roughly EUR 50 million (USD 59 million) into the Fund. This makes Germany the largest donor to the LDCF. In addition, Germany is providing technical advisory services on LDCF priorities, for example on innovative approaches in climate risk management, and also advising the Fund on designing project proposals. In this work, Germany is able to draw on its experience at country level to contribute to the strategic orientation and further development of the LDCF.

In total, Germany's commitments to the SCCF amount to EUR 90 million (USD 106 million) (as at October 2019), making it the largest donor. Germany made no further contributions to the Fund in the reporting period. Generally speaking, Germany concentrates its support on adaptation to climate change and provides advice on designing project proposals.

In 2017 and 2018, Germany paid a total of EUR 120 million (USD 142 million) into the AF and thus supports adaptation projects worldwide. In addition, Germany serves as a member of the Board, which is based Bonn. Through its active participation on the Board, Germany supports the strategic orientation as well as the operational implementation of the Fund.

The German contribution to the World Bank's CIFs totals EUR 550 million. With a contribution of EUR 500 million (USD 615 million) to the Clean Technology Fund (CTF) in the form of a loan, Germany is the Fund's fourth largest donor. Germany also supports the PPCR with a grant of EUR 50 million (USD 55.3 million). In addition to its financial contributions, Germany also plays an active part in the work of the CIFs.

Germany is a co-initiator of the FCPF and is currently the second largest donor, after Norway and ahead of the United Kingdom, with overall commitments of EUR 360.4 million (USD 425 million), of which EUR 350.4 million (USD 414 million) is from BMZ and EUR 10 million (USD 12 million) is from BMU). Germany has paid in EUR 100 million (USD 118 million) for the period 2017-2018. The pledges to the Multilateral Fund for the Implementation of the Montreal Protocol totalled USD 4.21 billion (as at: December 2018), with Germany's share standing at USD 398.8 billion. The German contribution in 2018 was EUR 23.8 million. (USD 28.1 million).

5.1.4.3 Multilateral financial institutions

Germany cooperates closely with multilateral financial institutions on climate change mitigation and adaptation. It facilitates intensive work by institutions on climate issues through capital contributions, regular contributions to funds of multilateral financial institutions and climate-specific trust funds. In addition, Germany promotes close cooperation with institutions in multilateral initiatives and partnerships, such as the above-mentioned NDC Partnership (see Section 5.1.3.2). In the executive bodies, Germany actively supports climate-related topics and clearly advocates a climate-oriented agenda.

Germany participates with regular contributions (core funding) to the following funds of MDBs: the IDA, the AfDF and the AsDF. These contributions are included in German climate finance in accordance with the imputed climate relevant shares established by these institutions. In

addition to this, the development banks themselves support the partner countries with substantial resources, which are refinanced on the international capital market (this corresponds to Germany's mobilised public climate finance on the lines of KfW climate finance). The way the non-concessional climate financing provided by multilateral development banks is reported needs to be harmonised with other donors. In 2017, the multilateral development banks jointly mobilised USD 35.22 billion in public climate finance (according to the banks' own calculations in the 2017 Joint Report on Multilateral Development Banks' Climate Finance,[57] published in June 2018). According to the Joint Report,[58] the public climate finance mobilised by the multilateral development banks totalled USD 43.1 billion in 2018. As a major shareholder of the banks, Germany contributed a great deal to this. In addition to capital contributions and funds for regular replenishment cycles of concessional financing, Germany makes additional contributions to climate-specific trust funds in multilateral finance institutions. CTF Table 7a lists all payments made.

5.1.4.4 Specialised UN organisations

Germany also pays annually into designated United Nations programmes to boost expertise and develop capacities in selected areas. Tables 7a and 7b lists the UN programmes supported.

Germany also provides funding for initiatives, fiduciary funds and knowledge centres. The support amounted to EUR 36.21 million (USD 40.88 million) in 2017 and EUR 22.02 million (USD 25.99 million) in 2018. Through these initiatives, Germany is strengthening capacity building in developing countries to implement climate change mitigation and adaptation measures, increases climate transparency and drives measures to implement the Montreal Protocol. In addition, it annually supports the activities of the UNFCCC secretariat as well as climate-related knowledge generation in several institutions. From 2017-2018, Germany supported the UNFCCC secretariat with EUR 11.72 million (USD 13.8 million) in compulsory and voluntary contributions. Germany also supports the secretariat of the Montreal Protocol, which is based at the UNEP headquarters in Nairobi, with EUR 300,000 (USD 354,000) annually.

Germany also makes voluntary contributions to the IPCC Trust Fund and has contributed about EUR 10.7 million (USD 12.63 million) in the current reporting cycle (2016-2022) to the Technical Support Unit of IPCC's Working Group II, which is based chiefly at the Alfred Wegener Institute (AWI) but also has a branch in Durban, South Africa.

5.1.5 Approaches to climate change adaptation

Climate change is already resulting in considerable costs[59] and jeopardising development successes that have already been achieved – in areas such as alleviation of poverty, drinking water and infrastructure. Germany therefore attaches great importance to supporting developing countries in adapting to climate change. It sees it as an international responsibility and has made it one of the four integral pillars of the German Strategy for Adaptation to Climate Change (2008). The German government is committed to protecting the poorest and most vulnerable sectors of the population from the impacts of climate change, prevent damage and loss, and insure households, businesses and countries against any damage that might occur. It aims to provide even-handed support for mitigation/climate action and adaptation. The proportion of climate finance spent on adaptation has increased steadily in recent years. In

[57] https://reliefweb.int/sites/reliefweb.int/files/resources/2017-joint-report-on-mdbs-climate-finance.pdf

[58] https://reliefweb.int/sites/reliefweb.int/files/resources/2018_Joint_Report_on_Multilateral_Development_Banks_Climate_Finance_en_en.pdf

[59] The IPCC's AR5 Synthesis Report estimates that developing countries worldwide are facing adaption costs of USD 70-100 billion each year. The UNEP Adaptation Gap Report expects the costs to be twice or three times as high.

2017, 38 % of bilateral climate finance was allocated to adaptation (EUR 1.205 billion or USD 1.358 billion) and 62 % to mitigation (EUR 1.940 billion/USD 2.187 billion). In 2018, adaptation's share was 46 % (EUR 1.252 billion/USD 1.478 billion); accordingly mitigation's share was 54 % (EUR 1.462 billion/USD 1.725 billion). Germany provides targeted support to the most vulnerable countries in the group of least developed countries (LDCs) and small island developing states (SIDS) to strengthen their adaptive capacities and increase the resilience of their agricultural production and infrastructure. Between 2015 and 2017, BMZ's technical cooperation projects provided direct support to approximately 13 million people in dealing with the impacts of climate change. Adaptation projects reached at least 4 million women. Furthermore, the adaptation capacity of almost 3,800 key stakeholders in partner countries was strengthened.

The priority areas of the German government's support are ecosystem-based adaptation (EbA) and adaptation of agricultural production and food security, water management and adaptation, risk management instruments in connection with climate change impacts, for example through innovative insurance solutions, and the development and implementation of national adaptation strategies in the context of countries' National Adaptation Plans (NAPs) and NDCs

In addition to BMZ's projects and programmes, BMU's International Climate Initiative (IKI) is also an important element of the climate finance Germany provides for adaptation.

A pilot programme funded by IKI supports the island state of Grenada in making adaptation to climate change a central and comprehensive process that is integrated into its national development planning. It is one of the first comprehensive projects worldwide that focuses on the development of a NAP.

5.1.5.1 Management of climate risks – disaster preparedness

As a signatory to the Sendai Framework for Disaster Risk Reduction, Germany supports developing countries in their endeavours to take precautions to protect critical infrastructure such as schools, hospitals and power stations. BMZ takes a comprehensive risk management approach, which combines tried-and-tested and innovative instruments from the fields of climate change adaptation, climate change mitigation, disaster risk management and social security into a single holistic approach in order to address the entire spectrum of disaster and climate risks and safeguard development successes.

5.1.5.2 Climate risk financing and insurance initiative – InsuResilience Global Partnership

The InsuResilience Global Partnership is the key global initiative in the field of risk financing and insurance schemes designed to provide better protection against climate-related natural disasters. It focus on particularly poor and vulnerable countries and sectors of the population. Building on the G7 InsuResilience initiative, launched in Elmau in 2015 by Germany/Federal Chancellor Merkel, which aimed to provide insurance cover for an additional 400 million poor and vulnerable people by 2020, the G20 welcomed the establishment of the Global Partnership for Climate and Disaster Risk Finance and Insurance Solutions at its summit in Hamburg in 2017. The V20 supported this initiative. The partnership currently has 63 members, including not only G20 and V20 countries but also representatives from the private sector, civil society, international organisations and the academic and scientific community. So far, BMZ has contributed over EUR 300 million (USD 350 million) and has provided headquarters in Bonn for the InsuResilience secretariat.

5.1.5.3 Integrating adaptation into national development planning

A key approach in BMZ's support to establish adaptive capacities involves promoting the integration of climate aspects into the national development and budget planning of partner

countries. The majority (83 %) of the NDCs, upon which implementation of the Paris Climate Agreement hinges to a large extent, include adaptation targets. Germany supports partner countries in designing their NAP processes, for example. The NAP process is regarded as the key vehicle that is crucial to achieving these adaptation targets. Germany is already supporting 54 partner countries in planning and implementing their NAP processes, either directly through bilateral support or indirectly through international initiatives such as the NAP Global Network (NAP GN). The NAP GN is a global national adaptation planning network, which BMZ launched in conjunction with other countries in 2014 in order to help global and national donor coordination in the area of climate change adaptation and to act as a communication forum for experts and government representatives.

5.1.5.4 Agriculture

Agriculture is particularly affected by climate change. Without adaptation, it will not be possible to achieve the production increases on the ground that are required to feed a global population that continues to grow rapidly, and simultaneously contribute as much as possible to reducing GHG emissions. Germany therefore strives to adapt agricultural development in partner countries to the challenges posed by climate change. Promoting food security in rural areas and agriculture is a great concern of the German government. Over EUR 1.5 billion (USD 1.77 billion) in development cooperation funding is allocated each year to food security, and agricultural and rural development. About EUR 0.5 billion (USD 0.59 billion) of that is provided by the special One World, No Hunger initiative. It finances over 300 projects mainly in African countries.

In addition, the German government supports the Food and Agriculture Organization of the United Nations (FAO), within the framework of its food security programmes, in adapting agriculture to climate change and reducing agriculture's impact on the climate. Scientists working in inter- and transdisciplinary research partnerships set up by the Federal Ministry of Education and Research (BMBF) have developed a knowledge base on the interactions between land management, climate change and ecosystem services as part of a funding measure on sustainable land management, which received a total of EUR 75 million (USD 84.5 million) in funding between 2009 and 2017. In a participatory approach, researchers are working with local partners to develop exemplary solutions and put them into practice in the regions of Africa, Asia, Europe and South America being studied. BMZ contributes EUR 20 million (USD 22.12 million) per year towards funding 17 international agricultural research centres.

Strengthening resilience to the impacts of climate change in land use in Africa plays a special role in capacity development. Land use is a particularly important factor there because ecosystem services safeguard livelihoods. Thus, the question of what changes in climate and what consequences for land use and water resources countries in Africa can expect is becoming increasingly urgent. In conjunction with partners from 11 West African countries and five Southern African countries, BMBF is building two regional competence centres for climate change and adapted land management (Regional Science Service Centres in West and Southern Africa, RSSCs) to enable the countries themselves to take valid decisions, for example with regard to their land use and water supply. Promoting young scientists and supporting these countries in building their own capacity plays a key role here. In the first phase (2010-2017/2018), BMBF contributed about EUR 100 million (USD 115 million) to financing the competence centres.

5.1.5.5 Water

Water is the medium by which climate change most directly impacts people, ecosystems and various industries. Poor people with low adaptive capacity are particularly affected. Consequently, almost a quarter (23 %) of BMZ's bilateral adaptation finance was allocated to the water sector in 2017. One of the aims that German international cooperation is working towards

is the implementation of effective adaptation measures in the water sector, which enable measurable improvement in climate resilience. This happens, for example, by storing water to offset climate-related planning uncertainties such as droughts and floods or by using treated wastewater in the event of more serious and frequent drought events. A specific example of how BMZ supports the local population in adapting to climate change in the water sector is the introduction of a new solar-powered drip irrigation system and agri-environmental training opportunities in Timor Leste. This innovative system enables farmers to store up to 60,000 litres of water in newly installed tanks. The fact that water can be stored and made available for longer increases their resilience to shorter rainy seasons and severe droughts.

It is not possible to express the extent of the involvement in figures because water is an issue that is addressed in a range of IKI's projects and funding areas.

In Peru, for example, the IKI is strengthening the resilience of vulnerable sectors of the population. That includes water management (e.g. setting up water councils) and long-term financing mechanisms for adaptation measures. Endangered ecosystems are also protected.

As part of BMBF's funding measure entitled Water as a Global Resource (GROW), research and development work on improved, forward-looking management of water resources are supported with funding totalling about EUR 30 million (USD 35 million). This is an important contribution to implementing the United Nations' SDGs in the water sector. The focus is on improving governance in the water sector. Taking the social context into account, approaches are being developed using specific examples (from Africa and South America and other places) to make efficient technologies and ways of using water a firm part of everyday practice. Training measures for relevant stakeholders, designed to transfer good practice to other regions, contribute to achieving this.

The Future-oriented Technologies and Concepts to Increase Water Availability by Water Reuse and Desalination (WavE) funding programme makes a vital contribution to correcting the imbalance between increasing water demand and limited water resources, and to addressing the problem of water scarcity. BMBF provides funding of about EUR 30 million (USD 35 million) for 13 joint research projects with partners from the scientific and academic community, the private sector and practice. The aim is to develop innovative technologies, processes and management strategies to sustainably increase water availability. Recycling industrial water, desalinating groundwater and surface water and reusing water in the form of treated municipal wastewater are all regarded as having high implementation potential. The studies and developments are done under practical conditions at locations in Germany and abroad (Viet Nam and Namibia). They incorporate industrial-scale demonstration facilities.

5.1.5.6 Ecosystem-based adaptation

EbA refers to sustainable use of ecosystems by the population in order to adapt to the negative impacts of climate change. It is a promising alternative or addition to the "grey" technical measures traditionally used. The principal aims are to protect and sustainably use ecosystems such as tropical and mangrove forests to strengthen the resilience of humankind and nature and mitigate the impacts of climate change.

Through the IKI, BMU advises partner countries on integrating the EbA approach into their planning processes and implementing it. It also supports measures to counter climate-related effects such as erosion in coastal areas, water catchments and mountain regions, droughts and reduced soil fertility. The measures therefore particularly aim at supporting adaptation in the fields of agriculture, livestock farming, fishing, aquaculture, water supply and infrastructure. In

this way, the EbA projects also help to safeguard livelihoods and reduce the risks of climate disasters.

The projects' focus is now not so much on pilot measures but more on mainstreaming and upscaling the approach. Involvement of the private sector and support for political processes also play an important role in ensuring the projects' sustainability.

The IKI invested over EUR 49 million (USD 58 million) in EbA in 2017 and 2018. The EbA Facility, launched in 2016, provides Small Island Developing States (SIDS) in the Caribbean with technical and financial support of EUR 25 million (USD 29.5 million) for the implementation of EbA measures. The Facility, which was set up as a sinking fund under the auspices of the Caribbean Biodiversity Fund (CBF), complements the existing endowment fund. This makes it possible to meet the urgent need for short-term financing. In particular, measures to protect, improve the use of and rehabilitate coastal ecosystems that are relevant to coastal ecosystems (especially coral reefs, mangroves and seagrass beds) are funded.

The projects financed by BMZ advise partner countries on integrating the EbA approach into their planning processes and implementing it. Model projects test EbA measures and compile and disseminate the results. EbA measures are used for example in the area of flood protection: water retention areas or preserving or restoring species-rich, resilient vegetation that can store water. As part of the Blue Action Fund, BMZ made EUR 55 million (USD 65 million) available between 2016 and 2018 for marine protection projects that contribute to adaptation to climate change in marine and coastal regions.

5.1.6 Approaches to reducing greenhouse gases

GHG emissions and CO_2 concentration in the atmosphere continue to rise to record levels. Developing countries are the first to feel the impacts of climate change; they are also more powerful there. It is also the poorest people who are harder hit by these impacts.

In order to achieve net zero emissions by around 2050 – and therefore meet the 1.5°C target, emissions would have to decrease by 45 % by 2030 compared with 2010. However, worldwide CO_2 emissions in 2018 were once again higher than the previous year. In fact, the increase was the highest for seven years. For that reason, one of German development policy's key goals is to contribute to reducing GHG emissions. To achieve this goal, Germany supports partner countries in developing low-emission economic and supply structures. This includes using renewable energy, increasing energy efficiency, reducing extremely climate-damaging fluorinated GHGs and promoting sustainable urban planning. Other areas of action include developing climate-oriented mobility and waste management strategies and also the conservation of natural carbon sinks.

5.1.6.1 Energy

Cooperation in the energy field is striving to promote a rapid transformation of the energy sector in emerging economies and developing countries. The aim is to achieve sustainable, needs-based, low-emission and climate-proof energy infrastructure at all levels and thus combine energy security and climate change mitigation.

To this end, the German government is drawing, for example, on the experience it has acquired with achieving an energy transition in Germany, and supports in particular expanding the use of renewable energy and increasing energy efficiency. Innovative solutions to utilising renewable energy sources to improve energy access and reduce energy poverty in developing countries are also included. The transformation of the energy sector is supported through the provision of innovative financing instruments, investment measures, guidance on the transfer of

technologies and expertise, development of institutional capacities and skills, policy advice in the partner countries, and cooperation with regional and multilateral partners.

Energy is one of the largest funding areas in Germany's development cooperation, which comprises financial and technical cooperation. In 2018, pledges (from budgetary and market funds) for financial cooperation totalled about EUR 3.0 billion (USD 3.541 billion). Generation of energy from renewables accounted for over EUR 1.9 billion (USD 2.242 billion) of that. As a result, an additional 1,414 MW of renewable electricity was generated. Overall, the funding provided in the energy sector in 2018 (i.e. for generation, energy efficiency, grid investment etc.) meant that around 3.5 Mt CO_2e were avoided. For example, BMZ is supporting Morocco's energy transition and, through a co-financing scheme with KfW, is funding the creation of one of the world's largest solar power plants in Quarzazate (Noor I-IV). This solar complex will generate electricity for at least 1.3 million people and avoid over 800,000 tonnes of CO_2 emissions per year.

The total funding for technical cooperation projects in the field of energy implemented by the Gesellschaft für Internationale Zusammenarbeit (GIZ) in 2108 was about EUR 600 million (USD 708 million), including co-financing arrangements. The projects focus on providing advice on creating the enabling policy, structural and technical environments needed to achieve an energy transition and build local capacity. An example of this is the Global Energy Transformation Programme, a BMZ-led multi-donor partnership. It offers developing countries and emerging economies comprehensive advisory services to drive forward transformation in their energy sector. At the same time, the programme mobilises private investment in decentralised renewable energy by supporting market access and establishing a pipeline of bankable investment projects. 31 projects with a projected investment volume of EUR 460 million (USD 543 million) will have provided advice on decentralised renewable energy by 2021. In this way, about 3.1 million people and 4,000 MSMEs will be able to have access to sustainable energy and 375,000 tonnes of CO_2 will be saved.

In addition, Germany is advocating for a gradual phasing out of fossil fuels by 2050, especially for bringing a rapid halt to coal expansion. In order to further strengthen the transformative character of German development cooperation's energy projects, the government, in line with its report on international coal finance for the economic committee of the German parliament[60] of January 2015, is no longer supporting the construction of new coal-fired power stations and retrofitting of decommissioned coal-fired power stations in partner countries.

BMU uses the IKI to support practical, ambitious and sustainable reform and transformation processes in the partner countries designed to promote low-carbon economic development. The focus is on improving conditions on the supply and demand side with the aim of shortening the time taken to achieving affordable low-carbon energy infrastructure, which in turn will also strengthen the partner countries' climate ambitions. The partner countries receive support with regard to the energy sector as a whole but also with individual issues such as grid integration of renewable energy and improving energy efficiency in the buildings and industrial sectors.

Since IKI was launched, its sustainable energy supply/renewable energy/energy efficiency portfolio has been one of the mainstays of the mitigation funding area. BMU pledged about EUR 49 million (USD 58 million) for 2017 and 2018 for projects to promote a sustainable energy supply in the partner countries.

As part of its project on Integration of Renewable Energies into the Indian Electricity System (I-RE), for example, IKI is supporting the Indian Ministry of New and Renewable Energy (MNRE) in

[60] Bericht der Bundesregierung zur internationalen Kohlefinanzierung für den Wirtschaftsausschuss des Deutschen Bundestages; online:http://www.bmwi.de/Redaktion/DE/Downloads/B/bericht-der-bundesregierung-zur-internationalen-kohlefinanzierung-fuer-den-wirtschaftsausschuss-des-deutschen-bundestages.pdf?__blob=publicationFile&v=5 .

developing the country's electricity market in a climate-friendly way and increasing renewable energy's share. To this end, it concentrates firstly on the electricity market and on analysing existing energy systems and secondly on funding mechanisms, especially those designed to disseminate decentralised photovoltaic systems on the roofs of buildings.

5.1.6.2 Transport

German development cooperation aims to promote energy efficient transport infrastructure and promote modes of transport that have less of an impact on the environment and climate. However, it is equally important that modes of transport are made accessible to poor and disadvantaged groups. The German government is supporting its partners in developing countries and emerging economies in a number of specific ways: in establishing and expanding sustainable public transport systems, in introducing regulations and measures for environmentally friendly passenger and freight transport, in making vehicle fleets more energy efficient and environmentally sound, and in improving transport planning in towns and cities.

Within the Transformative Urban Mobility Initiative (TUMI), German development cooperation (BMZ) supports training and professional development for over 1,500 technical and management professionals and is currently implementing 17 innovative pilot measures (including on electric mobility, digital solutions, transport safety, urban design). On behalf of the German government, KfW Development Bank providing EUR 2.9 billion (USD 3.423 billion) in funding for transport projects (urban transport/public transport: 64 %; long-distance transport/logistics: 32 %; rural transport: 4 %). The projects included a light rail system in Tunis, expansion of the tram network in Rio de Janeiro and Salvador de Bahia and a modern elevated metro rail in Nagpur, India. If the tram in Rio de Janeiro and metro in Salvador run at full capacity, over 18 million car journeys will be avoided. Over the life span of 20 years, GHG emissions will be reduced by more than 530,000 tonnes of CO_2e. The elevated metro rail in Nagpur enables a shift in urban transport from road to rail, resulting in anticipated CO_2e savings of about 67,000 tonnes per year.

BMU is supporting the creation of appropriate sustainable mobility structures through IKI. The funding volume for 2017 and 2018 totals EUR 37.8 million (USD 44.6 million). In countries with a rapid motorisation trend, such as Viet Nam and Kenya, IKI's TraCS project supports the transport ministries and other relevant agencies in systematically quantifying GHG emissions in the transport sector and calculating the reduction potential offered by different scenarios modelled. In this way, decision-makers in the partner countries have the tools to determine the transport sector's contribution to the NDCs.

5.1.6.3 Forest policy

The German government's international forest policy aims to halt deforestation and further forest degradation, preserve or restore forests as GHG sinks and tap into the CO_2 mitigation potential of sustainable forestry. It primarily supports concepts that reconcile forest protection and their sustainable use. It is one of the biggest donors worldwide in the area of international forest protection.

In 2018, BMZ made approximately EUR 2.1 billion (USD 2.478 billion) available for more than 200 forest initiatives. Currently, the support is focused on the sustainable use of forests for climate protection (REDD+) and conservation of biodiversity. Promoting the restoration of forest landscapes and deforestation-free supply chains are also priorities in BMZ's international forest policy. BMZ launched the African Forest Landscape Restoration Initiative (AFR100) in conjunction with the New Partnership for Africa's Development (NEPAD), which has since been renamed the African Union Development Agency (AUDA), and the World Resources Institute (WRI) at the 2015 Paris Climate Change Conference. The initiative aims to restore around

100 million hectares of forest landscapes in Africa by 2030 and, in doing so, also supports the implementation of the Bonn Challenge at regional level. This global initiative, which was launched by BMU in collaboration with the Global Partnership on Forest Restoration (GPFLR), aims as a first step to restore 150 million hectares of forest and forested landscapes by 2020, with that figure rising to total of 350 million hectares by 2030.

An important possibility for leveraging forest conservation lies in cooperation between governments and business and the creation of sustainable enabling environments. The German government therefore promotes private sector initiatives relating to soy, palm oil, coffee and cocoa and will further strengthen its cooperation with the private sector to establish "deforestation-free" supply chains.

For example, BMZ is supporting a district in West Kalimantan in Indonesia to establish a sustainable agriculture region, where export-related agricultural commodities such as palm oil, natural rubber and cocoa are produced. The region also has extensive natural forests and peat bogs that must be protected. The expansion of agricultural land is a threat to the natural forests. The aim is to create an enabling environment for sustainable, deforestation-free supply chains and to strengthen the capacity of government institutions, civil society and the private sector. Smallholder farmers are trained in sustainable agricultural practices and are integrated into global supply chains.

Since 2008, BMU's IKI has also been delivering important elements to support partner countries in implementing international mechanisms such as REDD+ and forest and landscape restoration (FLR) as part of the Bonn Challenge. The IKI provided around EUR 36.5 million (USD 43.1 million) in funding for forest and landscape restoration projects in 2017 and 2018.

Since December 2015, an IKI project has provided about EUR 4.6 million (USD 5.1 million) to support Initiative 20x20, which works to achieve country-specific forest and landscape restoration in Latin America and the Caribbean. The project analyses the costs and effectiveness of forest and landscape restoration measures and supports partner countries in designing plans to implement restoration measures. One of its aims is to optimise land use by increasing its productive capacity, reducing soil erosion, improving water cycles and protecting biodiversity, which the local population stand to benefit most from.

5.1.6.4 The waste management sector

The high proportion of organic waste in many emerging economies and developing countries, combined with often unregulated waste management, results in considerable levels of GHG emissions, mainly in the form of methane from landfills and rubbish tips. Setting up and developing circular economy systems worldwide is a high priority for the German government. According to the UN Environment Programme, transitioning to a circular economy could reduce global GHG emissions by between 10 % and 20 %.

Through its development cooperation, Germany supports the creation of national waste management strategies and legislation. It supports local authorities in planning and implementing waste prevention and collection and recycling concepts, and funds infrastructure for climate-friendly waste treatment and recycling. The focus is on recycling and energy recovery from waste (e.g. use of biogas and landfill gas) but equally on composting and biological-mechanical waste treatment. BMZ projects, e.g. in Serbia, Albania and Tunisia, are financed through the German Climate Technology Initiative (DKTI) and the Initiative for Climate and Environmental Protection (IKLU). For example, Serbia receives support in building capacity for integrated, recycling-oriented waste management.

Georgia, for example, is supported in implementing a modern waste management system that is environmentally sound and climate-friendly. A comprehensive waste management strategy is being developed and investment in new, regulated landfills and waste collection and transportation systems planned. Landfill gases will be collected and may be used to generate energy. There are plans for the landfills to include facilities for sorting recoverables and for biological pre-treatment of waste. Measures to boost acceptance of preventing and recycling waste are also being designed to be more market-oriented. The IKI believes that Bhutan, Mongolia and Nepal have great potential to reduce emissions of GHG and short-lived climate pollutants (SLCP) in the waste sector. One IKI project is therefore making a cross-level contribution to building capacity, including by carefully targeted improvement of the legal environment for NDCs and identification of appropriate waste technologies.

5.1.6.5 Urban development

The German government sees towns and cities as key players in endeavours to achieve a global sustainability agenda. German development cooperation activities promote the drafting and implementation of urban development strategies that incorporate climate change mitigation and resilience to the impacts of climate change in partner countries. A particular priority is to build infrastructure that is conducive to low-carbon development and is resilient to the impacts of climate change. In total, Germany provided more than EUR 10 billion (USD 11.8 billion) through KfW Development Bank for climate action in towns and cities between 2014 and 2018. However, since towns and cities often still do not receive sufficient finance for climate-friendly infrastructure projects, BMZ supports them, through the Cities Finance Facility (CFF) for example, in preparing their climate-friendly and resilient infrastructure projects in such a way that they are "bankable," i.e. eligible for financing. Projects that are already at a more advanced stage are used as beacon examples so that other cities can learn from them, enabling as many as possible to independently acquire sufficient funding for climate-friendly infrastructure.

Sustainable urban development has been a cross-sectoral funding priority of BMU'S IKI since 2015. The funding volume for 2017 and 2018 totals EUR 36.8 million (USD 43.4 million). The supported projects assist partner countries in developing strategies for dealing with the impacts of climate change in towns and cities and in making their economic structure more sustainable and low-emission. Support will be provided to build expertise and capacity at national and local level in knowledge transfer, technology cooperation, policy advice and investment. The Smart City approach, i.e. digital transformation, and climate-resilient urban development are priority areas.

The FELICITY project is an example of this. It involves IKI supporting cities and local authorities in Mexico, China and Brazil to develop innovative mitigation projects and acquire appropriate national and/or international funding.

Furthermore, Germany provides support through BMBF research projects with funding totalling EUR 13.2 million (approx. USD15.6 million) to urban growth centres for planning and managing urban infrastructure and services between 2014 and 2019. To this end, a planning method that can be quickly implemented across sectors is being identified and used in pilot projects in towns and cities in Egypt, Rwanda and Viet Nam.

5.1.6.6 Mitigation initiatives

The German government initiated the AREI and at the Paris Climate Change Conference pledged a total of EUR 3 billion up to 2020 to support it. Between 2016 and 2018, BMZ made new commitments for renewable energy, energy efficiency and power transmission and distribution in Africa amounting to more than EUR 2.3 billion (USD 2.715 billion) through bilateral technical

and financial cooperation. These commitments contribute fully to the achievement of the AREI targets.

The NAMA Facility was launched in 2012 at the initiative of BMU and the UK government. It finances innovative and transformative Nationally Appropriate Mitigation Actions (NAMAs) and comparable national initiatives that contribute to low-carbon development in developing countries and emerging economies around the world. As well as BMU and the United Kingdom, the European Union and Denmark are also donors. Two calls for projects with new funding pledges totalling EUR 165 million (USD 195 million) from all donors were conducted during the reporting period.

As the major donor, BMZ supports the Energising Development Partnership (EnDev) with the aim of eliminating global energy poverty. Since 2005, EnDev has helped 21.3 million people, 46,200 enterprises and 21,150 social institutions to obtain sustainable access to electricity or modern cooking and heating technologies. Most recently, between 2017 and 2018, EnDev helped 4 million people, 7,600 small and medium-sized enterprises and 1,750 social institutions to obtain sustainable access to electricity or modern cooking energy. In total, BMZ supported EnDev with approx. EUR 17.82 million (USD 21.03 million) from 2017 to 2018.

5.1.7 REDD+ approaches and important initiatives with German involvement

Reducing emissions from deforestation and forest degradation[61] is a cornerstone of Germany's international cooperation in the forest sector. Germany (BMZ and BMU) provided over EUR 1 billion (USD 1.180 billion) in financing for REDD+ in the period 2008-2018. Germany's development cooperation supports relevant forest countries in creating an enabling environment to implement REDD+ at national and sub-national level (e.g. good governance, participation of civil society and indigenous associations, monitoring of forests). In addition, it provides results-based financing for countries that can already demonstrate avoided deforestation. This occurs through bilateral and multilateral support programmes.

Germany is taking part in a joint initiative with Norway and the United Kingdom (GNU) in order to make further progress in protecting forests. The aim is to promote the REDD+ approach more broadly, implement integrated land-use programmes and strengthen private sector investment in deforestation-free value chains. The measures financed by the German government aim not only at reducing emissions but also at improving adaptation to the impacts of climate change. The German government views this initiative as part of the implementation of the New York Forest Declaration that was signed in September 2014. The GNU governments announced in Paris in December 2015 that they would provide USD 5 billion for the period 2015 to 2020, or USD 1 billion annually until 2020 for REDD+. BMZ launched the REDD Early Movers (REM) programme back in 2012 in order to support forerunners in forest conservation for climate change mitigation and to test results-based REDD+ finance. BMZ has to date made EUR 109.5 million (USD 129.23 million) in funding available for the programme and BMU EUR 9 million (USD 10.62 million); Norway and the United Kingdom have contributed the equivalent of around EUR 75 million and 86.5 million respectively (USD 88.5 and 102.9 million). Up to February 2019, EUR 103 million (USD 121.56 million) were disbursed for emission reduction activities in Brazil, Colombia and Ecuador.

Colombia, for example, has adopted a comprehensive policy framework in the last six years, which creates incentives for forest conservation and sustainable land use. This enabled the country to qualify for result-based payments of EUR 80 million (USD 94.42 million) from the REM programme, provided jointly by Norway, the United Kingdom and Germany. As the central

[61] Full English title: Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries, REDD+.

element of this policy, the government launched its Amazon vision – a vision that includes low deforestation rates and sustainable development in the region. At least 60 % of the money goes directly to farmers and indigenous communities at local level. Further investment in monitoring and governance in the forest sector, combined with improved land-use planning, means that the conditions needed to further control and reduce deforestation have been strengthened.

BMU's IKI uses carefully targeted projects to support the technical components and implementation of REDD+ and to involve civil society. As a result, many countries have succeeded in adopting appropriate REDD+ strategies, developing forest emission reference levels and corresponding forest monitoring, and creating the foundations for national implementation of REDD+. In 2017 and 2018, over EUR 71.3 million (USD 84.15 million) in funding for REDD+ projects was provided through the IKI.

In particular the LDCs and SIDSneed special support to meet the requirements for result-based payments under REDD+. For example, GIZ has been supporting the Pacific island states of Fiji, Papua New Guinea, the Solomon Islands and Vanuatu through the Pacific Community (SPC) since 2010. IKI's project entitled REDD+ Himalayas: Capacity building for using REDD+ to conserve natural biodiverse carbon sinks in the Himalayas has been supporting implementation of REDD+ in Bhutan, India, Myanmar and Nepal with approximately EUR 5 million (USD 5.9 million) since 2013. South-South transfer of knowledge and communication among the member states of the International Centre for Integrated Mountain Development (ICIMOD) are important aspects of the project. One of the priorities is to test REDD+ in practice, involving local forest users and indigenous groups; another is to support the national REDD+ Focal Points in developing national REDD+ strategies. The project has made a significant contribution to the national REDD+ strategy in India.

5.1.8 Mobilisation of private investment in climate change mitigation and adaptation measures in developing countries

Strategies and measures that help make financial flows consistent with climate-friendly development as set out in Article 2.1.c of the Paris Agreement ("shifting the trillions") and measures that contribute to mobilising private investment in climate change mitigation and adaptation are fundamental building blocks of German climate finance.

To redirect financial flows as set out in Article 2.1c of the Paris Agreement, clear pricing signals and reliable long-term conditions are needed. The aim is to deploy the limited public funds so that they effectively mobilise private funds (both through financial and technical cooperation) for climate change mitigation and adaptation with the highest possible transformative impacts in non-Annex I countries. This is therefore not just about the direct mobilisation effect; it also involves structural changes in the economy and in the financial sector brought about by taking climate change risks into account and integrating them into decision-making processes. Appropriate measures have been put in place in areas such as those described below.

The German government supports advisory services for policy-makers in establishing guidelines and regulations that facilitate private investment. By providing assistance in project development and preparation of funding proposals, public and private actors are also supported in mobilising investment. The actual and perceived risks relating to investments in climate change mitigation and adaptation can be overcome through advisory services on policy instruments and innovative financial products and by providing data and information.

Providing capital to institutions such as local banks for adaptation and mitigation actions and simultaneously building capacity enables them to develop adapted financial products and build up a portfolio over the long term.

At the same time, BMZ works with political decision-makers and financial market regulators in developing countries and emerging economies in order to support reform processes in their endeavours to make their finance systems more sustainable. In addition to this, BMZ – working in conjunction with local and regional financial institutions – has developed specific methods and instruments for integrating sustainability criteria into financial decision-making processes, for risk management and to promote more sustainable funding instruments and market segments.

Germany also promotes capacity building for various national public and private sector institutions, which is often a fundamental requirement for making private investment possible.

It promotes close cooperation between the private sector and governments in the field of comprehensive risk management (see 5.1.5.1) in order to provide actors in affected areas with risk management strategies that safeguard their incomes, food security, employment opportunities and access to loans in times of climate change. An example is the InsuResilience Global Partnership (see Section 5.1.5.2).

Germany is promoting a range of multi-actor dialogues in order to strengthen and replicate the results of successful practices and facilitate the participation of other donors. They facilitate exchange between actors from the public and private sectors in areas such as making governments' climate strategies accessible to private financiers and project developers.

In 2017, KfW Development Bank, using the OECD methodology,[62] mobilised EUR 230.05 million (USD 259.33 million) in private climate finance. In 2018, this figure increased to EUR 251.47 million (USD 296.79 million). DEG is mandated to work exclusively with the private sector. It assumes the risks that commercial banks and investors assume to only a limited extent or do not (or are not able to) assume at all. In this way, DEG facilitates the delivery of a suitable financial package in which private investors and commercial banks can take part. The private climate finance mobilised through DEG loans or equity participation is also determined on the basis of the OECD methodology. Using this method, private funds totalling EUR 256.11 million (USD 288.705 million) were mobilised by DEG in 2017; in 2018, EUR 216.17 million (USD 255.19 million) were mobilised.

5.2 Technology development and transfer

5.2.1 General

Technology transfer is a component in virtually all of the German government's climate-related bilateral cooperation. Environmentally friendly technologies, for example in the field of energy infrastructure, are an essential part of economic development and climate action. It is therefore not possible to separately report climate finance contributions that are solely categorised as technology transfer.

With regard to climate technology, low-carbon energy, climate-smart cities and resilient rural development are areas of particular relevance to German development cooperation.

Germany is involved in technology cooperation through its committed support to the UNFCCC Technology Mechanism and its organisations: the Technology Executive Committee (TEC) and the Climate Technology Centre and Network (CTCN). Germany has been supporting the TEC with voluntary contributions amounting to EUR 650,000 (USD 767,142) and the CTCN with EUR 1.05 million (USD 1.24 million) since 2013.

[62] The OECD aims to develop an international standard for recording mobilised private funding. Methods have already been developed for a number of financial instruments and are being used. A conservative definition of causal mobilisation and a fair allocation of the mobilisation success are sought in order to paint a realistic picture.

Through the DKTI, BMZ is financing modern, climate-friendly and climate-adapted measures – often relating to infrastructure – in emerging economies and developing countries, which reduce GHG emissions and promote adaptation to climate change. In 2017 and 2018, projects were approved with funds from this facility totalling about EUR 3.46 billion (USD 4.085 billion).

Since 2010, BMBF's CLIENT (International Partnerships for Sustainable Innovations) funding priority has been establishing international partnerships to research, develop and implement environment and climate technologies and services. It has supported partnerships with Brazil, Russia, India, China, South Africa, Viet Nam and Chile, among other countries (approx. EUR 60 million (USD 67 million) in 2010-2017).

The successor initiative CLIENT II funds international partnerships working on climate, environment and energy issues. The aim of the joint projects is to help reduce environmental impacts in the partner countries, utilise natural resources intelligently and sparingly, supply reliable, clean and affordable energy to all segments of the population and make a contribution to mitigating global climate change and adapting to climate change and natural risks. The regional priority areas for collaboration are in China and Viet Nam, Central Asia, South America, parts of Africa, and Iran. BMBF funding totalling EUR 100 million (USD118 million) has been earmarked for 2016-2023 to implement CLIENT II.

5.2.2 Energy sector

GET.pro is a multi-donor facility aiming to promote renewable energy to achieve equitable and climate-friendly development worldwide. It focuses on funding large-scale projects in the field of renewable energy. It builds on EUEI PDF, the predecessor project for which BMZ provided basic finance of EUR 13 million (USD 15.34 million). In hosting the secretariat of the Africa-EU Energy Partnership (AEEP), the Facility promotes high-level political dialogue between the two continents. Increased attention will be paid to establishing networks involving energy and climate actors in order to forge a cross-sectoral alliance for achieving development and climate goals.

Through the GET.invest programme, the project supports companies in developing bankable projects and in so doing contributes to closing the gaps between available climate funds and the numerous, but not always convincing, project approaches. GET.transform supports partner countries and regions to achieve their energy and climate targets and to create the enabling policy and regulatory environment that requires. By providing basic finance of EUR 7.1 million (USD 8.38 million), BMZ mobilised substantial co-financing (currently: approximately EUR 33 million (USD 38.95 million). Currently, 42 renewable energy projects, which are expected to reduce emissions by 680,000 tonnes CO_2e, are in the development stage.

Green People's Energy for Africa is a core initiative that contributes to implementing the Marshall Plan with Africa. Launched in early 2019, it supports the creation of decentralised renewable energy systems in rural regions of Africa with the involvement of local stakeholders and private investors. Its special features include the involvement of local authorities, cooperatives and local businesses, the promotion of local value added and productive use of energy, especially in agriculture, and creation of employment opportunities.

5.2.3 Transport sector

Germany is known for sustainable solutions and innovative concepts along the entire mobility and logistics chain. The German Partnership for Sustainable Mobility (GPSM) has also acted as a 'pilot' and is the key contact partner for sustainable mobility and logistics solutions from Germany. This professional network involving industry, academia and civil society promotes

dialogue on sustainable transport with actors from developing countries and emerging economies and processes Germany's lessons learned, tailoring them for specific target groups.

Technical cooperation advisory services help climate-friendly mobility options to gain a firm foothold in the market and increase the ability of subnational actors to plan and introduce climate-friendly technologies in the transport sector.

5.2.4 Private sector cooperation

Industry plays a key role in designing modern, future-oriented energy supply systems in our partner countries: as a technology supplier and source of finance. Many German development cooperation projects therefore aim to create a better technical and policy framework in the partner countries in order to ultimately recruit the support of the private sector as a key actor in the broad-based marketing of appropriate technologies.

Through its develoPPP.de programme, BMZ supports companies that invest in developing countries and emerging economies. They receive financial support and, if they request it, also technical support. Over 2000 development partnerships have been initiated since 1999 in all areas ranging from wastewater management to certification. BMZ supported projects with EUR 85 million (USD 100 million) in 2017 and 2018. Some of these were considered climate-related due to investments in renewable energy, energy efficiency, water treatment, recycling, biodiversity and forestry.

With the Project Development Programme for developing countries and emerging economies (PDP), which is one of the important cornerstones of the Energy Export Initiative, the Federal Ministry for Economic Affairs and Energy supports companies selling climate-friendly energy technologies, especially small and medium-sized enterprises, to enter particularly difficult markets that are often still in their early days. Like the Energy Export Initiative itself, the PDP also dates back to a request from the German Bundestag to the Federal Ministry for Economic Affairs and Energy to better dovetail foreign trade promotion activities and development cooperation (Bundestag Publications 15/4868 and 16/4962).

Currently, the PDP is being implemented in 10 countries in Africa, three countries in South and South East Asia and three countries in the Middle East[63], but it could also be extended to other countries in these regions if promising project opportunities were to emerge

To achieve the best possible integration with development cooperation activities, the Federal Ministry for Economic Affairs and Energy commissioned GIZ to implement the measures that are primarily directed at preparing the market. The choice of country is based on where GIZ – usually as a result of BMZ commissions – has already set up structures and networks and gained experience, especially in the field of energy, which the PDP can build on. The aim is to develop partnerships on equal terms between economic stakeholders.

In countries in which the PDP is not being implemented because they have a higher level of development (North Africa, South Africa and Namibia) the measures under the Energy Export Initiative still apply.

[63] Senegal, Mali, Ghana, Ivory Coast, Nigeria, Kenya, Zambia, Botswana, Madagascar, Mauritius, Viet Nam, Cambodia, Bangladesh, Pakistan, Lebanon and Jordan.

5.3 Capacity building

Capacity building is an integral part and core element of virtually all the German government's cooperation projects. It is therefore not possible to separately report finance streams used exclusively for capacity building.

The German government is involved in capacity building through bilateral and multilateral cooperation as well as various partnerships with the private sector, academia and civil society. In order to support partner countries in the effective implementation of the UNFCCC and the Paris Agreement, it provides comprehensive capacity building measures in the areas of GHG reduction, adaptation to climate change, technology development and transfer, and access to climate finance, as well as other specific sectors and cross-cutting aspects such as reporting (see sections 2, 3, 4, and 6, and CTF Table 9). The support measures for capacity building are designed to be context-specific, results-based and consistent with national priorities. In this work, it uses its range of international cooperation instruments and institutions to build capacities at individual, institutional and systemic level in the area of climate and development. See sections 5.1.4, 5.1.5 and 0, and CTF Table 9 in this Biennial Report for an example of capacity- related measures and initiatives in the areas of GHG reduction and climate change adaptation, and at sector level.

Building competencies is also an essential component in BMBF's research programme entitled Science Partnerships for the Assessment of Complex Earth System Processes (SPACES). Academics from German universities and non-university research institutions are working with partner institutions and universities in the Southern African priority countries Namibia and South Africa in academic cooperation projects. The programme helps to draft science-based recommendations on managing the Earth's systems and to ensure the sustainable use and conservation of ecosystem services in the region. In addition to the summer schools and workshops carried out alongside the project, BMBF initiated a supplementary study programme in conjunction with the German Academic Exchange Service (DAAD). This programme aims to provide training and continuing professional development to African university students and young researchers with a focus on environmental sciences, landscape ecology, geology and oceanography.

6 Other relevant information

6.1 Further developments in German climate policy

In 2019, the German government presented a programme of measures to implement the Climate Action Plan 2050, which is now being translated into specific policies and measures. The measures will be designed to ensure that the GHG reduction targets – overall and for individual sectors – are met by 2030. They include plans to use an allowances trading scheme to regulate CO_2 emissions caused by combustion of fossil fuels in the transport and heat sector from 2021. As a transitional measure, a fixed CO_2 price that will rise annually will be imposed from 2021 to 2025. A Climate Change Act will in future set the framework for reviewing and developing national climate policy. Annual, sector-specific emission budgets will be used to carry out the review.

A Annex 1: Reporting tables (CTF)

CTF Tables are published alongside with the Biennial Report on theUNFCCC website.

7 List of German legislation cited

Primary legislation (federal)

Act on the Prevention of Harmful Effects on the Environment Caused by Air Pollution, Noise, Vibration and Similar Phenomena	Gesetz zum Schutz vor schädlichen Umwelteinwirkungen durch Luftverunreinigungen, Geräusche, Erschütterungen und ähnliche Vorgänge
Basic Law (German constitution)	Grundgesetz
Car Sharing Act	Carsharinggesetz
Combined Heat and Power Act, CHP Act	Kraft-Wärme-Kopplungsgesetz
Decentralisation Act	Entflechtungsgesetz
Electricity Tax Act	Stromsteuergesetz
Energy Industry Act	Energiewirtschaftsgesetz
Energy-Related Products Act	Energieverbrauchsrelevante-Produkte-Gesetz
Energy Services Act	Energiedienstleistungsgesetz
Fourth Act Amending the Federal Trunk Road Toll Act	Viertes Gesetz zur Änderung des Bundesfernstraßenmautgesetzes
Local Authority Transport Infrastructure Financing Act	Gemeindeverkehrsfinanzierungsgesetz
Packaging Act	Verpackungsgesetz
Renewable Energy Sources Act	Gesetz zum Ausbau der erneuerbaren Energien (Erneuerbare-Energien-Gesetz, EEG)
Seventh Act Amending the Federal Trunk Roads Act	7. Gesetz zur Änderung des Bundesfernstraßengesetzes

Secondary legislation (federal)

Commercial Waste Regulation	Gewerbeabfallverordnung
Energy Conservation Regulation	Energieeinsparverordnung
Fertiliser Application Regulation	Düngeverordnung
Packaging Regulation	Verpackungsverordnung
Regulation on counting electricity-based fuels and processed biogenic oils towards greenhouse gas targets	37. BImSchV. (Verordnung zur Anrechnung von strombasierten Kraftstoffen und mitverarbeiteten biogenen Ölen auf die Treibhausgasquote)
Regulation on Crediting Reductions in Upstream Emissions	Verordnung zur Anrechnung von Upstream-Emissionsminderungen
Regulation to establish further provisions for reducing vehicle-fuel-related greenhouse gases	38. BImSchV. (Verordnung zur Festlegung weiterer Bestimmungen zur Treibhausgasminderung bei Kraftstoffen)

Translators' note: The English translations of German legislation cited should be seen as descriptive, rather than official. In particular, there may be discrepancies from previous texts published by German government agencies in which *Verordnung* has been translated as Ordinance. We believe that *Verordnung* corresponds more closely to secondary legislation commonly known in the English-speaking world as a Regulation or Regulations.