Expertenrat für Klimafragen

Report on the Estimate of German Greenhouse Gas Emissions for the Year 2020

Review and evaluation of emissions data in accordance with Section 12 (1) of the Federal Climate Change Act

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Table of contents

Figures

Executive Summary

On 12 December 2019, the German Bundestag passed the Federal Climate Protection Act (KSG 2019). The Act entered into force on 18 December 2019. The purpose of the Act is "to provide protection from the effects of worldwide climate change by ensuring achievement of the national climate targets and compliance with the European targets. The ecological, social and economic impacts shall be taken into consideration. The basis of the Act is the obligation according to the Paris Agreement, under the United Nations Framework Convention on Climate Change, to limit the increase in the global average temperature to well below two degrees Celsius and, if possible, to 1.5 degrees Celsius, above the pre-industrial level so as to minimise the effects of worldwide climate change, as well as the commitment made by the Federal Republic of Germany at the United Nations Climate Action Summit in New York on 23 September 2019 to pursue the long-term goal of greenhouse gas neutrality by 2050." (KSG 2019, official translation by BMU)

With the Federal Climate Protection Act, Germany has broken down its climate targets into six binding annual sectoral targets for the reduction of greenhouse gas emissions, as well as establishing a legal framework to ensure that these targets are achieved. For this purpose, the law defines a mechanism with a precise time sequence:

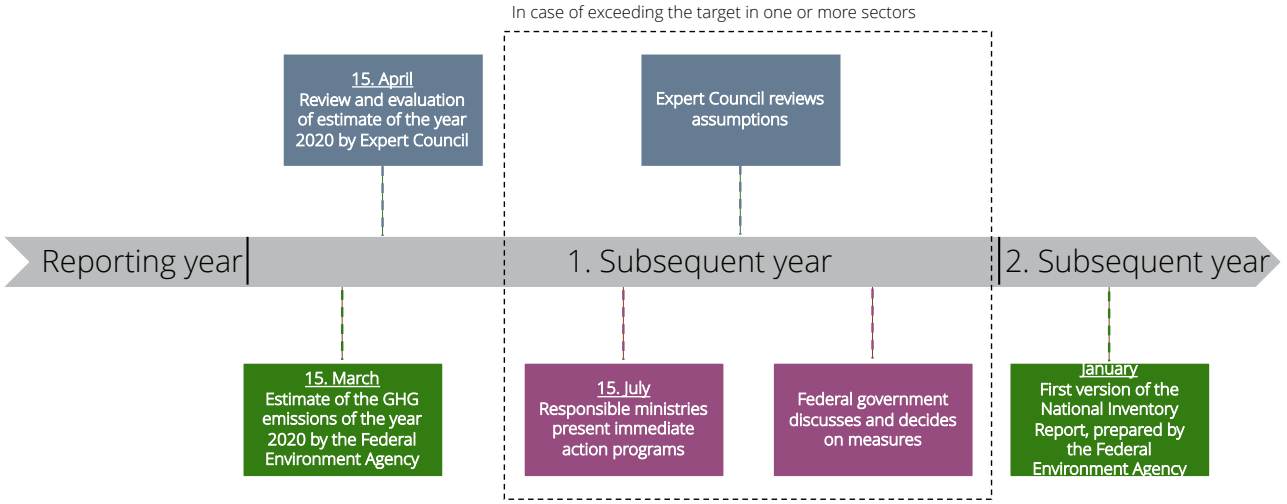
i) On 15 March of the year following the reporting year, the Federal Environment Agency publishes the emissions data of the previous year (Section 5 para. 1 KSG, official translation by BMU). This timely reporting results in rapid detection of deviations, defined as the difference between the reporting value of the Federal Environment Agency and the statutory target value, from the target values specified in the Federal Climate Protection Act for the individual sectors and in total.

ii) Within one month after transmission by the Federal Environment Agency, the Expert Council on Climate Issues shall submit an assessment of the published data (Section 12 para. 1 KSG, official translation by BMU).

iii) " If the emissions data referred to in section 5 subsections (1) and (2) of this Act indicate that the permissible annual emission budget for a sector has been exceeded in a reporting year, the responsible federal government ministry defined in section 4 subsection (4) shall, within three months following the presentation of the assessment of the emissions data by the Council of Experts on Climate Change established pursuant to section 11 subsection (1), present an immediate action programme for the relevant sector; the programme shall ensure compliance with the annual sectoral emission budgets in the subsequent years" (Section 8 para. 1 KSG, official translation by BMU).

iv) "The Federal Government shall deliberate on the measures to be taken in the relevant sector or in other sectors or on cross-sector measures and shall adopt these measures as quickly as possible. In so doing, it may take account of the existing flexibility allowed by the European Effort Sharing Regulation and alter the annual sectoral emission budgets referred to in section 4 subsection (5) of this Act. Before the proposal for a decision on these measures is produced, the assumptions regarding greenhouse gas emission reduction on which the measures are based shall be forwarded to the Council of Experts on Climate Change for assessment. The result of this assessment shall be attached to the proposal for a decision" (Section 8 para. 2 KSG, official translation by BMU).

Figure Z-1 Time sequence of the mechanism in accordance with the Federal Climate Change Act



Source: Council of Experts on Climate Change

The Climate Protection Act includes the establishment of an independent expert council for climate issues. The Expert Council, consisting of five experts from different disciplines, was appointed for the first time on 1 September 2020 for a period of five years. The tasks of the Expert Council on Climate Issues as defined in the Act are as follows:

i) The Expert Council on Climate Issues shall review the greenhouse gas emissions data produced annually by the Federal Environment Agency (UBA). It submits an assessment of the published data to the Federal Government and the German Bundestag.

ii) If the permissible annual emission level is exceeded, the Federal Government shall consult on the measures to be taken in the sector concerned or in other sectors or on cross-sectoral measures and shall adopt them as soon as possible. Before preparing the draft resolution on the measures, the Council of Climate Experts shall review the greenhouse gas reduction assumptions on which the measures are based. The result of the review shall be attached to the draft resolution.

iii) The Federal Government shall seek the opinion of the Council of Climate Experts on the greenhouse gas reduction assumptions underlying the following measures before initiating them: (1) changes in annual emission levels; (2) updating of the climate protection plan; (3) adoption of climate protection programmes.

iv) The Bundestag or the Federal Government may commission the Expert Council on Climate Issues with special reports.

The present report refers to the former task and makes an assessment of the data on greenhouse gas emissions for the year 2020 submitted and published by the Federal Environment Agency on 15 March 2021 (UBA 2021a).

The following documents were submitted to the Expert Council on Climate Issues by the Federal Environment Agency on 15 March 2021:

- Time series of emission data from 1990 to 2020, broken down by sectors and sub-sectors according to the source categories of the Common Reporting Format (CRF) under the European Climate Reporting

Regulation or according to a successor regulation adopted on the basis of Article 26 para. 7 of the European Governance Regulation (UBA 2021a).

- An accompanying report entitled "Previous year's estimate of German greenhouse gas emissions 2020" (UBA 2021b)
- A methodological report entitled "Previous year's estimate of German greenhouse gas emissions, general methodological volume" (UBA 2021c)
- A methodological report entitled "Previous year's estimate of Germany's greenhouse gas emissions 2020. Methodological volume for the publication of emissions data" (UBA 2021d)

Part I: Review and evaluation of the estimate of the year 2020

Z1 **The methodological procedure of the Federal Environment Agency for determining the emission data for the estimate of the year 2020 is consistent with the inventory reporting.** The estimate of 2020 essentially uses the same method as the National Inventory Report (NIB) and thus follows international guidelines. In this early publication, the Federal Environment Agency can only draw on a limited and partly still preliminary data set, which requires special methodological adjustments in its processing. Only part of the data used for the estimate of 2020 is based on real measurements, and even these are partially preliminary in nature. A much larger share of the data is based on estimates from different institutions. In particular, assumptions have to be made in a variety of ways when allocating cross-sectoral primary data to individual KSG sectors. According to the current state of knowledge of the Expert Council, the Federal Environment Agency uses almost all relevant data available at the time of the estimate of 2020.

Z2 **A spot check of the complex methodology used to calculate the estimate of the year 2020 did not indicate any fundamental consistency problems.** Various counter-calculations were carried out on a sample basis. The procedure of the Federal Environment Agency could in principle be reproduced in all cases. In particular, with regard to the settings made by the Federal Environment Agency within the scope of the estimates, there are no indications of a deliberate systematic bias. However, the estimates are based on different data sources and data statuses. These include institutional knowledge, for which neither complete documentation nor a stringent methodology exists. Particular attention was paid to the buildings sector in the analysis. The settings of the Federal Environment Agency for the allocation of emissions led to a shift of emissions from the buildings sector to the industry sector (by around 2 Mt CO_2e), which could not be verified by the Council of Experts nor could be reproduced.

Z3 **The informative value of the estimate of the year 2020 is generally limited by the lack of data sources at the early stage of their preparation compared to later versions of the National Inventory Report.** To examine the robustness of the estimate of the year 2020, an analysis of previous correction needs in the National Inventory reports was conducted. For the examined estimates of the years 2010 to 2018, significant corrections resulted, especially up to the second National Inventory Report. The data basis and methodology used do not differ significantly in the estimate of 2020 from those of previous years. Therefore, it can be expected that there will still be a need for significant adjustments to the numbers given in the estimate of the year 2020 at least until 2023. In the period between the publication of the 2020 emissions data by the Federal Environment Agency and the submission of this report, there were already relevant updates to the primary energy consumption data by the Working Group on Energy

Balances (Arbeitsgemeinschaft Energiebilanzen, AGEB). The emission data for 2020 published by the Federal Environment Agency must therefore be regarded as provisional in all sectors. In its publication on the estimate of the year 2020 (UBA 2021b), the Federal Environment Agency itself refers to the complete, official and detailed inventory data that will be submitted to the European Commission in January 2022.

Z4 **The relative corrections of total greenhouse gas emissions were small over the years. However, in some individual sectors, they were in the order of magnitude of or above the annual reduction amounts provided for in the Federal Climate Change Act.** The average correction required from the estimate of the previous year to the second inventory report was 0.9% for total emissions (corresponding to 7.8 Mt CO2e). For individual sectors, this ranged from 0.8% for energy and transport, to 2.6% for industry, 3.2% for buildings, 3.4% for agriculture, and 11.3% for waste management. Thus, the historical correction need in the energy and transport sectors is about a quarter of the annually fixed reduction quantities, for buildings and industry it is of a similar order of magnitude to the annually fixed reduction quantities, and for agriculture and waste management and miscellaneous it is several times higher.

Z5 **The historically observed need for correction matches the uncertainty data of the Federal Environment Agency in all but one sector.** In line with international standards, the Federal Environment Agency reports confidence intervals for the actual emission data in the individual sectors. For the first time, the Federal Environment Agency also reports such confidence intervals for the current reporting year 2020. The procedure for determining the uncertainties is in line with the IPCC guidelines.[1] The comparison of the historical correction requirements with the confidence intervals of the Federal Environment Agency shows no unexpected deviation both at the level of overall emissions and at the sectoral level, in all sectors except industry. For the industry sector, the confidence interval cannot be confirmed at this stage.

Z6 **In sum, the examination and evaluation of the data provided in the estimate of the year 2020 pursuant to Section 5 (1) KSG does not provide any indication that the Federal Environment Agency should have arrived at a different result in its point value estimates. At the same time, it is apparent that the uncertainty associated with this estimate is high in some sectors.**

Z7 **Taking into account the confidence intervals used by the Federal Environment Agency, it is *unlikely* that the buildings sector will have achieved its sector target in 2020 (Figure Z-2).** Based on the Federal Environment Agency's confidence interval data, the sector missed its target with a probability of 67.3%. According to the IPCC guideline,[2] the achievement of the target is thus described as *unlikely*. The agriculture and waste management sectors are *about as likely as not* to exceed their targets. The transport sector is *very likely* to have achieved its target. The energy sector and industry are *practically certain* to achieve their targets, taking into account the confidence intervals.

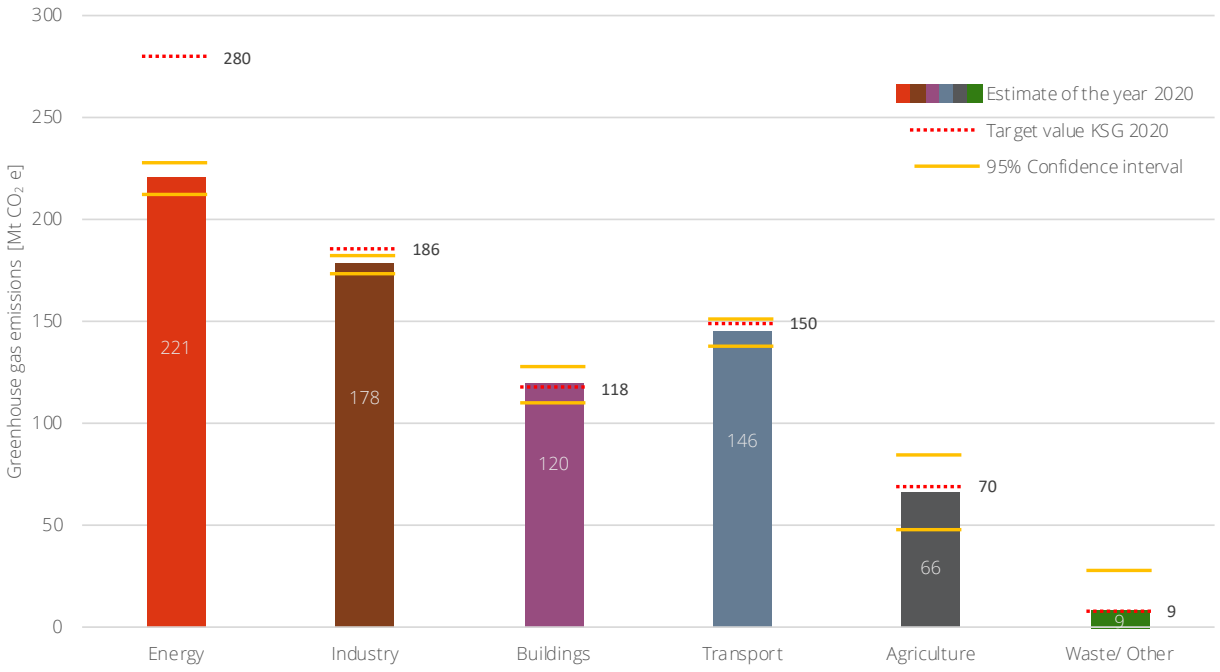
Z8 **The point value estimates of the Federal Environment Agency mean that the reported emission values for all of the sectors mentioned in Section 4 (1) KSG were below the target values, with the exception of the buildings sector.** The buildings sector was 2 Mt CO_2e above the sector target, from which the need

[1] IPCC: Intergovernmental Panel on Climate Change

[2] The following terms were used to indicate the assessed probability of an outcome, using IPCC nomenclature to describe uncertainties (Mastrandrea et al. 2010): practically certain 99–100% probability, very likely 90–100%, likely 66–100%, about as likely as not 33–66%, unlikely 0–33%, very unlikely 0–10%, especially unlikely 0–1%.

to present an immediate action programme is derived. The question of whether such an immediate action programme would actually be necessary for the buildings sector if a comprehensive analysis were conducted does not arise because of the mechanism provided for in the Federal Climate Change Act. Such a comprehensive analysis would have had to take into account other considerations such as laws already in effect or special effects in 2020. Such further analyses are not included in the evaluation of the emission data.

Figure Z-2 Target value comparison of the estimate of the Federal Environment Agency for the year 2020 with the permitted annual emission quantities of the Federal Climate Change Act

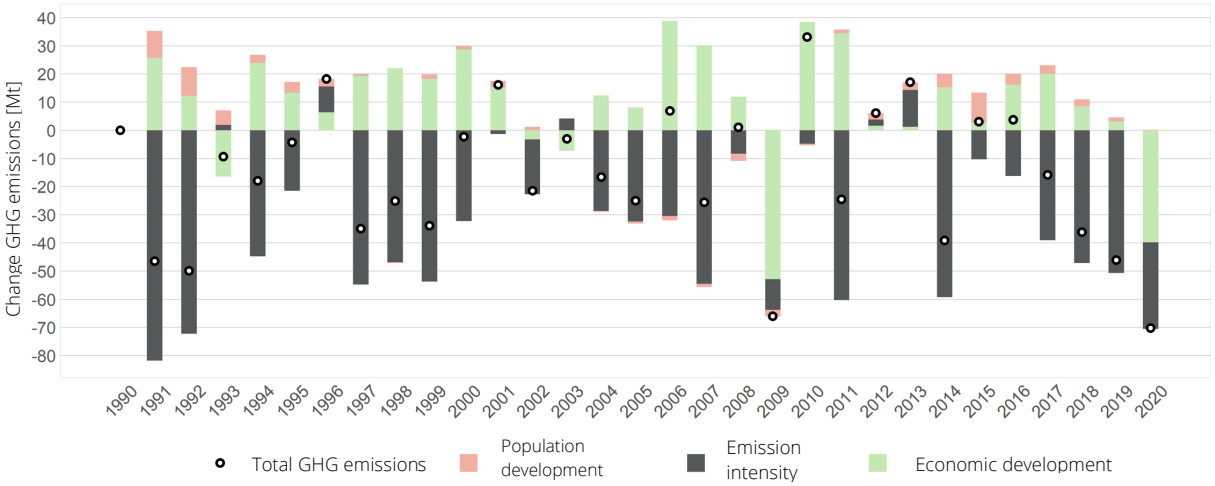


Data based on the estimate for the year 2020 of the Federal Environment Agency and the uncertainties of the estimate stated there. For Waste Management and Other, the lower edge of the uncertainty range is not shown. It is minus 10.5 Mt CO_2e. This negative uncertainty minimum results from the symmetry of the normal distribution but is not relevant for the assessment.
Source: Council of Experts on Climate Change.

Part II: Further considerations

Z9 **Using a simple decomposition analysis, more than half of the emission reduction in 2020 compared to the previous year 2019 can be attributed to the factor of a reduced economic output (measured in GDP per capita) (Figure Z-3).** The change in emissions from 2019 to 2020 is analysed based on a decomposition of emissions trends into population trends, economic trends, and emissions intensity factors. The total reduction in emissions in 2020 compared to the previous year was similar to the reduction from the year of the financial crisis in 2008 to 2009, but in 2020 the impact of reduced economic output was greater. The reduction in emissions intensity is identified as another important factor in the decrease in emissions between 2019 and 2020, as has been the case in previous years since 2014. According to this analysis, population development no longer plays a major role in the emissions trend at present.

Figure Z-3 Decomposition of total greenhouse gas emissions – changes compared with the previous year



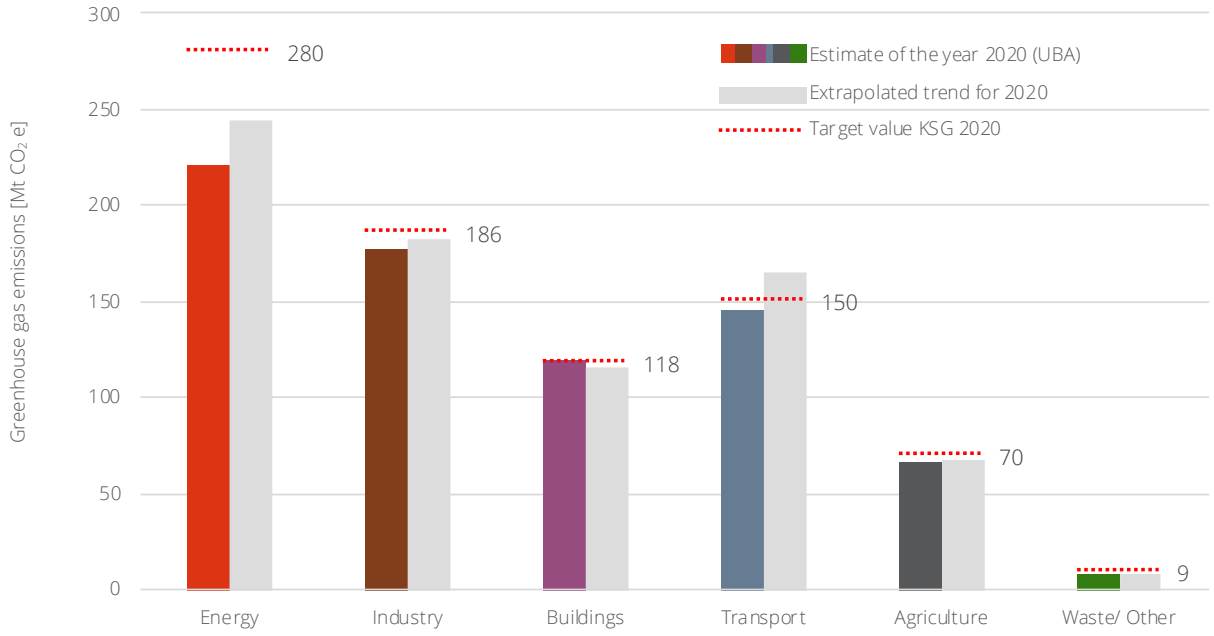
The figure shows a decomposition of the change in total annual greenhouse gas emissions (circle) into the components of population development (measured as number of inhabitants), economic development (measured as gross domestic product per capita) and emission intensity (measured as greenhouse gas emissions per unit of gross domestic product) in relation to the respective previous year.

Source: Council of Experts on Climate Change

Z10 **Based on a trend extrapolation, total greenhouse emissions in 2020 would have been 45 – 48 Mt CO_2e higher than actually reported in the estimate of the year 2020. This would represent 64% – 68% of the total observed decrease in emissions compared with the previous year. In the trend extrapolation, the buildings sector would have undercut its 2020 sector target by about 2% (2 Mt CO_2e), while the transport sector would have significantly exceeded its sector target by about 10% (15 Mt CO_2e) (Figure Z-4).** Based on an extrapolation of the trend of historical emission data, the special effects can be estimated quantitatively. As a first rough approximation, the emission data for 2020 can be compared with those values resulting from a simple extrapolation of the historical trends. On this basis, a hypothetical emission development for 2020 is calculated. According to this, all sectors would have met their respective targets, except for the transport sector. For the transport sector, an independent estimate of the hypothetical emission volume based on GPS data yields a value of 160 Mt CO_2e for 2020, thus also exceeding the sector target.

Z11 **Empirical examination of activity data in all sectors also shows that they have been influenced by special effects, including the measures taken to contain the Covid-19 pandemic. The influence of the special effects was substantial and varied in direction of impact.** The Covid-19 pandemic is believed to have had a substantial impact on emissions data, particularly in the transport sector. In the energy sector, on the other hand, other factors played an important role, such as the low price of natural gas and oil and the weather pattern in 2020. In the buildings sector, additional inventory effects came into play, especially of light heating oil – presumably due to the briefly lowered VAT rate and in anticipation of the new fuel emissions trading system introduced from 2021, among other factors. The Working Group on Energy Balances implicitly estimates the corresponding emission volume at 1.7 Mt CO_2e (AGEB 2021).

Figure Z-4 Comparison of emissions data from the estimate for the year 2020 (VJS UBA) with the values determined in the trend analysis for 2020 in relation to the target values in the Federal Climate Change Act.



Source: Council of Experts on Climate Change

Z12 **Targets set in the Federal Climate Change Act are affected by the increase in the European emissions reduction target from 40% to 55% by 2030 compared with 1990. The precise effect on national target will depend on decisions at the EU level regarding the implementation of European targets.** The targets set in the Federal Climate Change Act are also intended to ensure compliance with European targets, thus reflecting the common European target architecture. The current national target of at least 55% reduction by 2030 compared with 1990 is consistent with a 40% reduction at the EU level. The exact implications of the European target increase from 40% to 55% by 2030 compared with 1990 for the German sector targets cannot be conclusively assessed yet. These depend largely on pending decisions at the EU level, for which initial proposals are expected in summer 2021. Provided that the target architecture and the mix of instruments are not fundamentally changed, it is likely that at least the sector targets for those sectors subject to European effort sharing, i.e. transport, buildings, parts of industry, agriculture, and waste, will have to be adjusted to avoid an implementation gap. However, fundamental alternatives are also being discussed at the EU level, in particular the extension of the existing European Emissions Trading Scheme (EU ETS) to all sectors, as well as the introduction of an additional EU ETS for transport and/or buildings.

Z13 **As a result of the tightening of the EU target, the German emissions path until 2030 will change substantially compared with the status quo. This change will at the very least be indirect, but may also be direct, via a tightening of the KSG targets.** The shares between European emissions trading and effort-sharing regulation (ESR) have not yet been fixed. The EU Commission's impact assessment (EU 2020)

assumes that ETS sectors across Europe will reduce by 65% instead of 43% by 2030 compared with 2005. For the ETS sectors in Germany, this could result in a reduction of 46–50% (instead of 38%), depending on various illustrative allocation keys. Varying the assumptions based on scenarios that seem conceivable, a range of 62–68% overall reduction from 1990 levels could result for German GHG emissions in 2030. The current lack of clarity about the future emissions path makes forward-looking decisions for companies and households considerably more difficult. Therefore, it seems reasonable to shed light on possible scenarios at an early stage, especially regarding the currently valid division into ETS and ESR sectors. In this context, a greater harmonisation between the European framework and federal climate protection legislation should be pursued (see margin note Z18).

Z14 **The emission data of the estimate of the year 2020 imply an immediate need for action pursuant to Section 8 (1) KSG only in the buildings sector. Taking into account special effects and uncertainties, it becomes clear that the emission data of the estimate only represent a snapshot. The informative value about the structural emission development is limited, especially regarding a possible increase of the sector targets due to the European target tightening**. The sector targets have been achieved in the Corona year 2020 in all sectors except for the buildings sector. However, taking into account the uncertainty in the estimate, there may well be a change in this assessment in the subsequent National Inventory Reports in all sectors except energy and industry. Based on the Climate Change Act, however, this would not have any additional legal consequences. Moreover, with the exception of the energy sector, all sectors are quite close to the values of their respective sector target (Figure Z-2). Additional need for action becomes apparent through a trend analysis that attempts to quantify the impact of special effects on 2020 emission reductions. If historical trends had continued, the transport sector would have exceeded its target. Furthermore, it is expected that the recent EU decisions strengthening the climate targets will lead to a need for action in adjusting the targets in the Federal Climate Change Act. On this basis, there is not much scope to achieve potentially strengthened targets without additional measures, with the possible exception of the energy sector.

Part III: Conclusions

Z15 **The accuracy of the estimate of the previous year could be increased by making essential data available earlier, tapping into additional data sources, and expanding the methods.** In view of the great relevance of the sectoral values of greenhouse gas emissions of the estimate of the previous year for the development of immediate action programmes within the meaning of Section 8 (1) KSG, the collection methodology should be based on additional data sources and make use of further independent collection methods such as a physical measurement of emission values. In addition, a systematic analysis of the causes for the need for corrections in the past would be helpful to gain insights into where significant reasons for subsequent corrections to the emission data reported in March lay.

Z16 **In order to further develop the mode of action of the Federal Climate Change Act, it is suggested that an additional review mechanism be established for those sectors which, according to the estimate of the previous year by the Federal Environment Agency, achieved the sector target for the previous year.** According to criteria yet to be defined, the federal government could consider, in connection with the estimate of the previous year, whether the establishment of an immediate action programme might be appropriate despite a reported achievement of the target. Reasons for this could be the uncertainties in the estimate of the previous year (probability of a target shortfall not yet detected by the estimate of

the previous year), possible special effects and their impact on the emissions performance (target achievement not structurally determined), or intersectoral shift effects (target achievement at the expense of other sectors). The corresponding assessment would also have to take into account elements of a forward-looking analysis that includes climate policy measures and programmes already in place.

Z17 **To further develop the mode of operation of the Federal Climate Change Act, it is suggested that a consistent procedure for crediting emission quantities to subsequent years pursuant to Section 4 (3) be developed that also takes account uncertainties.** To minimise uncertainties, the most recent available data should be used for each crediting of overachievement or underachievement of the targets according to Section 4 para. 3 KSG. It is suggested that a consistent process for adjusting future values of sector targets based on both underachievement and overachievement be developed within the Federal Climate Change Act. This should consider both the uncertainty in the collection of emissions data in the estimate of the previous year and the corrections made later.

Z18 **For the assessment of immediate action programmes, a reallocation of sectors in the Federal Climate Change Act would be helpful, allowing for the clearest possible allocation of each sector to either the European Emissions Trading Scheme or the Effort Sharing Regulation.** This would allow transparent allocation to key climate policy mechanisms.

Z19 **To complete the picture of greenhouse gas emissions developments, it would be important to include emissions from land use, land use change, and forestry (LULUCF) with a reduction target analogous to the other sectors, as well as trade-related emissions.** Against the background of changes in the demand for biomass and land and the increasingly emerging changes in weather patterns and the consequences for the biosphere, especially forests, it should be examined how the Federal Climate Change Act could be harmonised with the European LULUCF Regulation and how minimum targets could also be formulated for LULUCF analogous to the other KSG sectors. However, this requires an improved data basis for a timely and sufficiently validated assessment. Finally, climate policy measures can result in territorial displacement effects that may hamper the overarching goal of reducing global emissions. It should therefore also be examined whether indicative information supplementing the national inventory reports could be provided for the collection of greenhouse gas emissions linked to imports and exports.

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