Analysis of Member States' 2019 GHG projections

Submitted under Article 14 of the EU Monitoring Mechanism Regulation (EU) No 525/2013

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1. Summary of the results from the 2019 quality control procedure

In the 2019 reporting cycle, again as in 2017, a significant improvement in the quality of the submissions compared to previous reporting years can be seen. All Member States, except Romania, provided submissions on GHG projections in 2019.
During the communication process the ETC/CME sent out on average 23 questions per Member State. The number of questions shared with Member States slightly increased from 506 to 630 due to the introduction of new checks compared to 2017. The majority of the findings were related to the completeness (99 questions) and consistency checks (84 questions). In terms of sectors concerned most questions referred to the energy sector (17%), almost half of the question were not directly related to a sector but were of a rather general nature, either concerning all sectors or the general reporting. The responsiveness of Member States and the collaboration with them has improved a lot over the last years, so the QA procedure was closed by the ETC/CME on time.

In 2019, 16 Member States reported on time compared to 13 in 2017. 13 Member States have reported earlier in 2019, eight Member States reported later compared to 2017. 19 Member States provided a resubmission during the QA procedure, whereas in 2017, 24 countries provided resubmissions. Also the total number of resubmissions decreased. In 2019, in total 23 resubmissions were provided during the QA procedure, in 2017 33 resubmissions were provided. The average time between initial and final resubmission has decreased from 46 days in 2017 to 32 days in 2019. The last final submission was provided by end of May, compared to 2019 where the last final submissions were received in July.

In 2019, the majority of Member States reported a lot of blank and/or zero values. Only eight Member States filled out all cells of the template with either a number or a notation key. Overall, improvements in completeness compared to the 2017 appear to be limited or reduced: The completeness of mandatory information has not changed a lot for most Member States in the reporting year 2019 compared to 2017. The completeness of voluntary information reported was substantially lower in 2019 compared to 2017: The number of Member States reporting a WOM scenario reduced, however reporting of intermediate years has increased since 2017. 17 Member States reported a WAM scenario, only three Member States reported a WOM scenario. Two Member States (Cyprus and Hungary) reported projections for all three scenarios. This is a reduction in completeness compared to 2017 when five Member States reported projections for all three scenarios.

Regarding the completeness of the time series 25 countries reported all mandatory years of the time series compared to all countries in 2017 (Hungary and Denmark did not report all mandatory years in 2019). Intermediate years were reported by 17 Member States compared to 20 Member States in 2017. Typical gap-filling and correction activities of the ETC/CME in 2019 were: calculation of intermediate years, gap-filling of missing information (LULUCF, Memo items Int. Navigation and Aviation, missing years), and deletion of historical figures if no projections are available and corrections of sum errors.

In 2019, 13 Member States chose 2016 as reference year, followed by 2015 (7 countries) and 2017 (6 countries). The deviations of Member States reference years compared to their inventories decreased compared to 2017, so again no reference year calibration was necessary in the 2019 reporting cycle. The Total emissions (without LULUCF) for the EU reference year deviates by 1.59% which is an increase compared to 2017 (0.13%) which is likely caused by the gap-filling of the 2017 year for countries that did not report this year.

In terms of ETS/ES reporting, the allocation of sectors to ETS/ES has improved compared to 2017, in 2019 only five Member States were affected compared to eight in 2017. A small improvement compared to 2017 submission on aligning reference year values with historic inventory data. The total of MS differing by more than 0.5% from historic values decreased form eight in 2017 to six MS in 2019. ETS and ES emissions for subcategories of the source category industrial processes were not reported in three instances. ETS and ES emissions for the projection reference year are generally well aligned with historic inventory data. Large upwards or downwards changes in ETS splits are well explained in accompanying report or were clarified through the QA/QC procedure.

The sum errors have been a major problem in the past reporting cycles; therefore the EEA has implemented automated CDR sum checks in 2017. In 2019, the overall sum check reported a 57% decrease in questions to the Member States. The most common sources of mistakes were problems with entering data into the template correctly and accidentally omitting values when transferring the data into the template.

The overall outliers check reported a 58% decrease in questions to the Member States (85 in 2017 vs. 36 in 2019). In most cases, there is a lack of transparency in the reporting and outliers were not described in the technical report. During the QA/QC procedure 67% of the questions have been successfully explained or corrected by the Member States, 17% of the cases were not addressed by the MS and further 17% will be solved by MS in future submissions.

In 2019, the ETC/CME additionally carried out a comparison of projections reported under the MMR and the projections reported in the draft National Energy and Climate Plan (NECP) for those countries where such data was available at the time of the checks. For this reason it could not be done for all Member States. Six Member States reported WEM projections and 2 Member States reported WAM projections that were identical with the draft NECPs. Differences were explained by Member States by differences in timing between preparation of the draft NECP and MMR reporting.

Regarding parameters, a total of 147 unique parameters were identified across submission data in 2019. Slightly more MS reported on the international fuel and carbon price parameters from projection year 2020 onwards than in 2017. The number of transport parameters decreased in 2019 compared to 2017. One major challenge persists: It is often not transparent in which units the parameters are reported, in addition the recommended units are often not used. The quality of parameters submitted by MS improved significantly since 2017. In 2017, 17 MS reported correct values for population, 8 MS for GDP and 7 MS for net electricity imports during the first submissions. In 2019, 24 MS reported correct values for population, 22 MS for GDP and 19 MS submitted correct values for net electricity imports, during the first submissions. All problems were solved after communication with the MS in 2019.

According to the ETC/CME analysis it is estimated that about 9 to 12 MS use the Commission recommended parameters on international fuel prices and EU ETS carbon prices. Due to potential uncertainty over exchange rates and implicit deflators of price data (the ETC/CME converts all monetary values to constant EUR2010), it is difficult to assess whether recommended guidance has been used. This may have led to some parameters classified as not following the recommended parameters.

Regarding the specific analysis on net electricity imports, Ireland and Latvia project to change from being (modest) net electricity exporters to net electricity importers between the reference year and 2020. These shifts were not reported in the 2015 and 2017 projections. Finland, Hungary and Lithuania project to change from net electricity importer to net electricity exporter between 2020 and 2030. Contrary to the result of the 2017 submissions, more imports than exports are projected in 2020.

The ETC/CME carried out a general analysis of the models applied by the Member States as reported in the model factsheets. In total, the analysis shows that Member States apply 123 different models used for GHG emissions projections. 45% of the models are using the bottom-up approach, a top-down approach is used in 17% of the models and the rest used various mathematical or statistical approaches (e.g., probabilistic and deterministic models). Geographic coverage of models varies from regional, to national, to international scope. However, most MS cover only their national scopes. Relatively few models addressed LULUCF; despite its significant impact on overall GHG emissions (this might not be relevant for the projection per se). 22 MS used specific models for GHG emissions from energy sectors. For agriculture and LULUCF sectors, 13 and 11 MS used specific models, respectively. Only nine and five MS had specific models for estimating emissions from waste and industrial processes, respectively.

As in previous reporting years a number of other major challenges apart from those mentioned above remain. This includes an apparent lack of internal Member States quality control procedures to ensure that the reported data is correct, the timeliness of the submissions, under reporting of voluntary elements, and insufficient transparency (e.g. very short, non-transparent reports submitted, missing information on links between GHG projections and policies and measures).

2. Introduction

This report provides a summary of the analysis of the EU Member States' (MS) submission of greenhouse gas (GHG) projections under Article 14 of the Monitoring Mechanism Regulation (MMR) [(1)] and its Implementing Regulation [(2)] in 2019. It aims at describing the main results of the Quality Assurance and Quality Control (QA/QC) procedure as carried out by the European Topic Centre for Climate change Mitigation and Energy (ETC/CME) (see ETC/CME Eionet Report 2019/7) in order to provide more transparency on the quality of the reported information under Art. 14 of the MMR. This includes the identification of progress and improvements made by the MS since the last mandatory reporting year (2019), and an outlook for the main challenges for future reporting.

The report is structured according to the quality criteria defined by the Intergovernmental Panel on Climate Change (IPCC) (see chapter 2.3). The first part includes a summary of the main results, followed by the chapter presenting the detailed results: Completeness and timeliness of reporting, number of resubmissions, followed by a general assessment of completeness of the reported information. The next chapter presents some statistics regarding the communication with the Member States. In the chapter on consistency and comparability a deeper insight on the quality of the data is provided, such as unit consistency, consistency with historical data, or split of ETS (Emission Trading Scheme) and ES (Effort Sharing) emissions. The assessment of accuracy and transparency provides some aggregated general results such as number of outliers and other deviations, in addition some illustrative cases are provided in this chapter in order to further explain how the checks work. A separate chapter covers a brief assessment of the reported parameters and the most common issues the ETC/CME detected during the Quality Assurance / Quality Control

[(1)] 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, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R0525&from=EN

[(2)] Commission Implementing Regulation (EU) No 749/2014 of 30 June 2014 on structure, format, submission processes and review of information reported by Member States pursuant to Regulation (EU) No 525/2013 of the European Parliament and of the Council, http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1503587972354&uri=CELEX:32014R0749

(QA/QC) process. It provides detailed insights on the completeness of the sectors, most common reporting issues and the major challenges. The final chapter points out the main conclusions and recommendations for future reporting cycles.

It has to be noted that the QA/QC procedure was applied to all EU Member States, as well as European Environment Agency (EEA) member countries. In 2019 Iceland, Norway and Switzerland provided voluntary submissions. An overall summary for these countries is provided in chapter 5.

The final GHG projections dataset for the EU and its MS can be found under following link: https://www.eea.europa.eu/data-and-maps/data/greenhouse-gas-emission-projections-for-6

2.1. The Union System for projections

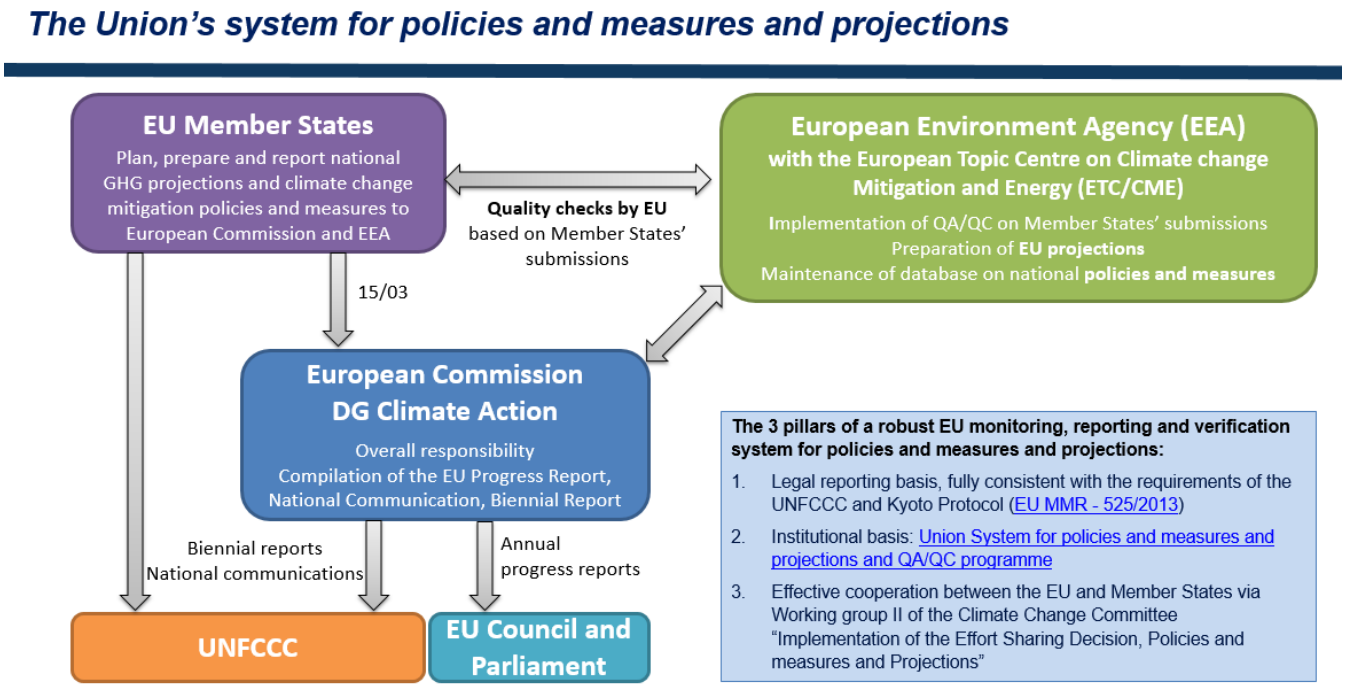
The Union system for policies and measures and for projections (Figure 1) represents the institutional, legal and procedural arrangements established for reporting on policies and measures and projections of anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol.

Overall responsibility for the Union system for policies and measures and projections of anthropogenic greenhouse gas emissions by sources and removals by sinks rests with the European Commission, more specifically its Directorate-General for Climate Action (DG CLIMA). The outcome of the system provides data for the evaluation of progress towards EU and international commitments, as per Article 21 of MMR and 4 and 12 of the UNFCCC and 3 of the Kyoto Protocol.

In accordance with Article 26(1) of Regulation (EU) No 525/2013, the Climate Change Committee established under Article 3 of Regulation (EU) No 182/2011 assists the Commission. The Committee is composed of representatives of the Member States and chaired by a representative of the Commission.

Working Group 2 'Implementation of the Effort Sharing Decision, Policies and Measures and Projections' was established under the Climate Change Committee as a regular body for exchange of information on projections and policies and measures between the Commission, the EEA and the Member States (EC, 2015).

Figure 1 Union System for Policies and Measures and Projections



Source: (EC, 2015)

2.2. Reporting requirements

Article 14 of the MMR and Article 23 and Annex XII of its Implementing Regulation set out the details for Member States to provide information on national GHG projections. Every two years starting from 2015 MS have to report GHG projections and accompanying information to the European Union.

The main mandatory elements of this reporting obligation are:

- GHG projections reported by gas (Total GHGs, Total ETS GHGs, Total ES GHGs, CO_2, CH_4, N_2O, HFC, PFC, SF_6, NF_3)
- For the reference year, 2015, 2020, 2025, 2030 and 2035
- Split by sectors in line with the common reporting format (CRF) format
- Sectoral split into ETS and ES emissions
- Report a with existing measures scenario (WEM)
- Provision of a model factsheet
- Provision of a sensitivity analysis of the total GHG
- Provision of a description of methodologies, models and underlying assumptions
- Provision of input and/or output parameters
- the impact of policies and measures identified pursuant to Article 13 indicators, if used

Where available, voluntary reporting items are:

- With additional measures scenario (WAM)
- Without measures scenario (WOM)
- Intermediate years

2.3. Scope of the QA/QC

The European Commission (DG CLIMA) is responsible for coordinating QA/QC activities on GHG projections at EU level and to ensure that the objectives of the QA/QC programme are fulfilled (see ETC/CME Eionet Report 2019/7). The European Environment Agency (EEA) is responsible for the annual implementation of the QA/QC procedures and is assisted by the ETC/CME.
As the Union projections are compiled as the sum of all EU Member States projections, it is very important that the Member States data meet certain quality objectives. The data quality objectives pursued by this QA/QC procedure are based on the core principles of data quality: transparency, completeness, consistency, comparability and accuracy. These quality principles have been initially defined by the IPCC to characterise the quality of historical emission inventories. They have a slightly different scope in the context of emission projections.

Transparency: means to ensure that transparent information is provided on underlying assumptions, methodologies used and sensitivity analysis performed in MS' national projections to enable further assessment by users of the reported information and for the purpose of the compilation of Union GHG projections.

Completeness: means to ensure that projections are reported by MS for all years, sources and sinks, gases and sectors as required under the MMR so that projections are available for the entire EU area to enable further assessment by users of the reported information and for the purpose of the Union GHG projections compilation (see also reporting requirements in Chapter 2.2)

Consistency: means to ensure that projections are reported by MS for all years, sources and sinks, gases and sectors as required under the MMR so that projections are available for the entire EU area to enable further assessment by users of the reported information and for the purpose of the Union GHG projections compilation.

Comparability: means to ensure that national estimates of projected emissions and removals reported by MS are comparable across MS. The allocation of different sources and sink categories by gas follows the split in accordance with the MMR and recommendations by the Commission with

regard to projections horizon, reference year (starting year), ETS/ES spilt, EU policies and measures to be taken into account and harmonised key assumptions are followed as appropriate.

Accuracy: means that projected estimates are accurate in the sense that they are plausible and neither systematically over- nor underestimated as far as can be judged and that uncertainties inherent to the methodology and input data are reduced as far as practicable. In addition, it should be ensured that an accurate aggregation of sectors for national GHG projections and an accurate aggregation of MS for the Union GHG projections are provided.

An additional quality principle used in this context is **timeliness** and it means that national GHG projections are submitted by 15 March for each reporting year in accordance with the MMR.
Further details on the QA/QC procedure are provided in the ETC/CME Eionet Report 2019/7.

In order to support the EU MS with the submission procedure, the EEA and the ETC/CME prepare and provide guidance documents such as a checklist for quality control, guidance for reporting parameters, guidance for reporting the ETS/ES split, etc. The documents can be found under: http://cdr.eionet.europa.eu/help/mmr

By end of 2018 the EU MS had to submit their draft National Energy and Climate Plans (NECP) within the new framework of the Energy Union Governance. This plan requires that MS also report on GHG projections. For this reason a new check has been introduced for the QA procedure 2019 in order to compare the projections reported under Art 14. of the MMR with those reported in the draft NECP. Moreover, the so-called WEM/WAM/WOM check was implemented which checks if the emissions of the WOM scenario are higher than the WEM, and that the WEM emissions are higher than the WAM. If this is not the case, the ETC/CME asked the Member States for an explanation.
Following up a recommendation from the UNFCCC review of the 3rd EU Biennial Report, all Member States were asked to clarify whether they have included or excluded indirect CO_2 emissions from the Total (wout LULUCF).
Furthermore in 2019, the EU aggregated dataset was extended and for the first time the transport sub-categories were compiled for the EU-28 aggregate. As a first step, the ETC/CME also compiled an additional EU dataset for all gases (CO_2, CH_4, N_2O and F-gases), but without the application of any gap-filling and error correction.
The following table provides an overview of the sectors and included in the EU aggregated dataset:

Table 1 Sector codes and sector names of the EU aggregated projections dataset

Sector code	Sector name	Sector code	Sector name
1	Energy	1.B	Fugitive emissions from fuels
1.A.1	Energy industries	1.C	CO_2 transport and storage
1.A.2	Manufacturing industries and construction	2	Industrial processes and product use
1.A.3	Transport	3	Agriculture
1.A.3.a	Domestic aviation	4	Land use, land use change and forestry (LULUCF)
1.A.3.b	Road transportation	5	Waste
1.A.3.c	Railways	M.IB aviation	Memo item: International bunkers aviation
1.A.3.d	Domestic navigation	M.IB naviga-tion	Memo item: International bunkers navigation
1.A.3.e	Other transportation	M.IB aviation in the EU ETS	Memo item: International aviation in the EU ETS
1.A.4	Other sectors	Total	Total w.out LULUCF
1.A.5	Other		

3. Results from the quality checking procedure

In the reporting cycle of 2019, 27 Member States and three EEA countries (Iceland, Norway and Switzerland) provided information on GHG projections in accordance with Art 14. of the MMR. Romania did not provide a submission and it agreed that the ETC/CME gap-filled the dataset with the projections submitted in 2017.

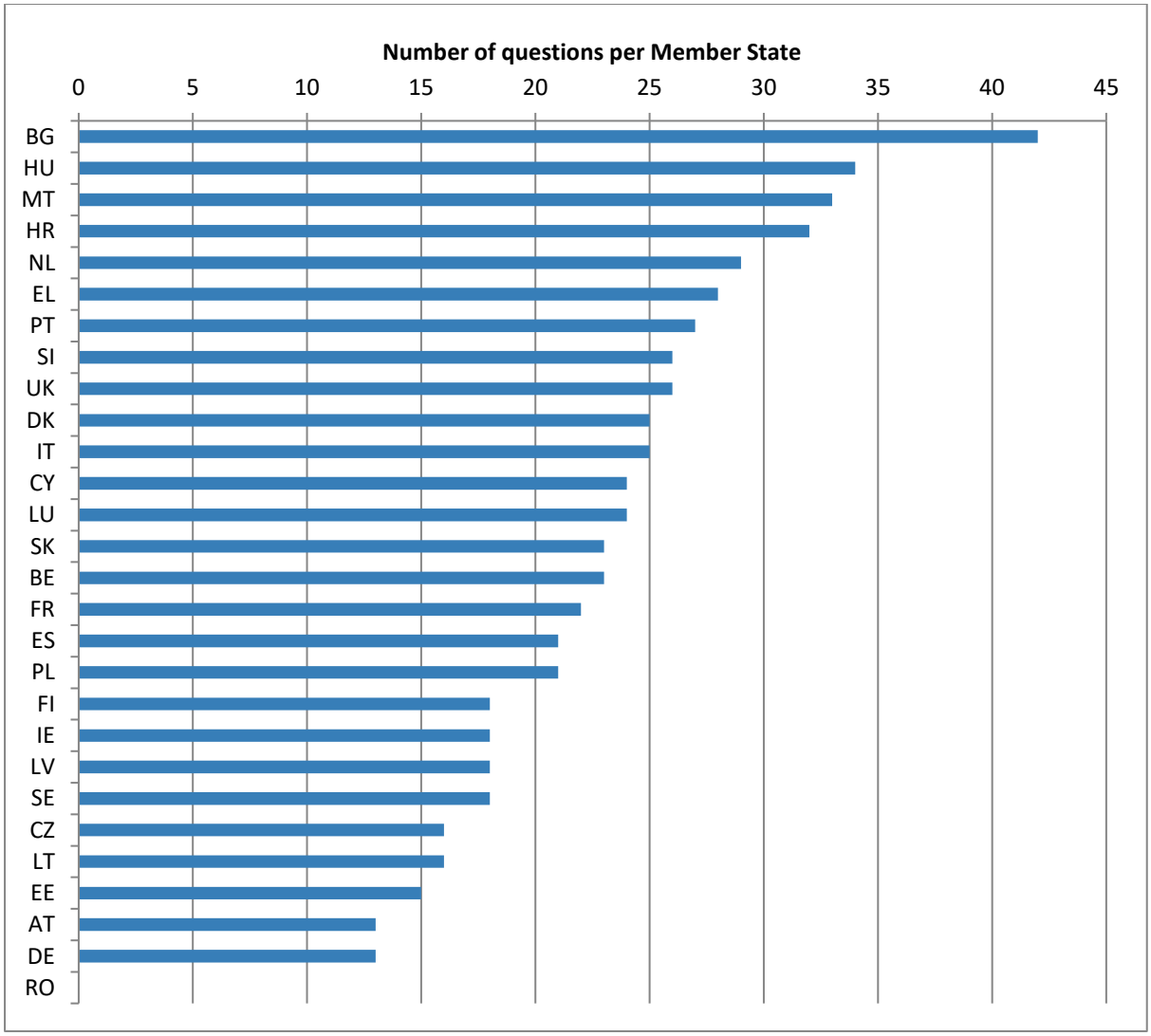
3.1. Communication with Member States

During the QA/QC procedure in 2019, the ETC/CME experts raised in total 630 questions to the Member States' experts (compared to 506 questions in 2017). 82 % of these questions could be solved directly with the Member States' experts in the communication process. The total amount of questions increased mainly because new checks were introduced (NECP check and the WEM/WAM/WOM check). Furthermore, following up finding during the UNFCCC review of the EU's 3rd Biennial Report, all Member States were asked on whether they include or exclude indirect CO2 emissions in their projections. 14% of the questions were solved directly by the reviewers and the remaining 4 % remain open because Member States preferred not to resubmit again, or for minor issues, the Member States delegated the correction to the ETC/CME. In the case of Cyprus the ETC/CME did not receive responses to the findings resulting from the QA/QC, so all of the issues remained open during the QA/QC. However, Cyprus confirmed via email that it agrees with the minor suggested changes by the ETC/CME and therefore the ETC/CME implemented them accordingly.

When an issue could not be solved and it was deemed to be insignificant or not directly affecting the quality of the EU aggregated projections, the finding was translated into a recommendation for future submissions. All issues that were solved by the ETC/CME experts were communicated to the MS' experts either in the communication log file or the MS feedback document which was distributed after the closure of the QA/QC procedure of the ETC/CME.

Figure 2 presents the number of questions per Member State. On the average the ETC/CME asked 23 questions per Member State which is a slight increase compared to 2017, when 18 questions per MS were asked. However, the number of questions sent to a Member State is not necessarily an indicator for the quality, as in many cases questions are grouped if a similar issue was detected for different sectors in order to reduce the number of similar questions. In addition, new checks were introduced in 2019 which also slightly increased the number of questions.

Figure 2 Number of questions per Member State (Note: Romania did not provide a submission in 2019)



The majority of the questions (Figure 3) were related to completeness (99 questions) and consistency (84), but also the ETS/ES check and the sum check triggered questions (50 and 37 respectively). Therefore, it can be concluded that the initial submissions provided by the Member States before the QA/QC are often incomplete and lacking consistency. However, in the course of the QA/QC the majority of Member States provided updated and additional information so the overall completeness and consistency has substantially improved. A summary of all recommendations is provided in Annex 2.

Figure 3 Number of questions per QA/QC check

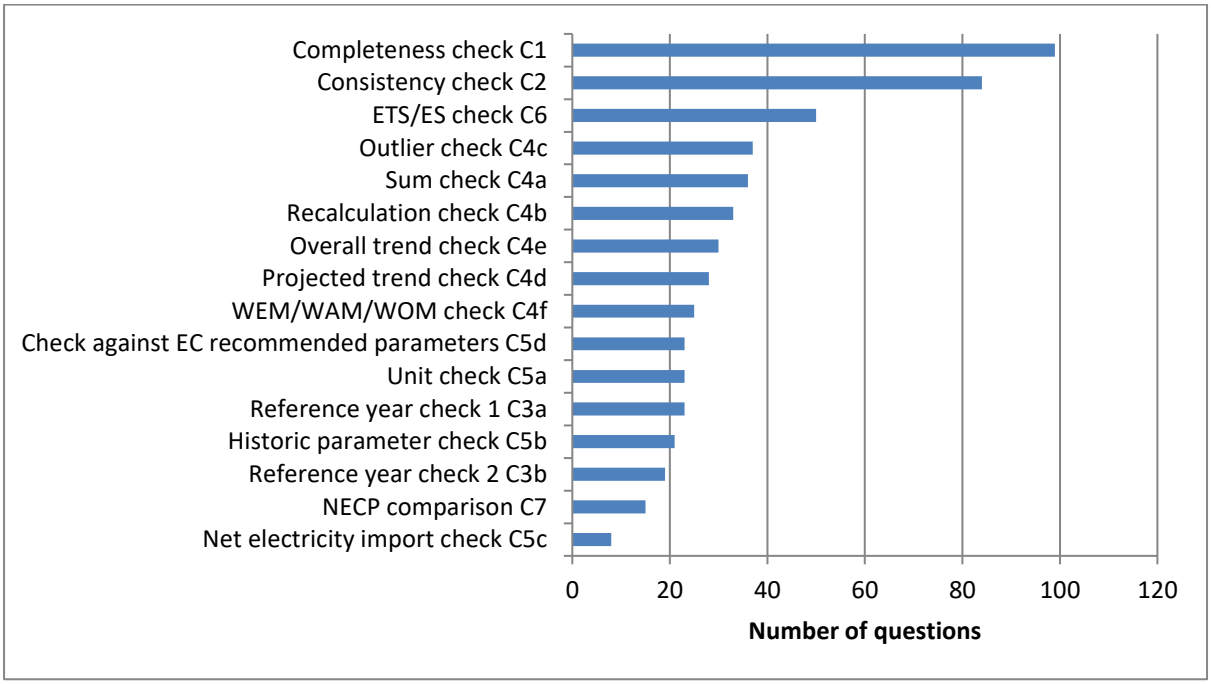
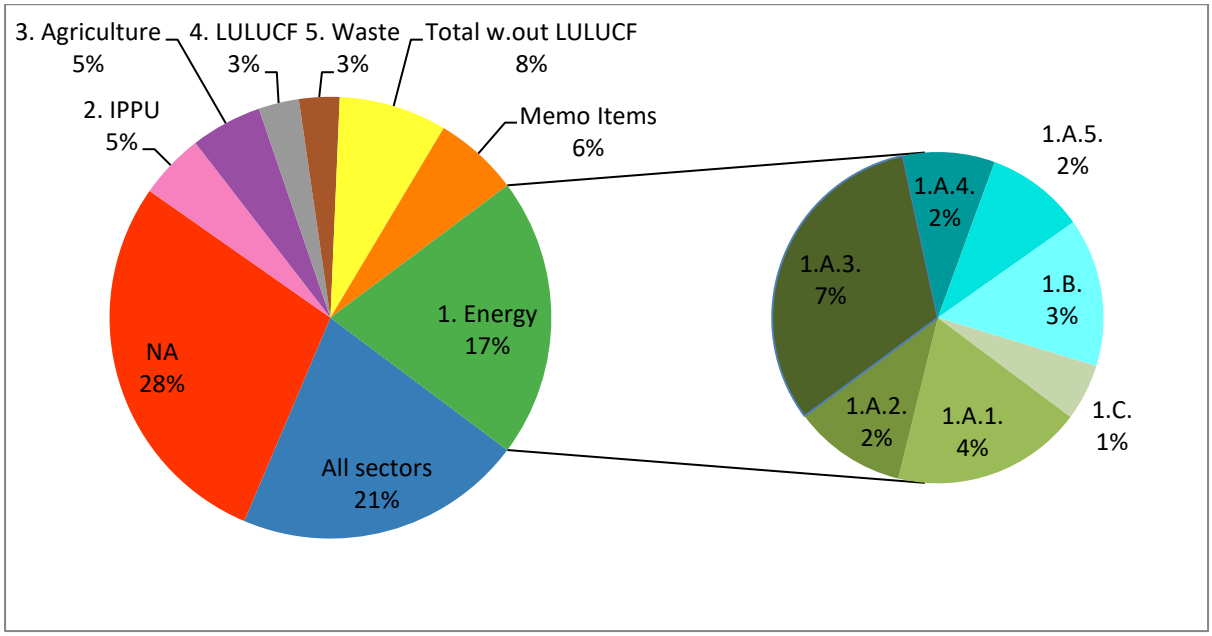


Figure 4 shows how the questions are distributed across the different sectors for the main sectors (left pie chart). Most of the questions (28%) were not related to any sector (NA – not applicable), while the 21% where related to all sectors. NA was used for general questions regarding the submission (e.g. no model factsheet provided, reporting of indirect CO_2). Questions related to "all sectors" typically include issues concerning the inconsistent use of notation keys or systematic sum errors. The largest sector in terms of questions raised is sector 1 Energy with 17 %. Compared to 2017 the distribution of the sectors concerned only slightly changed. For general issues (NA) the share is higher in 2019 (28% compared to 20%) due to the inclusion of new general checks (NECP, WEM/WAM/WOM check). The share of questions related to LULUCF also decreased, as in 2017 there were more misallocations of the LULUCF sector (i.e. figures included for ETS or ES) than in 2019. The pie chart on right side shows a further disaggregation of the energy sub-categories, of which the transport sector triggered most questions. This can be explained by the fact that in 2019 for the first time the 1.A.3 sub-categories were included in the EU aggregated dataset and therefore the ETC/CME checked these categories more thoroughly than in previous reporting years.

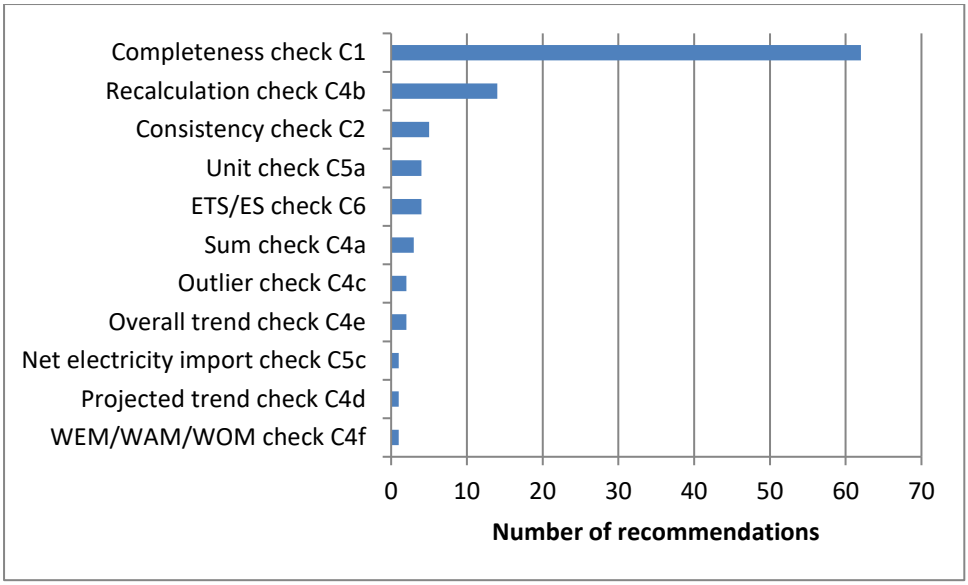
Figure 4 Questions per sector



The responsiveness and overall collaboration with the Member States has improved substantially in the past years. Most Member States replied within the given deadlines and the ETC/CME could close QA procedure on time and before it handed over the final dataset to EEA. Challenging issues occur in every reporting year and they were successfully solved in bilateral communication between the ETC/CME task leader and MMR reporters. Such challenges included the incomplete reporting (e.g. only main sectors reported but no further split into sub-categories provided), a consistent split of ETS and ES emissions (e.g. correct allocation of ETS emissions), or the gap-filling of missing years. To solve these issues and to ensure the consistency of the EU aggregated dataset, the ETC/CME has developed and suggested tailored solutions to the Member States concerned, which were then bilaterally discussed until a mutual agreement was found.

After the QA/QC procedure the ETC/CME has shared feedback documents with the Member States which summarise the results of the checks, the final data and includes recommendations on how to improve for future reporting. In 2019 the ETC/CME formulated in total 100 recommendations (Figure 5). Most recommendations request to increase completeness of reporting.

Figure 5 Number of recommendations related to the checks



3.2 Completeness and Timeliness

3.2.1. Date of submission and resubmissions

Figure 6 illustrates the timeliness of submissions in 2019. The first submissions are marked as green dots. 16 Member States submitted their projections before or on the official deadline of 15 March 2019 (Austria, Belgium, Bulgaria, Croatia, Czechia, Estonia, Ireland, Italy, Latvia, the Netherlands, Poland, Slovakia, Slovenia, Spain, Sweden and United Kingdom). This is a slight improvement compared to 2017, when 13 Member States had reported their projections by 15 March. Ten Member States (Denmark, Finland, France, Germany, Greece, Hungary, Lithuania, Luxemburg, Malta and Portugal) submitted within six weeks after the deadline (compared to 9 Member States in 2017). Bulgaria and Cyprus submitted 61 and 73 days after deadline, with Cyprus being the last EU Member State providing its submission by end of May. Romania did not submit projections in 2019.
As can be seen, the majority of Member States provided resubmissions (black dots in Figure 6) in the course of the QA/QC procedure. Eight countries did not resubmit, as the data passed the quality standards: Austria, Belgium, Germany, Greece, Luxembourg, Poland and Spain as a resubmission was not necessary. This is an improvement compared to 2017, when only four countries did not have to provide a resubmission. Cyprus did not reply during the QA/QC, but no resubmission was required as minor issues were solved by the ETC/CME in agreement with Cyprus. Some Member States (the Netherlands and Slovakia) even provided several resubmissions; encouraged by the ETC/CME they followed-up the issues and applied corrections during the process. On average the time between first submission and final resubmission amounted to 32 days which is an improvement compared to 2017 when the average time was 46 days. The majority of MS resubmitted the revised datasets in May and June.

Thirteen Member States have submitted earlier in 2019 compared to 2017. However three of these countries did not meet the reporting deadline although they improved timeliness: Greece, Hungary and Malta (Figure 7). Eight countries submitted later in 2019 compared to 2017 and none of them achieved a timely submission before the deadline: Bulgaria, Cyprus, Denmark, Finland, France, Germany, Luxembourg and Portugal.

Figure 6 Timeliness of submissions in 2019 by EU Member States (Note: Romania did not submit Projections in 2019)

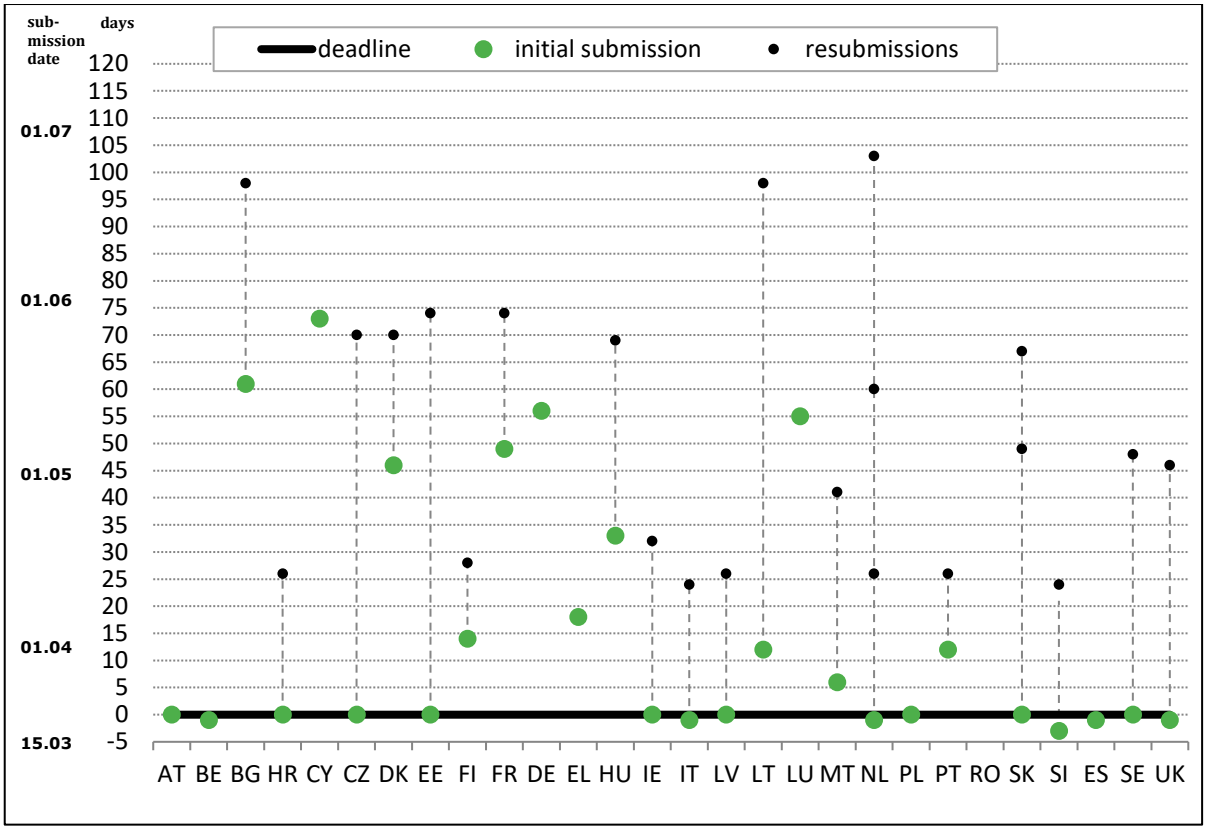
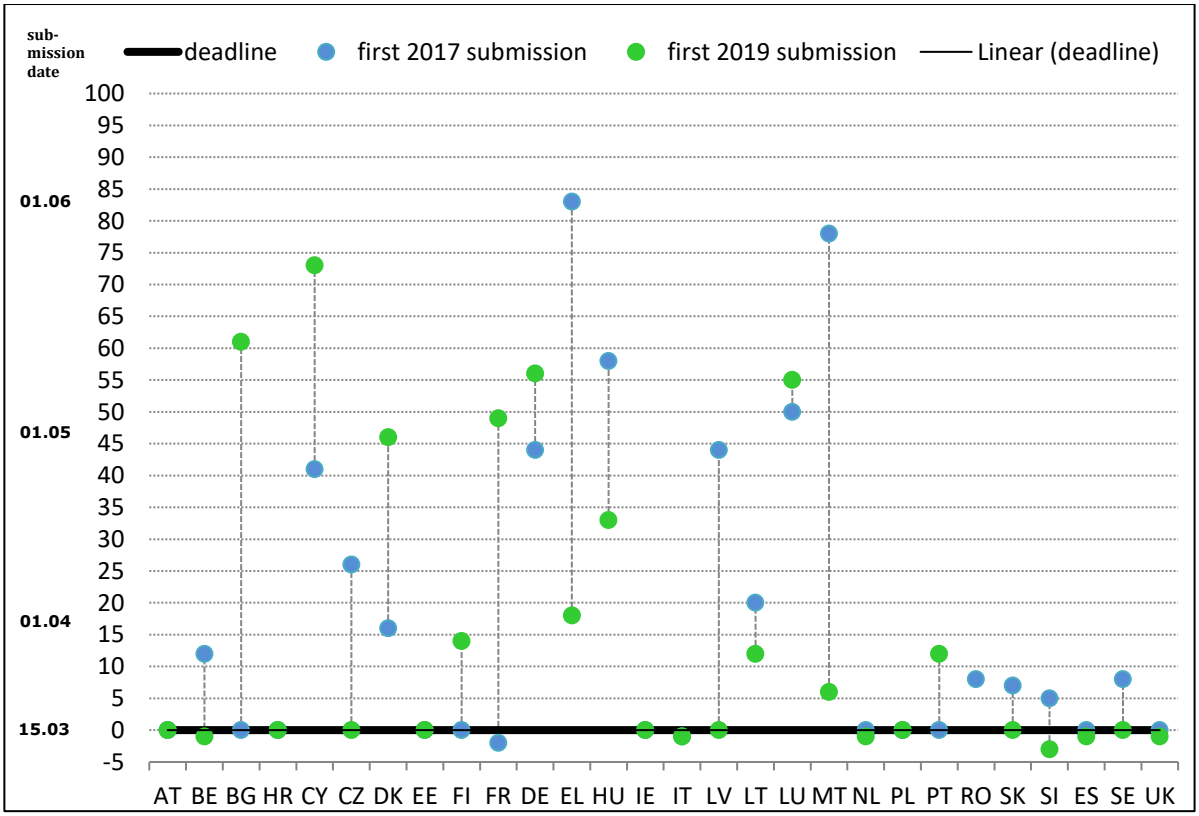


Figure 7 Comparison of timeliness of the first submission in 2019 compared to 2017



3.2.2. General completeness of submissions

The completeness of **mandatory information** (Table 1) has not changed a lot for most Member States in the reporting year 2019 compared to 2017. A rather complete sector split, GHG split, mandatory-WEM scenario and provision of parameters were provided by all Member States with the exception of Romania. In 2019, out of the 27 countries which provided projections four Member States did not provide information on the sensitivity analysis (Bulgaria, Cyprus, Hungary and Italy), but Cyprus and Italy provided further information to explain that a sensitivity analysis was planned for later in 2019. Only Italy did not provide model fact sheets in 2019, in 2017 two countries did not (completely) report on this. All Member States, with the exception of Romania, provided a report, some countries compile a consolidated report for projections and policies and measures (Art. 13 of the MMR) and therefore uploaded the reports in the PaMs folder only.

The completeness of **voluntary information** reported was substantially lower in 2019 compared to 2017. During the 2017 QA/QC procedure several countries replied that they plan to report on indicators in the next years, however only five Member States reported indicators in 2019. Half of the Member States reported emissions up to 2040, compared to just four in the 2017 reporting year which was the first time estimates could be reported for the year 2040. Regarding the scenarios only 17 Member States reported a WAM scenario, and only three reported a WOM scenario. This is a slight decrease in completeness of voluntary information, as in 2017 17 Member States reported a WAM and five Member States reported a WOM scenario.

It is important to note that this table presents the results **after** the QA/QC procedure which means that this includes information only for the (improved) resubmissions.

Table 1 Overview on completeness of reporting in 2019

	Updated projections	Required sector split	Required GHG split	Scenarios			Provision of parameters	Sensitivity analysis	Model factsheet/ description	Report	Provision of indicators	Reporting of the year 2040
				WEM	WAM	WOM						
AT												
BE												
BG												
HR												
CY												
CZ												
DK												
EE												
FI												
FR												
DE												
EL												
HU												
IE												
IT												
LV												
LT												
LU												
MT												
NL												
PL												
PT												
RO	No projections reported in 2019											
SK												
SI												
ES												
SE												
UK												

Legend:	
	Yes, reported
	Not reported (mandatory reporting items)
	Not reported but planned (mandatory reporting items)
	Not reported (voluntary reporting items)

Table 2 summarizes the completeness of mandatory emissions data, by gas, submitted at a two-digit IPCC sector level. The table shows the number of countries, from the maximum of 28 (EU-28 MS), that have submitted the mandatory data for the year 2020. This includes both numerical and notation key data.

Table 2 Number of countries that reported emissions data per sector and per gas for the mandatory year 2020 (Note: Romania did not submit in 2019 and is not included in this table)

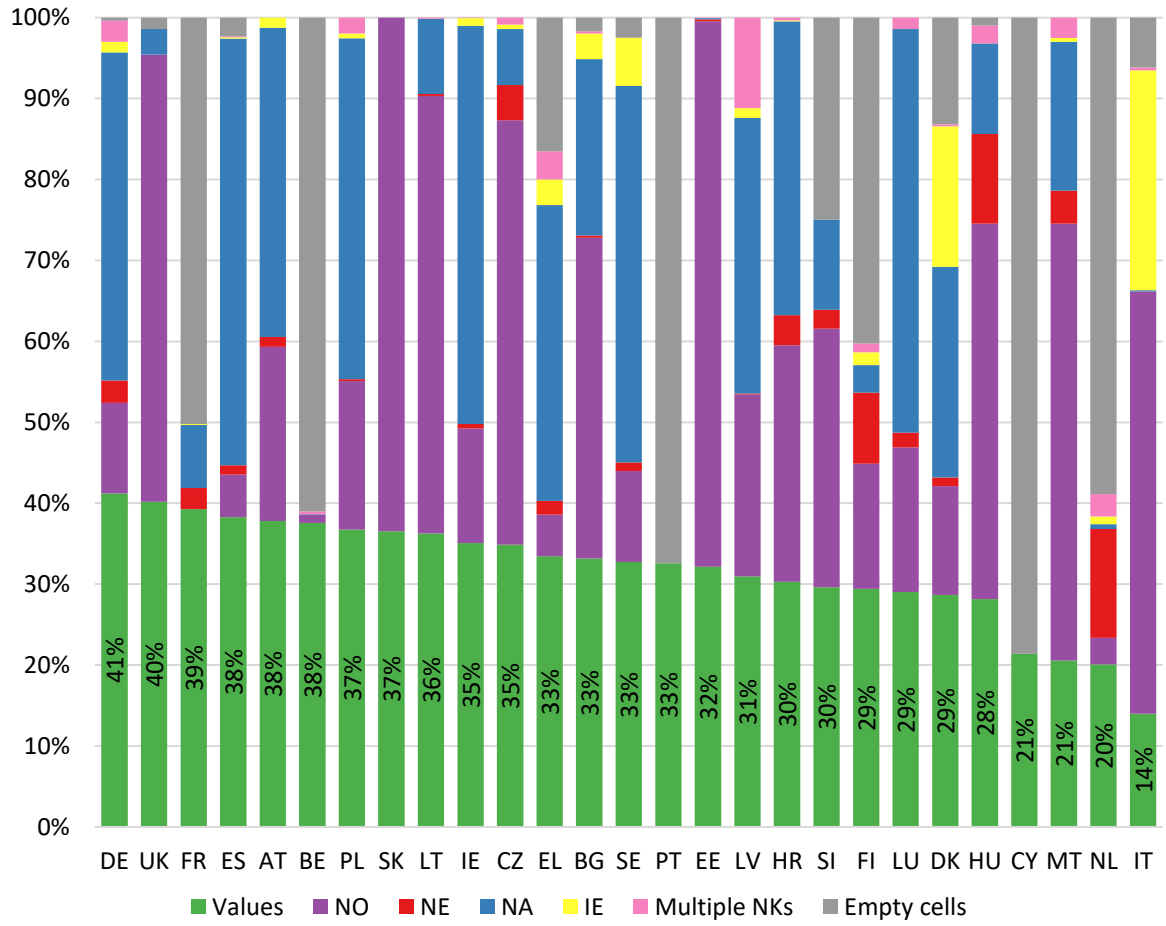
Category	CO2 (kt)	N2O (kt)	CH4 (kt)	HFC (kt CO2e)	PFC (kt CO2e)	SF6 (kt CO2e)	NF3 (kt CO2e)	Total GHGs (ktCO2e)	Split to ETS and ES GHGs (ktCO2e)
1.A. Fuel combustion	27	27	27	25	25	25	25	27	27
1.B. Fugitive emissions from fuels	27	27	27	25	25	25	25	27	27
1.C. CO2 transport and storage	26	26	26	24	24	24	24	26	25
2.A. Mineral Industry	27	26	26	25	25	25	25	27	27
2.B. Chemical industry	26	26	26	26	26	26	25	27	27
2.C. Metal industry	27	27	27	27	27	27	25	27	27
2.D. Non-energy products from fuels and solvent use	26	26	26	24	24	24	24	27	27
2.E. Electronics industry	25	25	25	26	26	26	26	27	27
2.F. Product uses as substitutes for ODS(2)	25	25	25	27	26	27	26	27	27
2.G. Other product manufacture and use	27	27	26	25	25	26	25	27	27
2.H. Other (please specify)	26	26	26	25	25	25	25	27	27
3.A. Enteric fermentation	24	24	27	24	24	24	24	27	27
3.B. Manure management	24	27	27	24	24	24	24	27	27
3.C. Rice cultivation	24	24	26	24	24	24	24	26	26
3.D. Agricultural soils	24	27	26	24	24	24	24	27	27
3.E. Prescribed burning of savannahs	24	26	26	24	24	24	24	26	26
3.F. Field burning of agricultural residues	24	27	27	24	24	24	24	26	26
3.G. Liming	26	24	24	24	24	24	24	27	27
3.H. Urea application	27	24	24	24	24	24	24	26	26
3.I. Other carbon-containing fertilizers	26	24	24	24	24	24	24	26	26
3.J. Other (please specify)	26	26	26	24	24	24	24	26	26
4.A. Forest land	26	26	26	24	24	24	24	27	25
4.B. Cropland	26	25	26	24	24	24	24	27	25
4.C. Grassland	26	26	25	24	24	24	24	27	25
4.D. Wetlands	26	26	26	24	24	24	24	27	25
4.E. Settlements	26	26	26	24	24	24	24	27	25
4.F. Other Land	26	26	26	24	24	24	24	27	25

Category	CO2 (kt)	N2O (kt)	CH4 (kt)	HFC (kt CO2e)	PFC (kt CO2e)	SF6 (kt CO2e)	NF3 (kt CO2e)	Total GHGs (ktCO2e)	Split to ETS and ES GHGs (ktCO2e)
4.G. Harvested wood products	26	24	24	24	24	24	24	27	25
4.H. Other	26	26	26	24	24	24	24	26	25
5.A. Solid Waste Disposal	25	24	27	24	24	24	24	27	27
5.B. Biological treatment of solid waste	23	27	27	24	24	24	24	27	27
5.C. Incineration and open burning of waste	26	26	26	24	24	24	24	26	26
5.D. Wastewater treatment and discharge	24	27	27	24	24	24	24	27	27
5.E. Other (please specify)	26	26	26	24	24	24	24	26	25
Memo items	26	26	26	23	23	23	23	27	23

Note: The color intensity implies the degree of completeness. Dark green = high level of completeness, light green = lower level of completeness. Romania did not submit Projections in 2019, therefore the max. count is 27.

Completeness is generally high for all sectors and pollutant combinations. The majority of missing data is linked to a lack of reported notation keys, with either zero or blank values provided, rather than missing projection estimates. There were some exceptions where numerical data was expected but was not provided, such as for LULUCF sectors (Cyprus). Figure 8 illustrates the use of the standard IPCC notation keys (not occurring (NO), not estimated (NE), not applicable (NA), included elsewhere (IE), and combinations of these notation keys), as well as empty cells in the different Member States. The graph shows that notation keys and empty cells make up for about 60% of the total mandatory data that have to be reported. The most commonly used notation keys are NO (not occurring) and NA (not applicable). As can be seen the share of empty cells is still high in many countries (Cyprus, France, Belgium, Portugal and the Netherlands) which constitutes a lack of completeness in the reporting.

Figure 8 Use of notation keys per Member State (WEM scenario and mandatory reporting years)



3.2.3. Completeness of time series and gap-filling

All Member States except Hungary and Denmark reported the mandatory years 2015, 2020, 2025, 2030 and 2035. In 2017 all Member States reported the mandatory years. Denmark did not report 2015 and Hungary did only report a time series until 2030. The fact that reporting of the year 2015 was mandatory caused some confusion, especially when a reference year after 2015 was selected. Missing mandatory years until 2035 were gap-filled by a linear trend extrapolation (applied to Hungary) or gap-filling with the inventory figures (applied to Denmark). The year 2040 could be reported voluntarily and was provided by 16 Member States which is a substantial increase compared to 2017, where only four countries reported this year.

Intermediate years were reported voluntarily by 17 Member States, for the other 10 countries the data for the intermediate years were gap-filled by linear interpolation by the ETC/CME. In 2017 only seven countries did not report the intermediate years.

Table 3 shows the Member States for which interpolation or extrapolation has been carried out and to which years it was applied.

Table 3 Completeness of time series for Total wout LULUCF (Total GHGs, WEM) as reported in the final submissions

WEM/ Total GHGs	2014	2015	2016	2017	2018-2019	2020	2021-2024	2025	2026-2029	2030	2031-2034	2035	2036-2039	2040
AT				RY										
BE		RY												
BG	RY													
HR		RY		I	I		I		I		I			
CY			RY											
CZ			RY	I	I		I		I		I		I	
DK		G	G	RY										
EE			RY											
FI				RY										
FR		RY	I	I	I		I		I		I			
DE			RY											
EL			RY	I	I		I		I		I		I	
HU			RY		I		I		I		E	E		
IE				RY										
IT			RY	I	I		I		I		I			
LV			RY											
LT			RY											
LU				RY										
MT		RY												
NL		RY	I	I	I		I		I		I			
PL		RY	I	I	I		I		I		I		I	
PT		RY	I	I	I		I		I		I		I	
RO		no projections reported in 2019												
SK				RY										
SI		RY												
ES			RY											
SE			RY		I		I		I		I			
UK			RY											

Legend

	reported
RY	reference year
I	gap-filling of intermediate years
G	gap-filling of mandatory information
E	extrapolation of mandatory information
	Reporting not mandatory

In Table 4 other gap-filling actions are listed which mainly concern the gap-filling of International Bunkers or any of the 1A3 subsectors due to non-reporting, as it was done for Italy and the Netherlands. The method applied for these sectors is the constant application of the latest inventory value for the whole time series. Gap-filling in this sense also includes the correction of sums of main

categories, which did not match the sum of sub-categories as reported by Member States (for more detailed information on the sum check see chapter 3.4). Another typical corrective action by the ETC/CME was the deletion of figures reported for historical years when no projections were available, because this would cause a jump in the time series in the EU projections.
For countries that do not report the WAM scenario, a gap-filling with the WEM data is applied by the ETC/CME, which was done for 10 Member States. In most cases the WAM scenario was subject to the same corrections as the WEM scenario, as errors are systematic.
In 2017, there were more corrective actions applied due to the misallocation of the sector Domestic Aviation (1.A.3.a) in the ETS (four MS) and the reporting of LULUCF under ETS and/or ES (four MS). In 2019 these issues were only identified for three countries (Greece, Denmark and Slovenia for 1A3a and Luxembourg for LULUCF).

Table 4 Overview of gap-filling and corrective actions applied to final submissions

	gap-filling and corrections WEM			gap-filling related to the WAM scenario
	Total GHG	ETS	ES	
AT	no	no	no	WEM=WAM
BE	no	no	no	no
BG	- correction of intermediate years - correction of Total wout LULUCF (Total GHGs)	no	no	WEM=WAM
HR	-gap-filling of memo items (navigation/aviation)	- deletion of figure reported for 1B in 2016 and adjustment of sums (sector 1 and Total)	- correction of 1B in 2016 and adjustment of sums (sector 1 and Total)	- gap-filling of sector 4 and memo items (aviation/navigation) - correction of 1B in 2016
CY	- gap-filling of sector 4 and memo items (aviation/navigation)	-sums of 1A1, 1 and Total wout LULUCF for the years 2016-2019 corrected	-sums of 1A1, 1 and Total wout LULUCF for the years 2016-2019 corrected	- gap-filling of sector 4 and memo items (aviation/navigation)
CZ	- gap-filling of memo item (aviation)	no	no	- same corrections as for WEM
DK	- 2015 and 2016 gap-filled with inventory data	-1A3a was deleted from ETS (from 1A3a, 1A3, 1 and Total) - 2015 and 2016 gap-filled with inventory data	- RY figure for sector 4 and memo items deleted, - RY corrected for 1A3, 1 and Total wout LULUCF (sum error with 1A3a involved) - 2015 and 2016 gap-filled with inventory data	WEM=WAM
EE	no	no	no	no
FI	- gap-filling of memo items (aviation/navigation) - figures for the years 2015-2017 of 1A3e/1A4 were deleted, sum was adjusted for 1A3, 1, Total wout LULUCF.	- figures for the years 2015-2017 of 1A3e/1A4 were deleted, sum was adjusted for 1A3, 1, Total wout LULUCF.	- figures for the years 2015-2017 of 1A3e/1A4 were deleted, sum was adjusted for 1A3, 1, Total wout LULUCF.	- same corrections as for WEM
FR	no	no	no	no
DE	no	no	no	WEM=WAM
EL	- Historical years for	1.A.3.a deleted	- Historical years	- Historical years for 1.A.3.e deleted,

	gap-filling and corrections WEM			gap-filling related to the WAM scenario
	Total GHG	**ETS**	**ES**	
	1.A.3.e deleted, 1.A.3.b adjusted to keep sum correct	from ETS and adjustment of subsequent sectors (1.A.3, 1, Total wout LULUCF)	for 1.A.3.e deleted, 1.A.3.b adjusted to keep sum correct	1.A.3.b adjusted to keep sum correct
HU	- extrapolation of time series from 2031-2035	- extrapolation of time series from 2031-2035	- extrapolation of time series from 2031-2035	- same corrections as for WEM
IE	no	no	no	no
IT	- calculation of 1A3 subsectors based on inventory split	- 1A3e ETS gap-filled with total 1A3 ETS value	- calculation of 1A3 subsectors based on inventory split	- gap-filling of WAM for ETS and ES for all sectors because ETS and ES were reported only for Total wout LULUCF, for ETS the reported Total wout LULUCF was multiplied with the sectoral share of the WEM to calculate the numbers per sector, for ES we calculated Total GHG minus ETS (1A1 and 1A2 had to be adjusted manually)
LV	-Historical years for 1.A.5. (Total GHG; Total ES) deleted, 1A4 adjusted on the other hand to keep sum correct.	no	-Historical years for 1.A.5. (Total GHG; Total ES) deleted, 1A4 adjusted on the other hand to keep sum correct.	- same corrections as for WEM
LT	no	no	no	no
LU	- Gap-filling of memo item int aviation in the EU ETS (figures copied from ETS)	no	-LULUCF deleted from ES	WEM=WAM
MT	- Gap-filling of memo items (aviation for period 2031-2034 and for historical years, navigation all years) - deletion of historical values for 1A3a for the year 2015 and 2016 (and adjustment of sector 1A3 and 1 and Total) - sum correction of intermediate years for 2031-2034 and 2036-2039 for Total wout LULUCF - correction of intermediate years from 2031-2035 and 2036-2039 for 1A1, 1A2, 1A3, 1A4, 1A5)	- correction of intermediate years from 2031-2034 and 2036-2039 for Total wout LULUCF, 1 and 1A1	-deletion of historical values for 1A3a for the year 2015 and 2016 (and adjustment of sector 1A3 and 1 and Total) - correction of intermediate years 2031-2035 and 2036-2039 for 1A1, 1A2, 1A3, 1A4, 1A5)	WEM=WAM
NL	- sum of sector 1 and Total wout LULUCF for the year 2015 was corrected - memo items (navigation and aviation in the EU ETS) were	no	- sum of sector 1 and Total wout LULUCF for the year 2015 was corrected	WEM=WAM

	gap-filling and corrections WEM			gap-filling related to the WAM scenario
	Total GHG	ETS	ES	
	corrected and interpolated between 2021 and 2029, and extrapolated from 2031 to 2035 - calculation of sub-sectors of 1A3			
PL	- RY figure for International aviation in the EU ETS deleted, because no projections reported	no	no	WEM=WAM
PT	- gap-filling of memo items (aviation/navigation)	no	no	- same corrections as for WEM
RO	Gap-filling with projections reported in 2017			
SK	no	no	no	- gap-filling of memo items (aviation/navigation)
SI	- gap-filling of sector 4 and memo item (navigation)	- ETS 1A3a subtracted from stationary ETS emissions	no	WEM=WAM
ES	no	no	no	no
SE	no	- for the year 2017 ETS/ES split was not provided, ETS was interpolated and then ES was calculated by Total GHG-ETS	- for the year 2017 ETS/ES split was not provided, ETS was interpolated and then ES was calculated by Total GHG-ETS	WEM=WAM
UK	no	no	no	no

3.3. Consistency and Comparability

3.3.1. Units

The QA/QC unit check ensures that the projections are reported in the correct units in line with the reporting template and that the ETC/CME seeks for clarifications if there are high deviations from historical data. For 13 countries some deviations were detected. Real unit errors were identified in four submissions (Austria, Bulgaria, France and United Kingdom) and triggered a resubmission by the latter three countries; Austria decided not to resubmit as the error was very minor. All other cases were sufficienctly explained by the countries and solved.
This check also helps to identify reporting gaps, e.g. if there is a figure reported in the GHG inventory, but for the projections blank cells or notation keys are reported, this will also trigger a question.

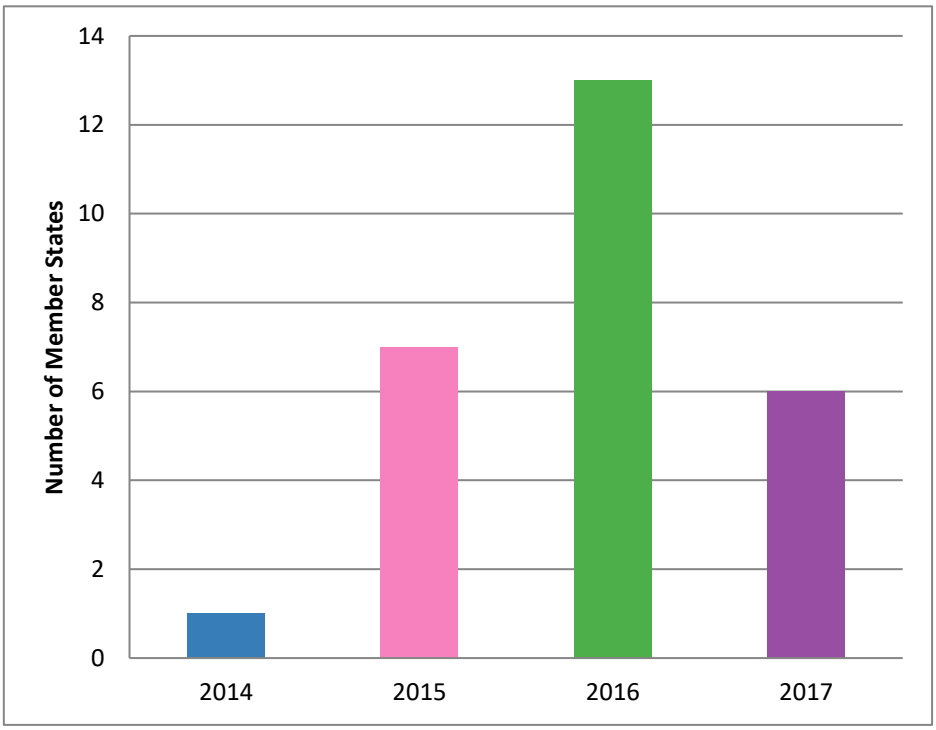
3.3.2. Reporting of indirect CO_2 emissions

Following up a recommendation from the UNFCCC review of the 3rd EU Biennial Report, all Member States were asked to clarify whether they have included or excluded indirect CO_2 emissions from the Total (wout LULUCF). This survey shows that eight Member States include indirect CO_2 emissions in their projections: Bulgaria, Denmark, Estonia, Finland, France, Hungary, Ireland and the Netherlands. For Cyprus and Romania no response is available. The other Member States replied that they do not include indirect CO_2 emissions in their GHG projections.

3.3.3. *Reference year*

The majority of Member States (13) chose the year 2016 as reference year (Figure 9). Seven Member States selected 2015 as reference year, six countries used the most recent inventory year 2017 as reference year. Bulgaria reported the earliest reference year, namely 2014.

Figure 9 Reference year reported by Member States



Legend:

AT	2017	EE	2016	IE	2017	PL	2015
BE	2016	ES	2016	IT	2016	PT	2015
BG	2014	FI	2017	LT	2016	SE	2016
CY	2016	FR	2015	LU	2017	SI	2015
CZ	2016	EL	2016	LV	2016	SK	2017
DE	2016	HR	2015	MT	2015	UK	2016
DK	2017	HU	2016	NL	2015		

An important quality criterion is the time series consistency between projections and historical data (inventories). The reference year for the Union GHG projections in 2019 is 2017, as this is the latest inventory year available when projections were prepared. Figure 10 presents the percentage differences between the reported reference year for the projections and the respective value reported in the GHG inventory for each Member State. Two inventory versions were available to the ETC/CME for the RY check, the Member States submissions underlying the EU GHG inventory version

of May 2018[3] and the Member States submissions underlying the EU GHG inventory version of January 2019[4].
The version that was used for the check was selected based on following considerations:

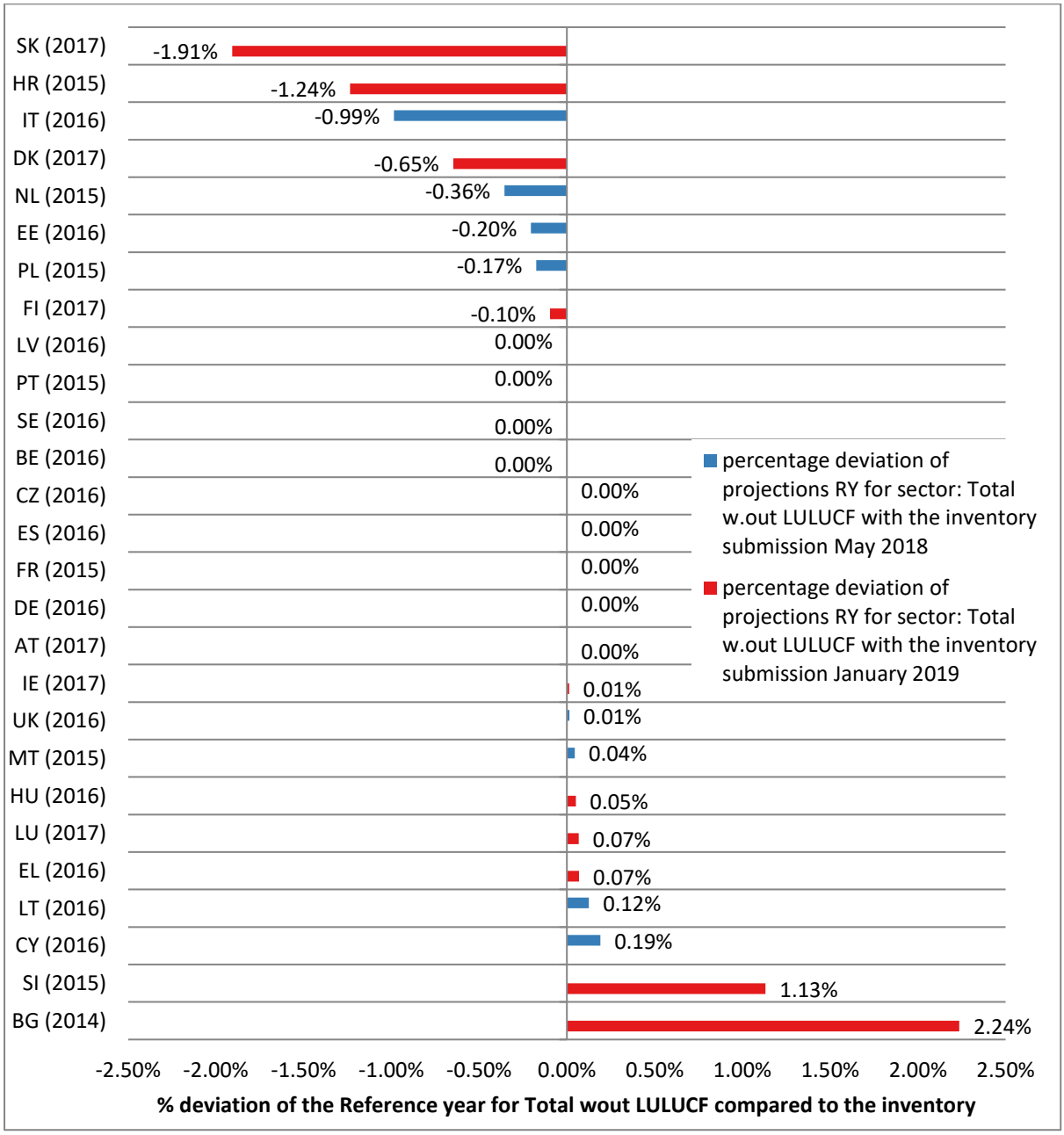
- Is the RY the same as the new inventory year (2017)?
- Does the MS mention the inventory data set on which the projections are based in the report?
- Which inventory suits better with the reported RY values?

In case that none of the above considerations is applicable, the standard approach according to the 2017 QA/QC procedure was applied and the newest inventory data available was considered (2019 submission).
In Figure 10 the comparisons of reference years and GHG inventory are illustrated as percentage deviation. 13 Member States were compared against their January 2019 submissions (pink bars in Figure 10) and 14 Member States against their latest submission used for the EU inventory submission of May 2018 (blue bars in Figure 10).
The majority of the projections reference years are well harmonised with the historical data and no reference year calibration of the time series was necessary in 2019. The largest deviation (+2.2 %) from the historical data was identified for Bulgaria that selected 2014 as reference year. But even this case did not lead to calibration of the time series, as the sectoral deviations were below the threshold of the sector-specific uncertainties.

There is no change compared to the 2017 reporting where already all countries passed the reference year check and no calibration was applied; only the percentage deviations between reference year and inventories even decreased more. In 2017 two countries exceeded the 3% threshold of deviation, whereas in 2019 all Member States were below the threshold.

[3] The May 2018 submission of the EU GHG inventory represents the latest, official submission of the EU to the UNFCCC for 2018 and therefore was the most recent data set available and likely to be used when the MS projections preparation started already in 2018. https://unfccc.int/documents/65886.
[4] The 2019 EU GHG inventory can be found at https://unfccc.int/documents/194921. It has to be noted that since the QA/QC procedure of the 2019 projections starts already in March the ETC/CME takes the January submissions of the EU Member States to the EU. This data is not published on the UNFCCC website.

Figure 10 Difference between total emissions of the reference years used by MS and the GHG inventory ( ) (same year) for Total w.out LULUCF (CO2-eq)

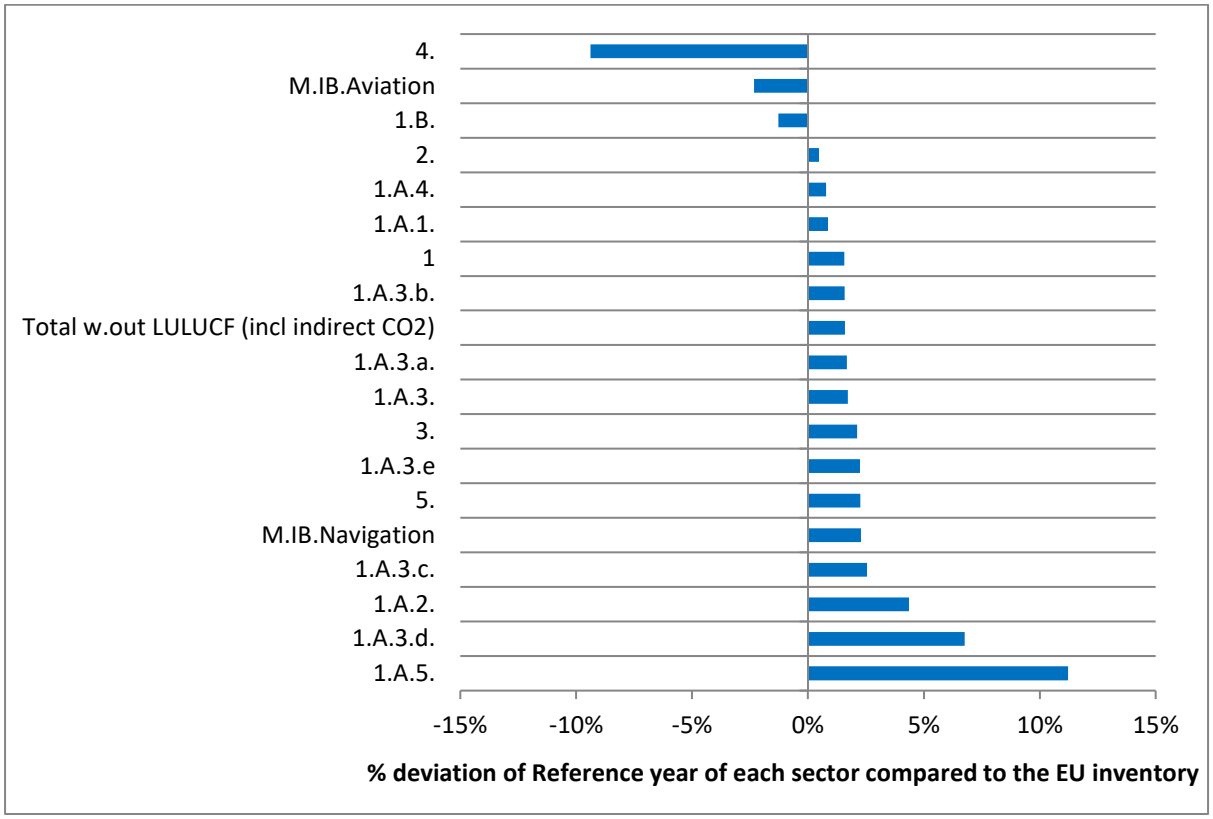


In the following figure (Figure 11) the percentage difference of the reference year for the Union GHG projections (2017) and the 2019 inventory is shown per sector. Sector 1C was reported as "NO" by all Member States. The highest deviations occur in sectors 1.A.5. (+11.23 %) and 4 (-9.39 %), which can be explained by non-reporting or the use of notation keys and in case of sector 4 due to the high interannual variation of the LULUCF inventory. For example if a Member State reports emissions for 1.A.5. in the inventory but provides a notation key "IE" (included elsewhere) for the projections because no sector-specific projections are available, this leads to deviations in both, the sectors where these emissions are excluded (1.A.5) and included (e.g. 1.A.4 or 1.A.1). The deviation in sector 1.A.3. is mainly caused by Italy as they did not report emissions for the 1A3 sub-categories.

Overall the deviation of the reference year of the EU for Total w.out LULUCF compared to the EU inventory is 1.59% and has increased compared to 2017 when EU reference year the deviation amounted to 0.13%. Reasons for the increased deviation could be the gap-filling of intermediate

years. In the 2019 reporting cycle 2017 is not a mandatory year. In the reporting cycle 2017, the year 2015 was the reference year and also a mandatory year. Therefore it was more likely that countries reported real inventory data for the reference year and so the deviation as rather low. On the other hand in the submissions 2019, many countries did not report a value for 2017 at all which then was gap-filled by linear interpolation by the ETC/CME for eight Member States. It is likely that the interpolated values deviate from the real inventory values.

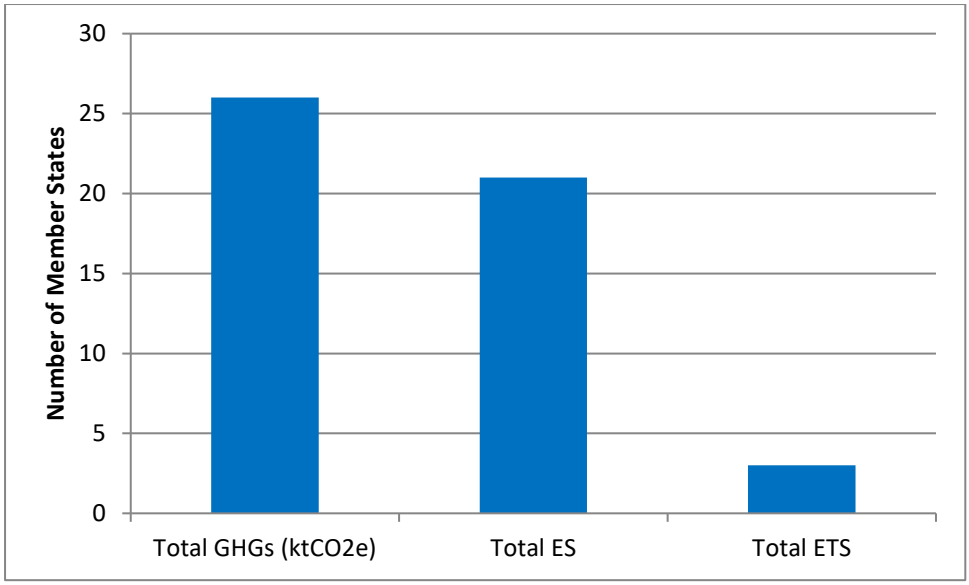
Figure 11 Percentage difference of the EU reference year compared to the 2019 inventory by sector (for year 2017)



3.3.4. Sector allocation

Sector allocation was identified as a large challenge in the previous reporting cycles. There were already improvements visible in the 2017 reporting year, but there was still some inconsistency in the reporting of memo items and the allocation of ETS/ES emissions. In 2017, four countries reported 1.A.3.a. under ETS and were not following the ETC/CME guidance, whereas in 2019 these issues were identified for Greece, Denmark and Slovenia. During the QA/QC the reallocation was agreed to ensure consistency for the EU dataset. Figure 12 shows the allocation of the sector Domestic aviation in 2019. All countries except for Italy reported 1A3a emissions for the Total GHGs, 21 Member States allocated a small portion of 1A3a under the ES which is correct. In the past Member States also often reported LULUCF emissions under ETS or ES, in 2019 it was only Luxembourg that accidentally reported LULUCF under ES. The Netherlands have reported Agriculture emissions under ETS, which were then reallocated to sector 1.A.4.c in a resubmission.

Figure 12 Allocation of 1A3a Domestic Aviation as reported by Member States in their final submissions



Note: Italy did not provide the sub-sectors of 1A3. The Netherlands provided a resubmission including a gap-filling of 1A3 sub-sectors as suggested by the ETC/CME

In 2017 the EEA and ETC/CME prepared a guidance document on the correct reporting of the ETS/ES split ("Guidance for reporting of ETS and ES projections under the MMR", EEA 2018[5]) in order to support the Member States in the correct reporting of ETS and ES projections. The document was also promoted by EEA for the 2019 reporting cycle.

[5] Available at http://cdr.eionet.europa.eu/help/mmr/Guidance%20for%20reporting%20of%20ETS%20and%20ESD%20projections%20under%20MMR.pdf

3.3.5. ETS and ES emissions

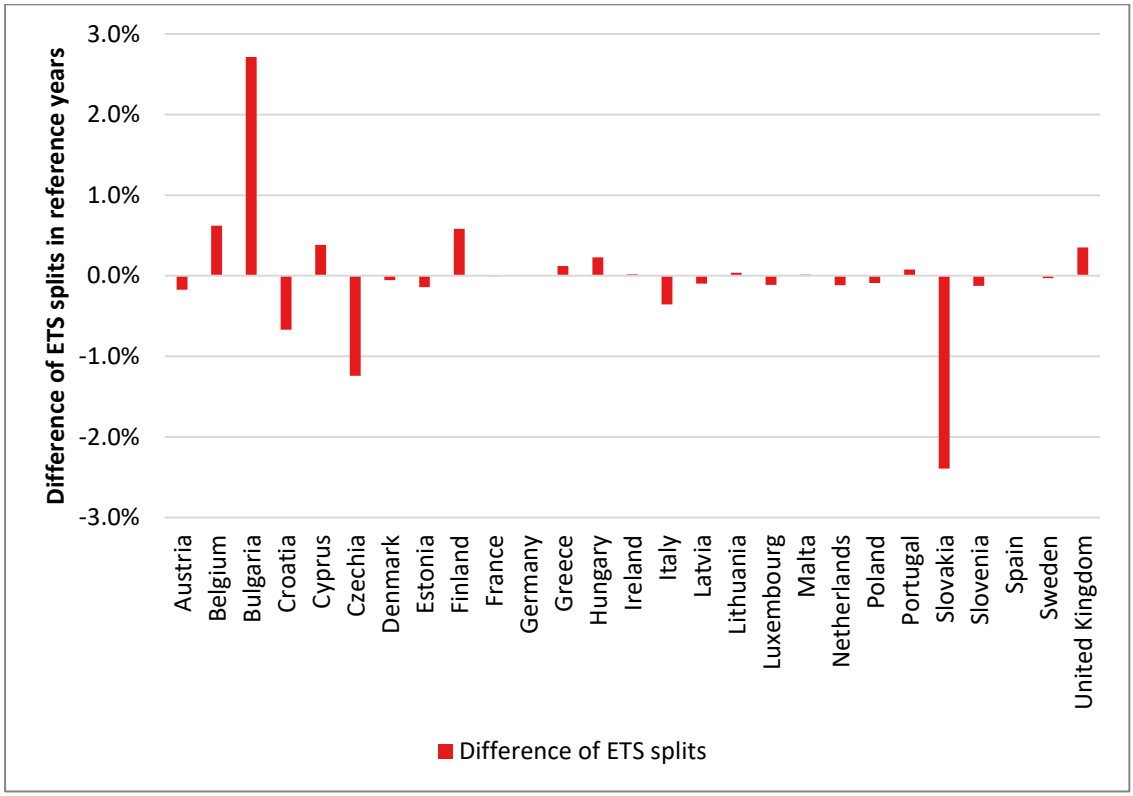
The projected emissions are reported separately for ETS and Effort Sharing (ES) emissions for each source category[6]. In the QA/QC process, the proper linking of projections to historical ETS and ES emissions and a consistent development of ETS and ES emissions in future years in Member State projections is analysed.
In addition, after the QA/QC procedure, the ETS and ES emissions from Member State projections are summed up to an EU projection. This projection of aggregated ETS and ES emissions is important for the monitoring of effects of the EU policies to tackle climate change and the projections data are used in several reports of the EEA.
In the checking process, ETS splits are used as an indicator reflecting the relative share of ETS emissions compared to total GHG emissions. The reference years of ETS and ES emissions in the projections should match historical ETS and ES emissions. This implies that the ETS split used for the projections should be consistent with historic inventory data. In addition, the ETS split should change rather slowly along the timeline. Large increases or decreases in the ETS split will raise questions during the QA/QC, to ensure that such changes are based on realistic assumptions. Splits that remain completely constant over time will also be followed up by the ETC/CME in order to ensure that the development of ETS and ES emissions is projected in sufficient detail. The rationale behind this is that in a mitigation scenario of steadily decreasing GHG emissions one would expect that ETS emissions decrease relatively rapid in response to the price level of carbon dioxide, as well as reflecting the general point-source nature of GHG emissions sources. This makes emissions abatement and reduction a relatively easy process compared to emissions reduction achieved from more diffuse emission sources (e.g. transport) covered under the ES Decision (up to 2020) and Regulation (after 2020). However, an opposite trend may also be noticed, for example in the case of strong promotion of electric vehicles replacing vehicles with an internal combustion engine. As ES emissions decrease, depending on how the additional electricity demand is satisfied (i.e. with fossil or low-carbon generation capacity) emissions shift from ES to ETS and the relative share of ETS in the total may increase.
For the checks mentioned above, historical ETS splits were calculated based on the total verified emissions under the EU ETS[7] and GHG inventory data from the 2019 submission. For historical ETS emissions on sectoral level, Member State reporting under Implementing Regulation (EU) No 749/2014, Annex V, have been taken into account. In this report, verified emissions under the EU ETS are compared to inventory emissions on subcategory level for the latest inventory year.
In the following the main results of the 2019 QA/QC procedure are presented.

1. ETS splits

In 2019 all but one MS (RO) reported ETS and ES emissions in the GHG projections. In most GHG projections the reported ETS emissions for the reference year match very well with the historical values from the GHG inventory. Figure 13 shows the percentage differences between the projection reference year ETS splits and historical ETS splits. Compared to the projections reported in 2017, the variations in difference between ETS split for the reference year and historic submission decreased, i.e. there are fewer Member States with more than 0.5% difference between the reported splits and historic data in the 2019 submission than in the 2017 submission (see ETC/ACM Technical Paper 2017/8, chapter 3.3.4). This may be explained by increasing knowledge and awareness of ETS and ES reporting in the projections.

[6] Draft guidance for reporting of ETS and ES projections available at: http://cdr.eionet.europa.eu/help/mmr
[7] from EEA EU ETS data viewer (EEA, 2019c): http://www.eea.europa.eu/data-and-maps/data/data-viewers/emissions-trading-viewer

Figure 13 Difference of ETS splits for the reference years of total GHG projections compared to historic ETS splits in respective reference years. Note that Romania is excluded as no projections were submitted in 2019

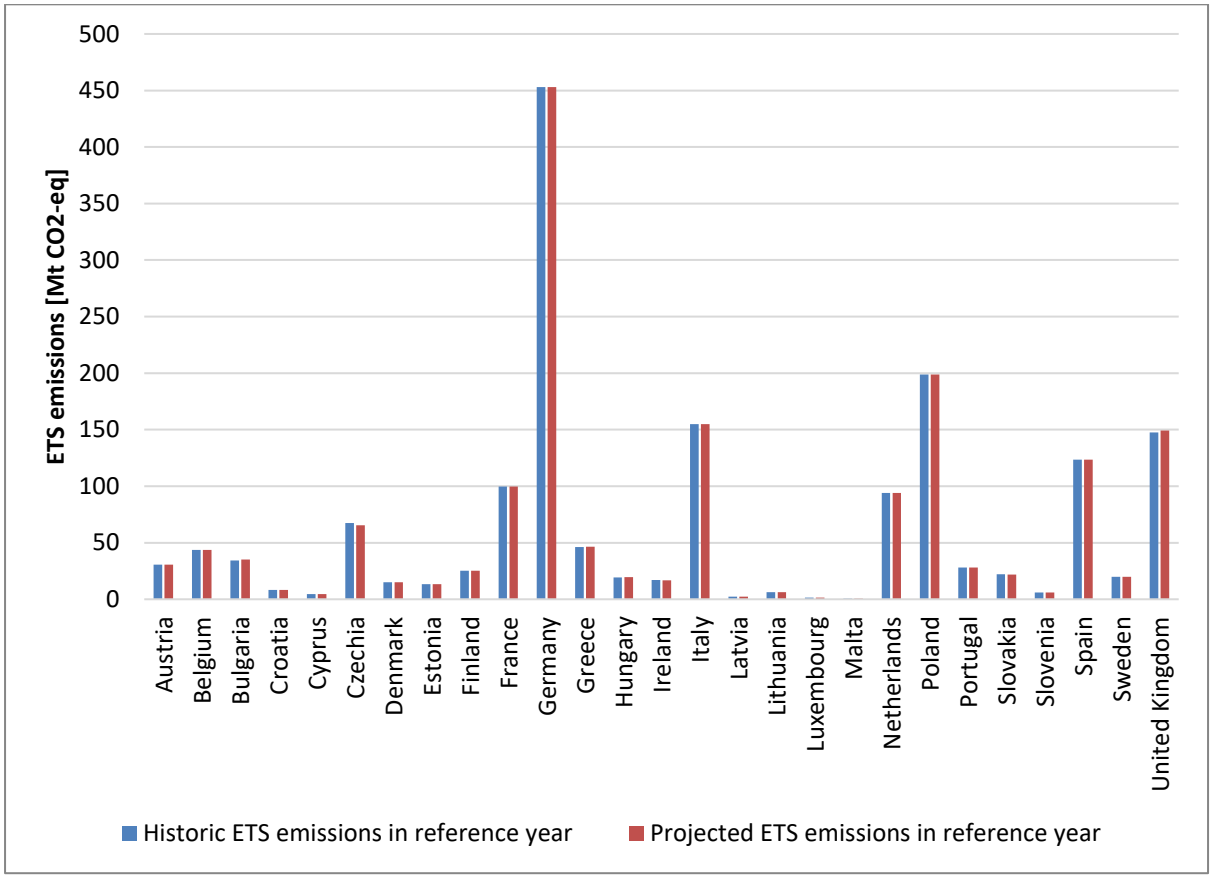


The largest difference between projection reference year and historical ETS split is identified for Bulgaria (2.7%). A higher ETS split implies that the level of ETS emissions is starting at a higher point which might lead to a slight overestimation of future ETS emissions. It should be noted that Bulgaria's reported total GHG emissions (w/o LULUCF) are slightly lower than historic data.

2. Absolute ETS and ES emissions

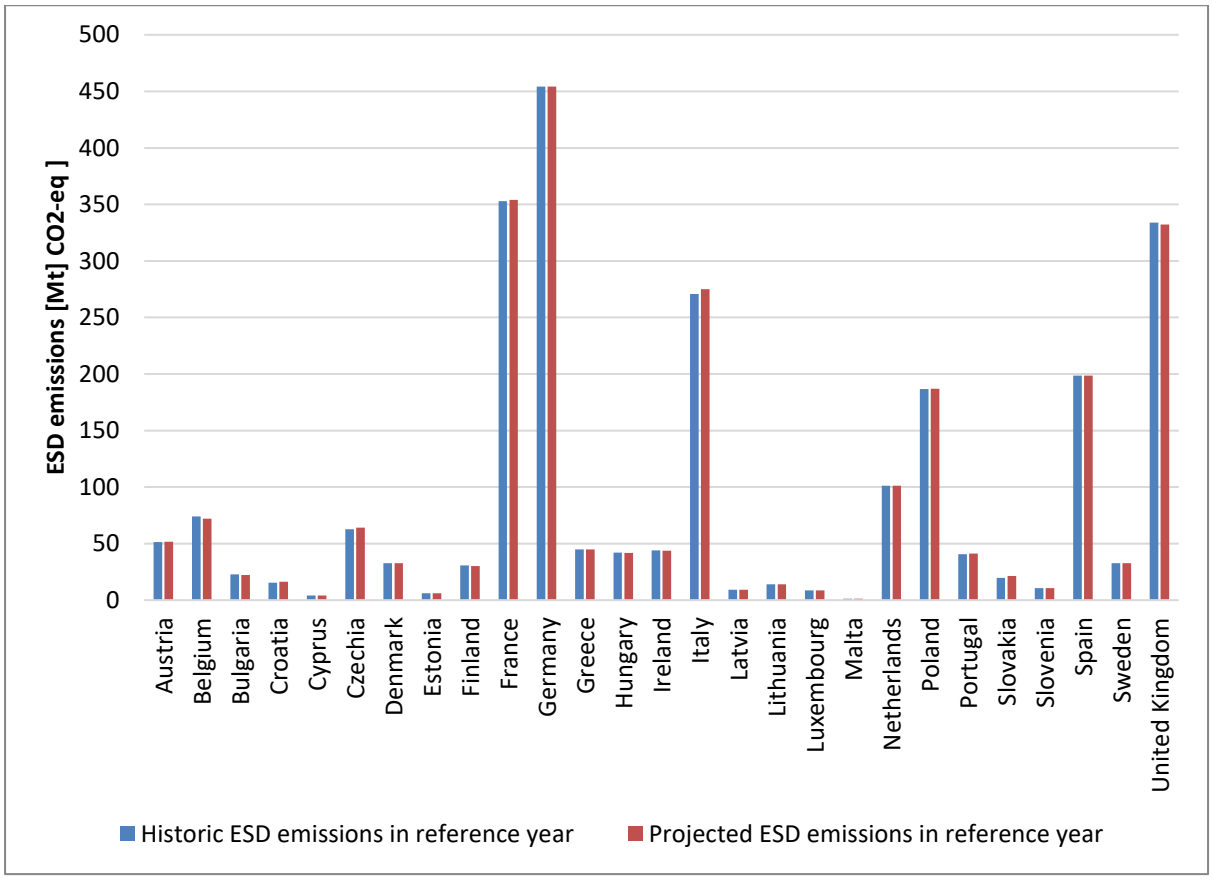
In Figure 14 historic and projected absolute ETS emissions are compared for the reference year used by each of the MS. The aggregate of ETS emissions of MS projections across all reference years is 1 783 Mt CO_2-eq, differing only 0.02 % from historic ETS emissions.

Figure 14 Historic and projected absolute ETS emissions for reference years. Romania is excluded as no projections were submitted in 2019.



In Figure 15 historic and project ES emissions are compared are compared for the reference year used by each of the MS. MS projections are very close to the historical emissions. Historical ES emissions add up to 2 566 Mt CO_2-eq, ES emissions in the submitted projections add up to 2 570 Mt CO_2-eq, a difference of 0.17%.

Figure 15 Historic and projected absolute ESD emissions by reference year. Romania is excluded as no projections were submitted in 2019.



3. Development of ETS and ES emissions

ETS split changes (i.e. changes in the share of ETS emissions relative to Total emissions) were calculated along the projected timeline to analyse the development of ETS and ES emission projections and to check the time series consistency (Table 5).

Table 5 Changes in ETS splits from MS reference year to 2035 in WEM scenario

	MS ref year - 2015	2020-2015	2025-2020	2030-2025	2035-2030
Austria	0%	-1%	-1%	0%	0%
Belgium	0%	-1%	3%	3%	1%
Bulgaria	0%	3%	-3%	-3%	-5%
Croatia	0%	-2%	-1%	-1%	-1%
Cyprus	-1%	-3%	-2%	1%	-5%
Czechia	-2%	-2%	-1%	2%	-1%
Denmark			5%	8%	6%
Estonia	3%	4%	-3%	-8%	-4%
Finland	-1%	-2%	-1%	-2%	0%
France	0%	2%	1%	1%	0%
Germany	0%	-3%	2%	-1%	1%
Greece	-2%	-5%	-4%	-2%	-4%
Hungary	0%	0%	-1%	-5%	
Ireland	-1%	-1%	3%	1%	-2%
Italy	0%	-1%	-1%	1%	0%
Latvia	-1%	2%	1%	-2%	-2%
Lithuania	-3%	-3%	0%	0%	1%
Luxembourg	-2%	-2%	0%	0%	0%
Malta	-10%	-1%	0%	0%	0%
Netherlands	0%	-4%	1%	-1%	-1%
Poland	0%	-3%	1%	1%	-4%
Portugal	0%	1%	-3%	-3%	-3%
Romania					
Slovakia	0%	-1%	-2%	0%	-1%
Slovenia	0%	4%	-1%	-1%	0%
Spain	-3%	-3%	-3%	0%	-1%
Sweden	1%	4%	2%	1%	0%
United Kingdom	-4%	-9%	-2%	0%	-2%

Legend:	
	decreases of ETS splits in 5-year steps of more than 3%
	increases of ETS splits in 5-year steps of more than 3%

Note: No ETS data for 2015 has been provided by Denmark. Hungary did not provide projection data for 2035. Due to rounding, threshold values that are not colour coded are within the acceptable range. Romania is excluded as no projections were submitted in 2019.
Source: MMR MS Projections 2019.

High increases or decreases in ETS splits have been highlighted in Table 5: Decreases of more than 3 % in blue and increases of more than 3 % in pink. For nearly all of these higher changes explanations have been given by Member States. For smaller countries the closure or start-up of a single plant might affect heavily the share of ETS emissions. With this, projected ETS splits might change considerably from one year to the next. For example, in the case of Malta electricity generation dropped considerably between 2015 and 2016 as a result of an increase in import of

electricity through the interconnector with the European grid. This shift is reflected in a substantial decrease of ETS emissions and correspondingly the ETS split. For Denmark the strong increase in emissions from 2020 onwards is due to the expiry of policies and measures actually in place, and their continuation is excluded from the WEM scenario. For Estonia, the increase in the ETS split in the period 2015-2020 and subsequent decrease in ETS split is largely related to the dynamics of oil shale mining and production of shale oil and electricity generation. When international oil prices are relatively high shale oil is a competitive product. In addition, oil shale is being used to generation electricity. However, old oil shale electricity production plants will be shut down in 2025, thus decreasing the installed power capacity by approximately 900 MW, which results in a strong decrease of ETS emissions. A final example for the UK shows a projected rapid increase of electricity sourced from renewable sources leading to a decrease in electricity sourced from coal and natural gas and subsequent decrease in ETS emissions.

4. Reporting of ETS and ES emissions

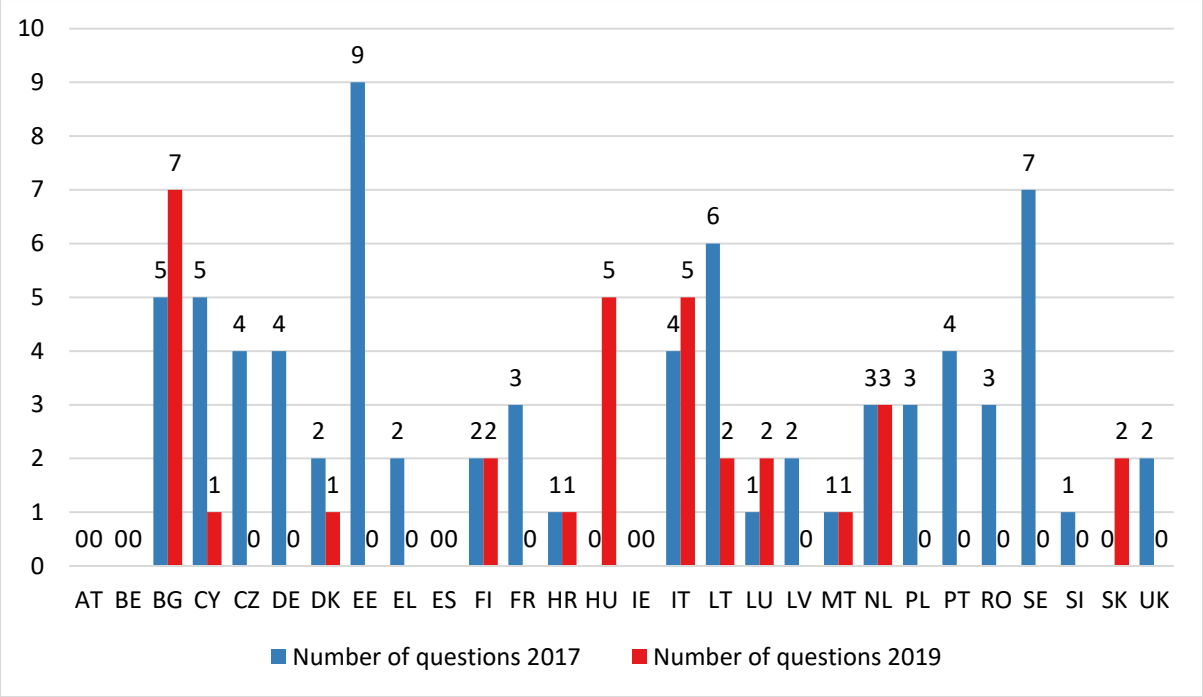
The reporting of ETS and ES emissions continuously improved since 2015 and became considerably more detailed in the 2017 and 2019 submission years. With regard to absolute ES emissions, most Member States subtracted domestic aviation from total GHG emissions to calculate ESD emissions (see Figure 12) and a considerable number of Member States subtracted NF_3 emissions too. Member States were asked to exclude emissions on ETS aviation from the ETS emissions to allow the calculation of a consistent set of stationary ETS emissions (see section 3.3.4).

3.4. Accuracy and Transparency

The results of the automated sum check introduced to the CDR in 2017 of the latest Member States' submission have been used. It checks the Member States data after being uploaded to the CDR and before the QA/QC process by the ETC/CME starts. In principal the automatic checks provided feedback to the Member States and it is recommended to adjust the submission if the automatic sum check failed. For the following countries, the sum check did not reveal any issues: Austria, Belgium, Czechia, Estonia, Germany, Greece, France, Ireland, Latvia, Poland, Portugal, Slovenia, Sweden, Spain and the United Kingdom. For the other countries, the sum check resulted in follow-up questions to MS experts in the QA/QC procedure. The issues were sometimes aggregated in case they applied to multiple sectors, years, GHGs and/or scenarios, resulting in 32 questions in total. Moreover, Italy, Malta, the Netherlands and Slovakia have seemingly used the new, voluntary template with integrated QC.

Although the ETC/CME experts used a clear threshold value for the checks, some MS were informed about a difference that was below the threshold value, but in such case the ETC/CME did not ask the MS for a corrective action.
In all cases where the difference was larger than the threshold value, corrective action was applied by the Member State (including a resubmission) or by the ETC/CME. Some sum errors persisted, such as for Bulgaria and Cyprus.

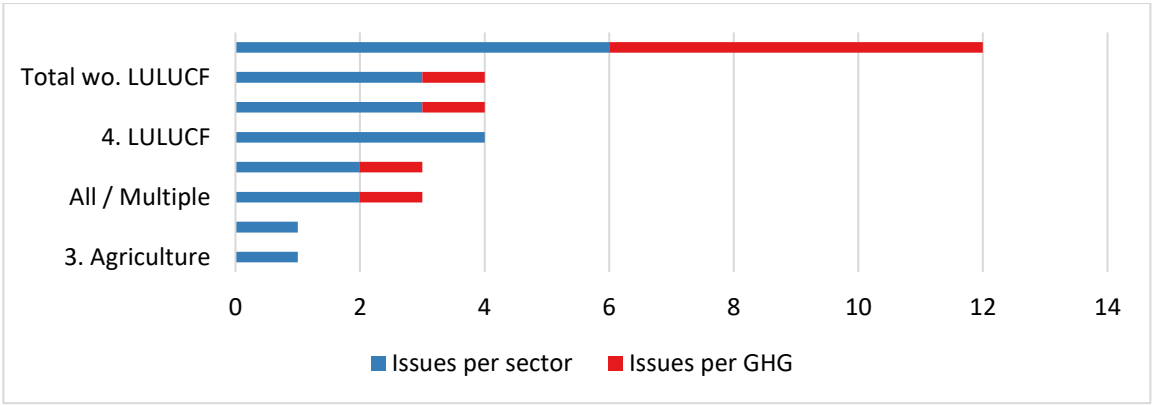
Figure 16 Number of questions related to the sum check per MS in 2017 and 2019



The most important problem was that the sum of the emissions of the subsectors did not correspond with the emission of the parent sector (30 questions to 12 Member States). There could be several reasons for this, including incomplete reporting. However, in most cases, this was caused by an error in reporting. Most of the failed sum checks related to the sector of Energy, with Total without LULUCF, Transport and LULUCF tied after it (Figure 17).

Member State experts mentioned two main reasons for failed sum checks: either there was a calculation/template mistake, or values were erroneously missing (and then promptly corrected).

Figure 17 Number of issues per sector (split per type of error).



The introduction of the automatic checks has finally marked an impact on the number of errors in the 2019 reporting. Automatic checks detected the sum errors and seem to have resulted in corrective actions by the Member States. Some of the failed checks, however, could have a reasonable explanation and therefore introducing more stringent automatic checks, e.g. blocking submissions, might be too restrictive.

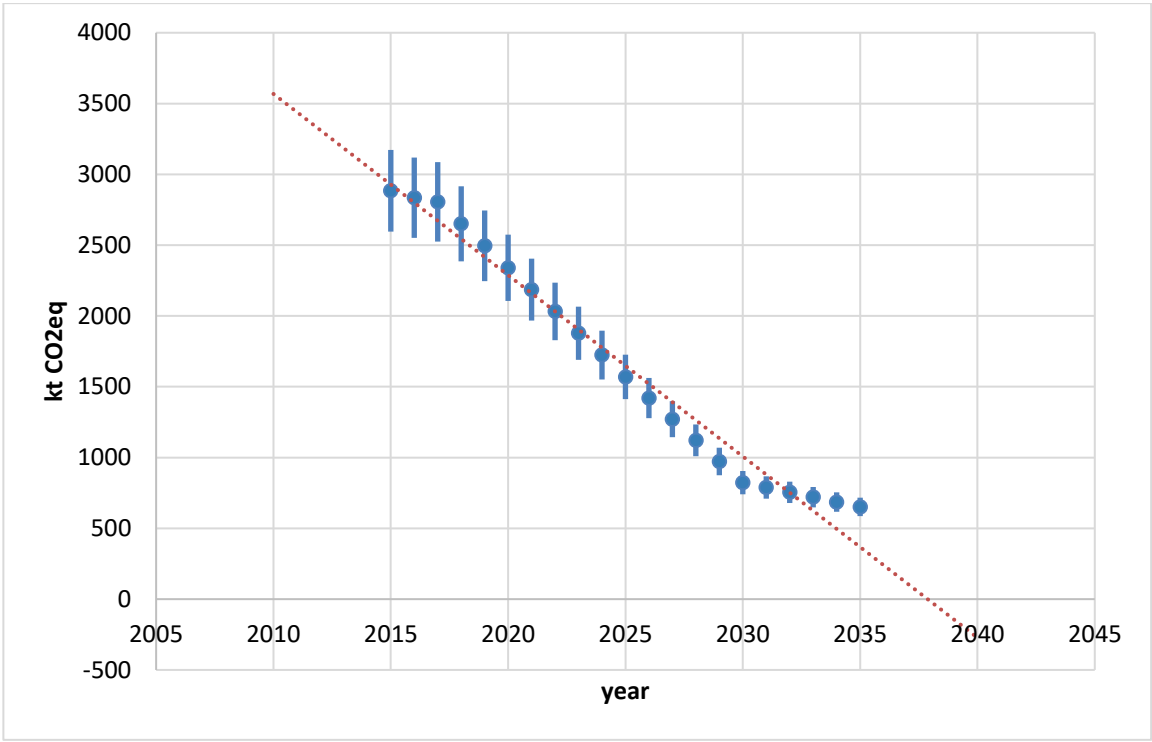
3.4.1. Outliers and trends

The outcome of the assessment of outliers and trends in Member States projections is based on four different checks. These checks are based on the reported projections information in 2019, inventory data and previously reported information on projections. Assessing trends and outliers is difficult if there are few data points in the time series (i.e. if no intermediate years are reported). For smaller Member States changes in emissions can show larger fluctuations in emissions, especially in sectors where emissions are dominated by few point sources (for example in the case of Malta).

The checks assume linear trends and use threshold values to indicate that the linear trend deviates from historical trends and previous projection trends. The linear trend line is also used to identify outliers, i.e. emissions in specific years that are much higher or lower than expected based on the linear trend line. It is important to highlight that findings based on these checks are not necessarily revealing an error in projections, but rather point out the need for further clarification, either via visual inspection of the data by the reviewer, consultation of the technical report, or a question to the Member State. Examples of cases where a potential issue did not result in a question to the Member States are:

- *Non-linear trends*: For example, the projection of total GHG emissions in the sector Industrial Processes of Belgium (Figure 18), which was flagged in the quality check for outliers. Visual inspection shows however that there is no outlier but that the issue is caused by a non-linear trend in projected emissions. All similar cases have been carefully analysed by the ETC/CME experts and did not result in a question to the Member State.

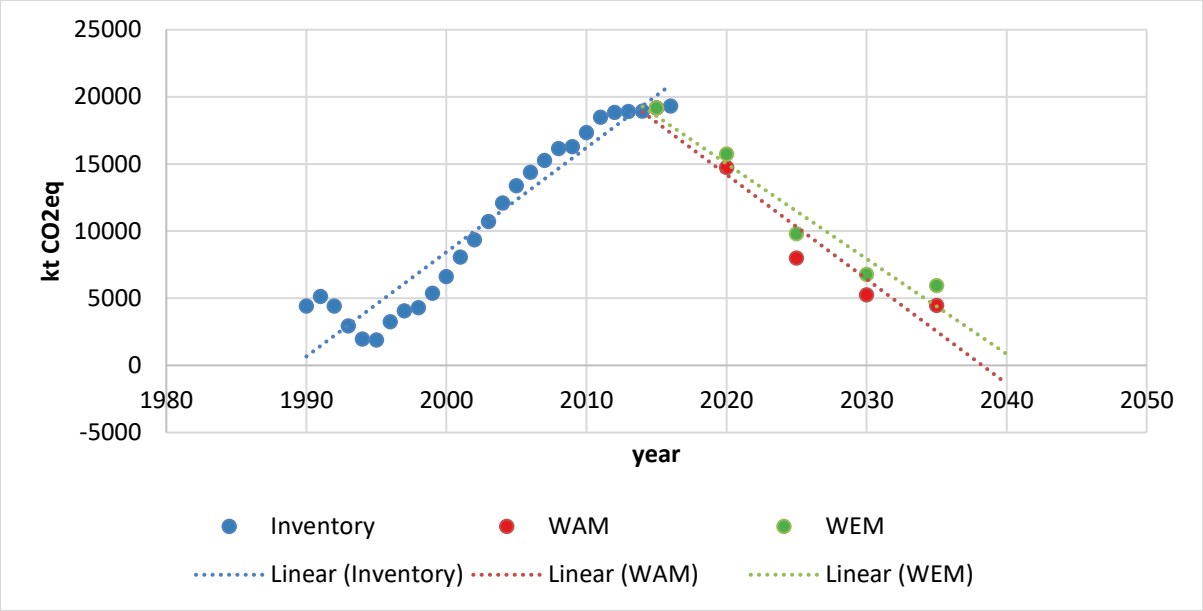
Figure 18 Outlier check, example for Belgium, Total GHGs emissions sector Industrial Processes (in kt CO2-eq)



- *Trends explained in the report*: For example, the quality checks showed a different trend in historical and projected HFC emissions. This is explained by the implementation of the F-gas regulation (in 2014), as explained in many technical reports, and therefore did not result in

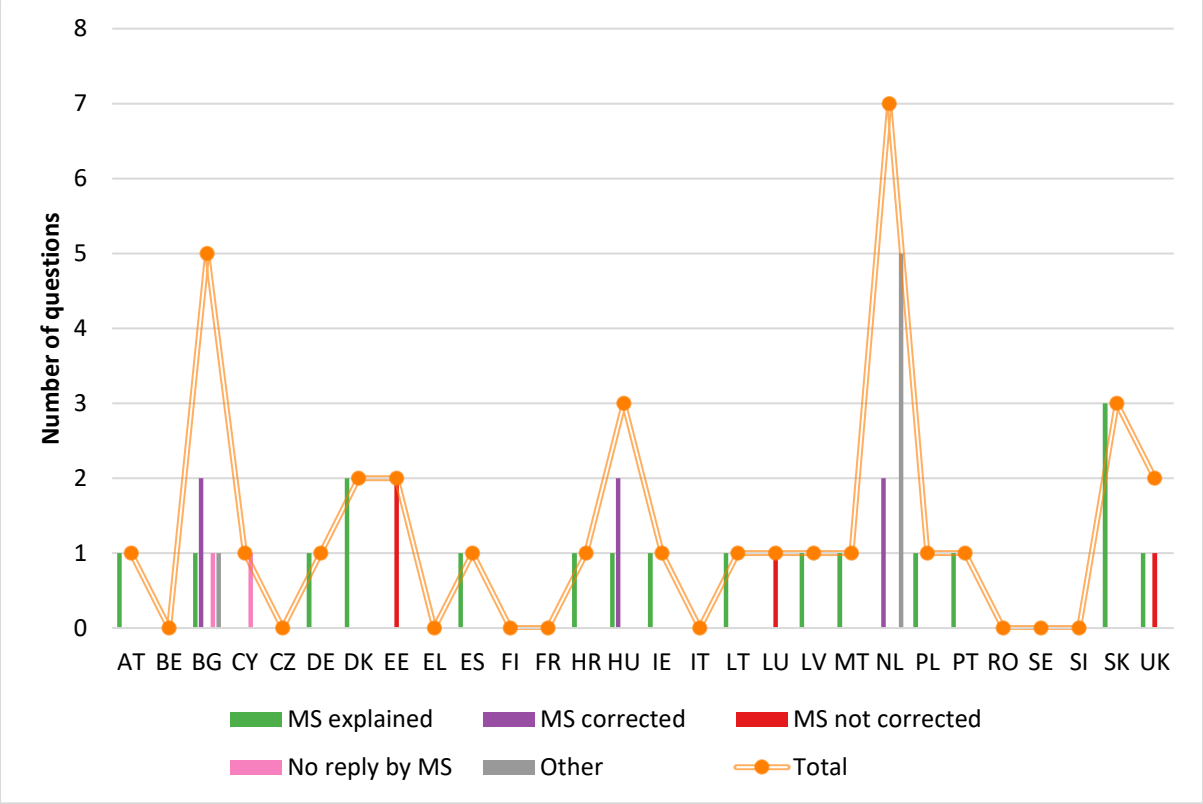
follow-up questions. In some cases, consultation of the technical report revealed inconsistencies between the values provided report and the reported values in reporting table.

Figure 19 Overall trend check, example for France, HFC emissions sector Total w.out LULUCF (in kt CO2-eq)



Despite these examples, several potential issues could not be resolved by inspection of the data or consultation of the technical report. This resulted in a total of 34 questions to the Member States (Figure 20). As with the sum check, specific issues were aggregated as much as possible per sector, GHG, or even QA/QC check to avoid needless duplication of questions.

Figure 20 Number of issues per country (split per category of response from the Member State)



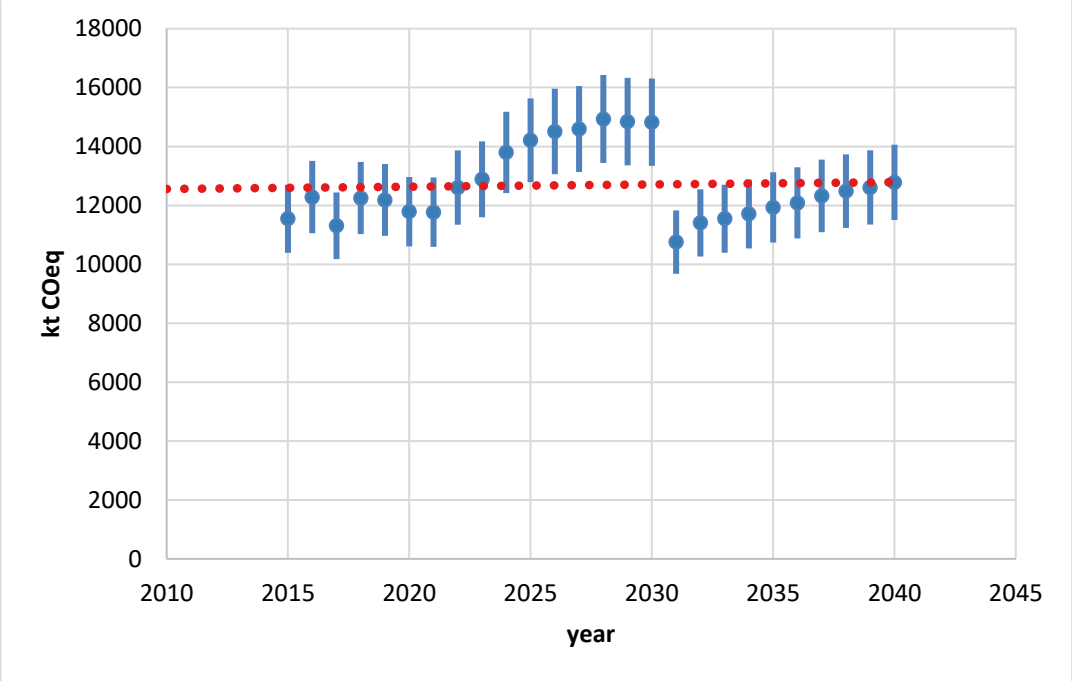
In seven cases Member State experts adjusted the report or the issue was resolved following other corrections (e.g. sum check). The following list provides examples for findings during the QA/QC procedure:

- Bulgaria fixed an inconsistency in the trend for sector 1.A.2. for Total ETS GHGs, with values for single years (2020 and 2025) much lower than the overall projected trend.
- For all the gases in sector 1.A.5 (WAM scenario), Hungary corrected the projections for years 2016-2017 that were higher than the projected emissions trend, and for which there was no explanation in the report.
- The Netherlands corrected the projected emissions of sector 2 for CO2 which were much higher than the historical emissions, and for which there was no explanation in the report.

In most cases (18), the Member State did not adjust emissions. In these cases, Member States provided a sufficient explanation or a reference to the explanation in the technical document was provided. Most of the issues that were identified could not be explained by visual inspection of the data related to following aspects:

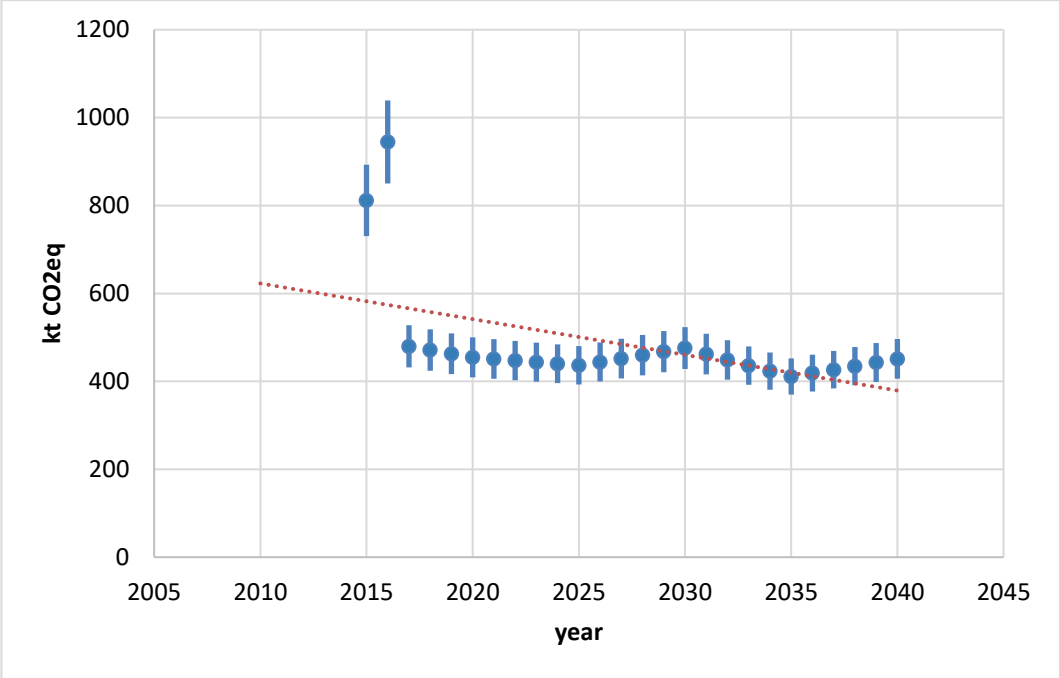
- The outlier check detected projected emissions that deviated from the linear trend that could not be explained through the information provided in the report. Member States explaining these cases referred to planned activities that affect emissions significantly. In the case of the Energy sector, this was mostly due to fuel switch or the planned closure of fossil-fuelled power plants (e.g. Ireland). In some cases, the impact on projected emissions is very significant, as is the case for Malta, but could also be more subtle, such as for Ireland

Figure 21 Outlier check, example for Ireland, total ETS emissions, sector Energy industries, WEM (in kt CO2-eq)



- The trend of historical emissions deviated from the trend of projected emissions. Most of the questions were directed to the Member States to clarify different trends in projected emissions and inventory data. An example of the findings is presented below for Slovakia (Figure 21). In their response Member States experts pointed towards the projected changes in underlying activity variables and the implementation and impact of PaMs.

Figure 22 Overall trend check, example for Slovakia, total ESD emissions, sector Energy industries (in kt CO2-eq)



3.4.2. Recalculations

In the case when projected emissions were markedly different from previous projections and no further information could be found in the report, for reasons of transparency MS experts were requested for an explanation and recommended to incorporate explanations for the recalculations in the technical reports. As an example, see Table 6 for Cyprus or Malta, which reported substantially different projections in 2019 compared to 2017. In total, 33 questions concerning the recalculation check were asked to 25 different Member States.

Table 6 Recalculation check, comparison for WEM and WAM scenarios for 2020 and 2030 of the 2019 submission against the 2017 submission. NA values express the lack of data for 2017, 2019 or both.

	WEM		WAM	
	2020	2030	2020	2030
AT	6%	6%	NA	NA
BE	-1%	8%	-4%	-8%
BG	15%	0%	NA	NA
CY	36%	30%	55%	36%
CZ	3%	2%	3%	0%
DE	4%	7%	NA	NA
DK	-3%	1%	NA	NA
EE	2%	-13%	4%	-12%
EL	-2%	-7%	NA	NA
ES	0%	-6%	NA	NA
FI	-7%	-9%	-7%	-11%
FR	7%	5%	NA	NA
HR	-3%	-5%	0%	7%
HU	10%	6%	9%	-5%
IE	0%	-3%	2%	-13%
IT	-2%	-2%	NA	NA
LT	-4%	-8%	8%	9%
LU	3%	6%	NA	NA
LV	2%	-15%	2%	-11%
MT	51%	58%	NA	NA
NL	-1%	-8%	NA	NA
PL	3%	14%	NA	NA
PT	0%	-24%	0%	-27%
RO	NA	NA	NA	NA
SE	0%	1%	NA	NA
SI	0%	0%	NA	NA
SK	5%	2%	6%	-12%
UK	-5%	-7%	-3%	-2%

On the other hand, this check also identifies submissions that were completely identical to the previous submission, which indicates that the projections were not updated (either completely or only recalibrated to the latest emission inventory data). It is the case of Slovenia that explained that they will commit to include the updated section in the next reporting.

3.4.3. Comparison of projections reported under Art 14. of the MMR with projections reported in the draft NECP

A comparison was made between the data included in the draft NECP and the MMR projections data reported by Member States. The results are presented in the two graphs below for respectively the WEM (Figure 23) and WAM (Figure 24) projections. As there were fewer Member States that reported WAM projections in the draft NECP, comparison was only possible for a smaller set of Member States. Only Member States that reported projections in 2019 and that had information in their draft NECP on 2020 and/or 2030 GHG emissions were included in the graphs below.

The graphs present the relative difference in total GHG emissions (excluding LULUCF) in 2020 and 2030 between the draft NECP and the MMR reporting. Positive values denote that the total GHG emissions of the MMR projections were higher than the projections in the draft NECP. The graphs show that for WEM projections, MMR reporting and the draft NECP was the same (i.e. Spain, Netherlands, Denmark, Poland, Czechia and Austria). For WAM projections, the reported information of the MMR and draft NECP was the same for two Member States, Czechia and Spain. For other Member States differences could be relatively high, ranging from 15% to –13%. The differences tended to be higher in 2030, but not for all Member States. For some countries the differences in projected emissions between the draft NECP and MMR were not consistent in 2020 and 2030, suggesting also a difference in the trend (for example for Estonian WEM projections and Slovakian WAM projections). For other Member States, such as French WEM projections, the differences between draft NECP and MMR were almost the same in 2020 and 2030, suggesting that the trend was similar in the draft NECP and MMR. Reasons for differences between MMR and draft NECP projections were:

- The most common explanation was that MMR projections were updated based on new modelling and/or adjusted to the latest inventory data. One Member State specified that the draft NECP included 2017 MMR projections.
- The updates of projected emissions were often limited to certain sectors which shows that consistency between draft NECP and MMR reporting could be much higher than the outcome of this check suggests.
- For none of the countries, the difference between NECP and MMR reporting was exactly the same in 2020 and 2030, both in absolute or relative terms. Suggesting differences were not due to a recalibration for more recent inventory data. For especially France, Luxembourg and Belgium these differences were alike and the trend therefore remained very similar for WEM projections in both NECP and MMR.
- Further updates to projections for the final NECP were already flagged by some Member States in their response.
- One Member States explained that projections for MMR and NECP were done by two different modelling consortia leading do small differences between MMR and NECP projections.

Figure 23 Relative differences between the WEM projections of the draft NECP and the MMR reporting for total GHG emissions in 2020 and 2030. Positive values mean higher emissions in the MMR reporting than in the draft NECP

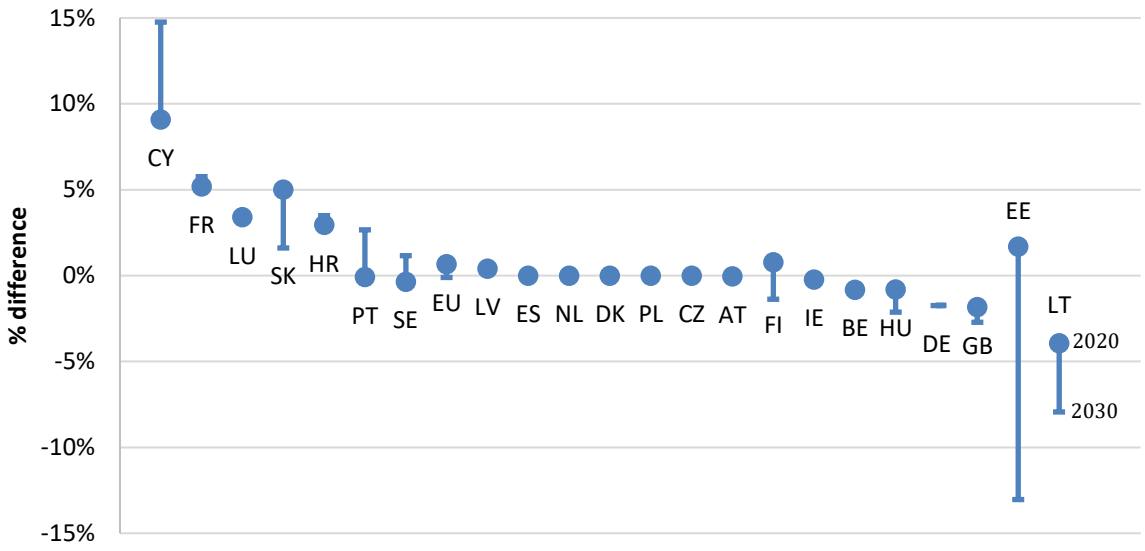
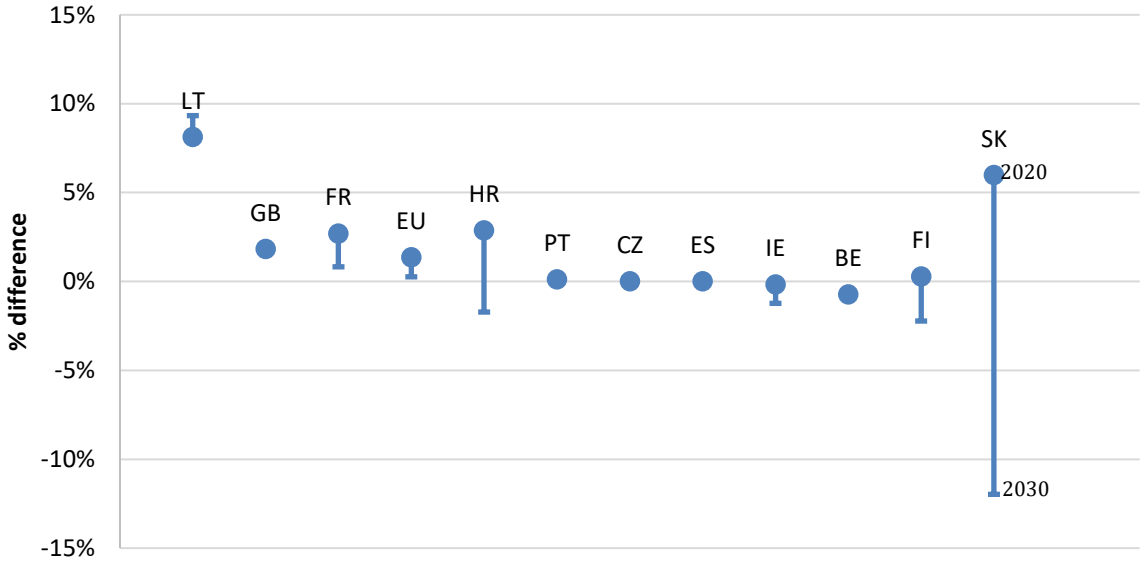


Figure 24 Relative differences between the WAM projections of the draft NECP and the MMR reporting for total GHG emissions in 2020 and 2030. Positive values mean higher emissions in the MMR reporting than in the draft NECP



3.4.4. Summary of the quality of the reported gases (CO_2, CH_4, N_2O, F-gases)

In 2019 for the first time the ETC/CME also prepared an EU dataset for the gases, because so far this database was only compiled for Total GHGs, ETS and ES emissions. However, due to the large additional amount of data and issues to be treated during the QA/QC procedure the ETC/CME did not apply any error correction or gap-filling (except for gap-filling of intermediate years), but it run the basic trend and sum check.

For individual greenhouse gases, the sectoral sum check (assessing whether the sum of emissions in subsectors equals the sectoral emission) of the first submissions of Member States showed that N_2O was

the gas with the most sum check errors with more than 50% of cases where the sum of subsectors did not match sectoral emissions (and with a median difference of 1.7%). Most of the errors were in the sector energy and agriculture. After N_2O followed CO_2 (26% of cases) as the individual greenhouse gas with the most errors (median difference 0.8%). CH_4 came third (18%), although the median difference (50%) was much larger than for the other GHGs. Large differences are often caused by missing reporting for one or more subsectors. For F-gases the sum of subsectors almost always matched the sectoral emissions. This is because F-gas emissions are limited to the sector industrial processes and therefore it is less likely to make errors.
The total GHG emissions reporting integrates these reporting errors made for individual greenhouse gases. As a consequence, most errors where found for the total GHG emissions. The median difference between the sum and reported sectoral emissions was 1.5%. Also for total ES emissions there were relatively many sectoral sum check errors (the median difference is 4.3%), while for total ETS emissions this was very small, with marginal differences (the median difference only 0.14%).
The data reported for the gases is therefore subject to similar quality issues as the data for Total GHGs and ETS/ES and errors seem to be often of systematic nature.

A comparison between GHGs for the trend check is complicated. The reason is that in case of low emissions, small absolute changes in the trend, could result in very large relative changes. As a consequence, if feedback for a specific greenhouse gas is given then it often concerns a sector where emissions are relatively less important (e.g. N2O and CH4 emissions in the energy sector, CO2 emissions in the sector waste). There is no meaningful difference among greenhouse gases in the number of findings linked to the trend checks (12 to 13 comments). Only for F-gases (7 comments) there were less comments to the Member States.
Most of the findings are not linked to a specific greenhouse gas, but rather to total GHG or ESD/ETS emissions. This is because comments are aggregated as much as possible to avoid duplicating comments in our feedback to the Member States. It is also worth noting that Member States not often adjust reporting based on the findings of the ETC, but rather provide a clarification for the observed trends.

3.5. Parameters

3.5.1. Reported parameters

The following tables (Tables 7) summarise the reporting of parameters that countries have used for their projections. The tables show the number of countries, from the maximum of 27 (EU-28 Member States minus Romania which did not submit projections), that have used the parameters listed in the table for the years 2015-2035 and the reference year. Evidently, not all parameters are used for projections. This reflects that some parameters such as GDP and population are more broadly applied in general models, while some are used only in specific, and usually more sophisticated, models.

A total of 147 unique parameters were identified across the MS submissions. Not surprisingly, the general parameters (GDP, population, international fuel prices for oil, coal, and gas, and the EU ETS carbon price) are reported by most MS. Other frequently reported parameters (for more than 20 MS) are often energy related such as: final energy consumption, gross inland consumption of energy carriers (fuels) as well as gross electricity production. In addition, most MS report on number of livestock, nitrogen input from fertilizer and manure, number of households and household size, as well as the amount of municipal solid waste going to landfills. Among the least reported parameters specified in the Table below are national retail energy prices.

In 2019, slightly more MS reported on the international fuel and carbon price parameters from projection year 2020 onwards than in 2017 (21-24 MS vs. 19-23 MS). The reporting of transport parameters decreased in 2019 compared to 2017 (13-17 MS vs. 21-22 MS).

Tables 7 Number of member states that reported the below projections parameters for given projection years and sectors

General Parameters	Reference /Base Year	2015	2020	2025	2030	2035
Population	22	25	26	25	26	24
Gross domestic product (GDP):-Real growth rate	14	16	17	16	17	16
Gross domestic product (GDP):-Constant prices	20	22	23	22	23	21
Gross value added (GVA) total industry	16	17	18	17	18	17
Exchange rates EURO (for non-EURO countries), if applicable	5	4	6	6	6	6
Exchange rates US DOLLAR, if applicable	7	7	10	10	10	10
EU ETS carbon price	16	20	23	23	23	21
International (wholesale) fuel import prices:-Electricity Coal	16	20	23	23	23	21
International (wholesale) fuel import prices:-Crude Oil	17	21	24	24	24	22
International (wholesale) fuel import prices:-Natural gas	17	21	24	24	24	22

Energy parameters	Reference /Base Year	2015	2020	2025	2030	2035
National retail fuel prices (with taxes included):-Coal, industry	6	6	7	7	7	7
National retail fuel prices (with taxes included):-Coal, households	4	5	5	5	5	5
National retail fuel prices (with taxes included):-Heating oil, industry	7	7	9	9	9	8
National retail fuel prices (with taxes included):-Heating oil, households	7	7	9	9	9	8
National retail fuel prices (with taxes included):-Transport, gasoline	6	6	8	8	8	7
National retail fuel prices (with taxes included):-Transport, diesel	8	8	9	9	9	8
National retail fuel prices (with taxes included):-Natural gas, industry	9	9	10	10	10	9
National retail fuel prices (with taxes included):-Natural gas, households	9	9	11	11	11	10
National retail electricity prices (with taxes included):-Industry	10	10	13	13	13	12
National retail electricity prices (with taxes included):-Households	16	18	22	22	22	21
Gross inland consumption: solid fuels	16	18	22	22	22	21
Gross inland consumption: total petroleum products	17	19	23	23	23	22
Gross inland consumption: gas	15	17	21	21	21	20
Gross inland consumption:-Renewables	9	10	13	13	13	12
Gross inland consumption:-Nuclear	14	15	19	18	18	17
Gross inland consumption:-Other	17	18	21	21	21	20
Gross inland consumption:-Total	15	19	22	22	22	20
Gross electricity production:-Coal	16	18	22	22	22	20
Gross electricity production:-Oil	17	20	25	25	25	23
Gross electricity production:-Natural gas	16	20	28	28	28	26
Gross electricity production:-Renewables	9	12	15	15	15	13
Gross electricity production:-Nuclear	13	16	19	19	19	17
Gross electricity production:-Other	17	19	23	23	23	21
Gross electricity production:-Total	18	18	22	22	22	20
Total net electricity imports						

Gross final energy consumption	14	15	18	17	17	17
Final energy consumption:-Industry	16	19	22	22	22	21
Final energy consumption:-Transport	16	19	22	22	22	21
Final energy consumption:-Residential	16	19	22	22	22	21
Final energy consumption:-Agriculture/Forestry	14	17	16	16	16	16
Final energy consumption:-Services	15	18	20	20	20	19
Final energy consumption:-Other	9	10	12	12	12	11
Final energy consumption:-Total	18	20	23	23	23	22
Number of heating degree days (HDD)	12	13	13	13	14	12
Number of cooling degree days (CDD)	5	6	6	6	7	5

Transport parameters	Base Year	2015	2020	2025	2030	2035
Number of passenger-kilometres (all modes)	12	16	17	17	17	17
Freight transport tonnes-kilometres (all modes)	12	17	17	17	17	16
Final energy demand for road transport	11	13	13	13	13	13

Buildings parameters	Base Year	2015	2020	2025	2030	2035
Number of households	17	19	22	22	22	21
Household size	17	17	21	21	21	20

Agriculture parameters	Base Year	2015	2020	2025	2030	2035
Livestock:-Dairy cattle	19	24	24	23	23	20
Livestock:-Non-dairy cattle	19	24	24	23	23	20
Livestock:-Sheep	20	25	26	25	25	22
Livestock:-Pig	20	25	26	25	25	22
Livestock:-Poultry	19	24	25	24	24	21
Nitrogen input from application of synthetic fertilizers	18	24	24	23	23	20
Nitrogen input from application of manure	17	21	22	20	21	18
Nitrogen fixed by N-fixing crops	7	8	8	8	8	8
Nitrogen in crop residues returned to soils	16	20	21	19	20	17
Area of cultivated organic soils	13	17	18	18	17	15

Waste parameters	Base Year	2015	2020	2025	2030	2035
Municipal solid waste (MSW) generation	14	18	18	17	18	16
Municipal solid waste (MSW) going to landfills	17	22	22	21	21	19
Share of CH4 recovery in total CH4 generation from landfills	15	19	19	18	18	16

Other parameters
84 other unique parameters (not listed above) were identified across MS submissions.

3.5.2. Most common parameter issues

The parameter tables (IR article 23 Table 3) were submitted by 27 Member States (compared to 28 in 2017). The comprehensive overview given in Table 8 summarizes the QA/QC process for each Member State and parameters that have been checked.
It can be clearly seen that least follow up was needed for the parameter population. There were a few countries which did not use the default units (purple), so the unit was converted by reviewers or countries resubmitted values (medium green) or explanations (blue) that solved the issue.
The overview also shows that for Belgium and Luxembourg GDP was not an input parameter for their projections and that net electricity imports was not used in the projections of seven Member States (yellow).
In most cases, the communication with Member States successfully solved the issues regarding the submitted parameters. This was the case because either data consistent to surrogate data was resubmitted, a notation key was resubmitted (grey) or because an explanation of the differences was given by Member State experts (blue). Explanations why GDP was not in line with surrogate data were mainly that Member States used data from their statistical office which is different to Eurostat or because conversion rates differed between the Member States and data used by the reviewers.
However, ten issues could not be solved (pink colours) as there was not enough time for iterative communication with the Member States. In most of the cases, Member States did not submit reference year values or the reference year in the first submission, so this was asked for in the first communication round. After the resubmission of these values and years, there was not enough time for follow-ups. This is significantly more than the remaining open issues in the 2017 submission.

Compared to 2017, the quality of parameters submitted by MS improved significantly. In 2017, 17, 8 and 7 MS submitted values for respectively population, GDP and net electricity imports where the reference year was in line with historic data, during the first submission. In 2019, 24, 22 and 19 MS submitted correct values for population, GDP and net electricity imports, respectively.

Table 8 'Heat Map' of QA/QC procedure and most common issues of the parameter checks

	Population	GDP	Electricity Imports
AT			
BE			
BG			
CY			
CZ			
DE			
DK			
EE			
EL			
ES			
FI			
FR			
HR			
HU			

	Population	GDP	Electricity Imports
IE			
IT			
LT			
LU			
LV			
MT			
NL			
PL			
PT			
RO			
SE			
SI			
SK			
UK			

Legend:
No follow up:
value in line with surrogate data
no use of default unit -> corrected by reviewer
no values submitted / values not used

Follow up: Neither value nor notation key given OR value not in line with surrogate data; issue solved
resubmission of notation key -> issue solved
resubmission of value consistent to surrogate data -> issue solved
explanation of reason for difference -> issue solved

Follow up: Neither value nor notation key given OR value not in line with surrogate data; issue NOT solved
no resubmission of MS -> issue not solved
resubmission of value NOT consistent to surrogate data / no explanation of reason for differences but issue also not followed up-> issue not solved

Note: Data of Member States was checked against surrogate datasets from Eurostat (Eurostat 2019, 2019a and 2019b) a): Population – Eurostat demo_pjan; GDP - Eurostat nama_10_gdp; net electricity import - Eurostat nrg_bal_c. Thresholds for the checks were 2 % for population and GDP and 4 % for net electricity imports.

3.5.3. Deviation from recommended parameters

In line with the MMR implementing legislation to increase EU wide consistency of projections, in June 2018, the European Commission provided Member States with recommended supranational parameters on ETS carbon and international oil and coal prices and provided a number of consistent other parameters e.g. international gas prices, GDP growth, population for the preparation of GHG projections (COM, 2018). Checks were carried out to gain insights into whether Member States experts used the provided values (Table 9). The classification was made by setting deviation threshold for individual parameters. Note however, that the situation can arise that for 2 projection years parameters do not deviate, but for other projection years they do. In these instances ETC/CME made a qualitative classification. In addition, it is possible that values happen to be in the same range as the commission guidance values, without actual use of the guidance. Similarly, due to potential exchange rate issues of price data (ETC/CME converts all monetary values to constant EUR2010), some parameters may have been classified as not following the Commission Guidance. It should be noted that in the 2019 QA procedure this check is of informative nature only and no follow up was made in case parameters deviated from the recommendations of the European Commission. The check was applied only on the parameters presented in the table below.

Table 9 Overview: Use of recommended parameters by the European Commission

	Coal price	Gas Price	Oil Price	Carbon price	Population	GDP		Coal price	Gas price	Oil price	Carbon price	Population	GDP
	Recommended parameters			Suggested assumptions				Recommended parameters			Suggested assumptions		
AT	yes	yes	yes	yes	yes	no	**IT**	no	no	no	yes	yes	not used
BE	not used	not used	not used	not used	no	not used	**LV**	no	no	no	no	close	no
BG	no	no	no	yes	yes	no	**LT**	no	no	no	no	no	no
HR	no	no	no	no	no	no	**LU**	not used	not used	not used	not used	no	no
CY	no	no	no	yes	yes	not used	**MT**	not used	not used	not used	not used	no	not used
CZ	yes	yes	yes	yes	yes	no	**NL**	no	no	no	no	close	not used
DK	no	no	no	no	no	not used	**PL**	no	no	no	no	yes	no
EE	yes	yes	yes	yes	no	no	**PT**	yes	yes	yes	no	no	no
FI	yes	yes	yes	yes	no	no	**RO**	n/a	n/a	n/a	n/a	n/a	n/a
FR	close	yes	yes	yes	no	no	**SK**	yes	yes	yes	no	not used	close
DE	no	no	no	yes	no	no	**SI**	no	no	no	no	no	no
EL	yes	yes	yes	yes	yes	not used	**ES**	yes	close	close	not used	no	not used
HU	no	no	no	no	yes	not used	**SE**	yes	yes	yes	yes	no	no
IE	no	no	no	yes	no	no	**UK**	no	no	no	no	yes	no

	Coal price	Gas price	Oil price	Carbon price	Population	GDP
Number MS using guidance in 2019	**9**	**9**	**9**	**12**	**9**	**0**
Number MS having used guidance in 2017	9	8	10	11	6	3

Legend:	
not used	parameter not used for projections
no	deviation to COM guidance > 3 % for prices >0.5 % for population and GDP
yes	deviation to COM guidance < 3 % for prices, < 0.5 % for populatiom and GDP
close	deviation up to +/- 2 %

In general, it can be observed that mainly the parameters for carbon price (used by 12 Member States) have been used by Member States as provided through the guidance. Greece and Czechia are the Member States that have followed the guidance mostly, except for the GDP expressed in terms of real growth rate. During the checking process it became clear that comparisons of parameters with monetary units carry a high level of uncertainty. The reason is that default units in the parameter reporting template are in constant EUR million or EUR/GJ. However, often no base year for the monetary values is given even though the guidance in column 'AS' specifies EUR2016 prices as a default. ETC/CME checks the values in EUR2010 prices, and is therefore required to apply a deflator to convert between EUR2016 and EUR2010 values. If Member States reported in default units of the reporting template, or reported in another unit conversion is needed to facilitate a comparison. In this case uncertainty is introduced, as there are various possible conversion factors. The following assumptions were used:

- If Member States reported in default units, it was assumed that the unit was EUR2016 / GJ (based on the guidance specified in column AS). This introduces uncertainty, because it cannot be confirmed.
- International fuel prices and EU ETS carbon prices were converted into EUR2010 / GJ and EUR2010 / t in order to facilitate comparison. An EU-wide deflator was applied for this purpose (based on Eurostat table nama_10_gdp)
- Absolute GDP was converted using a country-specific deflator (based on Eurostat table nama_10_gdp).
- If Member States reported in different units a conversion into EUR2010/GJ took place for comparison and the conversion also took place on the EU-wide deflator.

Due to these assumptions which introduce uncertainties deviations under ±4% were categorized as having used the recommended parameters.

3.5.4. Net electricity imports

An assessment of net electricity imports parameter for the reference year is shown in Figure 25. Panel a) shows the electricity imports as reported for the reference year, and panel b) shows the equivalent data from Eurostat (table nrg_bal_c). Where Member States did not submit a net electricity imports value for the reference year panel b) shows data for the year 2016. As would be expected, net importing states generally neighbour net exporting states.

The reduction of electricity imports or the increase of electricity exports are a primary reason for increasing ETS emissions. Up to 22 Member States reported on the parameter *net electricity imports* for their reference year and the year 2020 and 2030. In their 2019 submissions, Ireland and Latvia project to change direction from (modest) net electricity exporter to net electricity importer between the reference year and 2020. No other Member States project to change the direction of net electricity imports until 2020. This is a novel result in the 2019 submission as in the 2017 and 2015 submissions no MS foresaw shifting from exporter to importer or vice-versa. In total seven Member States reported to be exporters of electricity in the reference year in the WEM scenario (Czechia, France, Germany, Slovenia, Sweden, Ireland), while the others report to import electricity.

Figure 25 Net electricity imports and exports in TWh for reference years for the EU28. a) As reported in MMR MS projections 2019. b) As recorded by Eurostat (table: nrg_bal_c). Negative values indicate net export of electricity, positive values indicate net import

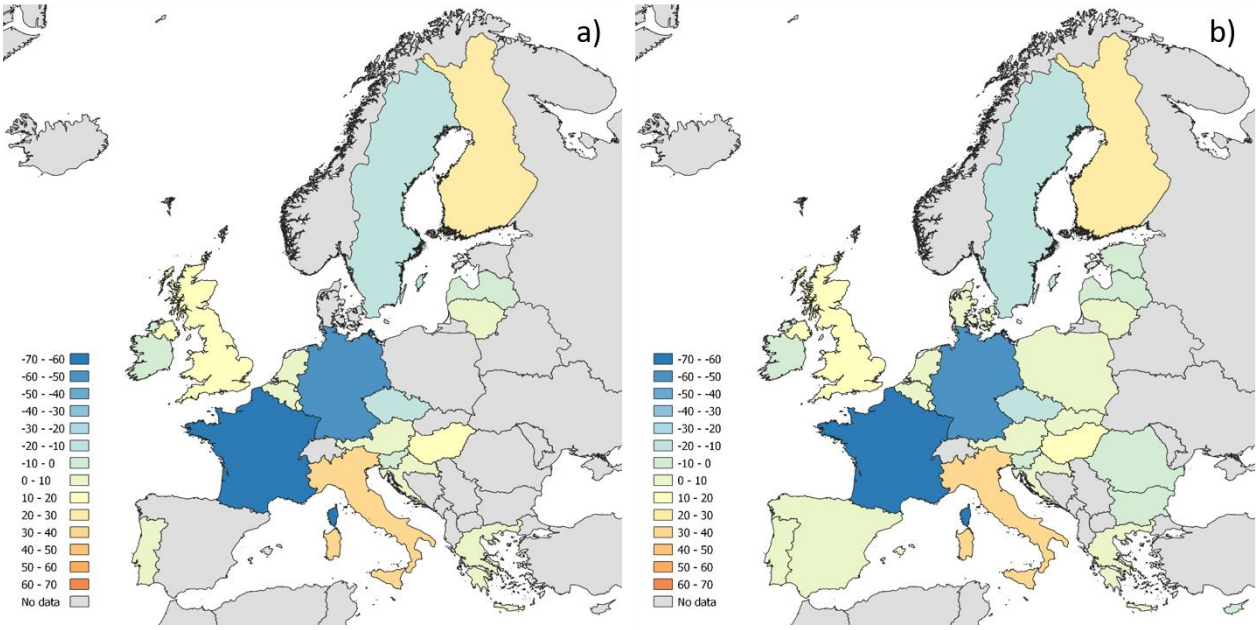
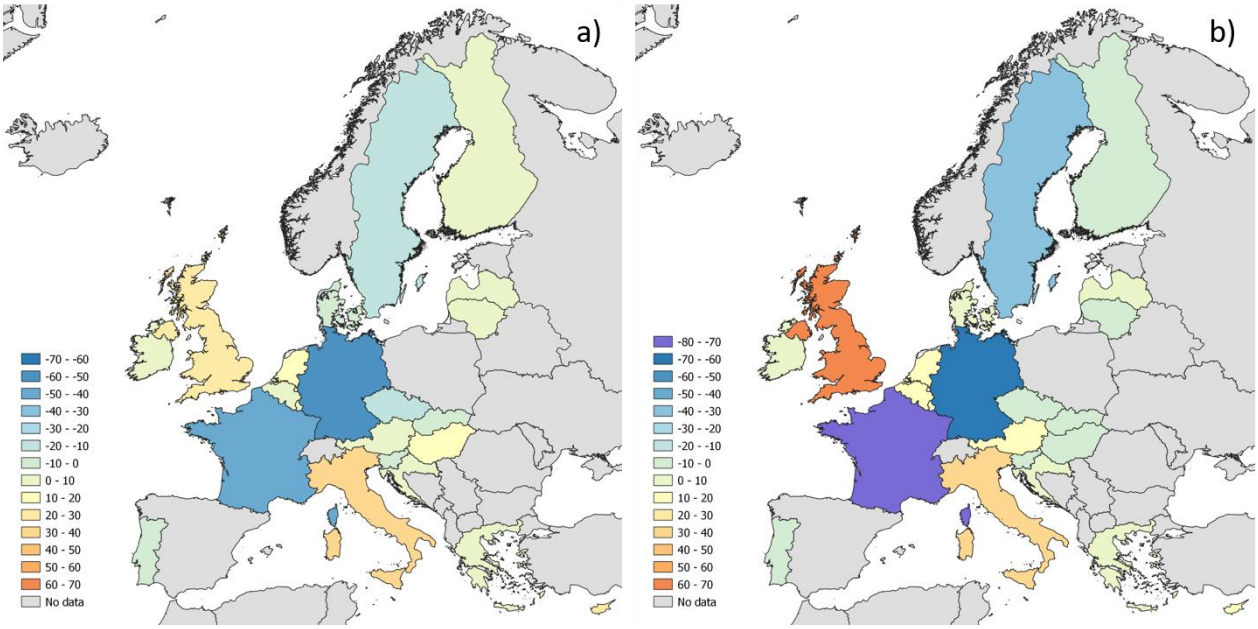


Figure 26 shows the net electricity imports in the WEM scenario for respectively the years 2020 (panel a) and 2030 (panel). The projected data show an increase in net exports and net imports for individual member states possibly reflecting the increased demand for energy, as well as the planning of additional (renewable) generation capacity and decommissioning of old (fossil) capacity. Finland, Lithuania and Hungary project to change from net electricity importer to net electricity exporter between 2020 and 2030.

Summing up the net electricity imports and exports for the WEM projections in 2020 and 2030 shows that in 2020 more imports are expected and in 2030 more exports are expected at the European level. This is contrary to the result of the 2017 submission, which projected more exports than imports in 2020. Though part of this could be explained by a different set of countries reporting on net electricity imports, it also showcases the rapidly changing structure of the European power system that is reflected in the projections. It needs to be noted that this only includes the data of the Member States who reported on net electricity imports. No gap-filling was applied in this case.

Figure 26 Net electricity imports and exports in TWh for the WEM scenario of EU28 for a) the year 2020 and b) the year 2030. Negative values indicate net export of electricity, positive values indicate net imports



Of the 12 electricity importing countries, nine project a decrease of net electricity imports in the period between the reference year and 2020. For seven Member States this is followed by further decreases in the period 2020-2030, but for two Member States (Austria and Belgium) net electricity imports are projected to increase significantly to more than double the imports of the reference year in 2030. From the seven electricity exporting countries, all except Sweden, Slovenia and Czechia are projecting lower exports in 2020 compared to the reference year, though exports are projected to increase again in the period 2020-2030 for France, Germany, Ireland and Latvia, while continuing the increase for Sweden.

4. Overview of models applied by MS

As part of the submission of projections, MS are requested to upload a summary of the models used in establishing their national projections (IR Article 23 Table 4). The submission template of Table 4 allows free text for fields related to model metadata including model name, model type, sectoral coverage etc. In this chapter, the models were categorized based on the description of each model provided by MS, not the actual mechanistic or mathematical characteristics of the applied models. As such, it is possible that the overlap among models have not been identified in the current classification. A total of 123 models were applied by 26 Member States. Cyprus did not report any models in Table 4 and Romania did not submit a projection this year. Seven models were identified to be used more than once and perhaps under various model names. For instance, several variations of MARKAL/TIMES model were used more than eight times according to the model fact sheets of the 2019 submission.

Table 10 summarizes model types according to the general approach of the models. Top-down approach is usually based on macroeconomic modelling principals, while bottom-up approach is based on disaggregation and the inclusion of a large number of technical parameters. When models have specific mathematical, mechanical or engineering characterizations that could not be classified as top-down and bottom-up, they were classified as other (e.g. process or decay models). Econometric models categorize energy demand into a large number of end-users of energy corresponding to different goods and services. The influences of various social, economic and technological factors are estimated under various scenarios based on energy demand and growth. Accounting models refer to those that apply a large number of technical and statistical parameters for calculating the total energy demand and associated emissions. Inventory models are established based on the existing stock of items or GHG emissions and factoring in variable parameters. Optimisation models optimise the choice of technology alternatives with regard to total system costs to find the least-cost path. Such models are also categorized as partial equilibrium models, since they balance demand and supply in the covered sectors. Simulation models constitute a very broad and heterogeneous group. Their modelling aspects depart from the pure optimization framework. They can include econometrically estimated relations. Large simulation models can include partial optimization (e.g. from a company perspective) and can consist of different modules.

Table 11 summarized the number of models that are used by MSs to cover various sectors. Twenty-two MS used specific models for GHG emissions from energy sectors. For agriculture and LULUCF sectors, 13 and 11 MS used specific models, respectively. Only nine and five MS had specific models for estimating emissions from waste and industrial processes, respectively.

Table 10 Overview of model types employed by Member states. Note that Cyprus did not submit any model information. Romania is excluded as no submission was received in 2019.

	Top-down					Bottom-up						OTHER	TOTAL
	Econometric	Accounting	Simulation	Supply and demand	Inventory	Econometric	Optimization	Simulation	Accounting	Inventory	Equilibrium		
AT	1					1		1	4				7
BE									5				5
BG			1										1
CY													
CZ							1		1	1			3
DE				2	1		1	2				1	7
DK				1		1	1	1					4
EE												2	2
ES	2					1				1			4
FI						1		1	2	3		8	15
FR						1							1
UK												3	3
EL							2					1	3
HR	1		1	1					1	1		3	8
HU									3			1	4
IE	1	1		1								2	5
IT								1					1
LT				1					1			3	5
LU	2							3				2	7
LV								1				2	3
MT												15	15
NL							1	3		2		2	8
PL							1			1			2
PT											1		1
SE	1							1					2
SI			1		1			2		1			5
SK				1	1								2
TOTAL	8	1	3	7	3	5	7	16	17	10	1	45	123

Table 11 Overview of the number of models employed by Member States on aggregated sectoral level. Cyprus did not submit any model information. Romania is excluded as no submission was received in 2019.

	Energy					Industrial processes	Agriculture	LULUCF	Waste	All	TOTAL
	Electricity and heat	Residential and commercial	Industry	Transport	All						
AT	1	2		3			1				7
BE		1	1	2	1						5
BG										1	1
CY											
CZ					1	1		1			3
DE		1	1	1	1	1	1	1			7
DK	1	1		1	1						4
EE	1									1	2
ES	2				1			1			4
FI		1	1	1	1	1	2	4	4		15
FR		1									1
UK	2				1						3
EL	2				1						3
HR	1	1	1	1	1		1		1		8
HU								3	1		4
IE	1	1			1		1			1	5
IT										1	1
LT	1			1	1			1	1		5
LU	1	1		3	1					1	7
LV					1		2				3
MT	2	2	1	4	1		2		2	1	15
NL	1	2	1	1	1	2	1				8
PL	1				1						2
PT										1	1
SE					1		1				2
SI		1		2	1		1				5
SK				1						1	2
TOTAL	17	15	6	21	18	5	13	11	9	8	123

The following points summarise the key information of this preliminary analysis:

- In total, 123 different models used for GHG emissions by MS.
- Bottom-up approach is used in 45% of the models.
- Top-down approach is used in 17% of the models and the rest used various mathematical or statistical approaches (e.g., probabilistic and deterministic models).
- In accounting and inventory models, the outcome of the models is largely dependent on emission factors that are applied in each model.
- In econometrics and optimization models, the assumptions defined under each scenario play important role on the reliability of the outcome. Furthermore, the outcome of these models is most likely affected by accuracy of socio-economic parameters (e.g. GDP, GVA) that are used in the models.
- Geographic coverage of models varies from regional, to national, to international scope. However, most MS cover only their national scopes.
- Relatively few models addressed LULUCF, despite its significant impact on overall GHG emissions (this might not be relevant for the projection per se).
- Twenty-two MS used specific models for GHG emissions from energy sectors. For agriculture and LULUCF sectors, 13 and 11 MS used specific models, respectively. Only nine and five MS had specific models for estimating emissions from waste and industrial processes, respectively.

5. Summary of QA/QC results for Iceland, Norway and Switzerland

Iceland, Norway and Switzerland are a member countries of the EEA network, which share a number of environmental commitments with the EU, such as for GHG emission reductions. For this reason these EEA countries can voluntarily participate in the QA/QC procedure of the EEA and the ETC/CME.
In 2019, Iceland, Norway and Switzerland submitted GHG projections on a voluntary basis. An overview of the reported information is provided in the following table:

Table 12 Overview of QA/QC results for Iceland, Norway and Switzerland

	first submission	resubmission	Reference year	Time series	Scenarios	Gases	main sectors reported	report	parameters	model factsheet
Iceland	15/03/2019	no	2017	2015-2035	WEM	all gases	most sectors	yes	yes	no
Norway	26/06/2019	no	2016	2015, 2016, 2020, 2030	WEM	all gases	yes	yes	yes	yes
Switzerland	15/03/2019	26/04/2019	2015	2015, 2020, 2025, 2030	WEM, WAM, WOM	all gases	main sectors only	yes (NC7)	yes	yes

During the QA procedure the ETC/CME sent 13 questions to Iceland and 10 questions to each Norway and Switzerland. Due to a unit error for CH_4 and N_2O, Switzerland provided a resubmission. For Norway and Switzerland the ETC/CME applied a gap-filling of the intermediate years. Iceland did not report LULUCF projections, therefore the ETC/CME applied a gap-filling based on the latest reported value from the national inventory.

6. Conclusions and recommendations

6.2. Conclusions

The mandatory biennial reporting of the GHG projections by EU Member States is an important source of information in terms of monitoring the achievement and tracking progress towards EU GHG reductions targets. The results of the QA/QC procedure in 2019 show that the Member States projections have slightly improved compared to previous submission years and provide evidence that the existing QA/QC procedure applied is effective in both identifying errors and stimulating improvement. This can also be seen in the still high number of resubmissions in the course of the communication with the Member States in 2019, which underpins the constructive and pro-active collaboration between the Member States experts and the ETC/CME as well as EEA experts.

The general timeliness of submissions and resubmissions has improved as well which is also demonstrated by the indicator which shows the distance between initial and final submission. The time between first and final submission has slightly decreased compared to 2017. The general quality of the data has improved as fewer countries provided a resubmission and the total number of resubmissions decreased compared to 2017.

In 2019 completeness of reporting did not improve compared to 2017, there is even a deterioration in some fields (reporting of mandatory years, the WOM scenario). The inclusion of the transport sub-categories in the EU projections database revealed that not all countries are reporting all categories as required by the reporting template. On the other hand, in terms of the data submitted, it can be concluded that the allocation of sectors to ETS and ES emissions has improved; also the corrections applied by the ETC/CME were more basic than in past years. 2019 is already the second reporting year in which no reference year calibration was necessary, and all submissions were deemed to be consistent with historical emissions. The accuracy and transparency checks are an important source of information to understand trends, outliers and recalculations, as the information in the reports is often lacking.

The quality of parameters submitted by MS improved significantly compared to 2017. However, the units are still a challenge, as this is often not clear from the reporting. In comparison to 2017 submission, 12 countries used the EU ETS carbon price, up from 11 in 2017. The same number of nine countries uses the recommended parameters for coal price. Nine countries used recommended parameters for oil price in 2019, while ten countries used them in 2017. Most used recommended parameter is carbon price (12 MS), followed by coal price, gas price, oil price and population (9 MS).

In the 2019 reporting year, for the first time a voluntary reporting template with integrated quality checks was provided to the Member States in order to support them in reporting correct data. The template included some basic sum checks, a scenario check and a completeness check. According to the templates submitted by the countries, the ETC/CME concludes that at least four Member States made use of this template. Although it cannot be directly related to this, it can be seen from the statistics of the checks that the number of questions related to sum checks has decreased in most countries. Together with the automated CDR checks which were successfully implemented already in 2017 this was another milestone to avoid basic reporting errors to increase awareness of the MS experts to improve their internal quality control procedures.

Based on the experience gained in the 2019 reporting cycle, the ETC/CME will continue to further develop the checking procedure. One lesson learnt is that with the inclusion of new items (e.g. sectors or gases) in the EU dataset, new challenges and issues occur, as it was the case for 1A3 sub-sectors and the gases. The checks revealed that the data for the gases has typically the same systematical errors as the Total GHGs, ETS and ES emissions. Therefore bringing the data for the gases to the same quality level would require a substantial effort by both the ETC/CME and the Member States.

6.3. Recommendations

Although the reporting has improved constantly in the past, some reporting challenges persist for Member States and the ETC/CME. In the following the main recommendations derived from the QA/QC procedure 2019 are listed which are mostly similar as in 2017. It has to be noted that these recommendations do not apply for all MS, but can be seen as a general summary of prevalent issues. A complete list of all recommendations in 2019 is provided in ANNEX 2.

Timeliness:

- Timely reporting of MS' submissions is needed. This allows also for a more efficient QA/QC procedure
- Fast responses of the MS experts allow for a more efficient and faster QA/QC procedure.
- The improvement of the quality indirectly affects the timeliness as fewer resubmissions are provided. Voluntary reporting templates with integrated checks are means to support enhancing the quality of the submission and should be further developed.

Completeness:

- Further increasing the completeness of mandatory information such as detailed underpinning explanatory data and a detailed, transparent report is needed. It would also facilitate more in-depth cross-comparison of reported projections and thus enhance the quality of the aggregated EU projections.
- It is important to communicate more clearly the reporting gaps of mandatory information to the Member States in order to improve completeness of the reporting.
- Additionally increasing the completeness of voluntary information such as notation keys would give additional information on the scope and completeness of estimated emission sources in a MS and would help identify typical errors such as transcript or sum errors.
- The voluntary reporting of a WAM scenario is especially valuable since they should complement the interpretation of the projected progress to target assessment of a WEM scenario as the scenario sheds light on the sum of policy effects of additional measures (WAM-WEM), in particular as a WAM scenario will often cover policies which are adopted at EU level but not yet at MS level.
- Voluntary reporting of a WOM scenario, if done in a methodologically consistent way, can be helpful to shed light on the sum of policy effects of implemented measures (WEM-WOM).

Consistency and comparability:

- The voluntary template is an important tool for a simple quality control routine for the Member States and if applied correctly it can reduce the number of questions and resubmissions necessary. Together with the checklist, the additional guidance documents for ETS/ES reporting[8] and parameters[9] reporting as well as the automated CDR checks, these tools should be further developed and promoted to the Member States.

[8] EEA (2018): Guidance for reporting of ETS and ESD projections under the MMR, will be available at: http://cdr.eionet.europa.eu/help/mmr/Guidance%20for%20reporting%20of%20ETS%20and%20ESD%20projections%20under%20MMR.pdf

[9] ETC/CME (2019): Guidance for reporting on projection parameters under Regulation (EU) No 525/2013 http://cdr.eionet.europa.eu/help/mmr/Article%2014%20Guidance%20for%20reporting%20on%20projection%20parameters.pdf

- Adapting the reporting template to pre-fill relevant sector-pollutant combinations with notation keys i.e. 3.A Enteric Fermentation as "NO" for CO_2, N_2O, HFCs etc. would reduce the risk of accidental insertion of data.
- Continue to focus on correct reporting of ETS and ES sectoral emissions, particularly with respect to CO_2 emissions associated with domestic aviation. One option would be to prefill the appropriate cells in the template with a notation key or comment such that sectoral emissions are not accidentally allocated to ETS or ES categories.

Accuracy and transparency:

- It is important for MS experts to explain sectoral trend changes and outliers in emission trends in the report that accompanies the submission of the national GHG projections dataset in order to increase the efficiency of the QA/QC process.
- Historical figures should not be reported for categories when no projections are available, because this interferes with the EU aggregated dataset.

Parameters:

- To facilitate a comparison with less uncertainty in the future it is recommended to update the reporting template with unmistakable units for all energy prices, e.g. same reference year as for GDP (Euro (2010)).
- In case, MS do not use provided guidance, units and if applicable conversion rate, should be provided as an additional information
- It is recommended to follow up with Member States if they do not use supranational recommended parameters by the Commission so that for every deviation at least a clear explanation is documented.
- Explicit specification of the year for which constant prices should be provided, in order to facilitate monetary unit conversion, even when commission guidelines were followed as a default.
- More iterations in correcting parameters data for future reporting are necessary to resolve the number of outstanding issues.

ANNEX 1 References

COM (2018): Recommended parameters for reporting on GHG projections in 2019. Final after consultation, 15/06/2018.

EC (2015): Elements of the Union System for Policies and Measures and Projections and the Quality Assurance and Control (QA/QC) Programme as Required under Regulation (EU) NO 525/2013 (online: https://ec.europa.eu/clima/sites/clima/files/strategies/progress/monitoring/docs/union_pams_projections_en.pdf , 18/10/2019)

EEA (2018): Guidance for reporting of ETS and ESD projections under the MMR, will be available at: http://cdr.eionet.europa.eu/help/mmr/Guidance%20for%20reporting%20of%20ETS%20and%20ESD%20projections%20under%20MMR.pdf

EEA (2019c): EU Emissions Trading System (ETS) data viewer, https://www.eea.europa.eu/data-and-maps/dashboards/emissions-trading-viewer-1

EEA (2019d): Guidance documents for Member States for reporting obligations under the Monitoring Mechanism Regulation (MMR), available at: http://cdr.eionet.europa.eu/help/mmr (05/11/2019)

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ANNEX 2 List of recommendations 2019

key words	Sector(s)	Gas(es)	Year(s)	Check performed	Recommendation as a result of the QA/QC procedure 2019
Completeness, Indicators	NA	NA	NA	Completeness check (C1)	It is encouraged to report indicators.
Notation keys	All sectors	All gases	All years	Completeness check (C1)	It is recommended to use notation keys to increase transparency. It is recommended to provide appropriate notation keys instead of reporting a 0.
WOM Scenario	All sectors	All gases	All years	Completeness check (C1)	We encourage the MS to report WOM scenario.
WAM Scenario	All sectors	All gases	All years	Completeness check (C1)	We encourage the MS to report WAM scenario.
Mandatory years	NA	NA	NA	Completeness check (C1)	It is recommended to report the mandatory years.
Non-mandatory years	All sectors	All gases	All years	Completeness check (C1)	It is recommended to provide annual projections for the years 2016-2019, 2021-2024, 2026-2029 and 2031-2034, 2036 - 2039
Mandatory sectors	All sectors	All gases	All years	Completeness check (C1)	It is recommended to report all mandatory sectors or to provide appropriate notation keys for these blank cells. Please briefly explain why these sectors/gases are not reported.
1A3 sub-sectors	1A3	All gases	All years	Completeness check (C1)	It is recommended to provide projections for 1A3 sub-sectors in future submissions.
Report	NA	NA	NA	Completeness check (C1)	For reasons of transparency we recommend to include the report or a reference to the report in the projections envelope and it is recommended to provide an English summary if the report is provided in a different language.
Emissions included elsewhere	All sectors	All gases	All years	Completeness check (C1)	It is recommended that in future submissions information on emissions included elsewhere is included in the report.
Fill out reference year columns	All sectors	All gases	Reference Year	Completeness check (C1)	It is strongly recommended to provide the reference year information for future submissions, so the data can be processed properly in the EEA database.
Historical years and projections	All sectors	NA	NA	Consistency check C2	It is recommended to not report historical years if no projections are available, because this will cause inconsistencies in the EU Dataset.
LULUCF/ESD	4	ESD	All years	Consistency check C2	It is recommended not to report LULUCF emissions in the ESD table.
Sum quality checks	All sectors	All gases	All years	Sum check (C4a)	It is recommended to apply some general quality checks to ensure that all sums are correct for future submissions.
Highlight important changes	All sectors	All gases	All years	Recalculation check (C4b)	It is recommended to highlight the most important changes compared to previous submission in the future technical reports.
Coherency with policies and measures	NA	NA	NA	Projected trend check (C4d)	It is recommended to keep coherency between projections and reporting on policies and measures.

Trend changes and outliers	All sectors	NA	All years	Outlier check (C4c)	It is recommended to clarify and describe reasons for trend changes and outliers in the technical report.
Sub-sectors ETS/ESD split	1, 1.A.1	All gases	All years	Overall trend check (C4e)	It is recommended to provide a consistent ETS/ESD split covering all sub-sectors in the future.
WAM emissions higher than WEM emissions	NA	NA	NA	WEM/WAM/WOM check (C4f)	It is recommended to provide an explanation if WAM emissions are higher than WEM emissions
Default units	NA	NA	NA	Unit check (C5a)	It is recommended to report in default units
Reference year for parameters	NA	NA	NA	Historic parameter (C5b)	It is recommended to report reference year values for all reported parameters as well
Electricity import values	NA	NA	Reference Year	Net electricity import check (C5c)	It is recommended to ensure that the correct values are reported for net electricity import in the next submission.
Domestic aviation in ETS	1A3a	ETS	All years	ETS/ES check (C6)	It is recommended to exclude 1A3a domestic aviation in the ETS sector.
ETS/ES split	All sectors	All gases	All years	ETS/ES check (C6)	It is recommended to ensure a consistent ETS/ESD split in future emissions.

ANNEX 3 Checklist for quality control (QC) checks for MS' national GHG projections under MMR Art. 14

1. Check whether all mandatory and available recommended reporting requirements are included

✓ Excel template includes GHG emissions:

- organised by sectors (incl. LULUCF) and memo items (mandatory)
- organised by gases: CO_2, CH_4, N_2O, HFC, PFC, NF_3, SF_6, (or group of F-gases) (mandatory)

Please note: LULUCF is reported only under Total GHG/CO_2, CH_4 and N_2O; Memo Items are only reported under Total GHG and not for ETS/ESD; No emissions for 1A3a domestic aviation reported under ETS

- for all years: RY, 2015, 2020, 2025, 2030, 2035 (mandatory) and intermediate years (good practice)

Please note: the reference year needs to be reported for all gases and sectors

- for all scenarios: WEM (mandatory), WAM (where available), WOM (where available)
- EU ETS/ESD split for sectors, years and scenarios (mandatory).
- notation keys in case of missing emissions data (good practice)
- projection parameters for mandatory years and scenarios (mandatory):

Please note: Only report those parameters that are used as input to the modelling of scenarios; Units are reported according to the default units as indicated in the reporting template. If this is not possible, please indicate the applied unit; Reference year and reference year value for the parameters need to be reported as well.

✓ Report including:

- description of methodologies/models used (model factsheet) (mandatory)
- underlying assumptions (mandatory)
- results of sensitivity analysis (mandatory)

2. Check whether internationally agreed GWP according to 2006 IPCC Guidelines were used and whether GHG were reported in the correct unit

- CO_2 in Gg CO_2; CH_4 in Gg CH_4, N_2O in Gg N_2O
- F-Gases in Gg CO_2eq
- Total GHG in CO_2eq = Gg CO_2 + Gg CH_4*25 + Gg N_2O *298 + Gg CO_2eq F-Gases

3. **Check whether the reference year (= starting year, base year) of projections is consistent with the historic emissions of the latest available inventory**

   - Total GHG emissions
   - Total ETS emissions
   - Sectoral level on main source category level of total GHG from latest GHG inventory

Please note: the sectoral difference between emissions in the reference year of the projections and historic emissions of the same year should be lower than the sector specific uncertainty reported in the NIR for emission inventories

4. **Checking that disaggregated emission projections equal the total sum you reported.**

   - by gas
   - by sector (Total GHG, ETS and ESD): Sector 1 = 1A1+1A2+1A3+1A5+1A5 etc.

Please note: the sectors should add up correctly especially when notation keys are used (IE)

   - ETS/ESD: ESD+ETS+CO2 domestic aviation=Total GHG

Please note: the difference should be less than 0.25 % of the total emissions (excl. LULUCF). 0.25 % was chosen as threshold for significance since a smaller difference could be attributed to rounding

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