

Analysis of Member States' 2021 GHG projections

Submitted under Art 38 (1)(b) of the Regulation on the Governance of the Energy Union and Climate Action (EU) 2018/1999

December 2021



European Environment Agency
European Topic Centre on Climate change
mitigation and energy



Authors:

Carmen Schmid (UBA), Georg Wartecker (UBA), Henrik Neier (UBA), Evert Bouman (NILU), Babak Ebrahimi (NILU), Dam Vo Thanh (NILU), Rosie Brook (Aether), Justine Raoult (Aether), Tom Dauwe (VITO), Kelsey van Maris (VITO), Javier Esparrago (EEA)

ETC/CME consortium partners: *AETHER*, Interprofessional Technical Centre for Studies on Air Pollution (*CITEPA*), Czech Hydrometeorological Institute (*CHMI*), Energy and Environmental Studies and Software Development (*EMISIA*), Institute for Applied Ecology (*ÖKO-INSTITUT*), *ÖKO-RECHERCHE*, Norwegian Institute for Air Research (*NILU*), Netherlands Environmental Assessment Agency (*PBL*), National Institute for Public Health and the Environment (*RIVM*), Environment Agency Austria (*UBA*), Flemish Institute for Technological Research (*VITO*)

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European Topic Centre on Climate
change mitigation and energy
Boeretang 200
B-2400 Mol, Belgium
Tel.: +32 14 33 59 77
Web: www.eionet.europa.eu/etcs/etc-cme
Email: etccme@vito.be

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Executive summary

In the 2021 reporting cycle, which is the first time Member States had to report in accordance with Art. 18 (1) (b) of the Regulation on the Governance of the Energy Union and Climate Action (EU) 2018/1999, all 27 EU Member States and three EEA countries provided a submission on their GHG projections.

Although a new reporting platform, Reportnet 3, and partially new or updated reporting tables were introduced, the total **number of findings** shared with the countries is almost the same as in 2019 when the last mandatory reporting cycle under the previous regulation took place. Also, the average number of questions per country is at the same level in 2021 compared to 2019.

The ETC/CME extended the existing checks to the new reporting tables. New checks were developed for the **new reporting tables** on detailed LULUCF tables and the information on sensitivity scenarios to ensure the consistency is ensured between the different numbers and scenarios.

Similar to previous reporting years on of the main challenges remained the **timeliness** of the submission. Only twelve Member States submitted their projections before or on the official reporting deadline. In addition, most countries provided a resubmission following up the findings by the ETC/CME during the QA/QC.

Regarding the **completeness** of the submission, most countries submitted all mandatory reporting elements. However, in the initial submissions some Member States did not provide the new reporting items were missing and they were delivered in a resubmission. Compared to 2019, five more countries provided a WAM scenario in 2021 and only one country did not provide the complete mandatory time series up to 2040 and there was only one country which did not provide a report which is not only a completeness issue, but also a **transparency** problem. Regarding the voluntary elements, seven countries provided the time series until 2050 and gap-filling of the intermediate years was applied to 12 country datasets.

Most Member States selected the year 2018 as the starting year (base year) of their projections and referred to the 2021 inventory submission as the underlying historical dataset. Overall, the deviation for the Total without LULUCF of the EU compared to the EU inventory amount to only 0.1 % and shows that the EU projections are **consistent with the historical time series**. Likewise, the results of the checks for the ETS and ESR emission projections show consistency with the historical time series and usually the difference of the base year compared to historical verified ETS data was below 1 %. Higher deviations occurred when countries used other national datasets. The results are similar for the ESR projections.

Other common issues that cause inconsistencies in the time series are the reporting of the wrong units, which is a particular challenge for the detailed LULUCF tables, because they require different units than in the main projections table. Another problem for the **time series consistency** is when countries report historical data for sectors and gases for which no GHG projections are available. In such a case, the ETC/CME asked the countries to resubmit the dataset or suggested a correction by the ETC/CME. Another typical source for inconsistencies are sum errors, i.e. the number of the parent category does not match with the sum of the sub-categories or the Total GHGs do not match with the sum of all gases. This problem is usually solved with a resubmission of a corrected dataset.

To ensure the **consistency and comparability** of the scenarios, the ETC/CME compares the results of the WEM, WAM and WOM scenario which triggered findings for 19 countries in 2021, e.g. when the result for the WEM was lower than the WAM.

Regarding the **accuracy and transparency** of the reported trends, the ETC/CME sought for clarification when outliers, implausible trends or significant recalculations were identified, but without any further explanation in the written report. Most issues were clarified during the QA/QC by the responses from the Member States. For ETS emissions a separate check of the changes in trend was conducted and it showed that most changes in trends have an explanation. It was noted that, especially for smaller countries, closures or start-ups of single plants can strongly affect the trend of ETS projections.

In total the countries reported 389 unique **parameters** across different sectors and the ETC/CME identified approximately 50 rather common parameters, which are reported by more than half of the Member States. The most common are population, different variations of Gross Domestic Product and Gross Value Added, energy consumption or production, household and transport system indicators and specific agricultural parameters (e.g. nitrogen input). Regarding the recommended parameters from the Commissions Guidance to harmonise the projections, four Member States followed the guidance rather closely. The most used recommended parameter was the EU ETS carbon price.

A relatively large number of issues with parameter values was resolved through explanation by Member States. Although reasons usually relate to the use of national datasets, and slight differences in e.g. exchange rates, it shows that this is still a source of uncertainty. Not all Member States provided an explanation why recommended parameters were not taken into account, but many countries explained that they preferred parameters from national data sources and other modelling exercises.

Despite the challenges with the change to the new reporting system, it can be concluded that the countries successfully managed the transition to report under the Gov. Reg. However, the **main challenge for the future reporting** cycles is not a technical one, but the timeliness of reporting, because delayed submissions have a significant impact on the timeline of the QA procedure and the related products that are based on the quality checked data sets.

1 Introduction

On March 15 2021, the EU Member States had to report for the first time their GHG projections in accordance with Article 18 (1) (b) of the Governance of the Energy Union and Climate Action Regulation (EU) 2018/1999 (Gov. Reg.) and Article 38 of the related Implementing Regulation (EU) 2020/1208, which repealed the Monitoring Mechanism Regulation (EU) No 525/2013 (MMR) and its implementing Regulation (EU) no. 749/2014. With the new reporting obligation, a new reporting platform (Reportnet 3.0) and revised or new reporting tables were introduced, including new reporting elements (see Box 1.1.). In order to support the Member States with the transition to the new reporting platform and templates the EEA and the ETC/CME prepared a Guidance document ⁽¹⁾ and conducted online webinars to train the reporters.

Box 1.1 Summary of main changes in reporting under the Governance Regulation (Gov. Reg.) compared to the MMR

- New reporting platform Reportnet 3.0
- New reporting tables for reporting GHG projections and related information including integrated voluntary tabs to perform basic quality checks before submission
- Detailed projections of emissions and removals from LULUCF, according to inventory and land accounting categories
- Possibility to report projections for the unspecified mix of HCFs and PFCs, and changes to the Memo Items
- Some key indicators already suggested in the regulation
- Energy related parameters / variables used for projections aligned with the regulation
- Sensitivity analysis results and their parameters have to be reported in tabular format in addition to textual report
- Report on information relevant for the accounting towards the ESR targets and the LULUCF Regulation

1.1 The Union System for projections

The Union system for policies and measures and for projections (Figure 1.1) 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. At the moment of writing this report, the [document detailing the elements](#) of the Union system has not been updated to reflect the transition from the MMR to the Governance Regulation.

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 39 of the Governance Regulation and 4 and 12 of the UNFCCC and 3 of the Kyoto Protocol.

In accordance with point (a) of Article 44(1) of the Governance Regulation (EU/2018/1999), the Climate Change Committee established under Article 3 of Regulation (EU) No 182/2011 assists the Commission.

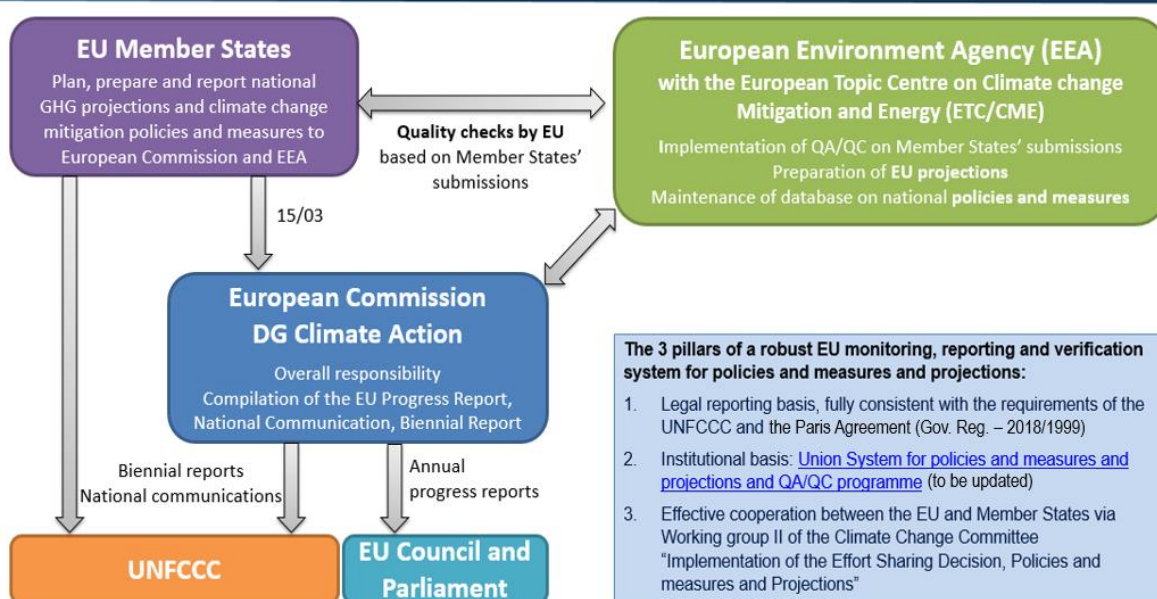
⁽¹⁾ https://www.eionet.europa.eu/reportnet/docs/govreg/projections/2021_reporting_guidance-ghg_projections_govregart18_v4-1.pdf/view

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 (European Commission, 2015).

Figure 1.1 Union System for Policies and Measures and Projections

The Union's system for policies and measures and projections

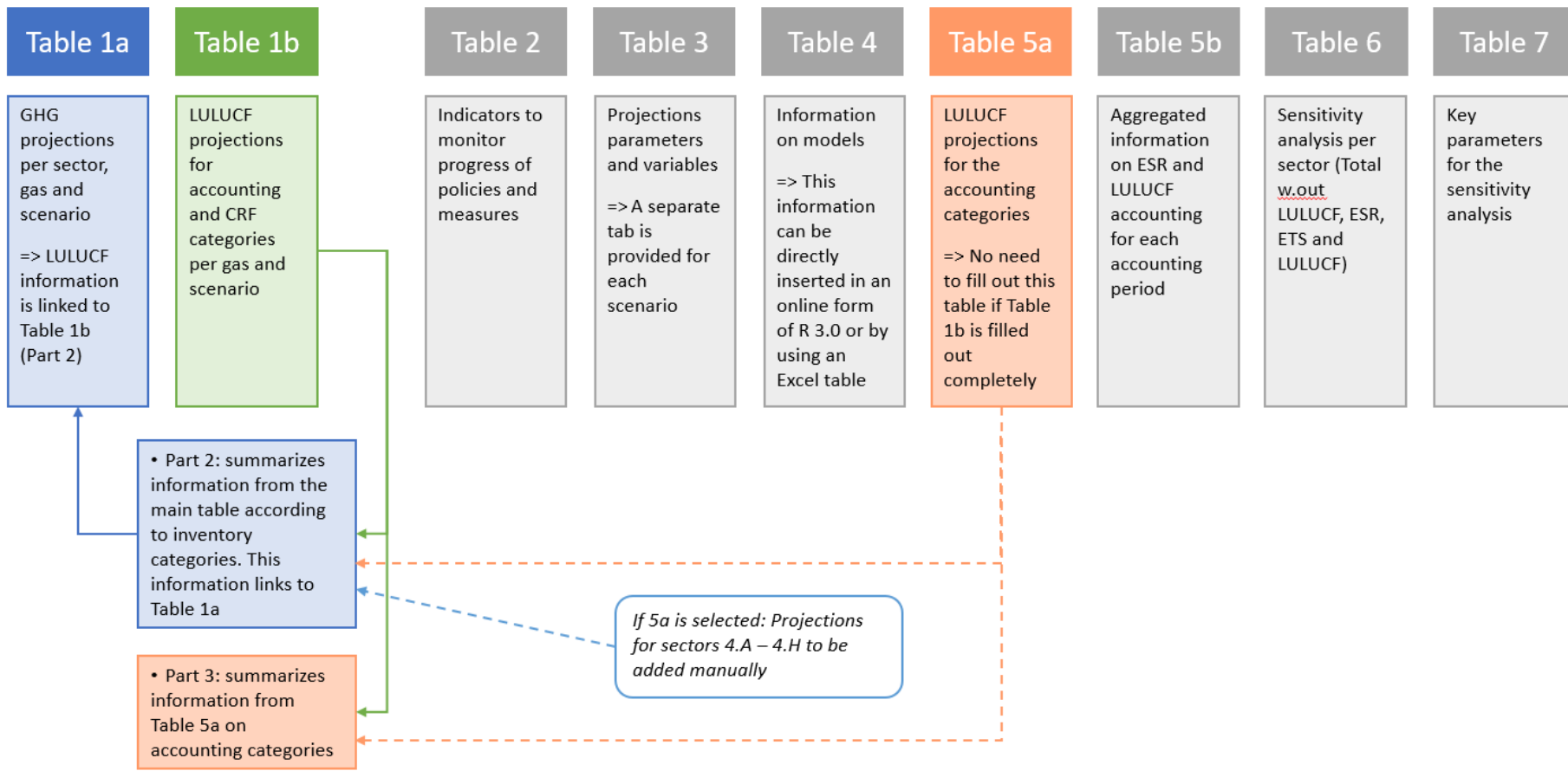


Source: Adapted from European Commission, 2015.

1.2 Reporting requirements

Article 18 (1) (b) of the Governance of the Energy Union and Climate Action Regulation (EU) 2018/1999 (Gov. Reg.) and Article 38 of the related Implementing Regulation (EU) 2020/1208 set out the details for Member States to provide information on national GHG projections. Every two years (starting from 2021 with the new reporting under the Gov. Reg.) the Member States shall report GHG projections and accompanying information to the European Union. In total there are seven reporting tables for the reporting of GHG projections and the related information under the Gov. Reg. which are briefly summarised in the following figure:

Figure 1.2 Overview of reporting tables for GHG projections and related information in accordance with Article 18 (1) (b) of the Governance of the Energy Union and Climate Action Regulation (EU) 2018/1999 (Gov. Reg.) and Article 38 of the related Implementing Regulation (EU) 2020/1208



The main mandatory elements of this reporting obligation are:

- GHG projections reported by gas (Total GHGs, Total ETS GHGs, Total ESR GHGs, CO₂, CH₄, N₂O, HFC, PFC, SF₆, NF₃, unspecified mix of HFCs and PFCs)
- the base year, 2020, 2025, 2030 and 2035, 2040
- Inventory version to which the GHG projections are related
- Split by sectors and categories in line with the common reporting format (CRF) format
- Detailed LULUCF projections including projections assigned to the LULUCF accounting categories according to the Regulation (EU) 2018/841
- Sectoral split into ETS and ESR emissions
- A with existing measures scenario (WEM)
- Information on models
- Provision of a sensitivity analysis of the total GHG, ETS and ESR
- Underlying key parameters for the sensitivity analysis
- Provision of a description of methodologies, models and underlying assumptions
- Provision of parameters and variables used in the projections

1.3 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 07/2021). The European Environment Agency (EEA) is responsible for the annual implementation of the QA/QC procedures and is assisted by the ETC/CME.

The Union projections are compiled as the sum of all EU Member States projections, therefore 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 Member States' 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 Member States for all years, gases, sources and sinks as required under the Gov. Reg., 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 internal time series consistency in all elements of national and Union GHG projections over a period of historic and future years as well as to ensure that key input parameters and assumptions are aligned across different sectors for national GHG projections and across different Member States for Union GHG projections.

Comparability: means to ensure that national estimates of projected emissions and removals reported by Member States are comparable across Member States. The allocation of different sectors and categories by gas follows the split in accordance with the Gov. Reg. which also defines projections horizon, base year (starting year), ETS/ESR split, EU policies and measures to be taken into account and harmonised key assumptions.

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 Member States 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 07/2021.

Due to the new reporting in 2021, the ETC/CME had to modify and update some of its checks. Apart from the extension of all checks to the new gases and sectors, the following updates were applied:

- The consistency check is extended to the LULUCF related information (provided in tables 1b and 5a)
- The sum check is extended to the LULUCF related information provided in tables 1b and 5a
- The new sensitivity analysis checks the units, parameters and scenarios related to the sensitivity scenarios (table 6, 7 and the report).
- The new interlinkages check based on Gov.Reg. Annex VI (e) checks that information on interlinkages between PaMs and projections are provided.
- The new time series check ensures that Member States do not report historical values for sectors/categories for which no projections are available in the reporting template because this causes strange jumps in the time series.

In order to support the EU Member States with the submission procedure, the EEA and the ETC/CME prepare and provide a guidance document which can be found under: <https://www.eionet.europa.eu/reportnet/docs/govreg/projections>. In addition, the EEA organised training webinars for the Member States experts to introduce the new reporting platform and the new tables.

The aggregated dataset for EU 27 does not include all emission sources as reported in the GHG projections. It includes main sectors and categories which are relevant to explain trends and which are mandatory to report. This selection increases constantly to adapt to the design of European policies and measures. The following table (Table 1.1) provides an overview of the sectors and categories included in the current EU aggregated dataset:

Table 1.1 Sector codes and sector names of the EU aggregated projections dataset

Sector code	Sector name	Sector code	Sector name
1	Energy	4	Land use, land use change and forestry (LULUCF)
1.A.1	Energy industries	4.A	Forest land
1.A.2	Manufacturing industries and construction	4.B	Cropland
1.A.3	Transport	4.C	Grassland
1.A.3.a	Domestic aviation	4.D	Wetlands
1.A.3.b	Road transportation	4.E	Settlements
1.A.3.c	Railways	4.F	Other land
1.A.3.d	Domestic navigation	4.G	Harvested wood products
1.A.3.e	Other transportation	4.H	Other
1.A.4	Other sectors	5	Waste
1.A.5	Other	M.IB aviation	Memo item: International bunkers aviation
1.B	Fugitive emissions from fuels	M.IB navigation	Memo item: International bunkers navigation
1.C	CO ₂ transport and storage	Total excl. LULUCF	Total excluding LULUCF
2	Industrial processes and product use	Total excl. LULUCF incl. Int. aviation	Total excluding LULUCF including the mem item international aviation (calculated by the ETC/CME)
3	Agriculture	Indirect CO₂	Indirect CO ₂ emissions

The final EU datasets includes the GHG projections for all years, starting with the EU base year (2019) until 2040 and until 2050 for those Member States that reported this year. Intermediate years were gap-filled by the ETC/CME with linear interpolation if not reported. The dataset is prepared for the all gases, including the ETS/ESR split.

2 Results from the quality checking procedure

In the reporting cycle of 2021, all 27 EU Member States and three EEA countries (Iceland, Norway and Switzerland) provided information on GHG projections in accordance with Art 18 (1) (b) of the Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action.

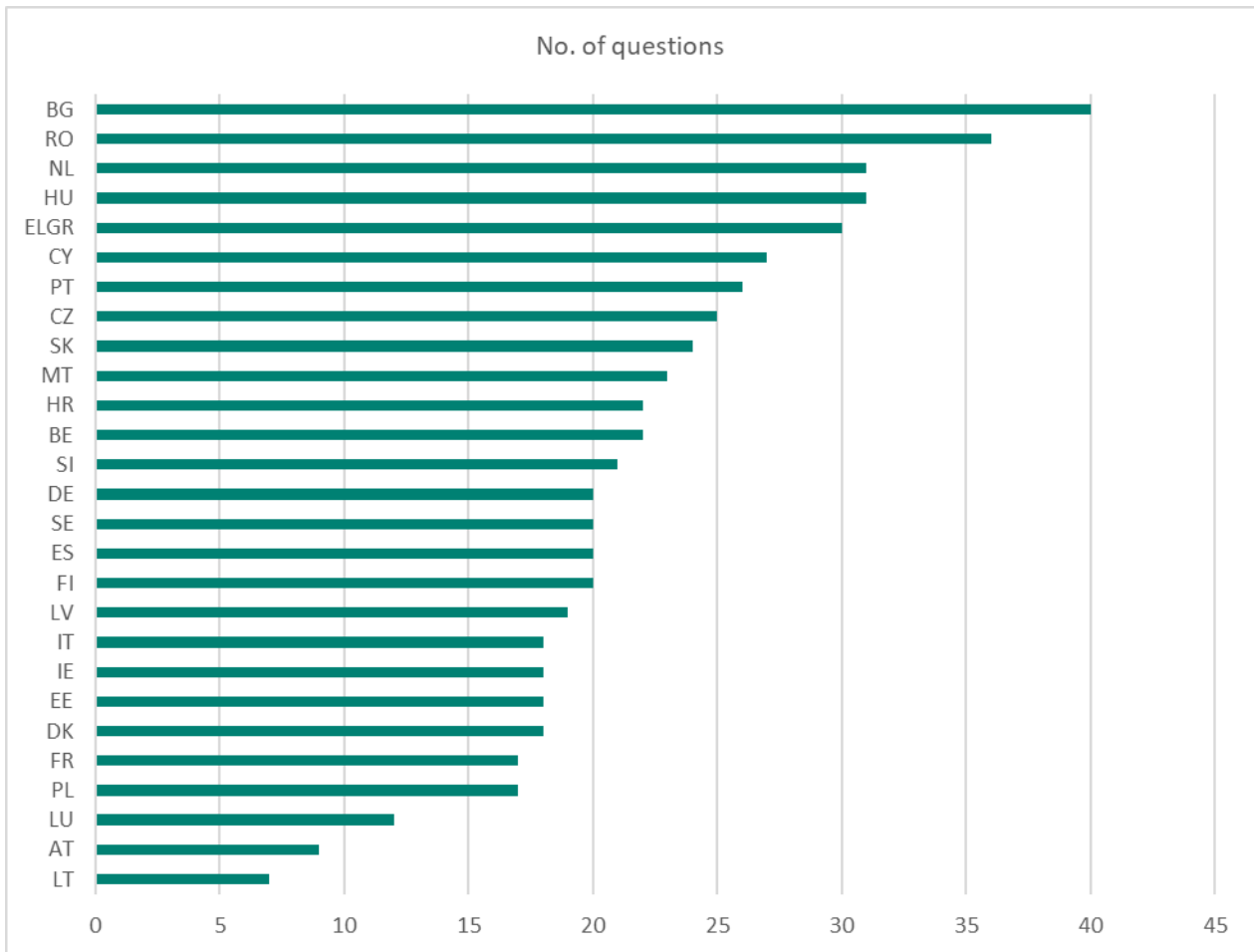
2.1 Communication with Member States

During the QA/QC procedure in 2021, the ETC/CME experts raised in total 625 questions to the Member States' experts (compared to 630 questions in 2019). 84 % of these questions could be solved directly with the Member States' experts in the communication process. The total amount of questions remained on the same level compared to the previous mandatory reporting years, because the checking procedure did not change substantially. 12 % of the questions were solved directly by the reviewers and the remaining 4 % remain open because as in 2019 Cyprus did not provide any responses to the findings from the initial checks. In addition, some issues with Germany were left open due to the late submission and because the communication procedure was not finalised at the time of the preparation of this report.

If findings were only partially or not solved with a resubmission but were deemed to be insignificant or not directly affecting the quality of the EU aggregated projections, the status was set to solved by reviewers. All issues that were solved by the ETC/CME experts were communicated to the Member States' experts in the communication log file.

Figure 2.1 presents the number of questions per Member State. On the average, the ETC/CME asked 22 questions per Member State which is very similar to 2019, when 23 questions per Member State were asked. However, it should be noted that the number of questions sent to a Member State is not necessarily a suitable indicator for the quality of a submission, 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.

Figure 2.1 Number of questions per Member State



The majority of the questions (Figure 2.2) 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.

Figure 2.2 Number of questions per check

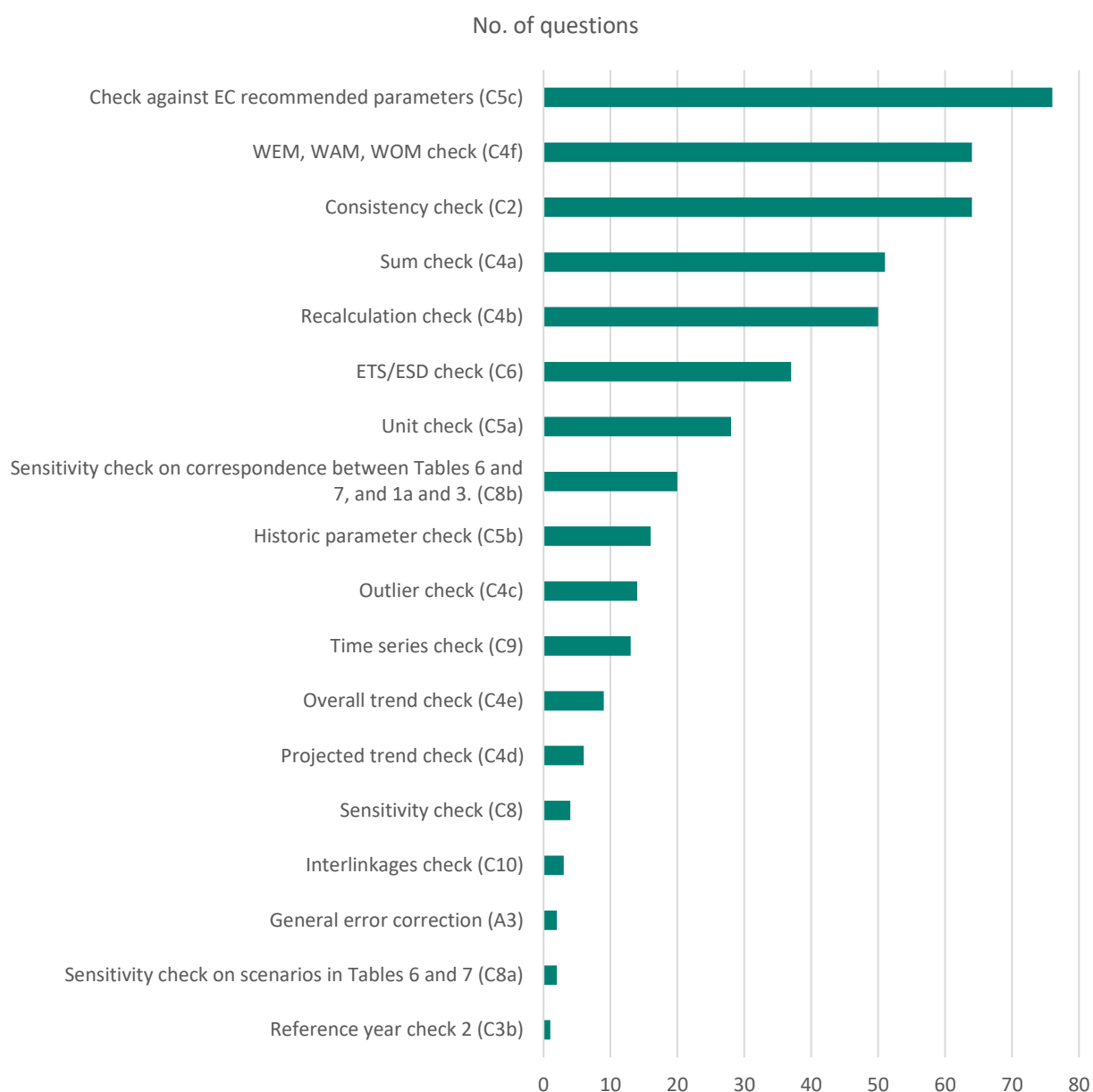
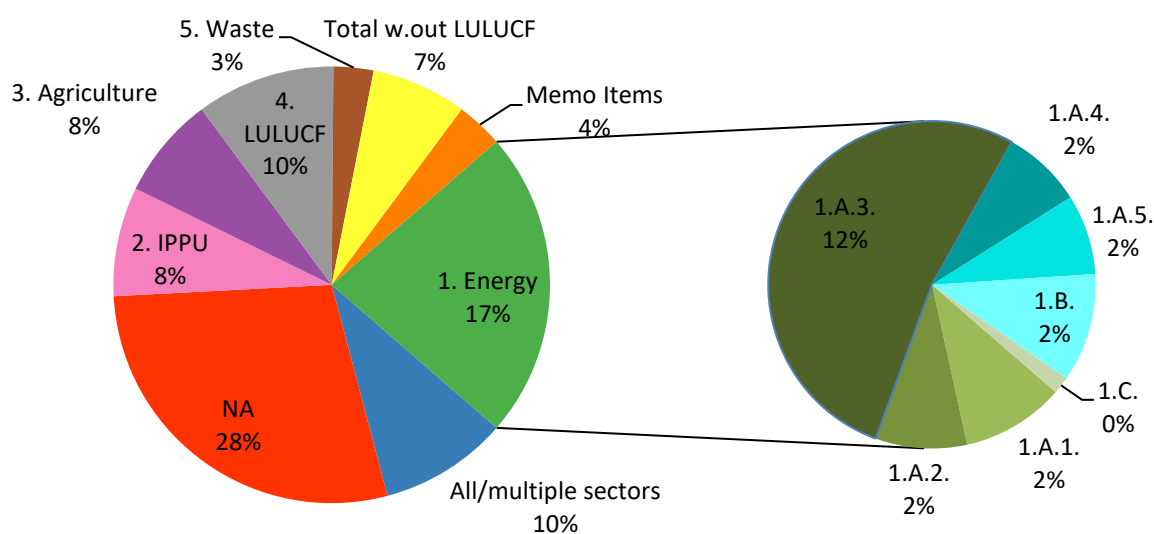


Figure 2.3 shows how the questions are distributed across the different sectors for the main sectors (left pie chart). Most of the questions (28 %) were not related to any sector (NA – not applicable). Not applicable was used for general questions regarding the submission (e.g. no model factsheet provided, reporting of indirect CO₂). 10 % of the questions were related to all or multiple sectors. Such questions 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 % of which most of the questions were referring to transport (1.A.3.). Compared to the 2019 reporting the distribution across sectors is very similar, with a slight increase of questions related to the LULUCF sector, which is due to the new and more detailed reporting under the Gov. Reg.

Figure 2.3 Distribution of questions across sectors



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 the Member States reporters. Such challenges included the delayed reporting of countries with significant impact on the EU numbers (Germany and France), 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.

2.2 Completeness and Timeliness

2.2.1 Date of submission and resubmissions

Figure 2.4 illustrates the timeliness of submissions in 2021. The first complete submissions are marked as green dots. Twelve Member States submitted their projections before or on the official deadline of 15 March 2021 (Austria, Croatia, Czechia, Estonia, Finland, Italy, Malta, Netherlands, Poland, Portugal, Romania and Spain).

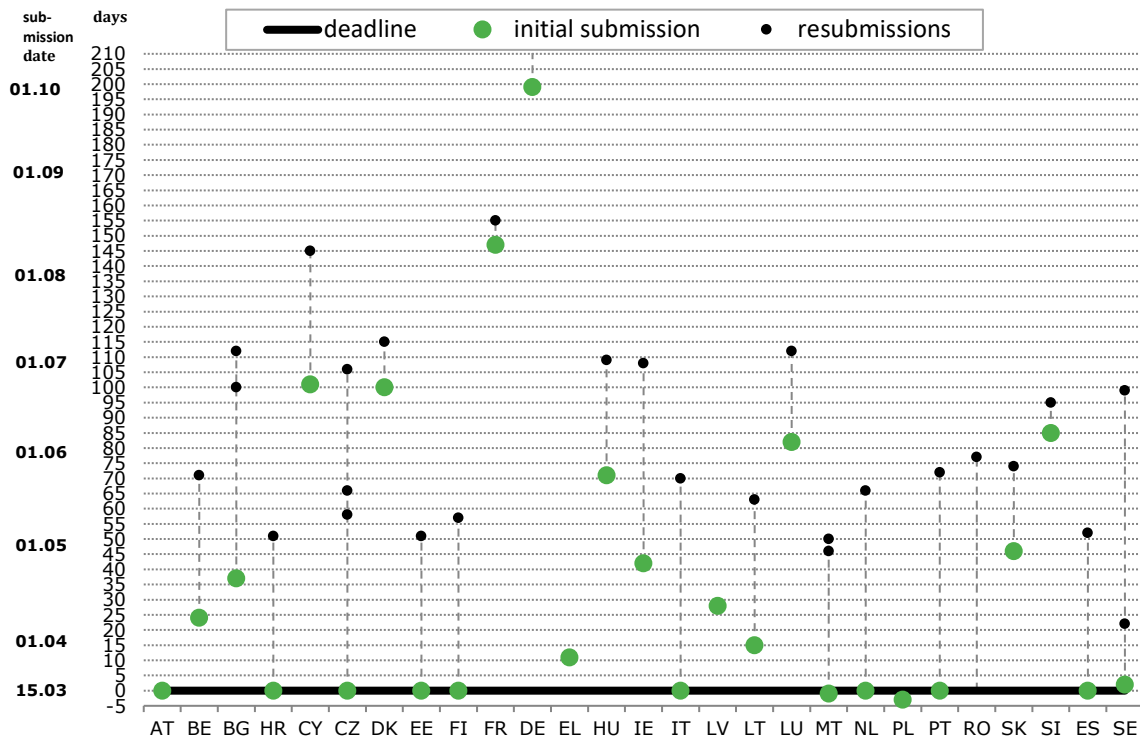
This is a deterioration compared to 2019, when 16 Member States had reported their projections by 15 March.

Seven Member States (Belgium, Bulgaria, Greece, Ireland, Latvia, Lithuania and Sweden) submitted within six weeks after the deadline (compared to 10 Member States in 2019). Eight Member States submitted even later (Cyprus, Denmark, France, Hungary, Luxembourg, Slovakia and Slovenia), with Germany being the last EU Member State providing its first submission by end of September and the final submission by end of October.

As can be seen, the majority of Member States provided resubmissions (black dots in Figure 2.4) in the course of the QA/QC procedure. Four countries did not resubmit, as the data passed the quality

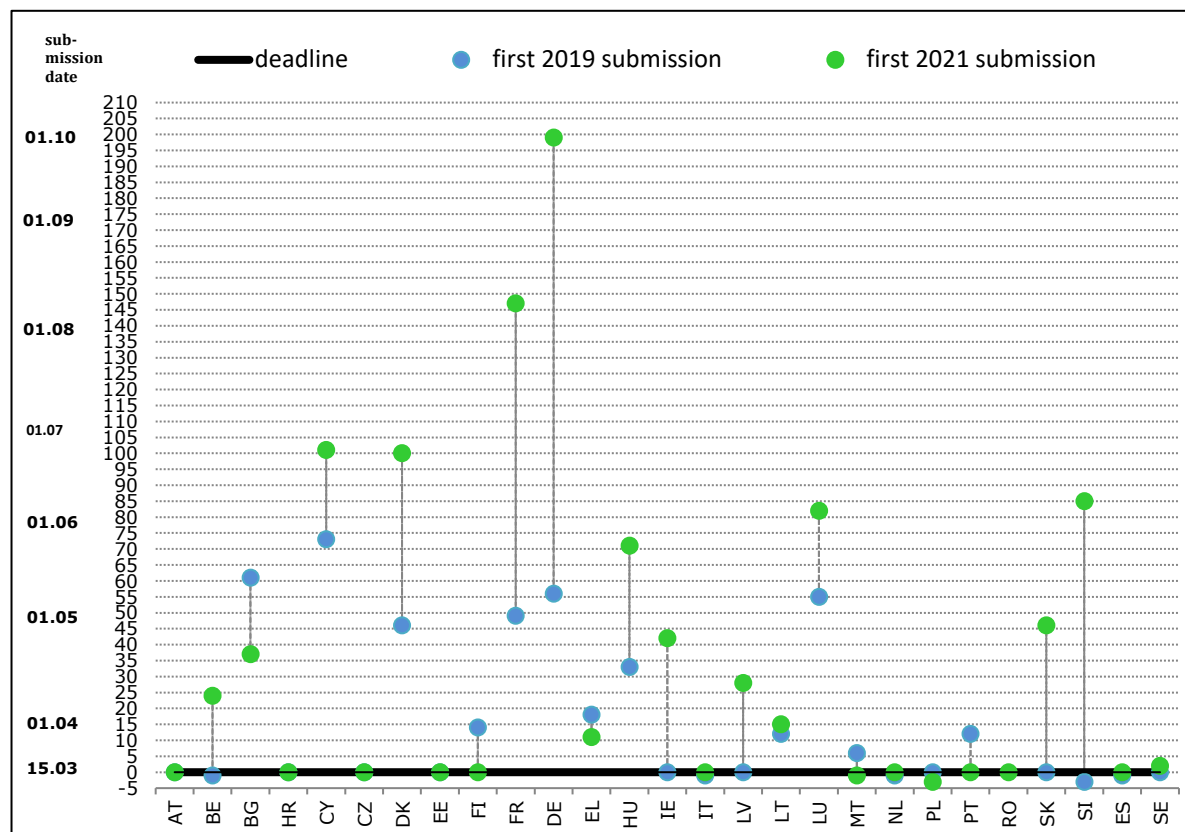
standards: Austria, Greece, Latvia and Poland as a resubmission was not necessary. This is two countries more compared to 2019, which can be related to the fact that in 2021 new reporting templates had to be used. Cyprus did not reply during the QA/QC, but no resubmission was required as minor issues were solved by the ETC/CME in agreement with Cyprus. Some Member States (Bulgaria, Czechia, Malta and Sweden) 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 44 days which is approximately 11 days more compared to 2019. The majority of Member States resubmitted the revised datasets in May and June.

Figure 2.4 Timeliness of submissions in 2021 by EU Member States



Six Member States have submitted earlier in 2021 compared to 2019 (Bulgaria, Finland, Greece, Malta, Poland and Portugal), on the other hand, 16 Member States submitted later in 2021 than in 2019. Four Member States submitted on the same date in both years (Austria, Croatia, Czechia and Estonia).

Figure 2.5 Comparison of timeliness of the first submission in 2021 compared to 2019



2.2.2 General completeness of submissions

The completeness of **mandatory information** has not changed a lot for most Member States in the reporting year 2021 compared to 2019. All Member States provided the mandatory WEM scenario in Table 1a and related parameters. All Member States provided a complete sector and gas split for the WEM scenario in Table 1a. In 2021, out of the 27 countries which provided projections, eight Member States did not provide information on the sensitivity analysis: Cyprus, Denmark, Germany, Greece, Italy, Luxembourg, Slovakia and Spain. Only Bulgaria did not provide model fact sheets in 2021. Only one country (the Netherlands) did not provide a specific report for projections or a combined report for projections and policies and measures (Art. 18 (1) of the Gov. Reg.) which is an improvement compared to 2019 reporting. For the first time in 2021, Member States were required to provide detailed LULUCF projections. All Member States provided detailed LULUCF projections in either part 1 of Table 1b or in Table 5a. For the first time in 2021, information on emission and parameter sensitivity scenarios could be provided in Tables 6 and 7, respectively. Out of the 27 Member States, 18 provided at least one scenario in both Tables 6 and 7 and 2 Member States submitted only Table 6 (see also section 3.2).

The completeness of **voluntary information** reported was substantially lower in 2021 compared to 2019. A total of 18 of the 27 Member States reported indicators in 2021. Regarding the scenarios, 22 Member States reported a WAM scenario, and only four reported a WOM scenario. This is similar to the reporting of voluntary information in 2019, when 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 2.1 Overview on completeness of reporting in 2021

	Updated projections	Required sector split	Required GHG split	Detailed LULUCF Projections	LULUCF accounted projections	Scenarios			Provision of parameters	Sensitivity analysis*	Model factsheet/ description	Report	Provision of indicators
						WEM	WAM	WOM					
AT	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
BE	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
BG	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Red	Green	Green
HR	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
CY	Green	Green	Green	Green	Green	Green	Green	Green	Green	Red	Green	Green	Orange
CZ	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
DK	Green	Green	Green	Green	Green	Green	Green	Green	Green	Red	Green	Green	Green
EE	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
FI	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Orange
FR	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
DE	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
EL	Green	Green	Green	Green	Green	Green	Green	Green	Green	Red	Green	Green	Orange
HU	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Orange
IE	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Orange
IT	Green	Green	Green	Green	Green	Green	Green	Green	Green	Red	Green	Green	Orange
LV	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
LT	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
LU	Green	Green	Green	Green	Green	Green	Green	Green	Green	Red	Green	Green	Green
MT	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
NL	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Red	Green
PL	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Orange
PT	Green	Green	Green	Green	Green	Green	Green	Green	Green	Red**	Green	Green	Green
RO	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
SK	Green	Green	Green	Green	Green	Green	Green	Green	Green	Red	Green	Green	Green
SI	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Orange
ES	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
SE	Green	Green	Green	Green	Green	Green	Green	Green	Green	Red**	Green	Green	Orange

Legend:

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

Notes: * Tables 6 and 7 reported, ** only table 6 was submitted

Table 2.2 summarizes the completeness of mandatory emissions data, by gas, submitted in Table 1a. The table shows the number of countries, from the maximum of 27 (EU-27 Member States), that have submitted the mandatory data for the year 2020. This considers numerical data only. Where gases are not applicable to a sector, the cells are in grey.

Table 2.2 Number of countries that reported numeric emissions data per sector and per gas for the mandatory year 2020 under the 'WEM' scenario

	CO ₂	N ₂ O	CH ₄	HFC	PFC	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total GHGs	Split to ETS and ES GHGs
Reporting in Table 1a										
1. Energy	27	27	27						27	26
1.A. Fuel combustion	27	27	27						27	26
1.A.1. Energy industries	27	27	27						27	26
1.A.1.a. Public electricity and heat production	25	24	24						24	25
1.A.1.b. Petroleum refining	19	18	18						18	20
1.A.1.c. Manufacture of solid fuels and other energy industries	20	20	20						20	19
1.A.2. Manufacturing industries and construction	27	26	26						27	25
1.A.3. Transport	27	27	27						27	27
1.A.3.a. Domestic aviation	26	25	25						26	25
1.A.3.b. Road transportation	27	26	26						27	27
1.A.3.c. Railways	24	23	23						24	25
1.A.3.d. Domestic navigation	25	24	24						25	25
1.A.3.e. Other transportation	16	16	16						16	16
1.A.4. Other sectors	27	26	26						27	27
1.A.4.a. Commercial/Institutional	26	25	25						26	25
1.A.4.b. Residential	26	25	25						26	26
1.A.4.c. Agriculture/Forestry/Fishing	26	24	25						26	26
1.A.5. Other	19	17	17						19	19
1.B. Fugitive emissions from fuels	25	18	25						25	25
1.B.1. Solid fuels	9	2	13						14	15
1.B.2. Oil and natural gas and other emissions from energy production	22	15	22						22	23
1.C. CO ₂ transport and storage	1								1	2
2. Industrial processes	26	26	17	27	20	4	26	8	27	26
2.A. Mineral Industry	25								25	24
2.A.1. Cement production	21								21	20
2.B. Chemical industry	20	18	13	2	2	2	2	1	20	18
2.C. Metal industry	22	2	13	3	10	1	3	1	22	20
2.C.1. Iron and steel production	16	1	9	1	2	1	1	1	17	16
2.D. Non-energy products from fuels and solvent use	25	3	4						25	24
2.E. Electronics industry				5	8	1	7	6	9	10
2.F. Product uses as substitutes for ODS (8)				26	11	2	1	1	26	26
2.G. Other product manufacture and use	7	23	4	4	2	1	24	1	24	24
2.H. Other	4	3	2	3	3	2	2	1	8	8
3. Agriculture	25	26	26						26	26

	CO ₂	N ₂ O	CH ₄	HFC	PFC	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total GHGs	Split to ETS and ES GHGs
Reporting in Table 1a										
3.A. Enteric fermentation			25						25	25
3.B. Manure management		25	25						25	25
3.C. Rice cultivation			9						9	10
3.D. Agricultural soils		25	1						25	25
3.E. Prescribed burning of savannahs		1	1						1	2
3.F. Field burning of agricultural residues		13	13						13	13
3.G. Liming	22								22	23
3.H. Urea application	24								24	23
3.I. Other carbon-containing fertilizers	8								8	9
3.J. Other (please specify)	1	2	2						2	3
4. Land Use, Land-Use Change and Forestry (LULUCF, reported emissions and removals) (9)	26	26	23						26	
4.A. Forest land	26	23	21						26	
4.B. Cropland	26	24	13						26	
4.C. Grassland	25	22	18						25	
4.D. Wetlands	25	17	10						25	
4.E. Settlements	26	23	5						26	
4.F. Other Land	16	14	2						16	
4.G. Harvested wood products	24								24	
4.H. Other	3	2	2						3	
5. Waste	20	26	26						26	26
5.A. Solid Waste Disposal			26						26	26
5.B. Biological treatment of solid waste		25	25						26	26
5.C. Incineration and open burning of waste	18	20	19						20	22
5.D. Wastewater treatment and discharge		25	25						25	25
5.E. Other (please specify)	2	3	5						5	6
Memo items	2	1	1						2	
IB.Aviation	20	19	19						20	1
IB.Navigation	18	17	17						18	1

Note: The colour intensity implies the degree of completeness. Dark green = high level of completeness, light green = lower level of completeness.

Completeness is generally high for all sectors and gas 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.

Table 2.3 summarizes the completeness of mandatory emissions data by gas and Table 2.4 by sectors for the year 2020. It counts the number of numerical values (excluding notation keys and empty cells) provided by the Member States for all applicable sectors/gases combinations (in line with the common reporting format for GHG inventories). For example, it is not possible to report CO₂ emissions from category 3A Enteric Fermentation according to the GHG inventory and therefore this category is not accounted for in this completeness analysis.

Completeness is generally high for most GHGs. The Total GHGs, Total ESR and CO₂ emission projections had the highest reporting of emissions/removals, with Member States on average providing numerical values for three-quarters of the applicable sectors. In most cases where completeness scores are low,

the Member State instead reported a notation key. However, in some cases the missing data is linked to either a zero or blank value being reported. For example, Belgium, Malta and Cyprus, the Netherlands and Romania reported a blank or zero for 20% of their submission for applicable sector/gas combinations. Only Germany and Spain reported emissions for the gas 'Unspecified mix of HFCs and PFCs' and all countries except for Belgium and Romania at least partially reported notation keys. All Member States reported the emission projections for the gases HFC and PFC.

Table 2.3 Completeness of mandatory reported numeric emissions data per gas for the year 2020, WEM scenario in Table 1a

	CO ₂	N ₂ O	CH ₄	HFC	PFC	Unspecified mix of HFCs and PFCs	NF ₃	SF ₆	ESR emissions	ETS emissions	Total GHG emissions
AT	82%	75%	69%	50%	40%	0%	40%	50%	83%	56%	84%
BE	82%	75%	65%	60%	60%	0%	40%	60%	85%	74%	84%
BG	80%	71%	71%	40%	40%	0%	0%	40%	63%	44%	81%
CY	63%	58%	53%	40%	0%	0%	0%	40%	62%	29%	67%
CZ	75%	67%	67%	50%	50%	0%	40%	50%	85%	44%	78%
DE	59%	67%	65%	70%	60%	50%	0%	70%	50%	0% ²	69%
DK	82%	79%	76%	40%	50%	0%	0%	40%	83%	47%	84%
EE	71%	69%	62%	40%	0%	0%	0%	40%	69%	38%	72%
ES	79%	77%	78%	40%	50%	40%	0%	40%	90%	56%	87%
FI	66%	48%	42%	50%	50%	0%	0%	50%	67%	38%	69%
FR	86%	83%	87%	70%	60%	0%	40%	60%	90%	71%	88%
GR	79%	77%	75%	40%	40%	0%	0%	40%	79%	50%	81%
HR	66%	67%	56%	40%	0%	0%	0%	40%	69%	44%	69%
HU	80%	77%	75%	40%	40%	0%	0%	40%	83%	62%	81%
IE	75%	77%	69%	50%	40%	0%	40%	50%	75%	44%	78%
IT	55%	58%	56%	30%	30%	0%	30%	30%	58%	32%	55%
LT	82%	81%	67%	40%	0%	0%	40%	50%	79%	56%	82%
LU	71%	65%	53%	50%	0%	0%	0%	40%	65%	35%	73%
LV	70%	65%	62%	40%	0%	0%	0%	40%	63%	35%	70%
MT	39%	46%	40%	40%	0%	0%	0%	0%	46%	18%	45%
NL	79%	62%	53%	40%	60%	0%	0%	40%	67%	56%	75%
PL	77%	73%	71%	40%	40%	0%	0%	40%	77%	62%	78%
PT	70%	62%	71%	40%	40%	0%	0%	40%	77%	47%	73%
RO	82%	73%	71%	40%	40%	0%	0%	40%	85%	44%	85%
SE	77%	79%	75%	50%	40%	0%	0%	40%	75%	44%	76%
SI	80%	69%	62%	40%	40%	0%	0%	40%	75%	41%	79%
SK	82%	71%	71%	40%	40%	0%	0%	40%	79%	59%	81%

(²) Germany did not provide GHG projections for ETS in the year 2020.

Table 2.4 **Completeness of mandatory reported emissions data per sector for the year 2020 in**
Table 1a

	Energy	IPPU	Agriculture	LULUCF	Waste	Total with LULUCF	Total without LULUCF	Memo
AT	84%	48%	68%	70%	81%	91%	91%	57%
BE	88%	60%	51%	57%	81%	91%	91%	71%
BG	78%	40%	61%	53%	81%	82%	82%	71%
CY	60%	26%	54%	60%	58%	73%	73%	71%
CZ	86%	54%	51%	57%	81%	91%	91%	0%
DE	53%	47%	66%	73%	73%	73%	73%	0%
DK	82%	42%	68%	70%	92%	82%	82%	86%
EE	71%	28%	51%	77%	81%	73%	73%	57%
ES	89%	52%	68%	70%	85%	91%	91%	43%
FI	59%	36%	61%	63%	58%	64%	82%	29%
FR	90%	66%	76%	83%	81%	91%	91%	57%
GR	83%	44%	61%	73%	81%	82%	82%	57%
HR	75%	36%	51%	70%	58%	73%	73%	0%
HU	91%	44%	66%	63%	81%	82%	82%	29%
IE	84%	32%	51%	80%	81%	91%	91%	71%
IT	57%	10%	76%	70%	81%	91%	91%	29%
LT	88%	41%	51%	80%	81%	82%	82%	71%
LU	68%	31%	59%	63%	58%	73%	73%	57%
LV	66%	24%	51%	73%	77%	73%	73%	86%
MT	50%	6%	34%	47%	62%	64%	64%	0%
NL	76%	45%	20%	77%	54%	82%	82%	86%
PL	79%	45%	61%	67%	81%	82%	82%	71%
PT	71%	45%	68%	80%	81%	82%	82%	0%
RO	80%	45%	68%	73%	77%	82%	82%	71%
SE	80%	43%	51%	77%	81%	82%	82%	57%
SI	77%	38%	51%	73%	81%	82%	82%	71%
SK	90%	43%	51%	60%	81%	82%	82%	71%

2.2.3 Completeness of time series and gap-filling

All Member States except Germany and the Netherlands reported GHG projections for the mandatory years 2020, 2025, 2030, 2035 and 2040. In 2019, also two Member States did not completely the mandatory years. Germany reported all mandatory years for the Total GHGs and gases, but for the ETS/ESR emissions the year 2020 was not reported due to the uncertainty related to the impacts of the pandemic. The Netherlands only reported the time series until 2030. In both cases, the ETC/CME applied a gap-filling (interpolation for Germany and extrapolation for the Netherlands).

The year 2050 could be reported voluntarily for the first time and was provided by seven Member States. Intermediate years were reported voluntarily by 15 Member States, for the other 12 countries the data for the intermediate years were gap-filled by linear interpolation by the ETC/CME. In 2019 only 10 countries did not report the intermediate years.

Table 2.5 shows the completeness of the time series as reported for the Total without LULUCF in the WEM and Total GHGs by the Member States and indicates for which interpolation or extrapolation has been carried out and to which years it was applied. Note that the situation may deviate for other sectors scenarios and gases.

Table 2.5 Completeness of time series for Total without LULUCF (Total GHGs, WEM) as reported in the final submissions in 2021

WEM/ Total GHGs	2015	2016	2017	2018	2019	2020	2021-2024	2025	2026-2029	2030	2031-2034	2035	2036-2039	2040	2050
AT				BY											
BE				BY	I		I		I		I		I		
BG	BY	I	I				I		I		I		I		
CY				BY	I										
CZ				BY	I		I		I		I		I		
DE				BY	I	G*									
DK					BY						I		I		
EE				BY											
EL					BY		I		I		I		I		
ES					BY										
FI					BY										
FR					BY		I		I		I		I		
HR				BY	I		I		I		I		I		
HU					BY		I		I		I		I		
IE					BY										
IT					BY		I		I		I		I		
LT				BY											
LU			BY												
LV				BY											
MT				BY							I		I		
NL				BY	I		I		I		E	E	E	E	
PL			BY												
PT				BY	I		I		I		I		I		
RO				BY	I										
SE				BY	I		I		I		I		I		
SI			BY												
SK				BY	I		I		I		I		I		

Legend:

	reported
BY	base year
I	gap-filling of intermediate years
G	gap-filling of mandatory information, *gap-filling for ETS/ESR only
E	extrapolation of mandatory information
	Reporting not mandatory

In addition, it should be noted that the ETC/CME carried out corrections, such as the correction of sums of parent 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 2.3.5). 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 (see also section 2.3.3).

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 five Member States, and for one Member States only the LULUCF WAM needed to be gap-filled. This is an improvement compared to 2019, when 10 Member States did not report a WAM scenario. In most cases, the WAM scenario and the gases (CO₂, CH₄, N₂O and F-gases) were subject to the same corrections as the WEM scenario, as errors are usually systematic.

A summary of all corrections and gap-fillings can be found in Annex 1.

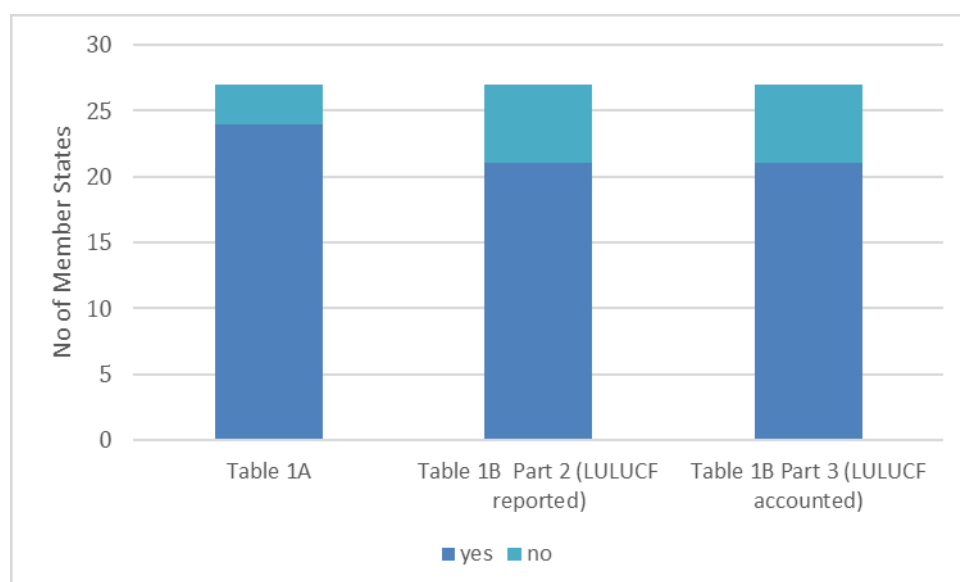
2.3 Consistency and Comparability

2.3.1 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. As there were new reporting templates and new tables with different units introduced in 2021, some Member States were facing challenges with the application of the correct unit.

For five countries some unit deviations were identified (Bulgaria, Croatia, Cyprus, Greece, Romania). The issues were clarified during the QA/QC and in those cases in which an incorrect unit was applied, the Member States provided a resubmission.

Figure 2.6 Number of Member States which reported the correct units in the initial submission



2.3.2 Base year

The majority of Member States (14) chose the year 2018 as the base year (Figure 2.7). Nine Member States selected 2019 as base year, three countries used 2017 as base year. Bulgaria reported the earliest base year, namely 2015.

Figure 2.7 Base year reported by Member States

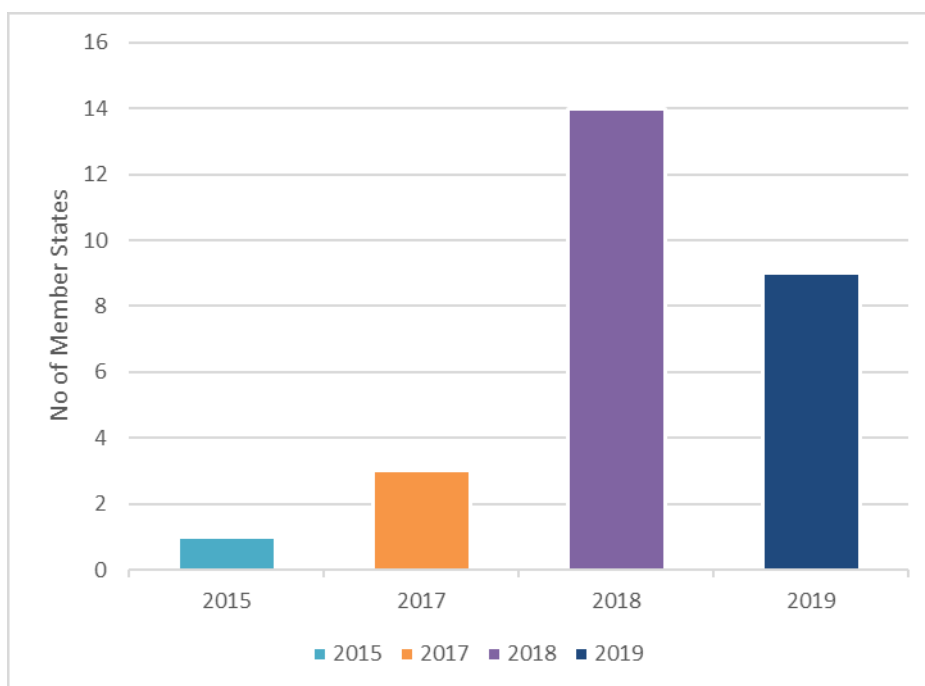


Table 2.6 Base year selected by the Member States

Member State	Base Year
AT	2019
BE	2018
BG	2015
CY	2018
CZ	2018
DE	2018
DK	2019
EE	2018
EL	2019
ES	2019
FI	2019
FR	2019
HR	2018
HU	2019
IE	2019
IT	2019
LT	2018
LU	2017
LV	2018
MT	2018
NL	2018
PL	2017
PT	2018
RO	2018
SE	2018
SI	2017
SK	2018

An important quality criterion is the time series consistency between projections and historical data (inventories) and that the projections are based on a recent inventory version (submission). To know the base year is not sufficient to understand if the projections are based on an updated dataset. Therefore, with the new reporting under the Gov. Reg. it became mandatory for the Member States to indicate the inventory submission version on which the projections were based. Table 2.7 shows the related GHG inventory versions as indicated by the Member States, noting that the date corresponds with the submission date of the respective inventory. Two countries (Denmark and Hungary) only provided the year. Latvia inserted 15/10/2020 which the ETC/CME interpreted as a typo and assumed that

15/01/2020 is the correct version. From the table it can be concluded that most Member States (15) have reported GHG projections which are based on updated GHG inventory data. Ten Member States used inventory data reported in 2020, which can be related to the fact that their projection modelling exercise started earlier when no 2021 submission data was available. Only two Member States (Poland and Slovenia) reported GHG projections based on an older GHG inventory version (from the year 2019).

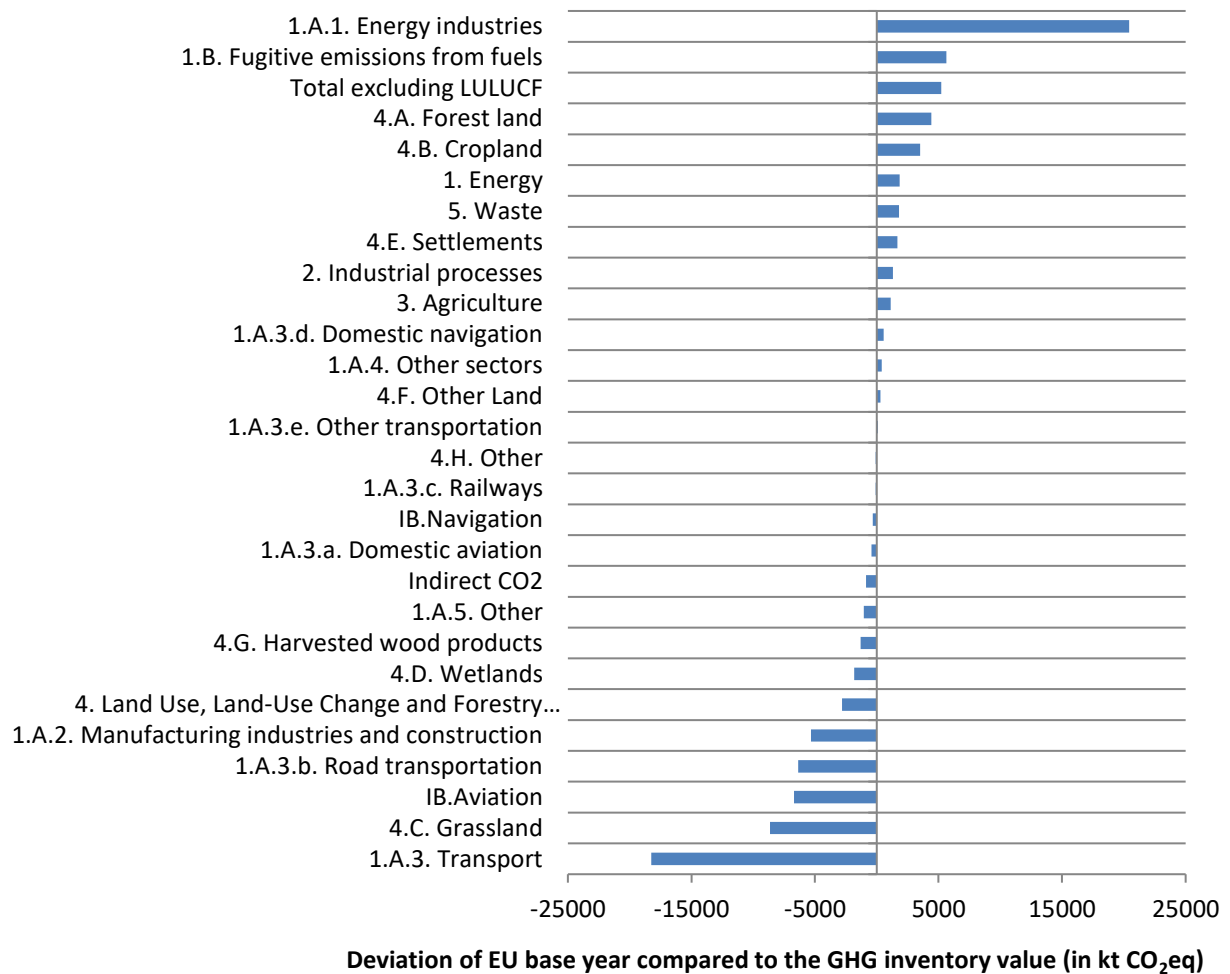
Table 2.7 Inventory versions on which the GHG projections are based

Member State	Inventory version						
AT	15/03/2021	EE	05/05/2021	IT	15/03/2021	PT	03/04/2020
BE	15/03/2021	FI	15/01/2021	LV	15/01/2020	RO	06/05/2020
BG	15/04/2020	FR	15/01/2021	LT	15/03/2021	SK	09/03/2020
HR	15/03/2021	DE	21/04/2020	LU	15/03/2021	SI	15/03/2019
CY	26/05/2020	EL	15/01/2021	MT	15/03/2020	ES	15/03/2021
CZ	15/03/2020	HU	2021	NL	15/03/2020	SE	15/01/2021
DK	2021	IE	15/03/2021	PL	23/05/2019		

The base year for the Union GHG projections in 2021 is 2019, as this is the latest inventory year available when projections were prepared. In Figure 2.8, the percentage difference of the base year for the Union GHG projections (2019) and the 2021 EU inventory is shown per sector. Category 1C was reported as “NO” (not occurring) by all Member States and is therefore not included in the figure.

The largest deviations in absolute terms occur in the category 1.A.1 and 1.A.3., because these are two of the largest sectors in the EU’s projections and inventory, but in relative terms the deviations are rather small (2.3 % and -2.2 % respectively). One of the main reasons why there are deviations is related to the gap-filling of the year 2019 for 11 Member States (see also Table 2.5) as this was not a mandatory year in the 2021 submission. Deviations are also typical in sectors for which there are high inter-annual variations and/or recalculations such as the LULUCF sector (4.) and in categories which are too small to be modelled separately and are included in another category (e.g. 1.A.5.). The overall deviation for the Total without LULUCF for the base year compared to the EU inventory year is 5213 kt CO₂eq, which is in relative terms only 0.1 % and therefore the EU aggregated time series can be seen as rather accurate.

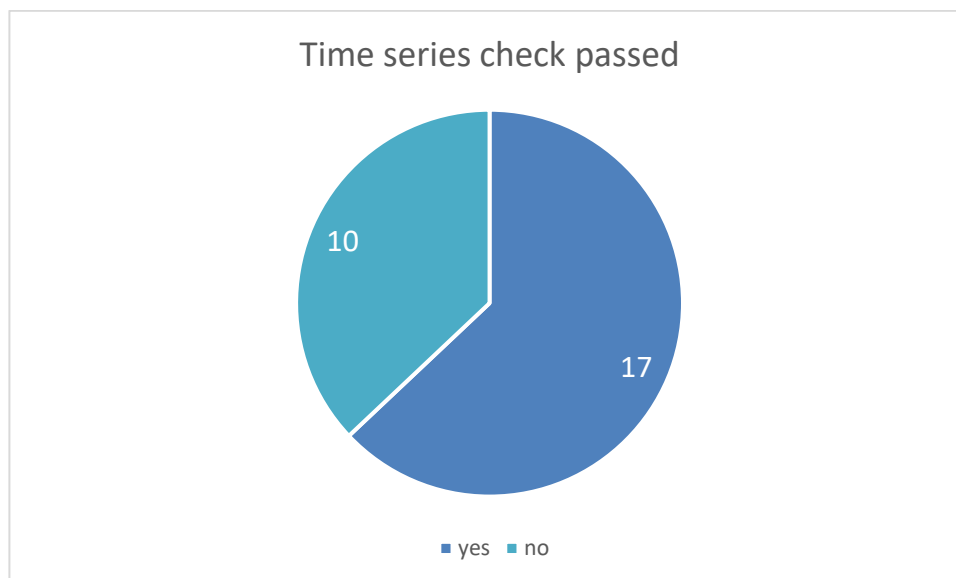
Figure 2.8 Difference of the EU reference year compared to the 2021 inventory by sector/category (for the year 2019)



2.3.3 Time series consistency

In past years the ETC/CME identified many Member States which reported historical values from the GHG inventory, even though no GHG projections were available. When aggregating the Member States projections data for the EU projections, this caused artificial jumps in the time series and therefore, in 2021 a new check was introduced to ensure that Member States do not report any values in the time series for sectors and gases for which no projections are available. Figure 2.9 shows that 10 Member States reported numbers for historical years for categories or sectors without projections. If the Member States did not correct this issue with a resubmission, the ETC/CME applied the correction in order to obtain a consistent EU aggregated dataset for the GHG projections.

Figure 2.9 Share of Member States reporting historical data without projections



2.3.4 ETS and ESR emissions

The projected emissions are reported separately for ETS and Effort Sharing (ESR) emissions for each source category. In the QA/QC process, the proper linking of projections to historical ETS and ESR emissions and a consistent development of ETS and ESR emissions in future years in Member State projections is analysed.

In addition, after the QA/QC procedure, the ETS and ESR emissions from Member State projections are summed up to an EU projection. This projection of aggregated ETS and ESR 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 and indicators of the EEA and the ETC/CME.

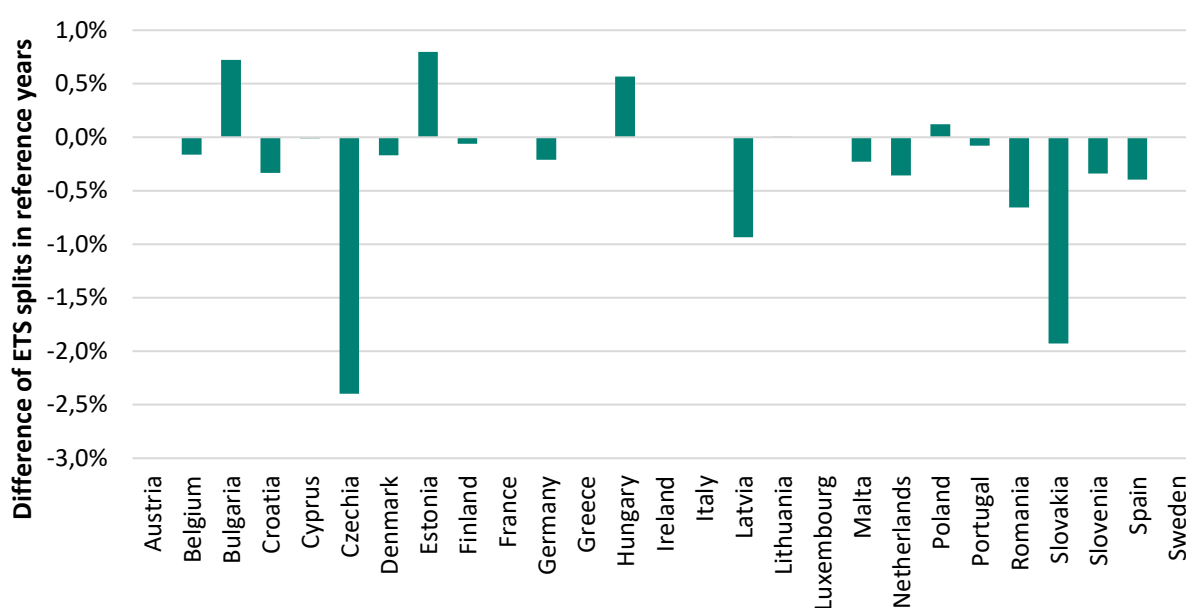
In the checking process, ETS splits are used as an indicator reflecting the relative share of ETS emissions compared to total GHG emissions. ETS and ESR emissions in base years of the projections should match to historical ETS and ESR emissions. This implies that the ETS split used for the projections 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 ESR 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 likely to occur faster in the ETS compared to emissions reduction achieved from more diffuse emission sources (e.g. transport) covered under the Effort Sharing Decision (until to 2020) and the Effort Sharing 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 ESR emissions decrease, depending on how the additional electricity demand is satisfied (i.e. with fossil or low-carbon generation capacity) emissions shift from ESR 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⁽³⁾ and GHG inventory data from the 2021 submission. In the following the main results of the 2021 QA/QC procedure are presented.

1. ETS splits

In 2021, 27 Member States reported ETS and ES emissions in the GHG projections. In most GHG projections the reported ETS emissions for the base year match very well with the historical values from the GHG inventory and differences are generally under 1%. Figure 2.10 shows the difference between the ETS split calculated from the reported projection for the base year and the historical ETS splits.

Figure 2.10 Difference of ETS splits for the base years of total GHG projections compared to historic ETS splits in respective base years



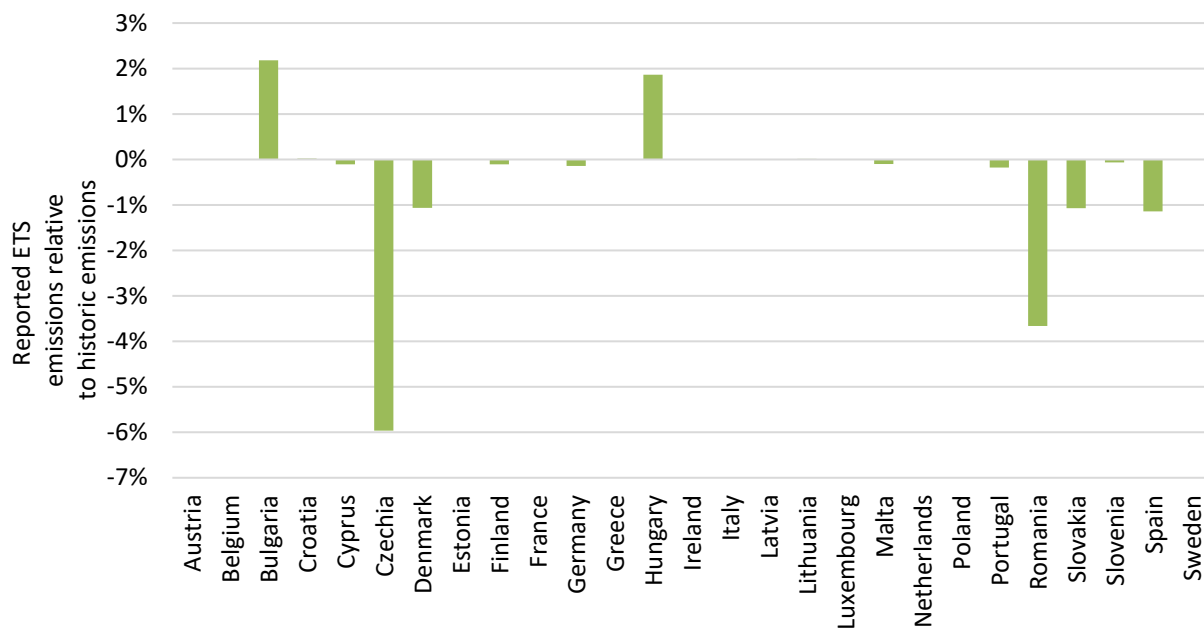
There are few outliers, notably Czechia and Slovakia. Here the difference may be explained through variations in input data used. For example, in the case of Czechia, ETS data for Sector 2 were based on own calculations, rather than the verified data used as benchmark in this check. Different data sources on a sectoral level lead to a discrepancy in total values. In the case of Slovakia, the reported total GHG emissions are approximately 2.7% higher for the base year compared to historic data leading to a small discrepancy in the ETS split.

2. Differences in reported ETS and ESR emissions

In Figure 2.11 historic and projected ETS emissions are compared for the base year used by each of the Member States. The aggregate of ETS emissions of 27 Member States projections across all base years is 1488 Mt CO₂-eq, differing only -0.43 % from historic ETS emissions for these 27 countries. Plotted in Figure 2.11 is the relative difference between reported ETS emissions and historic ETS emissions. Outliers here are Czechia (for reasons mentioned in the paragraph above) and Romania due to the use of a previous estimate of ETS emissions submitted in 2020.

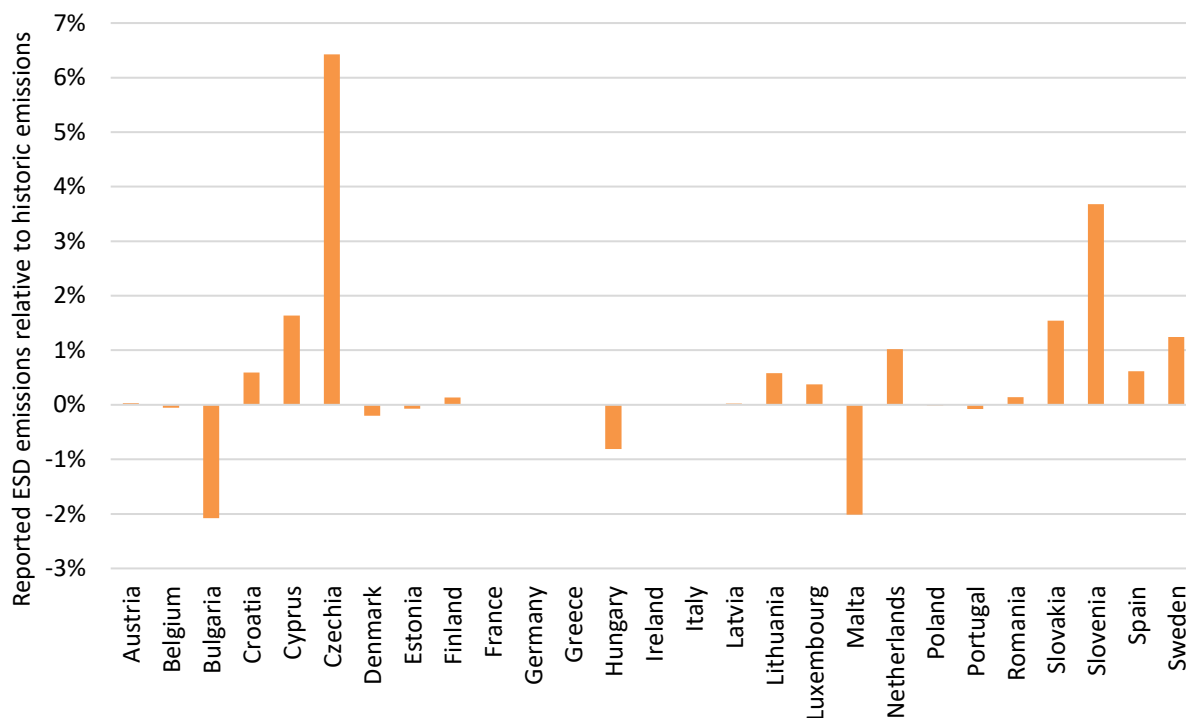
⁽³⁾ From EEA EU ETS data viewer (EEA, 2021): <http://www.eea.europa.eu/data-and-maps/data/data-viewers/emissions-trading-viewer>

Figure 2.11 Relative difference between historic and projected ETS emissions for base years



In Figure 2.12 historic and projected ESR emissions are compared for the base year used by each of the Member States. Member States projections are very close to the historical emissions. Aggregated historical ESR emissions of the reporting Member States add up to approximately 2214 Mt CO₂-eq, with only a difference of -0.31% between historic emissions and emissions reported in the projections. As with ETS emissions, ESR emissions reported by Czechia for the base year are considerably larger than historic ESR emissions, as a result of a sectoral bottom-up approach leading to a discrepancy in the totals. For Slovenia (approximately 3.7% higher reported ESR emissions in the base year), the discrepancy comes from the inclusion of updated values for the transport sector, that are not reflected in the historic benchmark.

Figure 2.12 Relative difference between historic and projected Effort Sharing emissions for base years



3. Development of ETS and ESR 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 ESR emission projections and to check the time series consistency (Table 2.8).

High increases or decreases in ETS splits have been highlighted Table 2.8. 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. Outliers are Bulgaria and Cyprus, where it is still not understood why emissions decrease considerably by the ETC/CME. Cyprus did not respond to the questions raised in the QA/QC and Bulgaria indicated that it is a model outcome based on projected energy balances.

For Greece, changes in the ETS split are due to a projected decrease in the use of lignite as a power source as well as the adoption of more stringent climate targets within its National Energy Climate Plan. Romania indicates also significant changes in ETS splits as a result of expected implementation of its NECP. Estonia reports an increase in ETS split in the period 2020-2025 associated with the construction of additional shale oil plants, and a decrease in ETS split in the period 2030-2035 due to a decrease in electricity produced in oil shale combustion plants. Malta reports that due to the expected electrification of a number of activities, the reliance on domestic (fossil) electricity production will temporarily lead to increased emissions thus resulting in a higher ETS split in the period 2020-2025. Finally, the Portuguese ETS split is reduced considerably in the next decade through decommissioning of coal fired power plants and a strong push for energy from renewable sources.

Table 2.8 Changes in ETS splits from 2020 to 2035 in WEM scenario

Member State	2025-2020	2030-2025	2035-2030
Austria	0%	0%	0%
Belgium	3%	3%	1%
Bulgaria	-1%	-4%	-9%
Croatia	0%	0%	1%
Cyprus	-9%	1%	-2%
Czech Republic	0%	2%	-2%
Denmark	-3%	-4%	0%
Estonia	4%	1%	-4%
Finland	0%	-3%	0%
France	0%	1%	1%
Germany		-1%	-2%
Greece	-5%	-2%	-4%
Hungary	-1%	-3%	-2%
Ireland	4%	-3%	3%
Italy	-2%	2%	4%
Latvia	0%	0%	-1%
Lithuania	0%	2%	0%
Luxembourg	0%	-1%	-1%
Malta	5%	0%	0%
Netherlands	2%	-4%	
Poland	0%	0%	-3%
Portugal	-4%	-6%	-2%
Romania	-5%	-6%	0%
Slovakia	-4%	-2%	1%
Slovenia	0%	1%	1%
Spain	-1%	0%	-2%
Sweden	1%	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%
	not reported

Note: Values that are not colour coded are within the acceptable range. The Netherlands did not provide data for 2035 in order to calculate a change in ETS split. Germany did not provide a ETS emission value for 2020 and it was not possible to calculate a change in ETS split for the time period 2025-2020.

4. Reporting of ETS and ESR emissions

The reporting of ETS and ESR emissions continuously improved since 2015 and became considerably more detailed in the 2017, 2019, and now 2021 submission years. With regard to absolute ESR emissions, all Member States subtracted domestic aviation from total GHG emissions to calculate ESR emissions in the final dataset. In addition, most Member States correctly implemented the ex- and inclusion of NF₃ emissions based on projection year; NF₃ emissions are to be excluded under the Effort Sharing Directive (until 2020), but included in the Effort Sharing Regulation (from 2021). 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.

2.3.5 Accuracy and Transparency

The sum check has been introduced in 2017 and has been elaborated in 2021 also for the new LULUCF tables 1b and 5a. For the following 14 countries, the sum check did not reveal any issues: Austria, Belgium, Spain, Greece, Croatia, Ireland, Lithuania, Luxemburg, Latvia, Malta, Poland, Portugal, Slovenia and Slovakia. This is similar to 2019 when there were no sum errors detected for 15 Member States. For the other countries, the sum check resulted in follow-up questions to Member States 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 42 questions in total. This is an increase compared to 2019, where 32 questions were asked, which is likely caused by the change to the new reporting tables.

Although the ETC/CME experts used a clear threshold value for the checks, some Member States were informed about a difference that was below the threshold value, but in such case the ETC/CME did not ask the Member States 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.

The most important problem was that the sum of the emissions of the sub-categories did not correspond with the emission of the parent category (29 questions). There could be several reasons for this, including incomplete reporting. The most common error is a different reported value for total excluding LULUCF than the sum of its sub-categories, which can sometimes be attributed to the reporting of indirect CO₂ emissions.

2.3.6 Outliers and trends

The outcome of the assessment of outliers and trends in the projections is based on four different checks. These checks are based on the reported projections information in 2021, 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.

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: Visual inspection shows that there is no outlier but that the issue is caused by a non-linear trend in projected emissions.
- Trends explained in the report: If the technical report provides an explanation in the technical report.

A limited number of potential issues could not be resolved by inspection of the data or consultation of the technical report. This resulted in a total of 26 questions to the Member States for outliers and trend checks combined. As with the sum check, specific issues were aggregated as much as possible per sector, category, GHG, or even QA/QC check to avoid needless duplication of questions.

2.3.7 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 Member States experts were requested for an explanation and recommended to incorporate explanations for the recalculations in the technical reports. In total, 44 questions concerning the recalculation check were asked to eighteen different Member States. The most common reasons for significantly different projections were changes in the PaMs, the use of a different model or methodology, and new or revised data.

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). In 2021, this was the case for Poland and Greece, who confirmed projections remained identical to their previous submission.

Table 2.9 Recalculation check, comparison total GHG emissions without LULUCF for WEM and WAM scenarios for 2025 and 2030 of the 2021 submission against the 2019/2020 submission

	WEM		WAM	
	2025	2030	2025	2030
AT	1.8%	1.9%	1.1%	0.9%
BE	-1.2%	1.1%	0.7%	5.4%
BG	6.5%	11.3%	New	New
CY	11.1%	10.2%	New	New
CZ	2.2%	2.2%	10.0%	22.6%
DE	6.2%	13.3%	No WAM	No WAM
DK	12.4%	19.7%	No WAM	No WAM
EE	21.0%	-0.9%	15.1%	-16.7%
ES	1.2%	3.8%	-1.4%	1.4%
EL	0.0%	0.8%	-0.1%	1.2%
FI	5.7%	11.4%	1.2%	2.0%
FR	9.8%	11.9%	No WAM	No WAM
HR	2.0%	3.8%	-2.0%	-1.5%
HU	5.7%	5.6%	0.2%	9.5%
IE	-0.1%	2.9%	-1.3%	-2.3%
IT	-0.6%	4.4%	4.5%	7.3%
LT	7.2%	11.6%	2.1%	2.0%
LU	-1.9%	-2.4%	-2.9%	-3.4%
LV	-2.6%	-2.3%	-1.2%	0.5%
MT	3.5%	4.1%	No WAM	No WAM
NL	-0.7%	6.8%	New	New
PL	0.0%	0.0%	0.0%	0.0%
PT	0.2%	0.3%	-1.3%	-2.9%
RO	13.3%	22.1%	12.9%	21.3%
SE	1.5%	6.3%	No WAM	No WAM
SI	-0.3%	-0.3%	-0.5%	-0.5%
SK	-6.8%	-6.3%	-9.8%	-18.9%

Note: Negative values means that the submission in 2019/2020 was lower as the new submission in 2021 (indicated by red colour). When the new projections are lower than the previous projections this is highlighted in green.

2.3.8 WEM/WAM/WOM check

In case Member States submit a WOM scenario, it was assessed if emissions in the WOM scenario are equal to or higher than emissions in the WEM scenario. Similarly, when Member States submitted a WAM scenario, it was assessed whether emissions in the WEM scenario are equal to or higher than emissions in the WAM scenario. For all sectors and gases where this was not the case, a question for clarification was sent to the Member State. This has been the case for 19 Member States, in total 62 questions related to WEM, WAM and WOM scenarios were posed. For the vast majority, the Member State offered an explanation, only in an exceptional case no answer was provided. Sometimes the reason why WAM emissions are higher than emissions under WEM are the result of a mistake in the model, sometimes there are explanations related to policies and measures (for example because under WAM more flights are allowed, or because a higher use of biomass is assumed, or a higher share of installed

heat pumps). Although the check does not aim to trigger corrective actions per se, some questions lead to the correction of errors by a resubmission.

2.3.9 *Interlinkages with PaMs*

The interlinkages check assesses if PaM and projections reporting is coherent. So ideally, when differences in projections cannot be explained by methodological changes, they can be explained by new PaMs. Additionally, the link between the projections in the WAM scenario, if submitted, and planned PaMs has been assessed. Information was taken from the PaM reporting under the Governance Regulation, if already available at the moment of the checks, or from the technical report. Three questions have been sent out, one each to Romania, Luxemburg and Hungary, either inquiring how the PaMs contributed to the projected emissions of the WEM and WAM scenarios or because of the lack of PaMs for the WAM scenario. In all three cases, explanations were provided: twice the explanation given clarified that the projections for the WAM scenario were not in line with the reported PaMs but were based on other elements instead. Romania referred to the assumptions as taken up in the report.

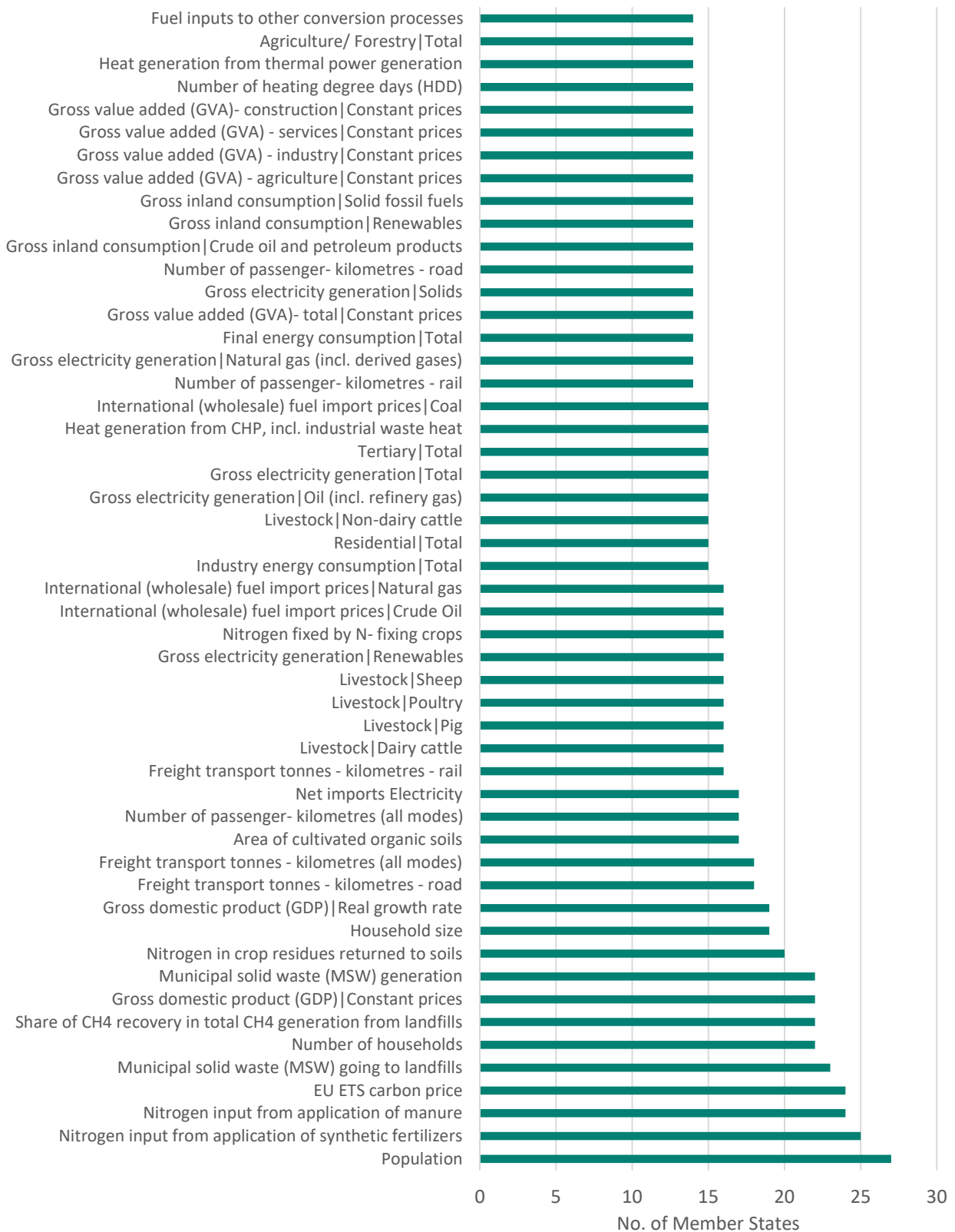
2.4 Parameters

2.4.1 *Overview of reported parameters*

With the introduction of the new parameter reporting Table 3 in the Implementing Regulation there are many more parameters that can potentially be reported. This is reflected in the submitted parameter tables from the Member States. In total about 389 unique parameters were reported by the countries. However, not all Member States report these parameters as not all parameters are used for projections. Some parameters such as GDP and population are more broadly applied in general models, and some are used only in specific, and usually more sophisticated, models.

In Figure 2.13 parameters are highlighted that were reported by more than half of the 27 EU Member States, i.e. the parameter is included if reported by more than 14 Member States, which is the case for 51 parameters. Unsurprisingly, most Member States report the parameter on the population. Other parameters reported are connected mostly to economy (different variations of Gross Domestic Product and Gross Value Added), the energy system (as either energy consumption or production), household and transport system indicators. In addition, a high number of countries reported specific agricultural parameters such as nitrogen input, which seem to be important parameters for the projections of the sector agriculture.

Figure 2.13 Parameters reported by more than 14 Member States (values for the year 2020)



2.4.2 *Most common parameter issues*

The parameter table (IR Annex XXV Table 3) was submitted by 27 Member States. The comprehensive overview given in Table 2.10 summarizes the QA/QC process for each Member State and the reported key parameters. It can be clearly seen that few follow-ups were 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 (light green) or explanations were provided by the countries (blue) that solved the issue. The overview also shows that GDP was not an input parameter in projections of five Member States and that net electricity imports was not used in the projections of nine Member States (yellow).

In most cases, the communication with Member States successfully solved the issues regarding the submitted parameters. This was the case when e.g. data consistent with the surrogate data (light green) was resubmitted or when an explanation of the differences was given by Member State experts (indicated in 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 from the data used by the reviewers. However, some issues could not be solved (pink) as there was no reply from the Member State on the findings. In some cases, Member States did not submit base year values or the base year in the first submission, so it was asked for it in the communication log. After the resubmission of these values and years, in some cases a deviation from reference data was found, but this was not followed-up due to time constraints.

A relatively large number of issues with parameter values was resolved through explanation by Member States. Although reasons usually relate to the use of national datasets, and slight differences in e.g. exchange rates, it shows that this is still a source of uncertainty.

Table 2.10 Heat Map of QA/QC procedure and most common issues of the parameter checks

Member States	Population		GDP		Electricity Imports	
	Initial submission	Follow-up	Initial submission	Follow-up	Initial submission	Follow-up
AT	Green	Green	Green	Green	Light Blue	Dark Blue
BE	Green	Yellow	Green	Green	Green	Green
BG	Purple	Green	Green	Green	Green	Green
CY	Light Blue	Pink	Light Blue	Pink	Yellow	Yellow
CZ	Purple	Light Blue	Dark Blue	Yellow	Yellow	Yellow
DE	Green	Green	Light Blue	Orange	Light Blue	Orange
DK	Light Blue	Dark Blue	Green	Green	Green	Green
EE	Green	Green	Light Blue	Dark Blue	Light Blue	Dark Blue
EL	Light Blue	Purple	Light Blue	Light Green	Green	Green
ES	Light Blue	Light Green	Light Blue	Purple	Yellow	Yellow
FI	Green	Green	Green	Green	Green	Green
FR	Purple	Yellow	Green	Green	Green	Green
HR	Green	Light Blue	Dark Blue	Green	Green	Green
HU	Light Blue	Light Green	Yellow	Light Blue	Light Blue	Orange
IE	Light Blue	Orange	Light Blue	Orange	Light Blue	Orange
IT	Purple	Green	Green	Yellow	Yellow	Yellow
LT	Green	Green	Green	Yellow	Yellow	Yellow
LU	Green	Yellow	Yellow	Yellow	Yellow	Yellow
LV	Green	Green	Green	Purple	Purple	Purple
MT	Light Blue	Dark Blue	Light Blue	Dark Blue	Yellow	Yellow
NL	Purple	Green	Green	Green	Green	Green
PL	Green	Light Blue	Dark Blue	Yellow	Yellow	Yellow
PT	Purple	Light Blue	Orange	Light Blue	Light Green	Light Green
RO	Purple	Light Blue	Purple	Light Blue	Purple	Purple
SE	Green	Light Blue	Dark Blue	Yellow	Yellow	Yellow
SI	Green	Light Blue	Dark Blue	Light Blue	Dark Blue	Dark Blue
SK	Light Blue	Light Green	Yellow	Yellow	Yellow	Yellow

Legend:

Initial submission:	
value in line with surrogate data	
value not in line with surrogate data	
no use of default unit -> corrected by reviewer	
no values submitted / values not used	
Follow up: issue solved	
resubmission of value consistent to surrogate data	
explanation of reason for difference	
Follow up: issue not solved	
no resubmission of Member States	
resubmission of value NOT consistent to surrogate data / no explanation of reason for differences but issue also not followed up	

Note: Data of Member States was checked against surrogate datasets from Eurostat (Eurostat 2021a-c) 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.

2.4.3 *Deviation from recommended parameters*

In line with the Implementing Regulation (Article 38(3)) to increase EU wide consistency of projections the European Commission provided Member States with recommended supranational parameters on ETS carbon price, international oil and coal prices and other parameters e.g., international gas prices, GDP growth, population for the preparation of GHG projections (European Commission, 2020). Checks were carried out to understand whether Member States used the provided values (Table 2.11). The classification was made by setting deviation threshold for individual parameters. Note that it is possible that for two projection years parameters do not deviate, but for other projection years they do (e.g. when national parameters are available, but not for the full time series). In these instances, the ETC/CME made an expert judgement if it can be assumed that the recommended parameters were used or not. In addition, it is possible that values happen to be in the same range as the recommended values, without actual use of the Commission's Guidance. Similarly, due to potential exchange rate issues of price data (ETC/CME converts all monetary values to constant EUR2010 for the comparison), some parameters may have been classified as not following the Commission Guidance. It should be noted that in the 2021 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 2.11 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	
AT	not used	not used	not used	no	no	no		IT	not used	not used	not used	yes	yes	no
BE	yes	yes	yes	yes	yes	no		LV	not used	not used	not used	yes	no	no
BG	no	no	no	no	no	not used		LT	not used	not used	not used	no	yes	no
HR	no	no	no	no	no	no		LU	no	no	no	not used	no	not used
CY	not used	no	no	no	no	no		MT	not used	not used	not used	not used	no	no
CZ	not used	not used	not used	no	no	not used		NL	no	no	no	no	no	not used
DK	not used	not used	not used	no	not used	no		PL	not used	not used	not used	no	yes	no
EE	not used	not used	not used	yes	yes	no		PT	no	no	no	no	yes	no
FI	not used	not used	not used	yes	no	no		RO	yes	yes	yes	not used	no	no
FR	not used	yes	yes	yes	yes	yes		SK	not used	not used	not used	not used	yes	not used
DE	no	no	no	no	yes	not used		SI	not used	not used	not used	not used	no	no
EL	no	no	no	no	yes	not used		ES	no	no	no	not used	no	not used
HU	no	no	no	no	no	not used		SE	yes	yes	yes	yes	no	no
IE	no	no	no	yes	no	no								

	Coal price	Gas price	Oil price	Carbon price	Population	GDP
Number Member States using guidance in 2021	3	4	4	8	10	1
Number Member States that used guidance in 2019	9	9	9	12	9	0
Number Member States that 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 population and GDP

In general, it can be observed that the parameter for the EU ETS carbon price has been used by eight Member States in line with the guidance. Belgium, France, Romania, and Sweden are the Member States that have followed the guidance mostly.

Not all Member States provided an explanation why recommended parameters were not taken into account, but rather indicated that they had opted for reporting values from other modelling exercises. For example, Germany explained that the parameters were taken into account, but that it was decided to use different values from more recent publications, such as the International Energy Agency's (IEA) World Energy Outlook, which suggested lower fuel prices. A similar reasoning was provided by the Netherlands. In the case of the carbon price, Germany only used the recommended parameters from

2030 onwards. In addition, some Member States used the values for the parameters used for their National Energy and Climate Plan projections, instead of the recommended parameters.

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 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 applied:

- 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.

3 Specific analysis of new reporting elements

3.1 New detailed LULUCF tables (1b, 5a, 5b)

In the new reporting framework under the Gov. Reg. the reporting for the LULUCF sector was substantially updated and extended. Due to the future accounting of the LULUCF sector in the EU's climate mitigation target, more detailed information on the LULUCF projections and the expected amount of accounted credits or debits from the LULUCF has to be reported. The Implementing Regulation (EU) 2020/1208 provides two tables of which one must be selected to report the LULUCF projections (table 1b or 5a) and table 5b to report on the cumulative projected accounting results for the LULUCF accounting categories as well as the ESR cumulative projections for the two accounting periods. It should be noted that in table 1b two mandatory summary tables are included which had to be filled out independent of the selection of table 1b or 5a.

All Member States reported table 1b, and five countries voluntarily reported table 5a in addition (Cyprus, France, Germany, Romania and Sweden). The mandatory summary tables part 2 and part 3 of table 1b were also reported by all Member States, even though in some cases the ETC/CME had to remind countries to provide the complete information for these tables. Some countries did not report all three gases, noting that this can be in line with the IPCC Guidelines, in case a certain management or land use/land use change is not occurring in the country, e.g. CH₄ due to forest fires or drainage of organic soils might not take place in all Member States and are therefore not reported by all countries. To ensure that there is no category/gas combination left out in the projections, the ETC/CME cross-checked all main sectors and categories with the GHG inventory and in case a category/gas combination is reported in the GHG inventory but not in the projections, this triggered a question to the Member State.

Table 3.1 Reported summary tables (part 2 and part 3 of table 1b) for the LULUCF sector

MS	Table 1b part 2				Table 1b part 3			
	Total GHGs (ktCO ₂ e)	CO ₂ (ktCO ₂ e)	CH ₄ (ktCO ₂ e)	N ₂ O (ktCO ₂ e)	Total GHGs (ktCO ₂ e)	CO ₂ (ktCO ₂ e)	CH ₄ (ktCO ₂ e)	N ₂ O (ktCO ₂ e)
AT	✓	✓	✓	✓	✓	✓	✓	✓
BE	✓	✓		✓	✓	✓		✓
BG	✓	✓	✓	✓	✓	✓	✓	✓
CY	✓	✓	✓	✓	✓	✓	✓	✓
CZ	✓	✓	✓	✓	✓	✓	✓	✓
DE	✓	✓	✓	✓	✓	✓	✓	✓
DK	✓	✓	✓	✓	✓	✓	✓	✓
EE	✓	✓	✓	✓	✓	✓	✓	✓
ES	✓	✓	✓	✓	✓	✓	✓	✓
FI	✓	✓	✓	✓	✓	✓	✓	✓
FR	✓	✓	✓	✓	✓	✓	✓	✓
GR	✓	✓	✓	✓	✓	✓	✓	✓
HR	✓	✓	✓	✓	✓	✓	✓	✓
HU	✓	✓	✓	✓	✓	✓	✓	✓
IE	✓	✓	✓	✓	✓	✓	✓	✓
IT	✓	✓	✓	✓	✓	✓	✓	✓
LT	✓	✓	✓	✓	✓	✓	✓	✓
LU	✓	✓		✓	✓	✓		✓
LV	✓	✓	✓	✓	✓	✓	✓	✓
MT	✓	✓		✓	✓	✓		✓
NL	✓	✓	✓	✓	✓	✓	✓	✓
PL	✓	✓	✓	✓	✓	✓	✓	✓
PT	✓	✓	✓	✓	✓	✓	✓	✓
RO	✓	✓	✓	✓	✓	✓	✓	✓
SI	✓	✓	✓	✓	✓	✓	✓	✓
SK	✓	✓	✓	✓	✓	✓	✓	✓
SE	✓	✓	✓	✓	✓	✓	✓	✓

Regarding table 5b, there were also some Member States that did not provide the information in the first submission, and therefore a resubmission was requested by the ETC/CME. Regarding the methodological aspects concerning table 5b, it should be noted that the results should be provided after application of the accounting rules (e.g. taking into consideration the Forest Reference Level or the base period). However, there were two Member States for which the check by the ETC/CME flags an inconsistency and where it can be doubted that the rules were applied correctly (Cyprus and Czechia). Three Member States confirmed in the QA/QC that they applied the accounting rules, but the checks from the ETC/CME still flag an inconsistency (Croatia, Hungary, and Latvia). For Bulgaria and Sweden the reporting was incomplete because categories were missing (BG) or the second accounting period was not provided (SE) for any of the accounting categories.

3.2 New tables on the sensitivity analysis (Table 6 and 7)

With the new reporting under the Gov. Reg. the reporting of sensitivity scenarios was updated and Member States have to provide the results of the sensitivity scenarios in standardised format for the following sectoral totals: Total without LULUCF, Total ETS, Total ESR and LULUCF. In addition, the related key parameters had to be reported in a separate table. The number of sensitivity scenarios reported by the 21 Member States who submitted data in either Table 6 or 7 is presented in Table 3.2. On average, Member States submitted three scenarios in both Tables 6 and 7. The Czech Republic submitted the most sensitivity scenarios, followed by Spain. Most Member States reported for all scenarios related parameters. Only Malta and Poland did not report parameters for all scenarios whereas Romania didn't report results but parameters. As these tables were reported for the first time in 2021, the checks did not go into detail to further investigate such discrepancies in sufficient detailed, but in depth checks should be developed for future reporting cycles.

Table 3.2 Overview of reporting of sensitivity analysis scenarios

Member State	Number of scenarios reported	
	Emissions (Table 6)	Parameters (Table 7)
AT	2	2
BE	4	4
BG	1	1
CZ	10	10
DE	5	5
EE	3	3
ES	9	9
FI	2	2
FR	1	1
GR	3	3
HR	6	6
HU	1	1
IE	1	1
LT	3	3
LV	4	4
MT	6	5
NL	1	1
PL	6	1
RO	0	1
SI	4	4

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

Iceland, Norway and Switzerland are member countries of the EEA network, which share a number of environmental commitments with the EU, such as for GHG emission reduction targets and mechanisms: Iceland and Norway take part in the EU Emission Trading System (ETS), while the Swiss Emission Trading System is linked to the EU ETS since 2020. In addition, Iceland and Norway have national targets under the Effort Sharing Regulation (EU 2018/842). For this reason, these EEA countries can voluntarily participate in the QA/QC procedure of the EEA and the ETC/CME.

In 2021, Iceland, Norway and Switzerland submitted GHG projections on a voluntary basis. An overview of the reported information is provided in the following table:

Table 4.1 Overview of QA/QC results for Iceland, Norway and Switzerland

Country	Iceland	Norway	Switzerland
First submission	04/05/2021	29/03/2021	15/03/2021
Resubmission	22/06/2021	no	03/05/2021
Base year	2019	2018 (2017 for LULUCF)	2017
Time series	2019-2040	2017/2018-2030	2017-2035
Scenarios	WEM	WEM	WEM, WAM, WOM
Gases	all gases	all gases	all gases
Main sectors reported	yes	yes	yes
Report	yes	yes	no
Parameters	yes	yes	yes
Model factsheet	yes	yes	yes
Sensitivity scenarios	yes	no	no

During the QA procedure, the ETC/CME sent 13 questions to Iceland, 11 questions to Norway and eight to Switzerland. Due to minor sum errors, Iceland and Switzerland provided a resubmission. All countries provided the intermediate years, so no gap-filling was applied by the ETC/CME.

5 Conclusions and outlook for 2022

The results of the QA/QC procedure in 2021 show that the QA/QC procedure is an important element of the Union system for GHG projection to identify reporting inconsistencies and errors, but also to stimulate improvements in the Member States' national systems. There was a big change in the reporting procedure in 2021 due to the switch to the new reporting platform Reportnet 3.0 and the new reporting templates under the Gov. Reg., which required the Member States to update their reporting system substantially. Despite these changes and related challenges, the QA/QC procedure and the cooperation between Member States, EEA and ETC/CME worked smoothly due to a well-established process over the past years. Online webinars with Member States reporters organised by the EEA with support by the ETC/CME and the guidance document for the new reporting templates seemed to be effective tools to ensure a smooth transition between the two reporting systems. Despite this transition, the statistics of the Member States communication (e.g. average number of questions per Member State) and numbers of resubmissions are comparable to previous reporting years.

However, as in previous reporting years there is still a lack of timeliness of the submissions. The official reporting deadline is March 15, but only 11 Member States provided their submission before or on the deadline which is a deterioration compared to 2019. Delayed submissions are a particular challenge when countries need to resubmit due to errors or inconsistencies in the dataset. The average time between initial submission and resubmission has increased by 10 days compared to 2019. Such delays in submissions and late resubmissions create bottlenecks in the dataflow between the other ETC/CME tasks, which further process and analyse the EU projections data, but delayed datasets are also critical for assessments and progress monitoring by the EEA and the European Commission.

Regarding the completeness of the submissions, the situation is comparable to previous reporting years for the unchanged reporting elements. The number of Member States reporting a WAM scenario has increased to 22 in 2021, compared to 17 in 2019. Only for the new reporting tables e.g. the sensitivity analysis and related key parameters, the submissions were less complete. The completeness of the time series (mandatory years and intermediate years) is also similar compared to previous reporting years. The allocation of sectors to ETS and ESR emissions seems to be no longer a challenge for the Member States as there are hardly any issue flagged in 2021. This could be related to the fact that in the new reporting template for table 1a cells are shaded in grey for implausible category-gases-combinations to facilitate the reporting.

In general, the corrections applied by the ETC/CME were more basic than in past years, because on the one hand, the Member States tend to correct most errors by themselves via resubmissions and on the other hand, there are fewer errors flagged. In addition, the new set of reporting templates have a series of automated quality checks integrated in the Excel files to flag potential sum errors or inconsistencies already before the submission. This seems to be an effective tool to prevent basic reporting errors and there could be further potential to integrate such checks also in the reporting platform 3.0. In 2021, the EU aggregated dataset was extended to include the main LULUCF sub-categories and to include a gap-filled and corrected time series for the gases CO₂, CH₄, N₂O and all F-gases, because the checks of previous years revealed, that the data for the gases has typically the same systematical errors as the Total GHGs, ETS and ESR emissions. For this reason, the gap-filling and error corrections as carried out by the ETC/CME were in most cases efficient.

It is important that the projections time series is well connected with the historical time series of the GHG inventory. In the past years, the ETC/CME applied a so-called base year check to identify potential discrepancies between the historical and projected time series with the option to conduct a base year calibration when the deviation is above a certain threshold. 2021 is the third consecutive year in which no such base year calibration was necessary and it can be concluded that the countries are sufficiently

aware of the importance of a consistent time series. With the new reporting, Member States have to indicate to which inventory version the projections time series is related to increase transparency. Most Member States reported a recent inventory version created in 2021, only two countries used an older inventory version, but were not flagged in the check. Therefore, it can be concluded that the reported GHG projections are consistent with historical emissions. This is also visible in the very small deviation of the EU base year compared with the EU GHG inventory value for 2019, which is only 0.1% or 5213 kt CO₂eq.

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. With the recalculations more knowledge is gained on how much projections change from submission to submission and to identify and to know the reasons for the most significant changes. For future QA/QC cycles it would be useful to also implement this check for ETS and ESR projections to understand the impacts of the recalculations on the progress towards the targets. The WEM/WAM/WOM check is an important check to identify inconsistencies in scenario definitions and to better understand the scenarios. In addition, in some cases it also helped to identify minor errors in the data.

A challenge for the parameters checks was that in some cases, Member States did not submit base year values or the base year in the first submission, so it first had to be asked in the communication log. As the checking procedure does not foresee a second round of communication with countries (with the only exception for severe issues that affect the EU dataset), the follow-up with countries cannot be completed due to the time constraints. 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 specifies EUR2016 prices as a default. This challenge can only be overcome with continued awareness raising with the Member States to report in the default units.

Regarding the new Tables 6 and 7 on the sensitivity scenarios, but also 1b, 5a and 5b on LULUCF, there is potential to further develop more advanced in-depth checks which could focus on the analysis the time series (for the sensitivity scenario) and the analysis of progress towards targets of the LULUCF sector.

There are also some potential improvements necessary for the reporting templates, namely to allow for the reporting of different base years for different sectors, because currently it is limited to select only a common base year for all sectors. During the QA/QC procedure, it became evident that not all sectors use the same starting point, depending on the timing of the model exercise.

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Abbreviations

CH ₄	Methane
CO ₂	Carbon dioxide
DG CLIMA	Directorate-General for Climate Action (at the European Commission)
EEA	European Environment Agency
ESR	Effort sharing regulation
ETC/CME	European Topic Centre on Climate change Mitigation and Energy
ETS	Emission trading scheme
F-Gases	Fluorinated gases (see HFC, PFC, SF ₆ and NF ₃)
GDP	Gross domestic product
GHG	Greenhouse gas
GJ	Gigajoule
Gov. Reg.	Governance Regulation (standing for the Regulation on the Governance of the Energy Union and Climate Action Regulation (EU) 2018/1999)
GWP	Global warming potential
HFC	Hydrofluorocarbons
kt	Kilotons (1000 tons)
LULUCF	Land use, land-use change and forestry (a sector of the GHG inventory)
MMR	Monitoring Mechanism Regulation (EU) No 525/2013
MS	Member State (of the European Union)
N ₂ O	Nitrous Oxide
NA, NE, NO, IE (or NK)	Not applicable, Not estimated, Not occurring, Included elsewhere (Notation keys according to 2006 IPCC Guidelines)
NF ₃	Nitrogen trifluoride
PaMs	Policies and measures
PFC	Perfluorocarbons
QA/QC	Quality assurance and quality control
SF ₆	Sulfur hexafluoride
Total wout LULUCF	Total without LULUCF (Total emissions of a country excluding the sector LULUCF)
WAM	With additional measures
WEM	With existing measures
WOM	Without measures

Annex 1: Overview of corrections and gap-fillings applied by the ETC/CME

		Data changed by ETC for sectors and years (please note: gap-filling of notation keys excluded!)											
Error correction or gap-filling	gapfilling of WAM with WEM	Total GHG	ETS	ESD	CO ₂	CH ₄	N ₂ O	NF ₃	SF ₆	HFCs	PFCS	Unspecified mix of HFCs and PFCS	
AT	no	no	no	no	no	no	no	no	no	no	no	no	
BE	no	no	no	no	no	no	no	no	no	no	no	no	
BG	no	yes (some intermediate years reported as having zero emissions; manual interpolation)							no	no	yes (some intermediate years reported as having zero emissions; manual interpolation)		
HR	In the resubmission in table 1a the LULUCF sectors were not updated for the year 2018 in the WAM scenario. According to page 16 of the MT's report, there is no WAM and WOM scenarios for LULUCF. The year 2018 WAM values of the LULUCF sector have been changed to the values of the 2018 WEM values of LULUCF	no	yes (2018 LULUCF) in WAM	no	no	yes (2018 LULUCF) in WAM			no	no	no	no	
CY	calculation of Total GHGs for LULUCF	no	yes 4.A-4F	no	no	yes 4.A-4F	sector 4: conversion into kt CH ₄	sector 4: conversion into kt N ₂ O	no	no	no	no	
CZ	sums for sector 1A3, 1, Total wout LULUCF corrected (Total GHGs, ETS and ESR)	no	yes 1A3, 1, Total wout LULUCF (2018)	yes 1, Total wout LULUCF (whole time series)	yes 1A3, 1, Total wout LULUCF (whole time series)	yes sum correction of Total LULUCF and sector 1 for BY and 2020	yes sum correction of Total LULUCF and sector 1 for BY	a small discrepancy in the gases split which seem to be related to roundings in sector 3 and incorrect sums in Total wout LULUCF/1. A very minor adjustment was carried out for N ₂ O to harmonise the dataset	no	no	no	no	
DK		yes	no	no	no	no	no	no	no	no	no	no	
EE	yes (value for 2018 has been replaced by the notation key NO for 1A5 Total GHGs, ESR, CO ₂ , CH ₄ and N ₂ O and was added to 1A4;)	no	yes (value for 2018 has been replaced by the notation key NO for 1A5 Total GHGs, ESR, CO ₂ , CH ₄ and N ₂ O and was added to 1A4;)	no	yes (value for 2018 has been replaced by the notation key NO for 1A5 Total GHGs, ESR, CO ₂ , CH ₄ and N ₂ O and was added to 1A4;)			no	no	no	no	no	
FI	historical values of 1A3e deleted and added to 1A3b	no	yes (1A3e)	no	yes (1A3e), value of indirect CO ₂ added for the memo items	yes (1A3e), Total excluding LULUCF: indirect CO ₂ added	no	no	no	no	no	no	
FR	no	yes	no	no	no	no	no	no	no	no	no	no	
DE	2019, 2020 ETS/ESR were gap-filled: 1) calculation of annual change rate of Total GHGs from 2018-2019 and 2019 to 2020. 2) multiplication of annual change rate to ESR sectors for the years 2019 and 2020, 3) calculation of ETS numbers for 2019 and 2020 by Total GHGs minus ESR. Note that the reported ESR emission for 1A3 had to be adjusted in both year to include the lacking 1A3e emissions which are now gap-filled. Also ESR emissions for 1A4 had to be adjusted for the year 2020, because the number would have led to a very high ETS value. linear interpolation of 2019/2020 for MIB aviation/navigation	yes	yes (MIB aviation/navigation for 2019, 2020)	yes all sectors 2019 and 2020	yes all sectors 2019 and 2020	yes (MIB aviation/navigation for 2019, 2020)	yes (MIB aviation/navigation for 2019, 2020)	yes (MIB aviation/navigation for 2019, 2020), re-insertion of value for 2.D which was accidentally deleted in the resubmission	no	no	no	no	

EL	no	no	no	no	no	no	the intermediate years of 2021-2025 were identical for sector 4 and 4.A, this seems to be a copy&paste error. The ETC/CME applied linear interpolation to correct it for WEM and WAM	no	no	no	no	no	no	no
HU	Still one rather minor sum correction had to be made for the BY of 4. in total GHG emissions (where the sum of LULUCF subsectors was off by 4kt compared to the reported LULUCF total); and errors in intermediate years of sector 2. (CO ₂ , 2021-2024)	no	yes (4. in BY)	no	no	yes (2. in 2021-2024)	no	no	no	no	no	no	no	no
IE	no	yes (LULUCF)	no	no	no	no	no	no	no	no	no	no	no	no
IT	no	no	no	no	no	no	no	no	no	no	no	no	no	no
LV	indirect CO ₂ emissions have been added to yes total wout LULUCF in total GHGs, ESR and CO ₂	no	yes (total wout LULUCF)	no	yes (total wout LULUCF + indirect CO ₂ emissions)	yes (total wout LULUCF)	no	no	no	no	no	no	no	no
LT	Total emissions were lower than the sum from ETS+ESR in sector 2. Therefore the difference has been subtracted from sector 2. in the gas ESR emissions.	no	no	no	yes (total wout LULUCF + 2.)	no	no	no	no	no	no	no	no	no
LU	yes (The sum of ETS + ESD was bigger than the total; after exchange with LU the surplus was subtracted from ETS)	no	no	yes (Total wout LULUCF and 2. for the years 2017-2019)	no	no	no	no	no	no	no	no	no	no
MT	yes (NO inserted for 4C grassland and 0 inserted for 4A base year)	yes	no	no	no	no	no	no	no	no	no	no	no	no
NL	BY value reported for 1A3e, but no projections. the 1A3e was included in 1A3b for the BY. Values accidentally reported for MIB aviation and navigation for the year 2031, this was deleted. 1A3e was reported as IE for Total GHGs, etc. but for N ₂ O a value was reported. Therefore the IE was replaced by the N ₂ O value and the sums of 1A3, 1 and Total without LULUCF were corrected (only necessary for the BY).	no	1A3e included in 1A3b in BY, gapfilling of CH ₄ /N ₂ O emissions for sub-sectors of 1A3 led to adjustments in the subsectors for total GHGs as well.	sum of Total excl LULUCF and sector was corrected for BY, 1A3e included in 1A3b in BY	sum of Total excl LULUCF was corrected for BY, gapfilling of CH ₄ /N ₂ O emissions for sub-sectors of 1A3 led to adjustments in the subsectors for total GHGs as well.	no	1A3a-1A3e gap-filled by using the BY share	1A3a-1A3e gap-filled by using the BY share	no	no	no	no	no	no
PL	historical years were reported for 1A3c and 1A3d, according to PL the emissions are reported under 1A3b for the projections, therefore the ETC/CME deleted the values and adjusted the numbers for 1A3b for the years 2017-2019 accordingly (for Total GHGs, ESR, CO ₂ , N ₂ O and CH ₄)	no	yes (1A3b,c,d)	no	yes (1A3b,c,d)			no	no	no	no	no	no	no
PT	1A5 only reported in BY for Total GHG, ESR, CO ₂ , CH ₄ and N ₂ O, but no projections, this was corrected and added to 1A4.	no	yes 1A5/1A4 BY	no	yes 1A5/1A4 BY			no	no	no	no	no	no	no
RO	no	no	no	no	no	no	no	no	no	no	no	no	no	no
SK	for some intermediate years NO was reported, this was deleted and gap-filled by numbers (linear interpolation). For 4.C Grassland numbers were included (linear interpolation between 2036-2039) because otherwise the sum of sector 4 would not be correct (for CO ₂ and Total GHGs). For HFC, PFC, SF ₆ the BY value was missing in sector 2, the value of the Total excluding LULUCF was used to gap-fill it.	no	yes (4C)	no	no	yes (4C)	no	no	no	no	yes (BY of sector 2)		no	no

SI	value of sector 4D for Total GHGs did not match the sum of the gases CO ₂ , CH ₄ and N ₂ O, therefore corrected (also correction of Total LULUCF necessary)	no	yes (4D, 4)	no	no	no	no	no	no	no	no	no	no	no
ES		no	yes (4F 2019-2040)	no	no	yes (4F 2019-2040)	no	yes (4F 2019-2040)	no	no	no	no	no	no
SE	yes (Sum of LULUCF subsectors in BY (total ghg emissions and N ₂ O) was not equal to 4.; manually made new sum of 4.)	yes	yes (4.)	no	no	no	no	yes (4.)	no	no	no	no	no	no

European Topic Centre on Climate change
mitigation and energy
Boeretang 200
B-2400 Mol, Belgium
Tel.: +32 14 33 59 77
Web: www.eionet.europa.eu/etcs/etc-cme
Email: etccme@vito.be

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