ETC CM Report 2023/09

Quality assurance and quality control procedure for national and Union GHG projections 2023

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Summary

The quality assurance and quality control (QA/QC) procedure is an element of the QA/QC programme of the Union system for policies and measures and projections to be established in 2023 according to Article 39 of the Gov.Reg. The European Environment Agency (EEA) is responsible for the annual implementation of the QA/QC procedures and is assisted by the European Topic Centre on Climate Change Mitigation (ETC/CM). The QA/QC procedure document describes QA/QC checks carried out at EU level on the national reported projections from Member States and on the compiled Union GHG projections. QA/QC procedures are performed at several different stages during the preparation of the national and Union GHG projections in order to aim to ensure the timeliness, transparency, accuracy, consistency, comparability and completeness of the reported information. The results of the 2023 QA/QC procedure will be presented in the related ETC/CM working paper.

1 Introduction

1.1 Background

From March 15 2021 onwards and every two years thereafter EU Member States have to report their GHG projections in accordance with Art. 18.1(b) of the Regulation Governance of the Energy Union and Climate Action (EU) 2018/1999 (Gov. Reg.) and the related Implementing Regulation (EU) 2020/1208, which repealed the EU Monitoring Mechanism Regulation (EU no. 525/2012). The years in-between mandatory reporting years, Member States are invited to voluntarily report on updated GHG projections, if available. These voluntary submissions are also subject of the QA/QC procedure as described in this document and the ETC/CM will prepare an updated EU projections dataset with the new submissions.

The QA/QC procedure at hand is an element of the QA/QC programme of the Union System for policies and measures and projections[1]. The European Commission (DG CLIMA) is responsible for coordinating QA/QC activities on GHG projections at EU level and ensures that the objectives of the QA/QC programme are fulfilled. The European Environment Agency (EEA) is responsible for the annual implementation of the QA/QC procedures and is assisted by the European Topic Centre for Climate Change Mitigation (ETC/CM[2]).

QA/QC procedures are performed at several different stages during the preparation of the national and Union GHG projections in order to aim to ensure the timeliness, transparency, accuracy, consistency, comparability and completeness of the reported information.

Firstly, quality control (QC) checks of national GHG projections are performed as technical routine activities by the MS's personnel compiling the projections. These QC checks aim at maintaining the quality of national projections as they are being compiled. Secondly, quality assurance (QA) checks of national GHG projections are carried out by the EEA and its ETC/CM to review the quality of MS reported projections against quality criteria. Thirdly, QC checks of the aggregated Union GHG projections are performed by the EEA and the ETC/CM to ensure that the data are compiled correctly at EU level. The QA/QC procedure document describes QA/QC checks carried out at EU level on the national reported projections from Member States and on the compiled Union GHG projections.

Additional information and guidance documents for Member States covering changes introduced by the new Gov. Reg. and ReportNet 3.0 platform can be found here: Gov.Reg. Projections — Eionet Portal (europa.eu).

[1] To be published. The MMR version of the document titled "Elements of the Union System for policies and measures and projections and the quality assurance and control (QA/QC) programme as required under regulation (EU) NO 525/2013", June 2015, available at: https://ec.europa.eu/clima/sites/clima/files/strategies/progress/monitoring/docs/union_pams_projections_en.pdf

[2] ETC/CM is a consortium of European institutes assisting the EEA in its support for European Commission

1.2 Objective

The objective of the QA checks is to provide evidence of the quality of MS reported projections. Where appropriate and in consultation with MS, corrective actions, or gap-filling according to the Gov.Reg. may be applied in order to enable a consistent compilation of Union GHG projections. The objective of the QC checks is to ensure that the data are compiled correctly at EU level.

This QA/QC procedure document describes:

- the quality criteria against which the projections are assessed
- the consultation process with MS
- the QA/QC checks that are performed at EU level
- the corrective actions that may be applied to MS reported information

The most recent final quality checked EU data set can be accessed under following link: Member States' greenhouse gas (GHG) emission projections — European Environment Agency (europa.eu).

2 General procedure

2.1 Quality criteria

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 (TCCCA). These quality principles have been initially defined by the Intergovernmental Panel on Climate Change (IPCC) to characterise the quality of historic emission inventories. They have a slightly different scope in the context of emission projections.

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

Completeness means to ensure that projections are reported by MS for all years, sources and sinks, gases and sectors as required under the 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.

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 MS for Union GHG projections.

Comparability means to ensure that national projected emissions and removals reported by MS are comparable across MS. The allocation of different sources and sink categories by gas follows the split in accordance with the Gov.Reg. and recommendations by the Commission with regard to projections horizon, reference year (starting year), ETS[3]/ESR[4] spilt, EU policies and measures to be taken into account and harmonised key assumptions are followed as appropriate.

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

An additional quality principle used in this context is **timeliness** and it means that national GHG projections are submitted by 15 March of a reporting year in accordance with the Gov.Reg.

[3] Emissions under the EU Emission Trading System
[4] Emissions under the Effort Sharing legislation

2.2 Quality assurance and control process and MS consultation (Gov. Reg. Article 18 (2))

Quality assurance and control (QA/QC) procedures are performed at several different stages during the preparation of the Union GHG projections in order to aim to ensure the timeliness, transparency, accuracy, consistency, comparability and completeness of the reported information.

The EEA and its ETC/CM carry out QA/QC procedures at EU level. Quality assurance (QA) checks of national GHG projections are performed to assess the quality of MS reported projections against the TCCCA quality criteria. Quality control (QC) checks of the compiled Union GHG projections are performed to ensure that the data are compiled correctly at EU level. The QA/QC checks are organised in three phases:

Phase I: Quality assurance of national projections and MS consultation

Phase I is focusing on quality assurance of reported data submitted by MS. The aim of phase I is to identify errors in the data submitted, and issues related to TCCCA.

Any potential issues identified by the reviewer, so-called findings, are communicated to MS via the communication log file. Findings deemed as significant will lead to questions. MS will be asked to provide explanations and/or data revised submission and will be informed about corrective actions that may be applied by the reviewers in case:

a) MS do not provide additional or corrected data or explanations or
b) MS do provide additional or corrected data or explanations, but it is not deemed satisfactory to solve the identified issues.

The *communication log file* also includes recommendations for the continuous improvement of national projections.

Phase II: Corrective actions

The corrective actions are part of phase II and consist of checking the MS resubmissions, filling identified data gaps, error corrections and the reference year calibration by the ETC/CM to ensure that all issues are solved.

When the ETC/CM has finished the final country dataset, the MS will receive an individual QA feedback document which include:

- recommendations for future submissions (*Recommendations)*,
- an overview of the completeness of the submission (*Completeness*),
- a comparison of the reported and final data *(Data visualisation)*.
- The final communication log including the conversations between MS and ETC/CM (*Communication log)*.

Phase III: Quality control of Union GHG projections

In phase III the ETC/CM performs *internal quality control checks* and compiles the Union projections.

Figure 2-1 Overview of QA/QC procedure.

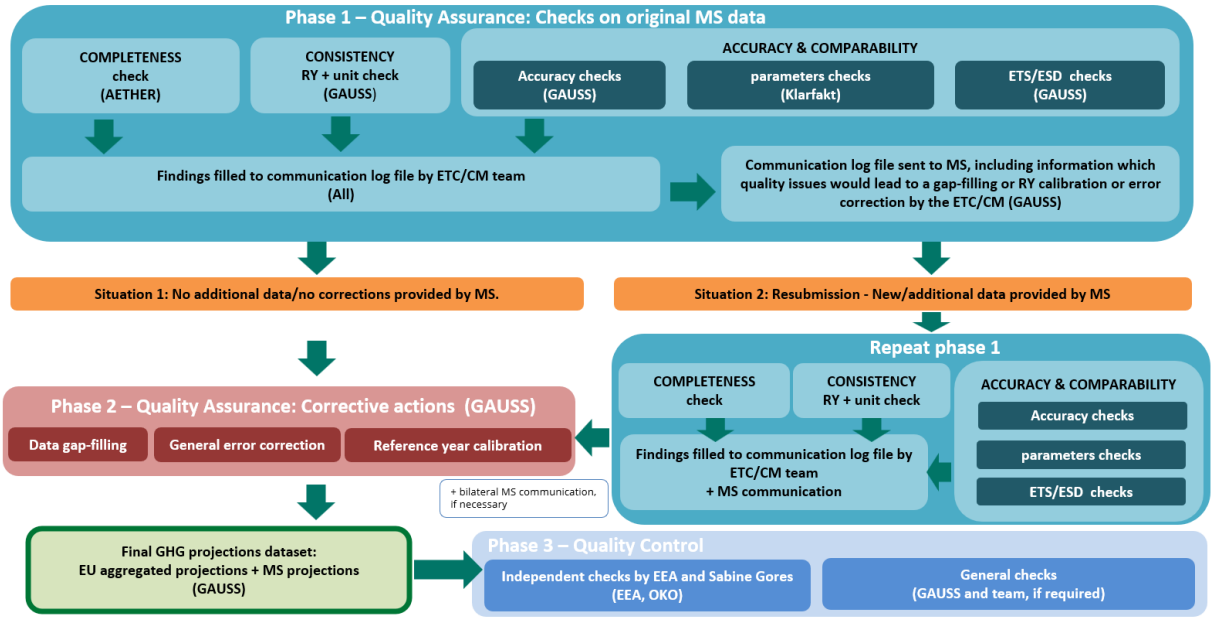
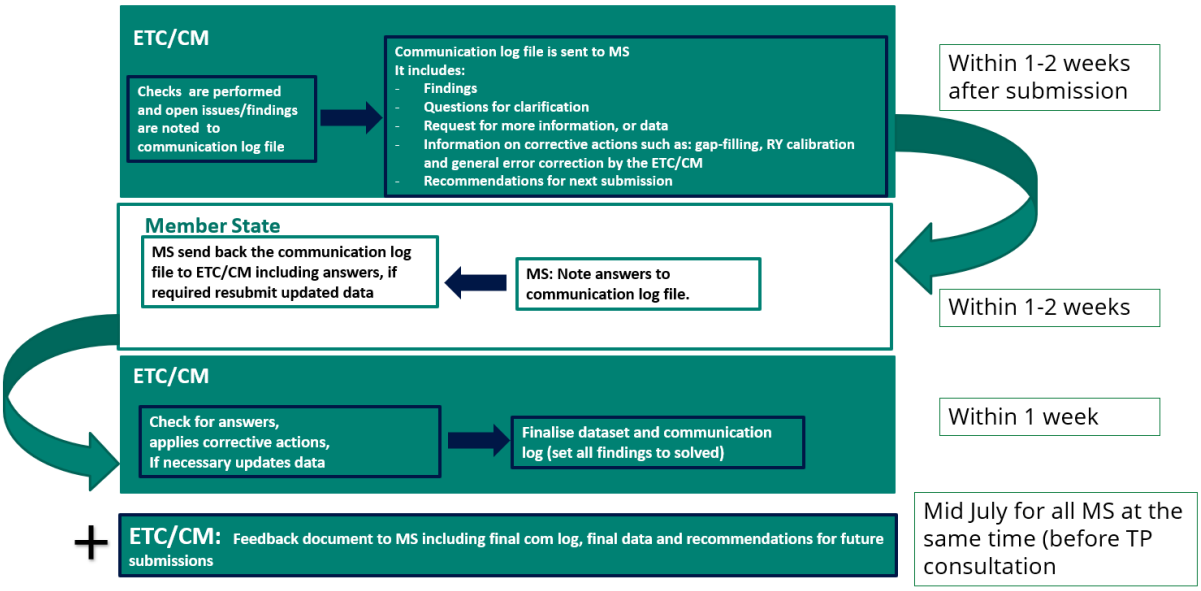


Figure 2-2 Communication process between Member States and ETC/CM.



2.3 Overview of quality checks

Table 2-1 and **Table 2-2** present the overview of the QA/QC checks and corrective actions for GHG projections, they are further described in section 3.

Table 2-1 Overview of QA/QC checks for GHG projections.

	Name of check	Objective	Method	Potential corrective action
C1	Completeness checks	Assess **completeness and transparency** of MS' submissions **(Gov.Reg. Art. 39(2))**	Reviewing MS' reporting template and the accompanying report with regard to mandatory **(Gov.Reg. Art.18)** and recommended reporting requirements. Filling in the *Status & completeness report* for each MS.	A1a, A1b,A1c, A1d, A1f, A1g
C2	Consistency check	Assess **consistency and comparability** of MS' submissions **(Gov.Reg. Art. 39(2))**	Checking whether the GHGs were reported in the correct unit. In addition, it is checked whether Memo Items and sector LULUCF is allocated correctly and to clarify if indirect CO_2 emissions are included in/excluded from the Total (without LULUCF).	A3
C3a	Reference year check 1	Assess **consistency** of MS' submissions. **(Gov.Reg. Art. 39(2))**	Checking whether the reference year of projections is consistent with the historic emissions of the inventory.	No
C3b	Reference year check 2	Assess **consistency** of MS' submissions. **(Gov.Reg. Art. 39(2))**	Checking whether an identified inconsistency between historic inventory and projected reference year is deemed significant.	A2
C4a	Sum check	Assess **accuracy** of MS' submission **(Gov.Reg. Art. 39(2))**	Checking that disaggregated emission projections by gas, sector, category and ETS/ESR split equal the total sum reported by MS.	A3
C4b	Recalculation check	Assess **accuracy** of MS' submission **(Gov.Reg. Art. 39(2))**	Comparing the total emission projection for each scenario with the total emission projection reported by MS in the last reporting period in order to identify if the submissions is identical or updated.	No
C4c	Outlier check	Assess **accuracy** of MS' submission **(Gov.Reg. Art. 39(2))**	Checking whether the reported emissions in a certain year are above or below the trend line of the projected emissions.	No
C4d	Projected trend check	Assess **accuracy** of MS' submission **(Gov.Reg. Art. 39(2))**	Checking if projected trend line seems plausible.	No
C4e	Overall trend check	Assess **accuracy** of MS' submission **(Gov.Reg. Art. 39(2))**	Checking whether the projected trend line gradient is significantly different from the historical trend line of MS' submission.	No
C4f	WEM, WAM, WOM check	Assess **accuracy** of MS' submission **(Gov.Reg. Art. 39(2))**	Checking whether emissions in WOM are larger than/equal to WEM and that WEM emissions are larger than/equal to WAM.	No
C5a	Parameter unit check	Assess **consistency and comparability** of MS' submission **(Gov.Reg. Art. 39(2))**	Ensuring that all MS use the same units.	A3

	Name of check	Objective	Method	Potential corrective action
C5b	Historic parameter check	Assess **consistency and accuracy** of MS' submission **(Gov.Reg. Art. 39(2))**	This check will be performed by determining the percent difference between data reported by MS and Eurostat data for each historic time step for which data is available by both sources.	No
C5c	Check against EC parameter recommendations	Assess **consistency and comparability** of MS' submission **(Gov.Reg. Art. 39(2))**	Data for projected years (2020, 2025, 2030, 2035, 2040, 2045, 2050) will be checked against recommended values.	No
C6a	ETS/ESR split check	Assess **consistency and comparability** of MS' submission **(Gov.Reg. Art. 39(2))**	The ETS/ESR split from emission inventories and EUTL data will be compared to the ETS split reported in projections files for total and main source categories and will be checked for inconsistencies. It will be checked if 1A3a Domestic aviation and International aviation in the EU ETS are not included in the ETS emissions to allow the calculation of Total ETS emissions from stationary combustion.	No
C6b	ETS stationary combustion check	Assess **consistency and comparability** of MS' submission (Gov.Reg. Art. 39(2)) and to ensure that only stationary ETS emissions are reported in **accordance with Directive 2003/87/EC**.	Check if emissions from 1.A.3.a. domestic aviation are reported under the ETS emissions.	A4
C7	NECP check	Compare projections reported under **Gov.Reg. Art 18.** with projections reported in the final NECP (projections reported under Gov.Reg. Art 3 and Annex I).	Check the absolute and relative difference of the projections reported under Art 18 of the Gov.Reg. and the NECP projections of WEM and WAM (if available).	No
C8a	Sensitivity analysis check on scenarios	Ensure that the emission scenarios reported in table 6 and 7 are consistent (**Gov.Reg. Art 39. (2))**	Check that each emission scenario in Table 6 is coupled to a parameter scenario in Table 7.	No
C8b	Sensitivity check - correspondence with reported projections & parameters	For the reported sensitivity scenarios in Tables 6 and 7, ensuring the information on GHG projections and sensitivity scenarios and the related parameters is consistent	Comparison of the base year and base year values of the GHG projections in table 1a with the RY values of the sensitivity analysis in table 6, and comparison of RY values of parameters in table 3 with the parameters used for the sensitivity analysis in table 7.	No
C9	Time series check	Ensure that MS do not report historical values when no projections are available.	Check that the base year value and projected time series include either values or notation keys, but not a mix of both.	A3

	Name of check	Objective	Method	Potential corrective action
C10	Interlinkages check	Check that information on interlinkages between PaMs and projections are provided **under Gov.Reg. Annex VI (e)**	Assessing whether recalculations or differences WEM and WAM can be explained by respectively new and planned PaMs.	No

Table 2-2 Overview of corrective actions.

Objective		Name of corrective action	Method
Seek to ensure **completeness and comparability** of Union projections **(Gov.Reg. Art. 39(2))** by implementing procedures to estimate any missing data from national projections in consultation with MS **(Gov.Reg. Art. 18(2)).**	A1a	Linear interpolation of intermediate years	It is **good practice** to provide data for intermediate years (e.g., 2021-2024). In case MS cannot provide intermediate reporting years, the dataset will be gap-filled by linear interpolation as required to compile Union projections.
	A1b	Gap-filling of mandatory reporting years	In case MS cannot provide data for the mandatory reporting years 2020, 2025, 2030, 2035, 2040, 2045, and 2050 **(Gov.Reg. Art.18 (2) and Annex XII) and the base/reference year**, the dataset will be gap-filled using a surrogate dataset (if available) or extrapolation, as required to compile complete Union projections.
	A1c	Sectoral gap-filling	In case MS cannot provide data organised by sub-categories **(Gov.Reg. Art.18(1)(b))**, the dataset will be gap-filled by using the relative shares of sectors of a surrogate dataset (GHG inventory), as required to compile sectoral Union projections. No gap-filling is foreseen for a missing gas split.
	A1d	Gap-filling Memo items	In case MS cannot provide data for **mandatory memo items** (international bunkers, international aviation), the dataset will be gap-filled by using the value of the latest historic inventory year for the entire time-series, as required to compile complete Union projections.
	A1e	Gap-filling of ETS/ESR projections	In case MS cannot provide data split by ETS/ESR **(Gov.Reg. Art.18 (1)(b) and Annex VII (b)** but the total emissions are available, the ETS/ESR emission projections will be gap-filled by using the ETS/ESR share of the total emissions of a surrogate dataset (historical or projected data).
	A1f	Gap-filling WAM	**Where available,** a WAM and a WOM scenario shall be reported **(Gov.Reg. Art.18 (1)(b) and Annex VII (a)**. In case MS cannot provide a WAM scenario, the dataset will be gap-filled by using the WEM scenario as WAM scenario, in order to compile a Union projections WAM scenario. No gap-filling is foreseen for a missing WOM.
	A1g	3.2.1.7. Complete gap-filling	Where a Member State does not submit complete projection estimates by 15 March every second year, and the Commission has established that gaps in the estimates cannot be filled by that Member State once identified through the Commission's QA or QC procedures, the Commission may prepare estimates as required to compile Union projections, in consultation with the Member State concerned **(Gov.Reg. Art.18 (2))**.
Seek to ensure time-series **consistency and accuracy** of Union projections **(Gov.Reg. Art. 39(2))** by implementing procedures to recalibrate	A2	Reference year (RY) calibration	It is **good practice** that the reference year of emission projections (RY) is consistent with the respective historic year of the emission inventory. In case MS show significant inconsistencies between RY and inventory year, the projections trend will be recalibrated and aligned to the historic year, as required to compile consistent Union projections.

Objective		Name of corrective action	Method
the starting year (base year) of MS national projections to the historic inventory year in consultation with MS.			
Seek to ensure **completeness and comparability** of Union **(Gov.Reg. Art. 39(2))** by implementing procedures to estimate any missing data from national projections in consultation with MS **(Gov.Reg. Art.18(2)).**	A3	Error correction	If a potential error cannot be clarified or corrected by MS, general error correction will be applied (e.g., unit correction, sum correction), as required to compile accurate Union projections.
	A4	Harmonisation of ETS emissions for stationary combustion	If domestic aviation projections (1A3a - ETS) are reported for the ETS projections in category 1.A.3.a, 1.A.3, 1.A., 1 or the Total without LULUCF, these emissions will be subtracted to derive a consistent value for stationary ETS emissions (in line with Directive 2003/87/EC) and to compile accurate Union projections.

2.4 Timeline

The following table presents an exemplary timeline for the interactions between Member States, EEA and ETC in mandatory reporting years. The timeline presented in **Error! Reference source not found.** can be subject to slight modifications by the ETC/CM and the EEA as the process depends much on the timeliness of submissions and responsiveness of the Member States.

Table 2-3 Timeline for QA procedure in mandatory reporting years (Note: dates marked with * are indicative).

When	What	Who
Until March 15	Preparation of the submission Completion of the reporting template Internal quality control. Annex 1 presents the recommended QC checks to be performed before the submission.	Member State
Until March 15	Preparation for QA procedure (preparation of check files, compilation of additional data used in the checks).	ETC/CM
By March 15 every two years (and voluntary submission in intervening years)	Submission to the European Commission (upload of report and reporting templates to new ReportNet 3.0 platform). T1a_T1b_T5a_T5b GHG projections by gas and categories as xlsx and T2, T3, T4, T6 and T7 for parameters, indicators, model factsheets and sensitivity analysis as xlsx.	Member State
March 15 –April 01*	Performance of QA checks and feedback to MS on data gaps and other findings. If necessary, ETC/CM request data or additional information.	ETC/CM
April 10 – April 19*	MS to respond to ETC/CM 's answers, to comment on findings and/or provide additional data.	Member State
April 20 – April 31*	Processing of corrections, changes as discussed with MS in the communication cycle.	ETC/CM
May 01 – May 14*	If necessary, solve open issues by further communication with MS	ETC/CM and MS
May 15 – May 31 May 15 – June 31	Compilation of EU projections dataset	EEA, ETC/CM
June 01 – September 30	Assessment, analysis, compilation of EU datasets and reporting in progress report and trends and projections report.	EEA, ETC/CM, EC
By July 15	ETC/CM provide feedback documents with main results of the QA/QC process to MS (Completeness status file and Gap-filling & calibration status file	ETC/CM

3 Quality checks

The first part of this section describes the automated checks implemented in Reportnet 3 as of 2023. After the data has been transferred to the EEA database Phase I starts, which is conducted by the ETC/CM and includes the quality assurance checks that assess the general quality of the submission with regard to TCCCA. The next Phase II is conducted after the communication with MS and includes all corrective actions. Finally, in Phase III the ETC/CM applies internal consistency checks, in terms of quality control, to ensure the quality of the final data.

In case any incomplete information or errors are detected in Phase I, the ETC/CM will consult MS via the communication log file. MS will be asked to provide the missing information or any other clarification as necessary. If MS do not provide the requested information, the ETC/CM may proceed with corrective actions for quantitative information if appropriate. Missing qualitative data is considered as not reported.

3.1. Before the submission: automated checks in the Reportnet 3

The Reportnet platform allows for the development of automated checks using the in-built tools or SQL language. The checks are classified in four levels of errors:

- Blocker – serious issues, the data cannot be submitted
- Error - the data may be released but some explanation is required. Datasets with errors should only be submitted under exceptional circumstances.
- Warning – less serious issues, does not prevent the data release.
- Information – minor issues or simple notifications.

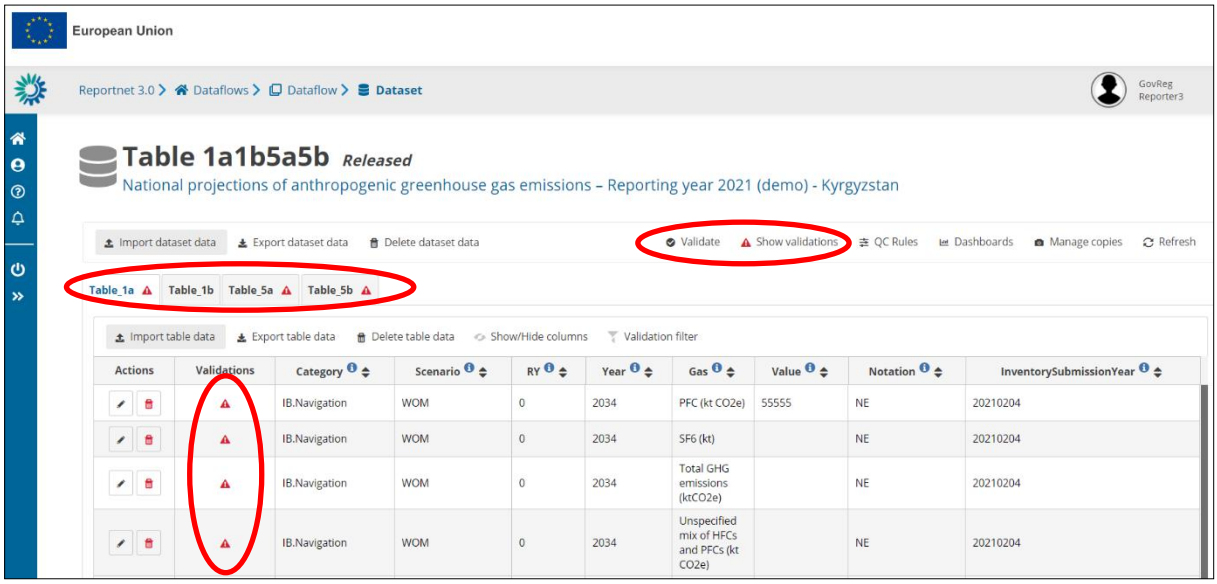
In 2023, seven types of automated checks were implemented. These are summarised in the list below and expanded in Annex 2. Further checks are expected to be implemented in future reporting cycles.

1. Mandatory table has no records
2. Mandatory values must not be missing
3. Records must be of certain type (e.g., text, integer, decimal, etc.)
4. Quantitative records should contain a value or notation key
5. Certain values must be a valid member of a referenced list.
6. Duplicated record
7. Missing units

Automated checks are triggered in Reportnet by the validation process, which runs at the moment of releasing the data and on demand by clicking the *Validate* button. A full list of automated checks can be found by clicking on the *QC Rules* button.

An error symbol appears in the tab of affected tables and next to each affected record. A description of the error appears by hovering the mouse over the symbol. Records can be filtered by type of error using the menu *Show validations*.

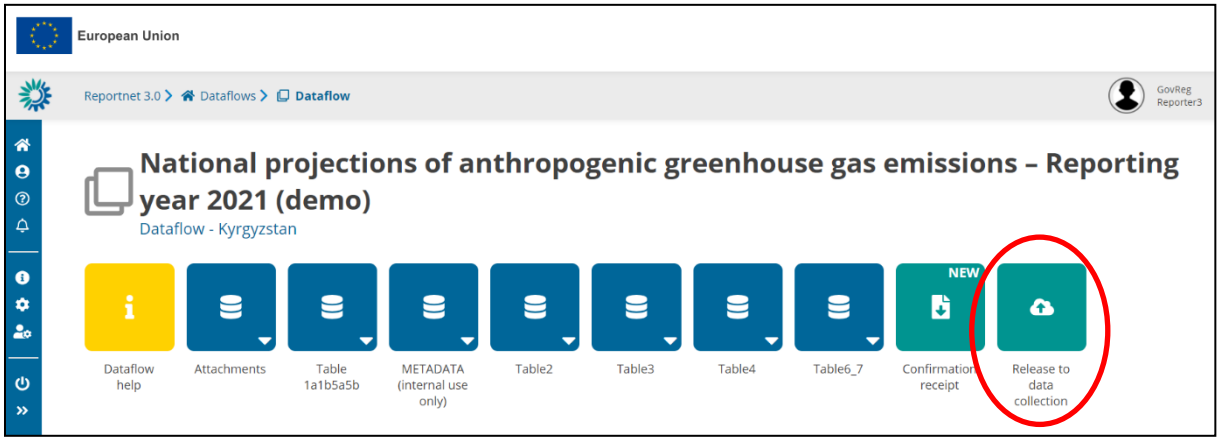
Figure 3-1 Where to find feedback from automated checks.



Source: Screenshot of Reportnet platform.

After running the automatic QA, the reporter is encouraged to have a careful look at the results. Only then, the submitting will be possible using the *Release to data collection* button. A confirmation receipt in pdf is automatically generated if the release is succesfull.

Figure 3-2 Example of how to release/submit data on Reportnet.



Source: Screenshot of Reportnet platform.

3.2. Phase I - QA of national projections and MS consultation

Phase I consists of the following checks:

- Completeness checks (C1)
- Consistency(C2)
- Reference year checks 1 and 2 (C3)
- Accuracy checks (C4)
- Parameter checks (C5)
- ETS/ESR checks (C6)
- NECP check (C7)
- Sensitivity analysis check (C8)
- Time series check (C9)
- Interlinkages check (C10)

3.2.1. Completeness checks (C1)

Name of check	Completeness checks
Objective	Assess **completeness and transparency** of MS' submissions **(Gov.Reg. Art. 39(2))**
Method	Reviewing MS' reporting template and the accompanying report with regard to mandatory **(Gov.Reg. Art.18)** and recommended reporting requirements. Filling in the *Status & completeness report* for each MS.
Potential corrective actions	Data gap-filling (A1a, b, c, d, f, g)
Threshold for significance	No

The completeness check comprises the following detailed checks:

- projections are reported on time and in the correct format via Reportnet 3 (mandatory)
- organised by sectors (incl. LULUCF) and memo items (mandatory)
- organised by gases: CO2, CH4, N2O, HFC, PFC, NF3, SF6 and unspecified mix of HFCs and PFCs (mandatory)
- for all years: RY, 2020, 2025, 2030, 2035, 2040, 2045, 2050 (mandatory) and intermediate years (good practice)
- for all scenarios: WEM (mandatory), WAM (where available), WOM (where available)
- EU ETS/ESR split for sectors, years, and scenarios (mandatory)
- notation keys in case of missing emissions data (good practice)
- Total cumulative LULUCF emissions/removals accounted and cumulative ESR emissions for the accounting periods 2021-2025 and 2026-2030 (mandatory)
- Aggregated LULUCF projections provided for reported (Table 1b part 2) and accounted (table 1b part 3) LULUCF projections (mandatory)
- projection parameters for mandatory years and scenarios (mandatory)
- projection indicators (voluntary)
- projection models (mandatory)
- sensitivity scenarios and key parameters (mandatory)
- Report including:
    - description of methodologies and models used (mandatory)
    - underlying assumptions (mandatory)
    - results of sensitivity analysis (mandatory)

With regard to the parameters, the completeness of the reported parameters is examined. This is determined by assessing that a value is provided for all mandatory years together with the units and data source.

The reports submitted by MS will be analysed regarding sensitivity analysis, transparent descriptions of methodologies, assumptions and models and whether sectoral, geographical and temporal coverage are explained in the report. With regard to models, the ETC/CM verifies that MS have filled the model factsheet.

3.2.2. Consistency check (C2)

Name of check	Consistency check
Objective	Assess **consistency and comparability** of MS' submissions **(Gov.Reg. Art. 39(2))**
Method	Checking whether the GHGs were reported in the correct unit. In addition, it is checked whether Memo Items and sector LULUCF is allocated correctly and to clarify if indirect CO_2 emissions are included in/excluded from the Total (without LULUCF). Since 2021 the consistency of the LULUCF information reported in table 1a and 1b (part 2) is checked
Potential corrective action	Error correction (A3)
Threshold for significance	No

This check ensures that the correct units are reported by the MS. MS may report in t CO_{2eq} instead of kt CO_{2eq}, CH_4 in kt CO_2eq instead of kt CH_4, or a copy-paste error may have occurred. The unit check applies for all main sectors and all gases reported for the reference year in Table 1a, table 1b Part 2/part 3 and table 6 (results of the sensitivity scenarios). For this reason, the GHG unit check assesses that all MS consistently use the correct units. However, there could be other reasons why a value is not reported in the correct unit (e.g., sum errors).

The check consists of two steps:

1) General unit check: Here the projected values are compared to the inventory values, and it is checked if they do not exceed or fall below a range of -/+10% to highlight extreme outliers. This check applies to all gases and on a sectoral level.
2) Then the sum (in $CO_{2eq)}$ of the Total (excluding LULUCF) for each gas by multiplying with the GWP from AR 4 is calculated. This sum is compared to the reported Total (excluding LULUCF) in CO_{2eq}:

    a) Calculate the Total

$$
\begin{aligned}
Total_{calc}(kt\ CO_{2eq}) &= Total_{rep}(kt\ CO_2) + Total_{rep}(kt\ CH_4) * 25 + Total_{rep}(kt\ N_2O) * 298 \\
&+ Total_{rep}(kt\ CO_{2eq}\ HFC) + Total_{rep}(kt\ CO_{2eq}\ PFC) \\
&+ Total_{rep}(kt\ CO_{2eq}\ unspecified\ mix\ of\ HFCs\ and\ PFCs) \\
&+ Total_{rep}(kt\ CO_{2eq}\ SF_6) + Total_{rep}(kt\ CO_{2eq}\ NF_3)
\end{aligned}
$$

    b) Calculate the difference between $Total_{calc}$ und $Total_{rep}$ and check if smaller/larger than zero:

$$Total_{calc}(kt\ CO_{2eq}) - Total_{rep}(kt\ CO_{2eq}) \neq 0$$

In case the range is exceeded (step 1) and/or the calculated Total is different from the reported Total (step 2), the MS will be consulted to seek for clarifications.

In this check it is also investigated if Memo Items (e.g., International Aviation) and sector LULUCF are correctly allocated. These sectors should not be reported under ETS or ESR. The ETC/CM will consult the MS and re-allocate the sectors during the Corrective Actions Phase if necessary.

Regarding the consistency of the LULUCF information reported in tables 1a and 1b (part 2), the ETC compares the time series provided in the two tables for the Total GHGs, CO_2, CH_4 and N_2O for all reported scenarios and categories. Any discrepancy in the numbers will trigger a question of clarification to the Member States.

3.2.3. Reference year check 1 (C3a)

Name of check	BY check 1
Objective	Assess **consistency** of MS' submissions. **(Gov.Reg. Art. 39(2))**
Method	Checking whether the reference year of projections is consistent with the historic emissions of the inventory.
Potential corrective action	Reference year (RY) calibration (A2)
Threshold for significance	Yes (depending on sector specific uncertainty)

This check compares the starting year of projections (defined as reference year) on a sectoral level to the respective year (the same year) reported in the latest available emission inventories (either the January submission 2021 or the final submission of 2020). It is assessed if there is an inconsistency between the historical and the projected value of this year and whether the difference is below a defined threshold of significance. The threshold was defined as the sector specific level uncertainty as reported by MS. The reference year check applies to table 1a (excluding LULUCF).

Table 3-1 Example of a reference year check 1 (C3a).

Sector	Base Year	BY projected (kt CO2eq)	Inventory emissions of base year (kt CO2eq)	Absolute difference (kt CO2eq)	Relative difference to inventory (%)	Sector specific uncertainty (%)	Check passed
3	2018	100	120	20	16.7%	5	no
2	2018	85	90	5	5.6%	10	yes

If the difference is larger than the sector specific uncertainty *Reference Year check 2* will be applied. In case the difference is below the threshold, the MS passes the check, and no further action is required.

3.2.4. Reference year check 2 (C3b)

Name of check	BY check 2
Objective	Assess **consistency** of MS' submissions. **(Gov.Reg. Art. 39(2))**
Method	Checking whether an identified inconsistency between historic inventory and projected reference year is deemed significant.
Potential corrective action	Reference year (RY) calibration (A2)
Threshold for significance	3% of Total without LULUCF

MS' projections will be further assessed if the sum of the absolute difference between the RY of the projections and the inventory has significant influence on the reported total emissions of the national projections. The difference will be compared against a threshold of 3% of the reported total emissions. The threshold was defined on the basis of the experience gained during the QA/QC process in the previous reporting cycles.

If the difference exceeds the threshold of significance for the total emissions the MS will be consulted by the ETC/CM that a reference year calibration across the whole time series and all gases (including the ETS and ESR emissions) may be applied to harmonise the MS submissions with the latest inventory data.

If the difference is below the threshold of significance for the ETS or ESR emissions, the MS will be consulted by the ETC/CM, but no calibration will be applied by the ETC/CM. A recommendation may be given to encourage MS to update the dataset for the next submission.

Table 3-2 Example of a reference year check 2 (C3b).

BY 1 check passed	Sector	Ref. Year	Base year value (kt CO2eq)	Inventory emissions of base year (kt CO2eq)	Absolute difference (kt CO2eq)	Relative difference to inventory (sum)	Thres hold	BY 2 Check passed	Sector calibration
	Total	2018		1500					
No	3	2018	100	120	***20***				
Yes	2	2018	85	90	5				
Yes	1	2018	20	21	1				
No	5	2018	15	50	***35***				
				sum	61	4%	3%	no	yes

For detailed information on the methodology of the RY calibration see chapter 3.3.2.

3.2.5. Accuracy checks (C4)

Sum check (C4a)

Name of check	Sum check
Objective	Assess **accuracy** of MS' submission **(Gov.Reg. Art. 39(2))**
Method	Checking that disaggregated emission projections by gas and sector equal the total sum reported by MS.
Potential corrective action	Error correction (A3)
Threshold for significance	Yes

Disaggregated values for each year are summed up and compared with the total. Sum of emissions of individual GHGs are compared to total GHG emissions and sum of emissions in subsectors and compared to reported sector emissions. The difference should be less than 0.25% of the total emissions. 0.25% was chosen as threshold for significance since a smaller difference could be attributed to rounding. Nevertheless, if manual control excludes that small differences are caused by rounding, this could result in a question to the MS to either explain or adjust the reporting.

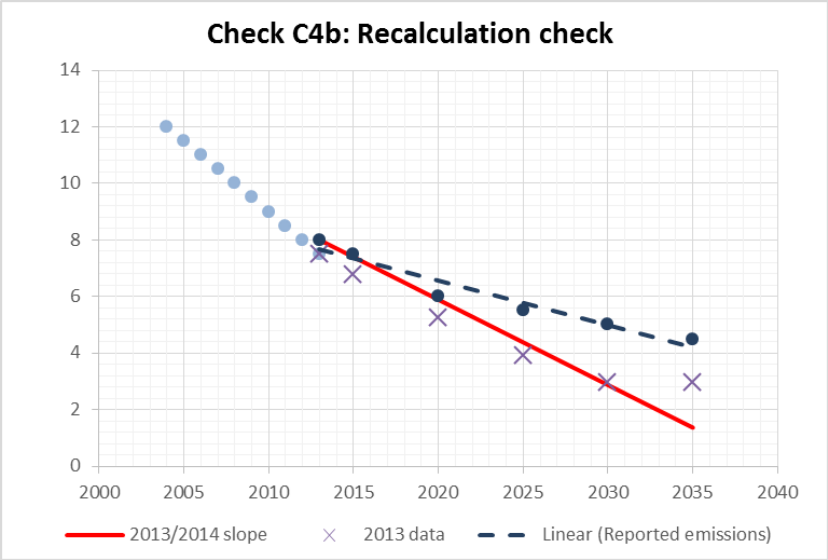
Recalculation check (C4b)

Name of check	Recalculation check
Objective	Assess **accuracy** of MS' submission **(Gov.Reg. Art. 39(2))**
Method	Compare the total emission projection for each scenario with the total emission projection reported by MS in the last reporting period.
Potential corrective action	No
Threshold for significance	Yes

The total emission projection for each scenario reported by MS and the total emission projection reported in the last reporting period will be compared. This includes the slope and the average emissions over the period. This check consists of two elements:

a) The threshold of significance is 15%. If the threshold is exceeded, visual inspection of the data in a graph confirms a marked difference and no explanation is provided in the report (e.g., change of projection model, new assumptions), the MS will be consulted by the ETC/CM, but no corrective action will be applied by the ETC/CM as this is a transparency issue. A recommendation may be given to encourage MS to provide an explanation in the next submission.
b) The new submission is identical to the previous submission (for a certain sector or gases or years). The Member States will be consulted by the ETC/CM in order to clarify why the projections were not updated.

Figure 3-3 Example of a recalculation check (C4b).

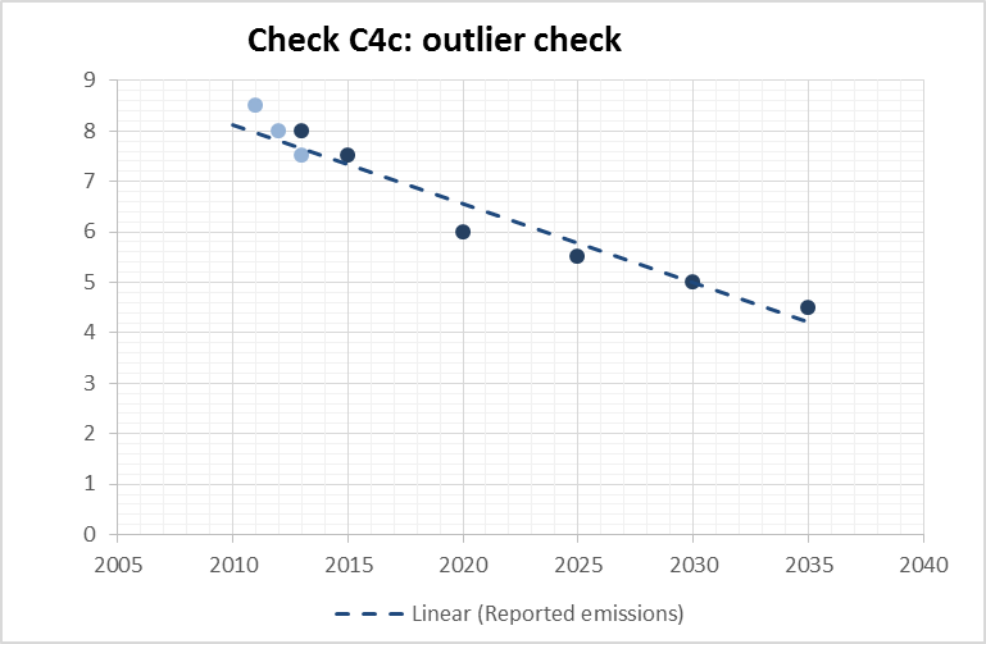


Outlier check (C4c)

Name of check	Outlier check
Objective	Assess **accuracy** of MS' submission **(Gov.Reg. Art. 39(2))**
Method	Checking whether the reported emissions in a certain year are above or below the trend line of the historic emissions.
Potential corrective action	No
Threshold for significance	Yes

It is checked whether there are outliers within the time-series of projected emissions by scenario and sector. An outlier is identified when the difference between the reported emissions and the emissions based on the linear trend line of projected emissions is more than 10% and visual inspection of the data in a graph. If the threshold is exceeded and no explanation is apparent (e.g., non-linear trend line) or is provided in the report, the MS will be consulted by the ETC/CM, but no corrective action will be applied by the ETC/CM. A recommendation may be given to encourage MS to provide an explanation in the next submission.

Figure 3-4 Example of an outlier check (C4c).



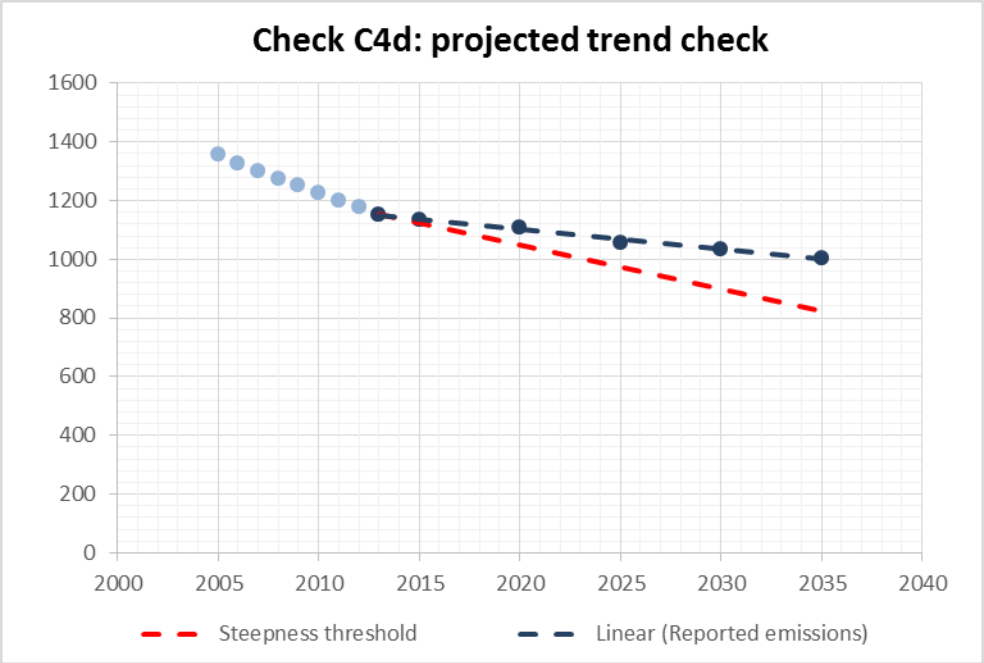
Projected trend check (C4d)

Name of check	Projected trend check
Objective	Assess **accuracy** of MS' submission **(Gov.Reg. Art. 39(2))**
Method	Checking if projected trend line seems plausible.
Potential corrective action	No
Threshold for significance	Yes

The slope of the trend line of projected emissions is calculated to check whether the trend line seems too steep. This check is done on a sectoral level. If the slope of the sectoral projections is higher or

lower than 5%, the ETC/CM will attempt to determine the reasons for the steep gradient in the projections report and by comparison with the recent historic emission trends. If no explanation can be found, the ETC/CM will consult the MS to identify the reason. No corrective action will be applied by the ETC/CM. A recommendation may be given to encourage MS to provide an explanation in the next submission.

Figure 3-5 Example of a projected trend check (C4d).

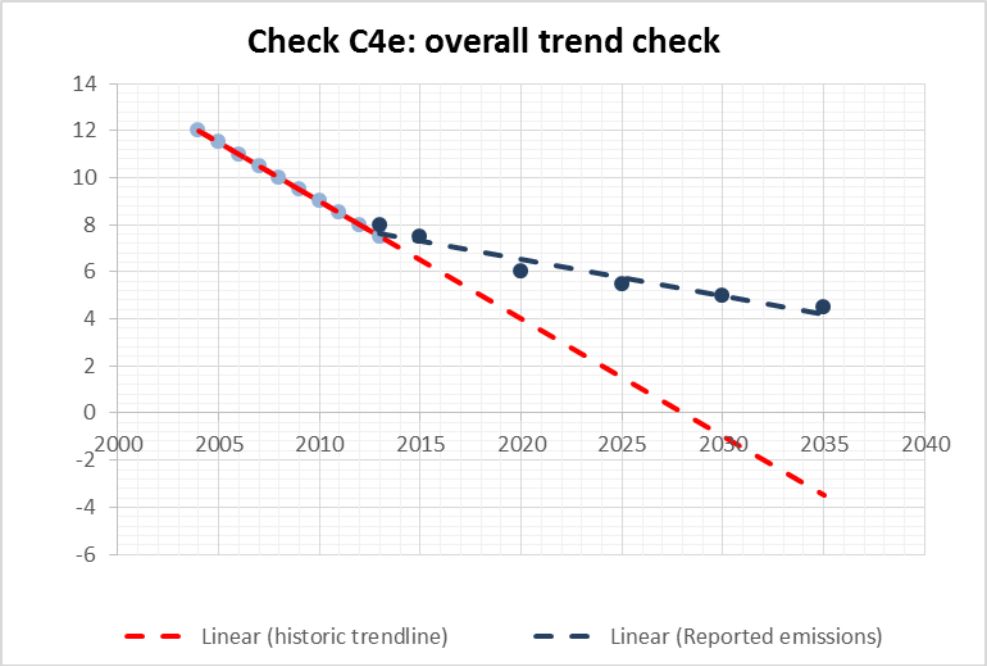


Overall trend check (C4e)

Name of check	Overall trend checks
Objective	Assess **accuracy** of MS' submission **(Gov.Reg. Art. 39(2))**
Method	Checking whether the projected trend line gradient is significantly different from the historical trend line of MS' submission.
Potential corrective action	No
Threshold for significance	Yes

It will be assessed whether the projected trend line gradient is not too different from the historical trend line by MS and scenario for totals and for matching sets of sector and gas. If the projected trend is inconsistent with the trend of the GHG inventory (standard deviation is more than 50% of emission levels), the ETC/CM will attempt to determine the reasons behind the difference in the trend from the projections reports. If no explanations are found, the ETC/CM will consult the MS to identify the reason. No corrective action will be applied by the ETC/CM. A recommendation may be given to encourage MS to provide an explanation in the next submission.

Figure 3-6 Example of an overall trend check (C4e).



WEM, WAM, WOM check (C4f)

Name of check	WEM, WAM, WOM checks
Objective	Assess **accuracy** of MS' submission **(Gov.Reg. Art. 39(2))**
Method	Checking whether emissions in WOM ≥ WEM ≥ WAM.
Potential corrective action	No
Threshold for significance	Yes

It will be assessed if emissions in the WOM scenario are equal to or higher than emissions in the WEM scenario and if emissions in the WEM scenario are equal to or higher than emissions in the WAM scenario. For all sectors and gases where this is not the case, a question for clarification will be asked to the MS.

3.2.6. Parameters checks (C5)

Member States are required to provide information on the parameters used in their projections (according to (EU) 2020/1208) Art. 38(d)). The checking of parameters allows a basic assessment of the plausibility of the GHG projections. Only the parameters used in the modelling have to be reported.

Unit check (C5a)

Name of check	Unit check
Objective	Assess **consistency and comparability** of MS' submission **(Gov.Reg. Art. 39(2))**
Method	Ensuring that all MS use the same units.

Potential corrective action	Error correction (A3)
Threshold for significance	No

In the first step historical data from Eurostat will be compared with reported projection data for the given reference year. If these are similar it is assumed that the unit is correct. If a detected difference can be explained by use of different units, data may be converted accordingly.

If differences between historical data and projected data can easily be explained by the use of incorrect units, MS will be informed. If no explanations can be found, the ETC/CM will consult the MS for clarification.

The unit check is carried out for the following parameters: Population, Gross Domestic Product (GDP), and net electricity import.

Historic parameter check (C5b)

Name of check	Historic parameter check
Objective	Assess **consistency and accuracy** of MS' submission **(Gov.Reg. Art. 39(2))**
Method	This check will be performed by determining the percent difference between data reported by MS and Eurostat data for each historic time step for which data is available by both sources.
Potential corrective action	No
Threshold for significance	No

Projected data for important parameters such as GDP and population should start from historical values (reference year) to ensure time series consistency. This check will be performed by determining the relative difference between data reported by MS and surrogate data for the projection reference year. Surrogate data for GDP, population are taken from the corresponding Eurostat datasets.

Historic values should be very close to the data reported in the datasets indicated above. Small differences may occur if data in the surrogate data set was updated after the preparation of each individual projection. It can be assumed that historic values should only differ insignificantly after updates of surrogate data sets, but a certain discrepancy should be taken into account and not be considered as an indication for an error. The deviation is calculated as the difference between data surrogate data source and MS' parameter data divided by the data of the surrogate data source. If no explanations for a significant deviation can be found, the ETC/CM will consult the MS for clarification.

Check against EC recommended parameters (C5c)

Name of check	Check against EC parameter recommendations
Objective	Assess **consistency and comparability** of MS' submission **(Gov.Reg. Art. 39(2))**
Method	Data for projected years (2020, 2025, 2030, 2035, 2040, 2045 and 2050) will be checked against recommended values.
Potential corrective action	No
Threshold for significance	No

This check is undertaken in order to explore whether the recommended parameters provided by the EC have been considered by Member States in their projections.[5] The check is only carried out for the following parameters: population, GDP, carbon price, gas, coal and oil import prices. Note that Member States should take into account the recommended parameters in their projections, but no corrective action will be applied, if this is not the case. While for population and price data absolute values are checked against each other, for GDP growth rates will be checked against each other.

3.2.7. ETS/ESR check (C6a)

Name of check	ETS/ESR check
Objective	Assess **consistency and comparability** of MS' submission **(Gov.Reg. Art. 39(2))**
Method	The ETS/ESR split calculated from EUTL data and emission inventories will be compared to the ETS split reported in projections files for total and main source categories and checked for inconsistencies.
Potential corrective action	No
Threshold for significance	Yes

Projected emissions shall be reported separately for ETS and ESR emissions for each source category. ETS splits, calculated as ETS emissions divided by total emissions per category, should be consistent and plausible between EUTL and inventory data and projections for historic years and should change along the timeline only in small steps. ETS splits allow a fast analysis of underlying shares of emissions under the ETS and ESR sector.

Firstly, it will be checked if total projected emissions have been reported separately for emissions in ETS and ESR sector and if sectoral sums add up correctly. If this is not the case on the level of total GHG, the MS will be informed and if no corrected dataset is provided, the ETC will apply a corrective action as explained in section 3.3.1. Note that this check also forms the basis for check C6b, as a difference in sectoral sums may indicate a misreporting of domestic aviation emissions (1.A.3.a).

If ETS and ESR emissions are reported separately, the ETS emissions will be compared to historic ETS emissions from EUTL. If projected total emissions are different by more than +/-3% compared to ETS emissions of the respective historic year, MS will be asked for clarification.

The ETS split calculated from ETS data and emission inventories will be compared to the ETS split reported in projections files for the reference year for total GHG emissions as well as for the main source categories. If the difference between ETS splits from inventories and reference year of projections is higher than 5 %, the ETC/CM reviewer will ask the MS for clarification. No correction will take place.

Secondly, projected ETS splits will be calculated along the timeline and checked for time series consistency. If no change of ETS split can be seen on the level of total GHG, MS will be asked for clarification to ensure that ETS and ESR emissions have been projected in sufficient detail. If the annual change of ETS splits is higher than 3% or lower than -3%, MS will be asked for underlying reasons of this, if no information has been given in projection reports.

[5] https://www.eionet.europa.eu/reportnet/docs/govreg/projections

3.2.8. ETS stationary combustion check (C6b)

Name of check	ETS stationary combustion
Objective	Assess **consistency and comparability** of MS' submission **(Gov.Reg. Art. 39(2)) and to ensure that only stationary ETS emissions are reported in accordance with Directive 2003/87/EC.**
Method	Check if emissions from 1.A.3.a domestic aviation are reported under the ETS emissions.
Potential corrective action	A4
Threshold for significance	No

With this check it is ensured that the sector 1A3a is not reported under sector 1.A.3.a., 1.A.3., 1.A., 1 and Total without LULUCF for Total ETS GHG emissions[6]. If 1.A.3.a is reported under ETS, Member States are asked to delete reported ETS emissions from these sectors. If it is not conducted by Member States, the ETC/CM will subtract these emissions from the sectors mentioned to derive a harmonised EU Total for stationary combustion in the EU ETS (see chapter 3.3.4).

3.2.9. NECP check (C7)

Name of check	NECP check
Objective	Compare projections reported under **Gov.Reg. Art 18.** with projections reported in the final NECP (Gov.Reg. Art 3).
Method	Check the absolute and relative difference of Gov.Reg. and NECP projections of WEM and WAM (if available).
Potential corrective action	No
Threshold for significance	No

EU MS have to submit National Energy and Climate Plans (NECPs) and biennial National Energy and Climate Progress Reports as part of the Energy Union Governance. This plan and progress reports requires that MS also report on projections. For this reason, a check has been introduced in order to compare the projections reported under Gov.Reg. Art 18 with those reported in the NECP and NECPRs. The ETC/CM will track differences upon request of the EEA when relevant. This is for informative purposes only and will not result in additional questions to the MS unless there is a significant discrepancy between the NECP and reporting under the Gov.Reg. that were not already addressed in previous reviews or that are not explained in the technical report (see also recalculation check).

3.2.10. Sensitivity analysis checks (C8)

With the new reporting under the Gov. Reg. MS have to report on their sensitivity scenarios including the underlying key parameters which were varied for this analysis (table 6 and 7). For this reason, new quality checks were developed related to the sensitivity analysis.

[6] In accordance with footnote 4 of the Implementing Regulation (EU) 2020/1208 the scope of the ETS emissions has to be in line with Directive 2003/87/EC, the scope (specified in ANNEX I)

Sensitivity check on scenarios in Tables 6 and 7 (C8a)

Name of check	Sensitivity check – consistency
Objective	Ensure that the sensitivity scenarios reported in table 6 and 7 are consistent (**Gov.Reg. Art 39. (2))**
Method	Check that each sensitivity scenario in Table 6 is coupled to a parameter scenario in Table 7.
Potential corrective action	No
Threshold for significance	No

This check is conducted automatically by comparing the number of sensitivity scenarios that are reported in tables 6 and 7. It is expected that for all emission sensitivity scenarios reported in table 6, corresponding parameter sensitivity scenarios are reported in table 7 and vice versa. This check only considers the consistency in the number of scenarios reported.

Sensitivity check on correspondence between Tables 6 and 7, and 1a and 3. (C8b)

Name of check	Sensitivity check - correspondence with reported projections & parameters
Objective	For the reported sensitivity scenarios in Tables 6 and 7, ensuring the information on GHG projections and sensitivity scenarios and the related parameters is consistent
Method	Comparison of the reference year and reference year values of the GHG projections in table 1a with the RY values of the sensitivity analysis in table 6, and comparison of RY values of parameters in table 3 with the parameters used for the sensitivity analysis in table 7.
Potential corrective action	No
Threshold for significance	No

Member States report projected sensitivity scenarios for emissions (table 6) and the corresponding parameters (table 7). Reference years and reference year values are also reported. It is expected that the reported reference year in the sensitivity scenarios matches the reference year in tables 1a and 3 and that the values are the same i.e., that the sensitivity scenarios begin from the same reference point. This check first assesses whether the reported reference year values are the same through an automatic comparison of tables 1a, 3, 6 and 7. Where the same reference year has been reported, the values are then compared for emissions (table 1a vs table 6) and parameters (table 3 vs table 7). Any discrepancies are flagged.

3.2.11. Time series check (C9)

Name of check	Time series check
Objective	Ensure that MS do not report historical values when no projections are available.
Method	Check that the base year value and projected time series include either values or notation keys, but not a mix of both.
Potential corrective action	Deletion of base year value, if no projections are reported and replacement by the same information reported for the projections. Respective adjustment of sums of higher categories and ETS/ESR split, if necessary. (A3)
Threshold for significance	Not applicable

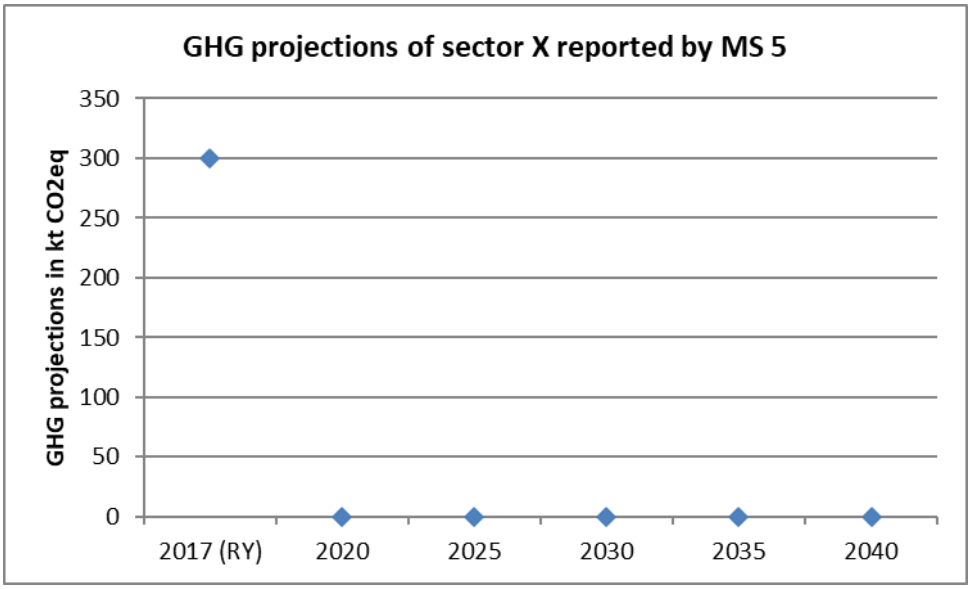
The time series check ensures that the time series of the sectoral EU aggregated projections are consistent. The major source of inconsistencies was caused when Member States reported historical data although no projections are available (as shown in the example below, **Error! Reference source not found.**). Therefore, the ETC/CM conducts a check to all sectors included in the EU aggregated projections dataset to ensure that the MS either report values or notation keys along the whole time series and the reference year. Note that this only applies for inconsistencies between the reference year and the rest of the time series. If for a sector projected values are only provided up to a certain year in the future and afterwards a notation key because the activity is expected to stop, this will not be raised in this check, because it is correct reporting.

Table 3-3 Example for time series inconsistency due to a mixed use of notation keys and values.

Data for sector X	2019 (BY)	2020	2025	2030	2035	2040
MS 1	17	19	13	12	11	13
MS 2	194	121	145	158	151	100
MS 3	15	20	17	19	6	7
MS 4	342	370	239	230	250	249
MS 5	300	IE	IE	IE	IE	IE
MS 6	19	20	20	15	11	14
EU aggregate if not corrected	887	550	434	434	429	383
corrected EU aggregate	587	550	434	434	429	383

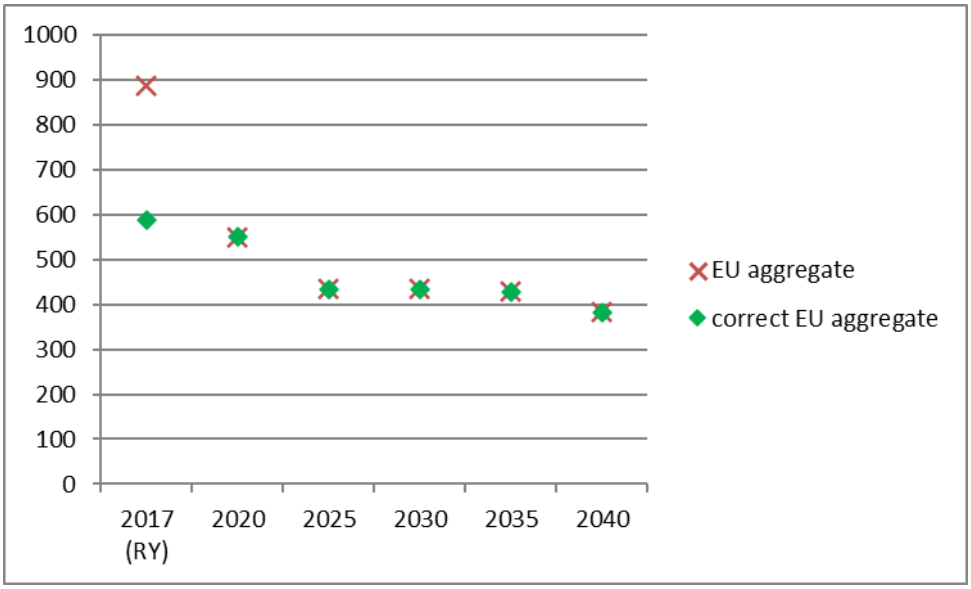
The following figure visualizes the time series of MS 5.

Figure 3-7 Visualisation of time series with inconsistent use of notation keys and values.



The impacts on EU aggregate for sector X is presented in the following figure.

Figure 3-8 Corrected time series.



If a MS reports notation keys for the projections but a value for the reference year, this will be raised in the QA/QC. In case no resubmission is provided, the ETC/CM will correct it to ensure the EU time series is consistent.

3.2.12. Interlinkages check (C10)

Name of check	Interlinkages check
Objective	Check interlinkages and coherence of projections and PaM reporting as required under Gov.Reg. Annex VI (e).
Method	Assessing whether recalculations or differences WEM and WAM can be explained by respectively new and planned PaMs.
Potential corrective action	None
Threshold for significance	No

When performing the recalculation check, it will be assessed if important differences can be explained by new PaMs that have been implemented (if differences cannot be explained by methodological changes). When WAM projections are reported, it will be checked if this corresponds with planned PaMs. Information will be taken from the PaM reporting under the Gov.Reg., if already available at the moment of the checks, or from the technical report.

3.3. Phase II - Corrective actions

Phase II consists of the following corrective actions:

- Data gap-filling (A1)
- Reference year (RY) calibration (A2)
- Error correction (A3)

3.3.1. Data gap-filling (A1)

In the following section different gap-filling methods are described. Examples are provided to demonstrate transparently how the ETC/CM may fill data gaps.

Objective of data gap-filling: Seek to ensure **completeness and comparability** of Union projections **(Gov.Reg. Art. 39(2))** by implementing procedures to estimate any missing data from national projections in consultation with MS **(Gov.Reg. Art. 18(2)).**

Linear interpolation of intermediate years (A1a)

Name of corrective action	Linear interpolation of intermediate years
Method	It is **good practice** to provide data for intermediate years (e.g., 2021-2024). In case MS cannot provide intermediate reporting years, the dataset may be gap-filled by linear interpolation as required to compile Union projections.

In order to fill the data gaps between mandatory reporting years (e.g., 2021-2024) the ETC/CM reviewer applies linear interpolation between the reported years. The interpolation is applied for CO_{2eq} on sectoral and total level.

Table 3-4 Reported by Member State.

	Total GHG (kt CO_2eq)					
Sector/category	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
1A	1000					800
2B	150					50

Table 3-5 Gap-filled by ETC/CM (A1a).

	Total GHG (kt CO_2eq)					
Sector/category	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
1A	1000	960	920	880	840	800
2B	150	130	110	90	70	50

Gap-filling of mandatory reporting years (A1b)

Name of corrective action	Gap-filling of mandatory reporting years
Method	In case MS cannot provide data for the mandatory reporting years 2020, 2025, 2030,2035, 2040, 2045 and 2050 **(Gov.Reg. Art.18 (2) and Annex XII) and the base/reference year**, the dataset will be gap-filled using a surrogate dataset (if available) or extrapolation, as required to compile complete Union projections.

In order to fill the data gaps of mandatory reporting years (e.g., 2015) the ETC/CM reviewer applies linear interpolation between reported years. The interpolation is applied for CO_{2eq} on sectoral and total level. For instance, when a MS only reports data from 2019 – 2035, but no data for 2040, the ETC/CM reviewer will extend too short time series to the mandatory projection horizon. A suitable option will be selected in close consultation with the Member States experts. The options are either to apply a trend extrapolation of the years 2030-2035 or by applying constant numbers after 2035 (see tables below).

Table 3-6 Reported by Member State.

	Total GHG (kt CO_2eq)		
Sector/Category	**2030**	**2035**	**2040**
1A	1000	800	
2B	150	170	

Table 3-7 Gap-filled by ETC/CM (A1b) – Option trend extrapolation.

	Total GHG (kt CO_2eq)		
Sector/Category	**2030**	**2035**	**2040**
1A	1000	800	600
2B	150	170	190

Table 3-8 Gap-filled by ETC/CM (A1b) – Option constant trend.

	Total GHG (kt CO_2eq)		
Sector/Category	**2030**	**2035**	**2040**
1A	1000	800	800
2B	150	170	170

Sectoral gap-filling (A1c)

Name of corrective action	Sectoral gap-filling
Method	In case MS cannot provide data organised by sub-categories **(Gov.Reg. Art.18(1)(b))**, the dataset will be gap-filled by using the relative shares of sectors of a surrogate dataset (GHG inventory), as required to compile sectoral Union projections. No gap-filling is foreseen for a missing gas split.

For the EU aggregated dataset, it is necessary that certain categories and sub-categories are reported by all Member States to ensure the EU aggregated projections are correct and complete.

In order to gap-fill a missing sub-category, the ETC/CM reviewer applies relative shares of the sub-categories according to the latest GHG inventory submission. If the affected sub-categories are also reported for ETS/ESR, these projections are gap-filled in a second step (described in section on gap-filling of ETC/ESR projections). Before any of these gap-filling is applied to the Member States data, the ETC/CM will communicate this with to the Member States experts to confirm the procedure and approach.

Example:
The MS only reports emission projections for sector 1, but no disaggregation on sub-category level 1.A.1, 1.A.2., etc.

Table 3-9 Reported by Member State.

	Total GHG (kt CO2eq)					
Sector/category	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Total (excl. LULUCF)	824	829	811	782	773	762
Energy total (1)	800	810	790	760	750	740
1A1						
1A2						
1A3						
1A4						
1A5	5	2	2	2	2	2
1B	11	10	12	13	14	13
1C	NO	NO	NO	NO	NO	NO

The ETC/CM applies a gap-filling by using the share of sub-categories from the latest year in the GHG inventory assuming a constant trend of the share along the projected time series.

Table 3-10 Inventory information used for gap-filling.

Sector/category	Emissions in 2019	Share of sub-categories of sector 1
Total w.out LULUCF	839	
1	821	100%
1A1	301	37%
1A2	170	21%
1A3	200	24%
1A4	150	18%
1A5	6	
1B	12	
1C	NO	

Table 3-11 Gap-filled dataset (A1c).

	Total GHG (kt CO2eq)					
Sector/category	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Total (excl. LULUCF)[7]	824	829	811	782	773	762
Energy total (1)	800	810	790	760	750	740
1A1	293	297	290	279	275	271
1A2	166	168	164	157	155	153
1A3	195	197	192	185	183	180
1A4	146	148	144	139	137	135
1A5	5	2	2	2	2	2
1B	11	10	12	13	14	13
1C	NO	NO	NO	NO	NO	NO

([7]) In this example the Total (excl. LULUCF) is not changed.

Gap-filling of Memo items (A1d)

Name of corrective action	Gap-filling of Memo items
Method	In case MS cannot provide data for **mandatory memo items** (international bunkers, international aviation), the dataset will be gap-filled by using the value of the latest historic inventory year for the entire time-series, as required to compile complete Union projections.

If the time series of memo items (international bunkers, international aviation) is missing, the latest historic value of the latest available national inventory is applied as a constant value to the projected time series.

Gap-filling of ETS/ESR projections (A1e)

Name of corrective action	Gap-filling of ETS/ESR projections
Method	In case MS cannot provide data split by ETS/ESR **(Gov.Reg. Art.18 (1)(b) and Annex VII (b)** but the total emissions are available, the ETS/ESR emission projections will be gap-filled by using the ETS/ESR share of the total emissions of a surrogate dataset (historical or projected data).

If MS do not provide complete GHG emission projections for ETS and ESR sectors, the ETC/CM reviewer applies a gap-filling by using either surrogate datasets or the application of sectoral shares of surrogate datasets, depending on which option is deemed more suitable by the Member States and ETC/CM experts. Relevant data sources to support the gap-filling are the GHG inventory (e.g., Annex V of the Implementing Regulation (EU) No 749/2014 on historical ETS emissions) to obtain a sectoral split or the latest available projections by the European Commission to obtain a projections trend.

In case a gap-filling is necessary, the ETC/CM reviewer will suggest at least one or several gap-filling options to the Member State in order to decide on the most suitable approach.

Gap-filling of WAM (A1f)

Name of corrective action	Gap-filling of WAM
Method	**Where available,** a WAM and a WOM scenario shall be reported **(Gov.Reg. Art.18 (1)(b) and Annex VII (a)**. In case MS cannot provide a WAM scenario, the dataset will be gap-filled by using the WEM scenario as WAM scenario, in order to compile a Union projections WAM scenario. No gap-filling is foreseen for a missing WOM.

The ETC/CM will use the national WEM scenario reported by MS as WAM scenario. This is applied to the Total GHGs, Total ESR, Total ETS emission projections, as well as the for the gases (CO_2, CH_4, N_2O, HFCs, PFCs, unspecified mix of HFCs/PFCs, SF_6 and NF_3).

Complete gap-filling (rejection of submitted dataset) (A1g)

Name of corrective action	Complete gap-filling
Method	Where a Member State does not submit complete projection estimates by 15 March every second year, and the Commission has established that gaps in the estimates cannot be filled by that Member State once identified through the Commission's QA or QC procedures, the Commission may prepare estimates as required to compile Union projections, in consultation with the Member State concerned **(Gov.Reg. Art.18 (2))**.

Where Member States do not submit complete projections and the gaps cannot be filled in consultation with the Member State during this QA procedure, the Commission may prepare estimates to compile the Union projections, also in consultation with the Member State **(Gov.Reg. Art.18 (2))**. The QA procedure predefines following criteria and cases which could trigger a complete gap-filling:

- No projections provided at all.
- No updated projections provided, the submission contains the same data as previously submitted.
- The RY is outdated and the trend between RY and 2017 deviates substantially from the historic trend in the inventory.
- The submission is delayed and cannot be checked in the QA procedure.

In all cases the Member State will be contacted first to seek for further clarification. If sufficient explanation is provided and it can be ensured that the quality of the Union projections is not affected, the provided dataset will be accepted. If there is no data available or the risk of introducing bias in the Union projections, an alternative data set will be selected by the experts of the Commission, EEA, and the ETC/CM for gap-filling the Member States' projections.

3.3.2. Reference year calibration (A2)

Name of corrective action	RY calibration
Objective	Seek to ensure time-series **consistency and accuracy** of Union projections **(Gov.Reg. Art. 39(2))** by implementing procedures to recalibrate the starting year (reference year) of MS national projections to the historic inventory year in consultation with MS.
Method	It is **good practice** that the reference year of emission projections (RY) is consistent with the respective historic year of the emission inventory. In case MS show significant inconsistencies between RY and inventory year, the projections trend will be recalibrated and aligned to the historic year, as required to compile consistent Union projections.

The staring year of national projections is defined as reference year. If the reference year shows significant inconsistencies with the respective historic year from the latest available national inventory (see RY year check 1 and 2 in chapters 3.2.3 and 3.2.4), the projected trend will be recalibrated. To calibrate MS' projections with historic inventory data, a calibration factor will be calculated for each sector and multiplied with the MS' time-series (sectoral and total emissions).

$$calibration\ factor = \frac{inventory\ year}{reference\ year}$$

Example:

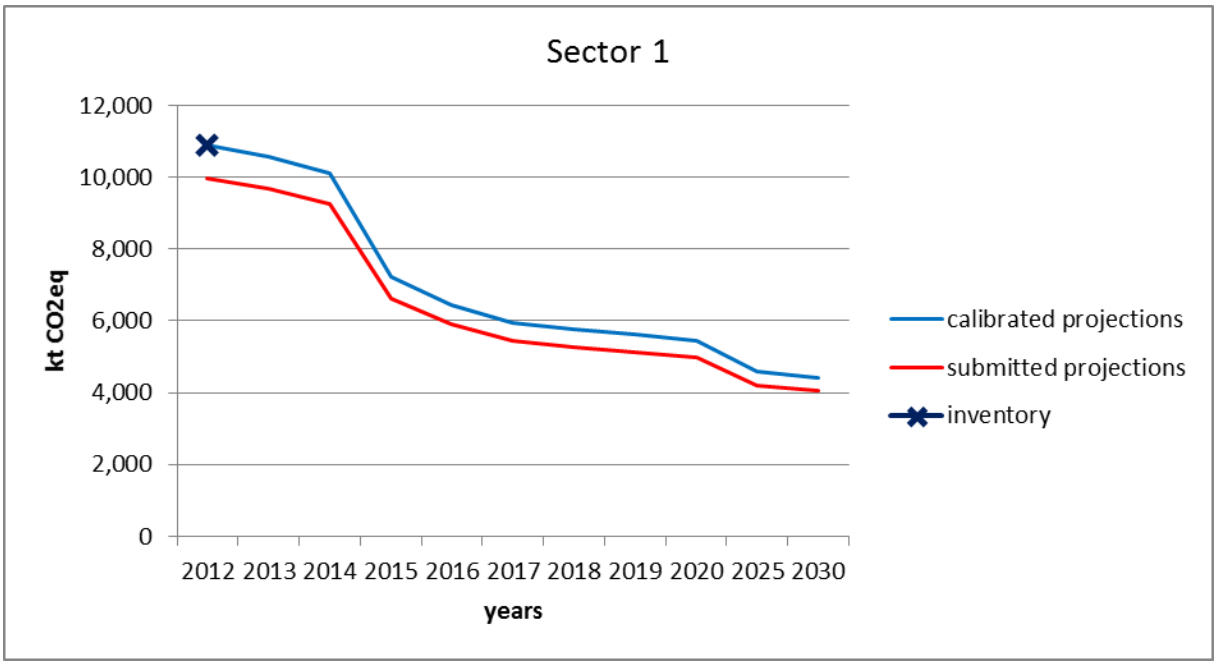
Sector 1 emissions of a MS:

RY 2012: 9 953 kt CO_{2eq}

Inventory year 2012: 10 879 kt CO_{2eq}

- Calibration factor: 1.093
- The submitted time series (red line) of sector 1 is multiplied by this factor and is shifted above (blue line)
- For the other sectors the same methodology applies to result in a consistent value for Total (excl. LULUCF)

Figure 3-9 Example of a reference year calibration (A2).



3.3.3. General error correction (A3)

Name of corrective action	Error correction
Objective	Seek to ensure **completeness and comparability** of Union **(Gov.Reg. Art. 39(2))** by implementing procedures to estimate any missing data from national projections in consultation with MS **(Gov.Reg. Art.18(2)).**
Method	If a potential error cannot be clarified or corrected by MS, general error correction will be applied (e.g., unit correction, sum correction), as required to compile accurate Union projections.

Here the correction of general errors such as units and copy paste errors are included. As there is no general method for this type of corrective action, a suitable method will be applied for each specific case. A typical correction is the deletion of values reported for the reference year when no projections are provided in order to ensure a consistent time series for the EU dataset. In this case, the ETC/CM also adjusts the sums of overarching sectors and the ETS/ESR split, if necessary.

3.3.4. Harmonisation of ETS emissions for stationary combustion (A4)

Name of corrective action	Harmonisation of ETS emissions for stationary combustion
Objective	Seek to ensure **completeness and comparability** of Union **(Gov.Reg. Art. 39(2))** by implementing procedures to estimate any missing data from national projections in consultation with MS **(Gov.Reg. Art.18(2)).**
Method	If domestic aviation projections (1A3aETS) are reported for the ETS projections in sector 1.A.3.a, 1.A.3, 1.A., 1 or the Total w.out LULUCF, these emissions will be subtracted to derive a consistent value for stationary ETS emissions (in line with Directive 2003/87/EC) and to compile accurate Union projections.

The Gov. Reg. (Annex VII (b)) requires that the EU ETS projections are only provided for stationary combustion (in accordance with Directive 2003/87/EC). Therefore, it is necessary that the ETS emissions exclude emissions from sector 1A3a domestic aviation. For this reason, the ETC/CM deletes the 1.A.3.a aviation emissions for ETS from all relevant sectors (1.A.3.a, 1.A.3, 1.A., 1 or the Total without LULUCF) and ensures that 1A3a and International aviation in the EU ETS are only reported for Total GHGs, Total ESR (if applicable) and the relevant gases.

3.4. Phase III - QC of Union GHG projections

In phase III the ETC/CM repeats a selected set of checks to the final corrected dataset in order to make sure that no errors have been introduced during Phase II. The following checks will be repeated by the ETC/CM in this phase (see description in previous chapters):

- Sum check across sectors and gases of the final Member States and EU data included in the EU aggregated projections dataset.
- Visual inspection of the projected time series.
- ETS/ESR check to ensure the categories are allocated correctly and that the ETS/ESR split is matching.

The sum check will be extended and performed not only on a sectoral, but also on a MS and EU level to ensure that no errors have been introduced during the aggregation of MS' projections to Union GHG projections. In addition, the EEA will conduct independent internal data checks to the draft EU aggregated projections dataset to ensure the four-eyes-principle is applied.

List of Abbreviations

Abbreviation	Name
CDR	Central Data Repository
DG CLIMA	Directorate-General for Climate Action
EC	European Commission
EEA	European Environment Agency
ES	Effort Sharing
ETC/CM	European Topic Centre for Climate change Mitigation
ETS	Emission Trading System
EU	European Union
GDP	Gross Domestic Product
GHG	Greenhouse Gas
Gov. Reg.	Regulation on the Governance of the Energy Union and Climate Action
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
LULUCF	Land Use, Land-Use Change and Forestry
MMD	Monitoring Mechanism Decision
MMR	Monitoring Mechanism Regulation
MS	Member State
NECP	National Energy and Climate Plan
NIR	National Inventory Report
QA	Quality Assurance
QC	Quality Control
RY	Reference Year
SWD	Commission Staff Working Document
TCCCA	Transparency, Consistency, Completeness, Comparability, Accuracy
UNFCCC	United Nations Framework Convention on Climate Change
WAM	With Additional Measures
WEM	With Existing Measures
WOM	Without Measures

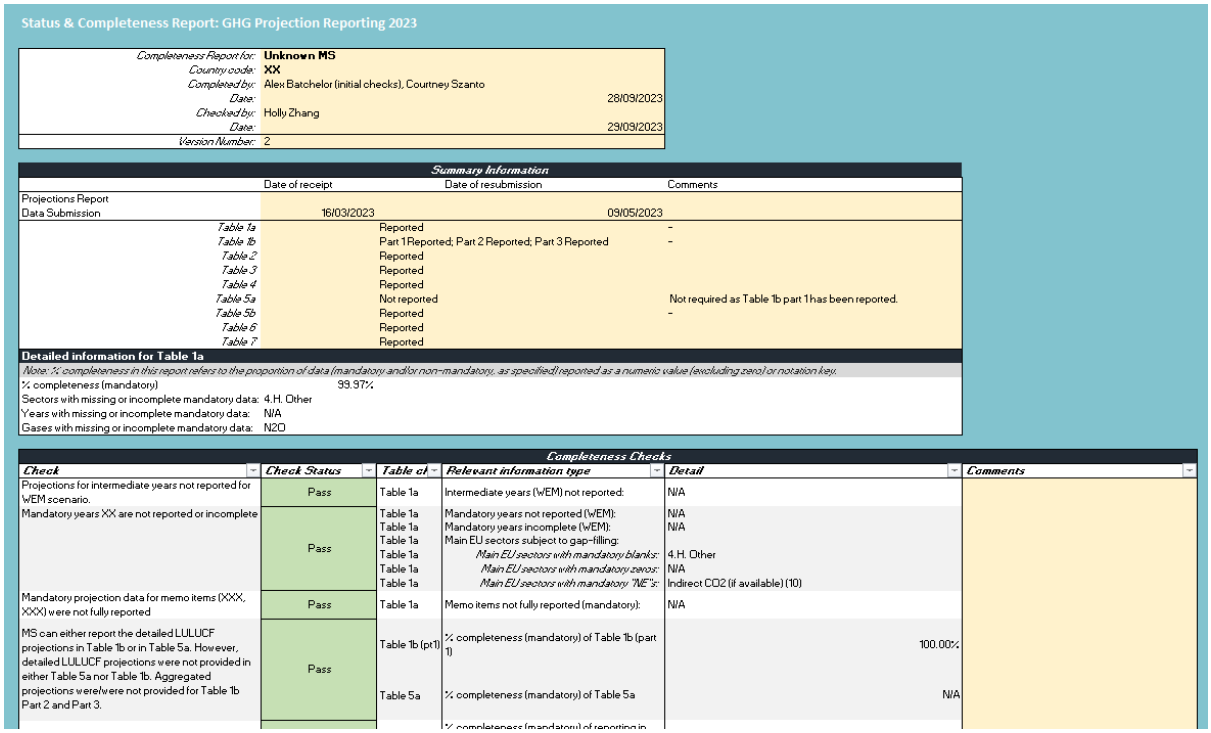
Annex 1

Figure A1.1 Example of communication log file.

Communication Log sheet: This sheet is used to record communications to and from Member States relating the Quality Assurance / Quality Control procedure and to track the progress of the QA/QC procedure. The orange columns are filled by the ETC/CM reviewer.
The MS can provide responses and information in the blue columns.

MS	Date	Comment ID	Status	Name of ETC/CM reviewer	Reporting Table/Report	Sector	Gas	Year(s)	Check performed (refers to "QA/QC procedure doc")	Finding	Question to MS/ Recommendation	Proposed corrective action by ETC/CM	MS answer	Response supplied by	Contact details (Email)	Date	Conclusion	Corrective action applied (by MS, by ETC/CM, not applied)	Submission year

Figure A1.2 Example of status files (completeness – showing the top part of the status and completeness report) (1/2).



Status & Completeness Report: GHG Projection Reporting 2023

Completeness Report for:	**Unknown MS**
Country code:	**XX**
Completed by:	Alex Batchelor (initial checks), Courtney Szanto
Date:	28/09/2023
Checked by:	Holly Zhang
Date:	29/09/2023
Version Number:	2

Summary Information

	Date of receipt	Date of resubmission	Comments
Projections Report Data Submission	16/03/2023	09/05/2023	
Table 1a	Reported		-
Table 1b	Part 1 Reported; Part 2 Reported; Part 3 Reported		-
Table 2	Reported		
Table 3	Reported		
Table 4	Reported		
Table 5a	Not reported		Not required as Table 1b part 1 has been reported.
Table 5b	Reported		-
Table 6	Reported		
Table 7	Reported		

Detailed information for Table 1a

Note: % completeness in this report refers to the proportion of data (mandatory and/or non-mandatory, as specified) reported as a numeric value (excluding zero) or notation key.

% completeness (mandatory)	99.97%
Sectors with missing or incomplete mandatory data:	4.H. Other
Years with missing or incomplete mandatory data:	N/A
Gases with missing or incomplete mandatory data:	N2O

Completeness Checks

Check	*Check Status*	*Table of*	*Relevant information type*	*Detail*	*Comments*
Projections for intermediate years not reported for WEM scenario.	Pass	Table 1a	Intermediate years (WEM) not reported:	N/A	
Mandatory years XX are not reported or incomplete	Pass	Table 1a	Mandatory years not reported (WEM):	N/A	
		Table 1a	Mandatory years incomplete (WEM):	N/A	
		Table 1a	Main EU sectors subject to gap-filling:		
		Table 1a	*Main EU sectors with mandatory blanks:*	4.H. Other	
		Table 1a	*Main EU sectors with mandatory zeros:*	N/A	
		Table 1a	*Main EU sectors with mandatory 'NE's:*	Indirect CO2 (if available) (10)	
Mandatory projection data for memo items (XXX, XXX) were not fully reported	Pass	Table 1a	Memo items not fully reported (mandatory):	N/A	
MS can either report the detailed LULUCF projections in Table 1b or in Table 5a. However, detailed LULUCF projections were not provided in either Table 5a nor Table 1b. Aggregated projections were/were not provided for Table 1b Part 2 and Part 3.	Pass	Table 1b (pt1)	% completeness (mandatory) of Table 1b (part 1)	100.00%	
		Table 5a	% completeness (mandatory) of Table 5a	N/A	
			% completeness (mandatory) of reporting in		

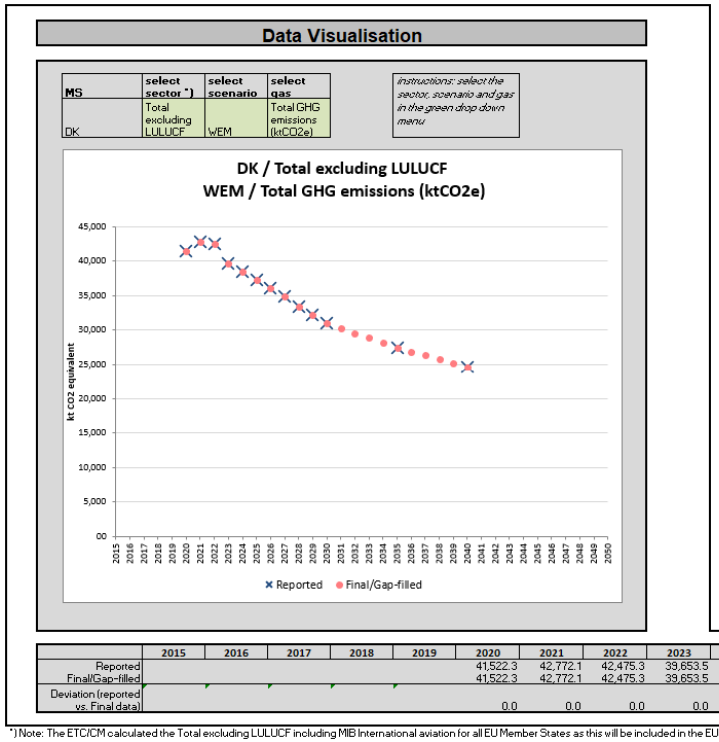
Figure A1.3 Example of status files (completeness – showing the background analysis which creates the status and completeness report) (2/2).

Scenarios

				MS_Value_C1	(Multiple Items)	*exclude zero; include everything else*	
Table 1b pt 1							
Scenario	**Value**	**Count of Value**		**Scenario**	**Value**	**Count of MS_Value**	
WEM	M-C	1176		**WEM**	M-C		
	NM	4312			NM	4	
WAM	NM	5488		**WAM**	NM		
WOM	NM	5488		**WOM**	NM		
Grand Total		16464		**Grand Total**		4	
				MS_Value_C1	(Multiple Items)	*exclude zero; include everything else*	
Table 1b pt 2							
Scenario	**Value**	**Count of Value**		**Scenario**	**Value**	**Count of MS_Value**	
WEM	M	210		**WEM**	M	1	
	NM	630			NM	7	
WAM	NM	840		**WAM**	NM		
WOM	NM	840		**WOM**	NM		
Grand Total		2520		**Grand Total**		8	
				MS_Value_C1	(Multiple Items)	*exclude zero; include everything else*	
Table 1b pt 3							
Scenario	**Value**	**Count of Value**		**Scenario**	**Value**	**Count of MS_Value**	
WEM	M	210		**WEM**	M		
	NM	630			NM	4	
WAM	NM	840		**WAM**	NM		
WOM	NM	840		**WOM**	NM		
Grand Total		2520		**Grand Total**		4	
				MS_Value_C1	(Multiple Items)	*exclude zero; include everything else*	
Table 5a							
Scenario	**Value**	**Count of Value**		**Scenario**	**Value**	**Count of MS_Value**	
WEM	M-C	948		**WEM**	M-C	1	
	NM	3476			NM	6	
WAM	NM	4424		**WAM**	NM		
WOM	NM	4424		**WOM**	NM		
Grand Total		13272		**Grand Total**		7	

% completeness (numeric data and notation keys)	Table 1b pt1	Table 1b pt2	Table 1b pt3	Table 1b (all)	Table 5a
Mandatory reporting	0.00%	0.48%	0.00%	0.06%	0.11%
Mandatory & non-mandatory reporting	0.02%	0.32%	0.16%	0.07%	0.05%
WAM scenario				0.00%	0.00%
WOM scenario				0.00%	0.00%

Figure A1.4 Example of data visualisation.



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2050
Reported						41,522.3	42,772.1	42,475.3	39,653.5	38,437.4	37,266.3	36,062.3	34,946.5	33,460.1	32,229.5	30,999.5					27,493.0					24,657.4	
Final/Gap-filled						41,522.3	42,772.1	42,475.3	39,653.5	38,437.4	37,266.3	36,062.3	34,946.5	33,460.1	32,229.5	30,999.5	30,283.2	29,585.6	28,888.1	28,190.5	27,493.0	26,925.8	26,358.7	25,791.6	25,224.5	24,657.4	
Deviation (reported vs. Final data)						0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30,283.2	29,585.6	28,888.1	28,190.5	0.0	26,925.8	26,358.7	25,791.6	25,224.5	0.0	

*) Note: The ETC/CM calculated the Total excluding LULUCF including MIB International aviation for all EU Member States as this will be included in the EU aggregated projections dataset. This data will show in the row for final/gap-filled data.

Annex 2

Table A2.1 List of automated checks built in Reportnet for GHG Projections.

Error message	Description	Tables affected	Level of error	Since
Mandatory table has no records	This error will flag any empty table that has been marked as mandatory.	Attachments Table 1a Table 2 Table 3 Table 4 Table 5b Table 6 Table 7	Error	2021
The value must not be missing or empty	This error will flag any empty field in a record that has been marked as mandatory.	All tables (only mandatory field)	Error	2021
The value is not a valid [type of record]	Values must conform to the field type (e.g. text, integer, decimal, etc.). For example, if a field is classified as integer, any textual record will display the message "The value is not a valid whole number"	All	Error	2021
The record should contain a value or notation key	For quantitative records, users must introduce either a value or a notation key. This error will flag cases where both are left empty.	All (only quantitative fields)	Error	
The value is not a valid member of the referenced list.	Certain values have to be part of a predefined list. Most notably, category values and notation keys must conform to a list.	All	Error	2021
Duplicated record	Finds duplicated records (i.e. those having the same identifying parameters such as category, year, gas, scenario…)	All	Error or Warning	2021
Missing Units: At least one of the unit fields (default or additional) must be filled in.	Checks that the unit of this record has been defined, either by the default or the additional units	Table 3 Table 7	Error	2021

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

The European Topic Centre on Climate change mitigation (ETC/CM) is a consortium of European institutes under contract of the European Environment Agency.

European Environment Agency
European Topic Centre
Climate change mitigation