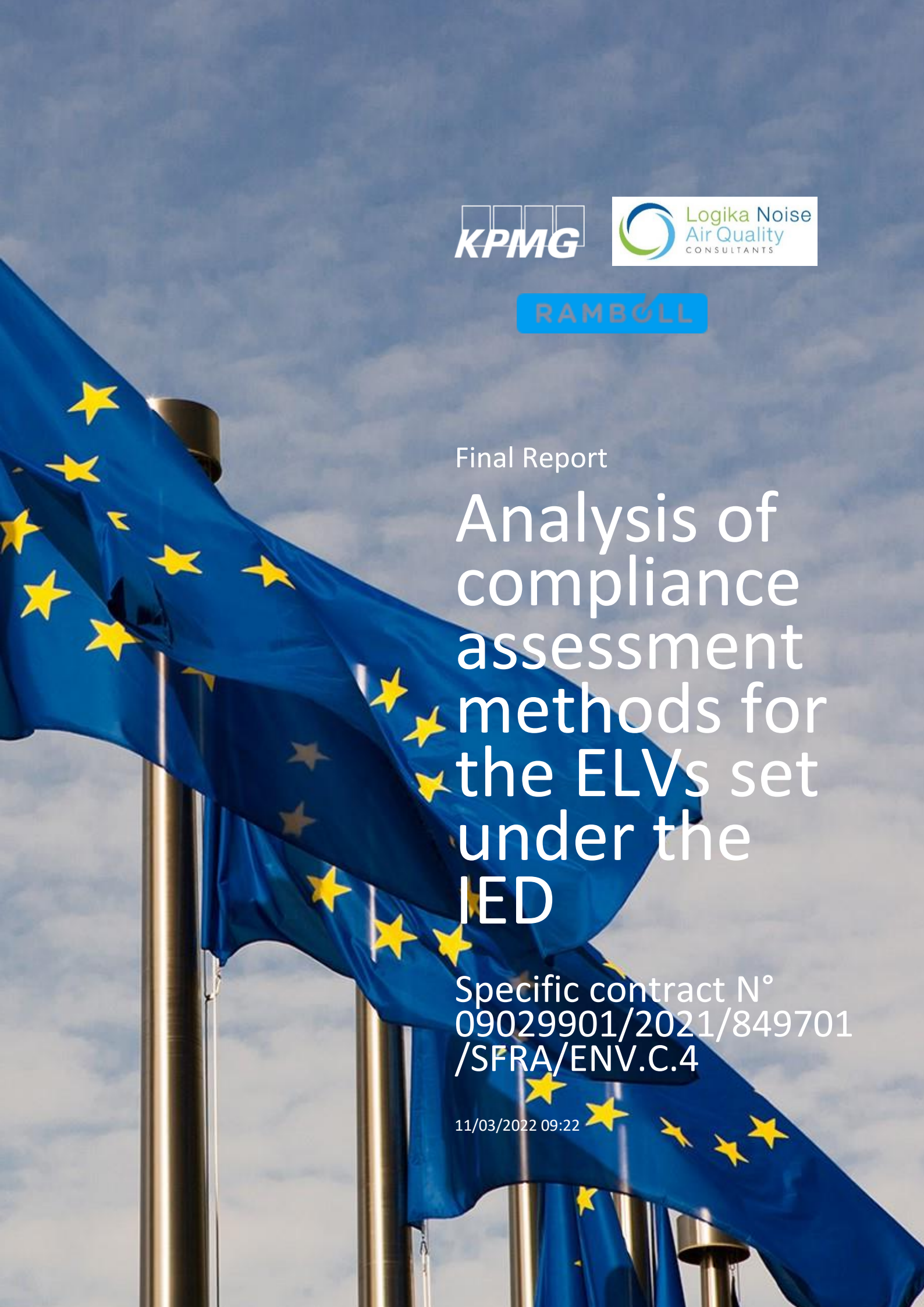

Final Report

Analysis of compliance assessment methods for the ELVs set under the IED

Specific contract N° 09029901/2021/849701 /SFRA/ENV.C.4

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Contents

EXECUTIVE SUMMARY

Purpose of this contract

This is the final report for Specific Contract No 09029901/2021/849701/SFRA/ENV.C.4 "Analysis of compliance assessment methods for the ELVs set under the IED". The overall aim of this contract was to provide a better understanding of how the different provisions of the Industrial Emissions Directive (IED) related to emissions monitoring and compliance assessment have been / are being implemented in practice by the Member States and the challenges and complexities that are being faced. This review has then fed into the development of potential solutions to resolve the issues, some of which have been taken into account in the ongoing revision of the IED. Solutions for improvement have taken into account a number of factors including (amongst others) the IED provisions themselves (and overall spirit of the Directive to prevent or reduce pollution), current Member State practices and technical constraints.

Background

The IED was introduced following a 2-year long, extensive review of the industrial pollution policy framework and was intended to further control industrial pollution while addressing some of the issues which were identified in the review of the IPPC Directive and sectoral legislation (which the IED replaced). Whilst the IED has helped to address a number of these issues, some implementation issues and challenges still remain. The 2018-2020 IED implementation support contract surveyed the Member States to understand the key challenges they were facing with respect to implementation. A number of common challenges were identified including some related to measurements, their representativeness, measurement uncertainty and monitoring below the detection limits. Furthermore, the 2020 IED evaluation identified a number of specific issues related to the assessment of compliance and how measurement uncertainties are taken into account. Whilst there was limited information identified on the scale of the issue and exact approaches by each Member State it was clear that there is some variability across the EU which can lead to quite significant differences in implementation and compliance with permit conditions.

Following the evaluation and the commitment in the European Green Deal to review EU measures to address pollution from large industrial installations and how to make them fully consistent with climate, energy and circular economy policies, the IED revision commenced in 2020[1] with the aim of tabling a proposal for its revision in early 2022. The revision has a broad remit but will touch upon some of the issues identified in the evaluation related to monitoring and compliance assessment.

Policy options being considered of relevance for this contract primarily concern further harmonisation and/or provision of guidance regarding key implementation requirements, including (amongst others) (i) implementation of BAT conclusions in permits; (ii) consistency of ELVs with BAT performance of the plant and (iii) monitoring and compliance assessment. This includes options to introduce compliance assessment rules for IED Chapter II installations as well as the potential to streamline and harmonise compliance assessment for activities covered by both Chapter II and Chapters III and IV.

Approach

The approach taken to deliver this contract was based around three main delivery tasks which included the following:

- An initial analysis of existing IED provisions for implementing ELVs and assessing compliance.
- Analysis of Member State challenges and approaches being taken. This has included the development of a Member State data collection proforma, an initial desk based review of existing sources to prefill the proformas followed by direct engagement with the Member State authorities to check the prefilled information and fill gaps.

[1] https://ec.europa.eu/environment/industry/stationary/ied/evaluation.htm

- Building on the outputs of the review of existing IED provisions, the Member State challenges and approaches being taken as well as approaches taken in selected non-EU countries, a series of possible approaches / solutions to some of the key areas of the IED dealing with monitoring and compliance assessment and where the Member States have faced the greatest challenges with implementation have been proposed and assessed.

IED gap analysis

A high level review of the IED provisions as well as those in the BAT Conclusions has been undertaken in order to identify where the main gaps are in relation to compliance assessment (Section 2). This includes both gaps as well as provisions that are not entirely clear and/or are left up to the Member States to implement which in turn has led to differences in implementation. The findings of the gap analysis are described in Section 2.3.

The primary gap relates to the fact that whilst Article 14(1) introduces the requirement for compliance monitoring and assessment in permits, it does not explicitly define the rules upon which compliance assessment should be based. Rather, it simply requires Member States to include in permits "*conditions for assessing compliance with the emission limit values*" (Article 14(1)(h)), introduce measures in permits that include "*suitable emission monitoring requirements, specifying the methodology, frequency and evaluation procedures*" (Article 14(1)(c)) and, under Article 14(1)(d), and an obligation to supply the competent authority, on at least an annual basis, with information based on the results of the monitoring under Article 14(1)(c) that allows the competent authority to verify compliance with the emission limit values.

In particular, Chapter II does not address how measurement uncertainty should be considered when assessing the results of monitoring data obtained under Article 14(1)(c) against emission limits. Maximum levels of measurement uncertainty, expressed as a percentage of the emission limit value, are provided in Annex V and Annex VI for LCPs and WIs. The challenge, however, is that these requirements in the IED annexes do not apply to Chapter II IED compliance assessment, although some Member States do use them as reference for setting conditions in permits for installations under Chapter II (e.g. some Member States have indicated that they use the % values in Annex V Part 3 for calculating validated average values for other sectors). Furthermore, there is a certain amount of ambiguity in terms of how the maximum uncertainty levels in point 9, Part 3 of Annex V and point 1.3, Part 6 of Annex VI should be interpreted.

Other gaps and/or potential uncertainties identified include a lack of a formal definition of Normal Operating Conditions (NOC) or Other Than NOC (OTNOC) in Chapter II with Member States largely responsible for defining such conditions for Chapter II installations. This can lead to variations in approaches with potentially different allowances made across the EU. Furthermore, BAT-AELs introduced under the LCP and WI BAT conclusions contain different averaging periods to those introduced under Annex V and Annex VI, or do not necessarily reflect the same coverage of averaging periods as those introduced under Annex VI and Annex VI. This can introduce uncertainty as to what limits and monitoring requirements should be reflected in permits and/or can lead to operators and Member State authorities needing to assess compliance for the same pollutants and processes multiple times.

Member State challenges and approaches

Section 3 of the report sets out the review of the Member State approaches and practices currently adopted in compliance assessment across the EU. This includes an assessment of the key implementation challenges that they are facing in relation to undertaking compliance assessment under the IED. At least some information was identified as part of the initial desk based review and/or provided as part of the consultation for nearly all Member States with only four providing no response and with major gaps. Even for those Member States that did respond to the consultation, some data gaps remain. These are documented in Section 3 as well as in the individual Member State profiles provided in Annex 3.

For Chapter II compliance assessment and horizontal issues (described in Section 3.2.1), the main challenge identified related to how measurement uncertainty should be taken into account. Other challenges faced by the Member States include dealing with measurements at low concentrations and how to define start-up/shut-down and OTNOC between and within sectors.

For Chapter III compliance assessment (Large Combustion Plants) (described in Section 3.2.2), the key challenges faced by the Member States in relation to assessing compliance with ELVs for LCPs relates to how measurement uncertainty should be taken into account, how OTNOC can be defined consistently and how to assess

measurements made at low concentrations. Other challenges include assessing compliance with ELVs from Chapter V and emission levels associated with BAT with different averaging periods, compliance assessment using continuous and periodic measurements, and calculation of operating hours for the purpose of assessing the basis for specific conditions for plants operating a limited number of hours per year.

For Chapter IV compliance assessment (Waste Incineration Plants) (described in Section 3.2.3), the key challenges identified include uncertainty in the requirements for measurement uncertainty with no uniform approach to the validation of continuous monitoring results, uncertainty in the assessment of compliance with ELVs from Chapter IV and emission levels associated with BAT with different averaging periods and defining NOC, OTNOC and the effective operating time consistently.

The approaches taken by each individual Member States (where information was available) for compliance assessment for Chapters II, III and IV installations / plants are summarised in Sections 3.2.1, 3.2.2 and 3.2.3, respectively, whilst a horizontal review across all Member States is presented in Section 4.2. The horizontal review has matched and grouped similar approaches to the key issues and challenges identified. This categorisation of approaches provides an EU level summary of the different approaches employed so that the potential options for addressing the solutions are clear.

Available approaches to address identified issues

The horizontal review of Member State (Section 4.2) has been supplemented with a review of the approaches taken in selected non-EU countries (Section 4.3). This information, together with any additional insights identified from relevant literature and the ongoing revision of the IED, has then been used to describe each of the key issues and identify potential solutions to resolve them. In some instances there are multiple options for each issue whereas for others it is more limited. The potential impacts of the options have then been qualitatively screened against a series of criteria[2] to understand the impacts that they may have, including the extent to which they would address the issue (Section 4.4).

There are a number of different high-level options that could be considered, both legislative and non-legislative, to address some of the issues identified related to compliance assessment. These include the following:

- Stand-alone guidance to support MSs with implementation.
- Further capacity building e.g. expansion of the support provided via the IED implementation support contract and platform.
- Commission FAQs / legal opinion on specific issues.
- Further details to be captured in future BREFs and BAT Conclusions (activity specific and/or horizontal i.e. ROM).
- Legislative change in the IED with further details in delegated or implementing acts.

Section 4.5 provides a summary of all of the potential options considered. The three options considered most beneficial from an environmental perspective are options #02 (introduction of compliance assessment rules for Chapter II installations), #05 (including key principles in the IED for defining and minimising start-up and shut-down and OTNOC periods) and #09 (extending Chapter II rules related to measurement uncertainty to Chapters III and IV). Options #02 and #09 are also considered positive from a technical feasibility, coherence and proportionality perspective. The same is true for Option #07 (option #02 plus compliance assessment rules for Chapter II installations taking precedent over other compliance assessment provisions); however, unlike Options #02 and #09, there is a potential weakly negative environmental outcome (risk) associated with Option #07.

[2] Including economic impacts, environmental outcome, extent to which they address the issue(s), political feasibility / acceptability, technical feasibility, coherence with existing rules and practices and proportionality. No specific social impacts (e.g. on employment) are anticipated with any of the options bar the potential health benefits associated with any reductions in emissions.

1 Introduction

1.1 This report

This is the final report for Specific Contract No 09029901/2021/849701/SFRA/ENV.C.4. This report sets out the findings for each of the project tasks including the consultation with the Member State authorities on the challenges they face and approaches that have been taken to address these challenges. The work has been led by Air Quality Consultants Ltd supported by KPMG and Ramboll.

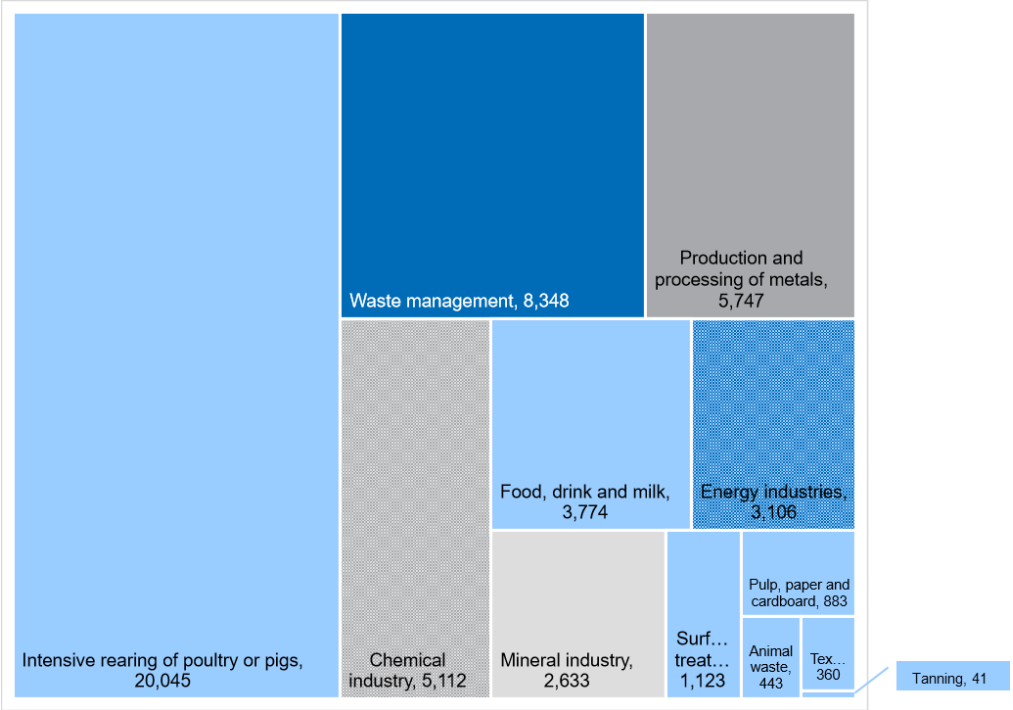
1.2 Background

1.2.1 Industrial Emissions Directive (2010/75/EU)

In the light of the European Green Deal where Europe declared its ambition to reduce greenhouse gas emissions by 50% to 55% compared with 1990 levels by 2030 as well as zero pollution, industrial activities are more than ever needed to contribute to the transformation into a sustainable economy.

The primary instrument in place is the Industrial Emissions Directive 2010/75/EU (IED) which has the objective to prevent and control the pollution of air, water, or soil caused by industrial installations. The Directive sets out the main principles for permitting and controlling large industrial and livestock (hereafter agro-industrial) installations based on an integrated approach. Best Available Techniques (BAT) as defined in BAT Reference documents (BREFs) should be applied to reach a high level of environmental protection. The IED covers around 50 000 agro-industrial installations in the EU. The figure below summarises the number of installations broken down by sector.

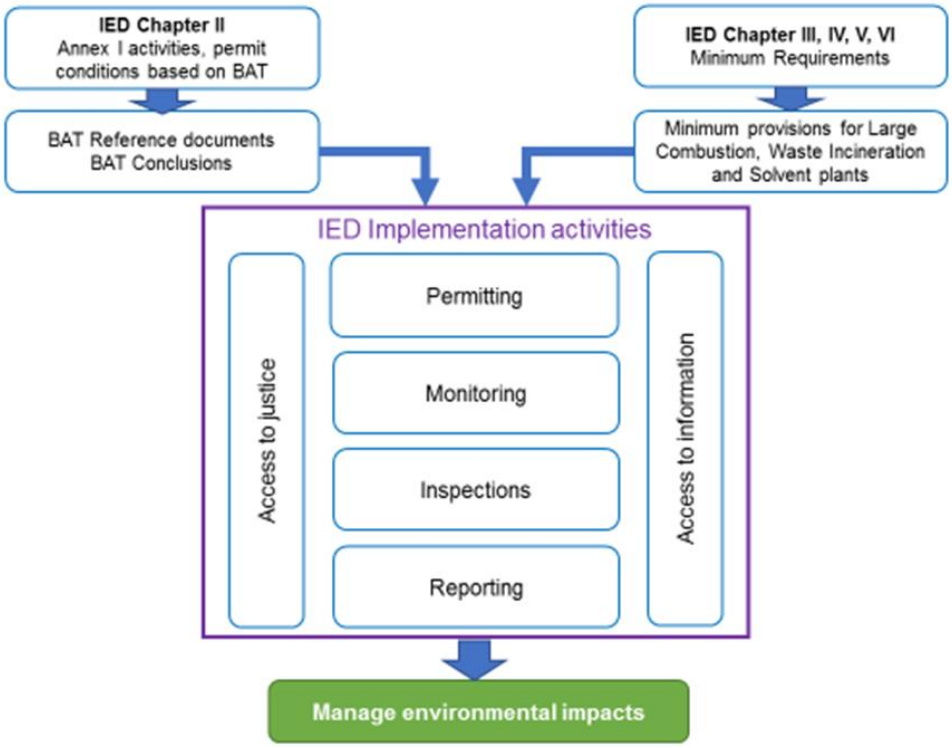
Figure 1 Total number of permitted installations by sector (EU28, 2015)



Source: Data collated as part of Ricardo, 2018.

These are required to operate in accordance with permits issued by Member States' competent authorities. The figure below provides an overview of the IED and how its different elements link together and feed into the core activities of permitting, monitoring and enforcement.

Figure 2 Overview of the IED (Ricardo, 2020)



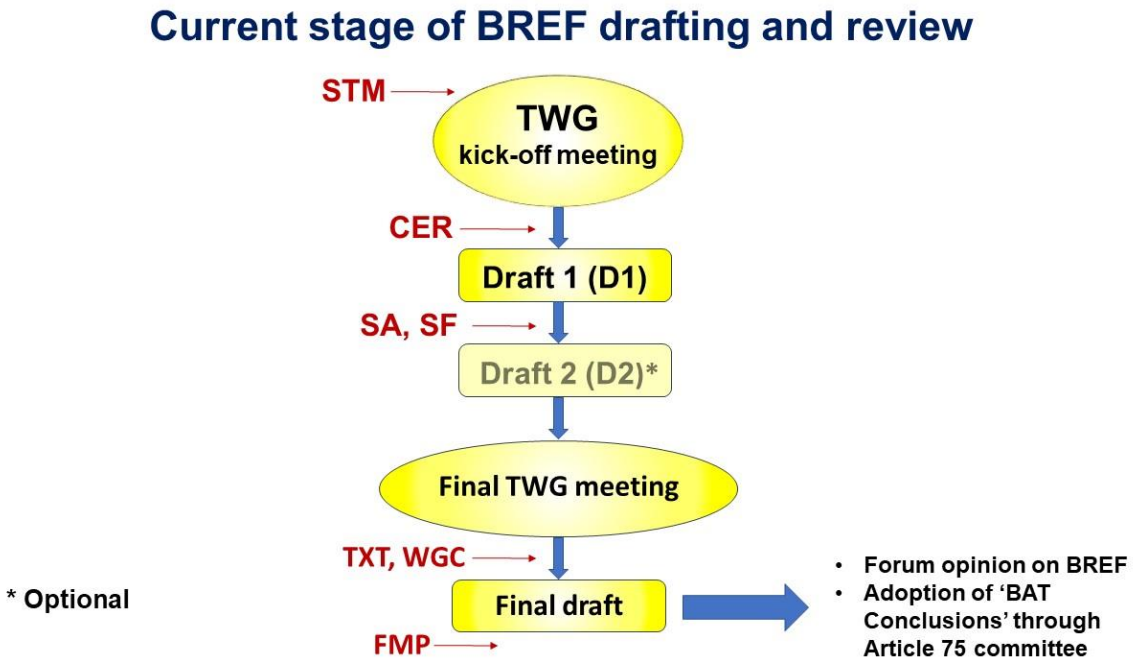
The permit extends to all environmental aspects of an installation's operating activities, including emissions, waste, resource use, noise, prevention of accidents and restoration of the site upon closure. All permit conditions must be based on Best Available Techniques (BAT) conclusions (BATC) within 4 years of adoption of the BATC. The BATC are adopted by the European Commission following an exchange of information among technical experts culminating in BAT Reference Documents (BREFs). They are adopted as implementing decisions. BATC can contain BAT-Associated Emission Limits (further referred to as BAT-AELs) (a numerical range of emission levels), BAT conclusions with associated environmental performance levels other than emission levels (further referred to as BAT-AEPLs) (e.g. BAT-associated environmental performance levels commonly concern raw materials, energy or water consumption, as well as waste generation) or may be descriptive requirements not associated with either BAT-AELs or BAT-AEPLs (e.g. concerning monitoring, site remediation or environmental management systems). Installation operators may apply for a derogation from BAT AELs, where they can demonstrate that achieving the BAT-AELs would lead to disproportionately higher costs compared to the environmental benefits owing to the geographic location, local environmental conditions, or technical characteristics of the installation. In addition, the IED sets provisions for environmental inspections of installations, requiring authorities to undertake site visits to permitted installations.

The BREF process and development and adoption of the BAT conclusions (BATC) drives the updating of permits for individual installations in each sector. The Commission has adopted 17 BAT conclusions under the IED, seven BREFs are currently being worked on:

- Ferrous Metals Processing (FMP)
- Common Waste Gas Treatment in the Chemical Sector (WGC)
- Textiles (TXT)
- Smitheries and Foundries (SF)
- Slaughterhouses and Animal By-products (SA)
- Ceramics (CER)

- Surface Treatment of Metals and plastics (STM)[3]

The figure below summarises the latest status of each of these i.e. the stage at which BREF is currently at (as of February 2022).



Out of 17 already reviewed BREFs there are also a number of them that are now being (or have already been) fully implemented by the Member States i.e. updating permits in order to take into account the BATC.

1.2.2 Implementation challenges

The European Commission has the responsibility of ensuring the correct implementation of EU legislation including the IED. The Commission Communication "EU actions to improve environmental compliance and governance" sets out an Action Plan to increase compliance with EU environmental law and improve environmental governance. This includes more collaborative working with the Member States to improve compliance.

The IED was introduced following a 2-year long, extensive review of the industrial pollution policy framework. The motivation behind it was to further control industrial pollution while simplifying regulations and lowering the administrative burden, supporting innovation and improving enforcement and providing better coherence with other aspects of EU environmental policy acquis. In particular, a number of issues were identified in the review of the IPPC Directive and sectoral legislation, which the IED was intended to resolve:

- Vague provisions on BAT: flexibility for competent authorities to deviate from BAT in the permitting process and unclear role of the BREF in the permitting process.
- Uncertainties regarding the legal framework on compliance reporting, inspections and permit reviews.
- Complex legislation causing inconsistencies and uncertainties regarding interpretation of the requirements and unnecessary administrative burden.
- Clarification and/ or extension of scope required to better control pollution and reduce emissions at source.

[3] Call for initial positions.

Whilst the IED has helped to address a number of the identified issues, some implementation issues and challenges still remain. The 2018-2020 IED implementation support contract surveyed the Member States to understand the key challenges they were facing with respect to implementation. Common challenges included the following:

- **Issues with implementation of BATC for specific sectors**: the sectors most commonly mentioned by the Member States were Intensive Rearing of Poultry and Pigs and Waste Treatment
- Relationship between **horizontal and vertical BREFs** and using them in permitting.
- **Issues related to BAT-AELs, AEPLs and setting ELVs in the permits**: main challenges relate to setting ELVs in permits based on information in BATC, difficulties in assessing if a specific technique can be considered as BAT. Permit reconsiderations in cases of significant pollution or after the publication of BAT conclusions / use of general binding rules (GBRs).
- Use of **stricter Emission Limit Values (ELVs)** to comply with environmental quality standards (Article 18).
- **Issues related to the definitions in the IED**: main difficulties concern definitions of installation, directly associated activities, Other Than Normal Operating Conditions (OTNOC). Lack of coherence with definitions used in other legislation applicable to industrial sites has also been reported.
- **Scope of activities covered by Annex I of the IED and BATC**: Member States reported issues in defining main activity of the installation, directly associated activities and have reported numerous questions on whether a specific activity is covered by Annex I.
- **Conflicting requirements of other national legislation, including other types of permits**: Some Member States have reported that IED permits are not always well aligned with the planning permits or other permits that sites are issued. In a few cases national legislation prevents implementation of some of the provisions in the IED and/or specific BATC.
- **Setting ELVs for indirect emissions to water**: some Member States have reported challenges with setting emission limit values for emissions to water which is being transferred off-site for treatment in the urban or independently operated waste water treatment plants
- **Article 15(4) derogations** specifically lack of information on implementation of Article 15(4) in other Member States and issues with cost-benefit analyses (CBA) methodologies
- **Issues related to measurements**: their representativeness, measurement uncertainty and monitoring below the detection limits.
- **Public participation** such as improving web access to permits, decision documents and inspection reports and the challenges identified in EEB's "Burning: the evidence" report.
- **Site closure / baseline reports**.
- **Compliance assessment.**

As the European Commission aims to increase compliance with EU environmental law within Member States the proper implementation of the IED is of paramount importance across all installations regulated.

1.2.3 Revision of the IED

Following the IED evaluation and the commitment in the European Green Deal to review EU measures to address pollution from large industrial installations and how to make them fully consistent with climate, energy and circular economy policies, the IED revision commenced in 2020[4] with the aim of tabling a proposal for its revision in early 2022. The revision has a broad remit but will touch upon some of the issues identified in the evaluation related to monitoring and compliance assessment.

Policy options being considered of relevance for this contract primarily concern further harmonisation and/or provision of guidance regarding key implementation requirements, including (amongst others) (i) implementation of BAT conclusions in permits; (ii) consistency of ELVs with BAT performance of the plant and

[4] https://ec.europa.eu/environment/industry/stationary/ied/evaluation.htm

(iii) monitoring and compliance assessment. This includes options to introduce compliance assessment rules for IED Chapter II installations as well as the potential to streamline and harmonise compliance assessment for activities covered by both Chapter II and Chapters III and IV.

As part of the ongoing revision of the IED, an open public consultation was launched on the Commission's "Have Your Say" website[5] on 22 December 2020, which remained open until 22 March 2021. Some of the questions in the survey touched upon elements related to compliance assessment. Relevant feedback received against each of these is summarised below (taken from the Ricardo draft OPC analysis).

Table 1: Summary of OPC findings of relevance for compliance assessment

Question	Summary of findings
Q#11: To what extent do you think that the *functioning of these current IED procedures needs to be improved in the future to optimise them*? Sub-option touched on emissions monitoring and compliance assessment.	Business associations have most strongly felt that no changes are needed for **reporting of emissions monitoring data related to compliance** with environmental permit conditions to operate the (agro)industrial plant, with 78 respondents (73% of those who expressed a view) stating they thought no changes were required. A majority of environmental NGOs and around half of civil society NGOs thought that a complete system overhaul was required for **reporting of emissions monitoring data related to compliance**. Public authorities and EU citizens provided mixed responses with regard to changes required.
Q#22 - When reviewing policy options in the IED and E-PRTR, how would you assess the following, in relative importance. Sub-option focused on ensuring a level playing field.	The majority of respondents across all stakeholder groups felt that it was relatively or very important to consider options to ensure a level playing field for companies and consistent regulatory information across EU Member States. Only two respondents felt it was relatively unimportant.

In addition to the OPC, a detailed Targeted Stakeholder Survey for IED experts and stakeholders was launched on 8 February 2021, and remained open until 2 April 2021. This included a number of much more detailed questions looking at issues related to emissions monitoring and compliance assessment (amongst others). In particular, various questions were included related to whether the introduction of common compliance assessment rules with emission limit values under Chapter II of the IED would improve implementation and contribute to a level playing field in terms of inspection and enforcement of environmental permits across the EU.

The majority of respondents (80 out of 105) from Industry expected no to slight improvement to the implementation of the IED as a result of introducing common assessment rules with emission limit values under Chapter II of the IED. This contrasted to the majority of respondent from Environmental NGOs (6 out of 6), Local/Regional (4 out of 7) and National (17 out of 18) Member State authorities and others (6 out of 7) who indicated that the introduction of common compliance assessment rules would result in moderate or significant improvement in IED implementation.

Industry were also asked to what extent the introduction of common rules for compliance assessment would contribute to a level playing field in terms of inspections and enforcement of permits for their sector across the EU. Responses were mixed with around 40% expecting moderate or significant improvement, around 35% only slight improvement and the remaining 25% expecting no impact. Around 75% of Member State authorities (local/regional and national) felt that common rules would contribute moderate or significant improvements in terms of simpler interpretation and better compliance control.

1.3 Aims and objectives

The overall aim of this contract was to provide a better understanding of how the different provisions of the IED related to emissions monitoring and compliance assessment have been / are being implemented in practice by

[5] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12306-EU-rules-on-industrial-emissions-revision

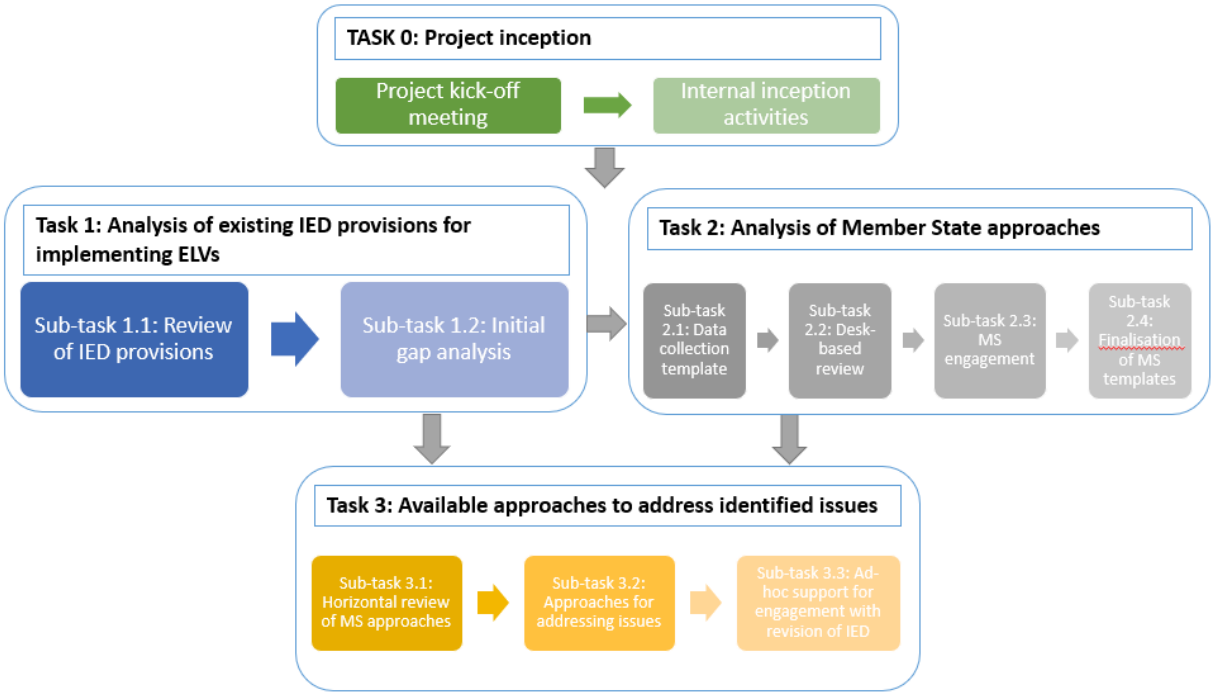
the Member States and the challenges and complexities that are being faced. This review feeds into the development of potential solutions to resolve the issues, some of which have fed into the ongoing revision of the IED. Solutions for improvement have taken into account a number of factors including (amongst others) the IED provisions themselves (and overall spirit of the Directive to prevent or reduce pollution), current Member State practices and technical constraints.

1.4 Approach

The approach taken to deliver this contract was based around three main delivery tasks as well as a Task 0 for inception activities. The figure below provides an overview of how the tasks were broken down.

Task 1 of this contract set the basis for the further analyses capturing the provisions that are in place in the IED and BAT conclusions and subsequently the areas of focus for later tasks. Task 2 represented the central component of this contract and where the bulk of resources was required. Task 3 subsequently built on the outputs of this task in order to propose approaches / solutions to some of the key areas of the IED dealing with monitoring and compliance assessment and where the Member States have faced the greatest challenges with implementation.

Figure 3: Project flowchart outlining methodological framework



In order to provide inputs to the ongoing IED revision, the order of work was shifted slightly at inception so that some elements of Task 3 could be brought forward and a briefing paper setting out the issues, current MS approaches (based on existing materials) and possible options / solutions for compliance assessment rules for Chapter II activities was drafted and submitted separately (final version submitted on 15 September 2021). Materials developed for the briefing note have been included within this report and elaborated where necessary and possible.

2 IED provisions

2.1 Overview

A review has been undertaken of the existing IED provisions for implementing emission limit values (ELVs) in permits and assessing compliance. These provisions concern (amongst others) t*he averaging periods in which emission limit values are expressed, emissions monitoring requirements, the assessment of the compliance of an installation with its emission limit values, including the determination of the validated average values and the notion of Normal Operating Conditions (NOC).* The scope of this review was to include IED Chapter II (both in the IED itself and/or in the 17 BAT conclusions adopted under the IED), Chapter III (and Annex V) and Chapter IV (and Annex VI).

All of these provisions have been captured in an MS Excel based database (Annex 1) to ensure that all of the provisions are stored in a consistent and comparable manner thus enabling sorting of different elements and regrouping as necessary e.g. to bring together all elements on a particular topic such as determining validated average values.

2.2 Key provisions related to compliance assessment

The key provisions of the IED and BREFs / BAT conclusions related to emissions monitoring and compliance assessment are discussed below.

2.2.1 IED

IED Chapter II

As set out in Article 10, Chapter II of the IED sets out provisions applicable to all activities listed in Annex I. This includes, amongst others, general principles governing the obligations of operators, permit application, conditions and reconsideration, as well as monitoring and reporting provisions.

Emissions monitoring of relevant permit parameters and reporting to competent authorities forms the basis, along with environmental inspections, for assessing compliance under the IED. According to Article 14(1) of the IED, permits should include:

> *"(c) suitable emission monitoring requirements specifying:*
>
> > *(i) measurement methodology, frequency and evaluation procedure; and*
> >
> > *(ii) where Article 15(3)(b) is applied* [setting of emission limit values that are different to those in the BAT conclusions]*, that results of emission monitoring are available for the same periods of time and reference conditions as for the emission levels associated with the best available techniques;*
>
> *(d) an obligation to supply the competent authority regularly and at least annually, with:*
>
> > *(i) information on the basis of results of emission monitoring referred to in point (c) and other required data that enables the competent authority to verify compliance with the permit conditions; and*
> >
> > *(ii) where Article 15(3)(b) is applied, a summary of the results of emission monitoring which allows a comparison with the emission levels associated with the use of best available techniques*."

Article 14(1)(e) also specifies

> "*…appropriate requirements concerning the periodic monitoring of soil and groundwater in relation to relevant hazardous substances likely to be found on site and having regard to the possibility of soil and groundwater contamination at the site of the installation*".

Finally, Article 14(1)(f) and (h) specifies the following in relation to defining other than normal operating conditions and the need to include conditions for assessing compliance:

> *"(f) measures relating to conditions other than normal operating conditions such as start-up and shut-down operations, leaks, malfunctions, momentary stoppages and definitive cessation of operations.*

…

(h) conditions for assessing compliance with the emission limit values or a reference to the applicable requirements specified elsewhere."

Article 14 (3) specifies that "*BAT conclusions shall be the reference for setting the permit conditions*".

Article 15 (3) states:

"*The competent authority shall set emission limit values that ensure that, under normal operating conditions, emissions do not exceed the emission levels associated with the best available techniques as laid down in the decisions on BAT conclusions referred to in Article 13(5) through either of the following:*

(a) setting emission limit values that do not exceed the emission levels associated with the best available techniques. Those emission limit values shall be expressed for the same or shorter periods of time and under the same reference conditions as those emission levels associated with the best available techniques; or

(b) setting different emission limit values than those referred to under point (a) in terms of values, periods of time and reference conditions.

Where point (b) is applied, the competent authority shall, at least annually, assess the results of emission monitoring in order to ensure that emissions under normal operating conditions have not exceeded the emission levels associated with the best available techniques."

Article 16 of the IED further elaborates on Article 14(1)(c) and includes the following:

"*1. The monitoring requirements referred to in Article 14(1)(c) shall, where applicable, be based on the conclusions on monitoring as described in the BAT conclusions.*

2.The frequency of the periodic monitoring referred to in Article 14(1)(e) shall be determined by the competent authority in a permit for each individual installation or in general binding rules.

Without prejudice to the first subparagraph, periodic monitoring shall be carried out at least once every 5 years for groundwater and 10 years for soil, unless such monitoring is based on a systematic appraisal of the risk of contamination."

<u>IED Chapters III, IV, V and VI</u>

Chapters III (Large combustion plants), IV (Waste incineration and co-incineration plants), V (Solvent using activities) and VI (Titanium dioxide production) and associated annexes set out specific monitoring requirements linked to the emission limit values and other parameters that are included in the IED for these activities.

In particular, Annexes V and VI set out emission monitoring and rules for assessment of compliance with emission limit values including consideration of Normal Operating Conditions for LCPs and Effective Operating Time (EOT) for (co-)incinerators covered under Chapters III and IV, respectively.

Article 38 of the IED (Chapter III) states:

"*3. The competent authority shall determine the location of the sampling or measurement points to be used for the monitoring of emissions.*

4. All monitoring results shall be recorded, processed and presented in such a way as to enable the competent authority to verify compliance with the operating conditions and emission limit values which are included in the permit."

In addition, Article 39 (Chapter III) states:

"The emission limit values for air shall be regarded as being complied with if the conditions set out in Part 4 of Annex V are fulfilled."

Parts 1 and 2 of Annex V of the IED establish ELVs applicable to LCPs. Point 1 of both Parts 1 and 2 is identical, making the following provision concerning reference conditions for calculating ELVs:

"1. All emission limit values shall be calculated at a temperature of 273.15 K, a pressure of 101.3 kPA and after correction for the water vapour content of the waste gases and at a standardised O_2 content of 6% for solid fuels, 3% for combustion plants other than gas turbines and gas engines using liquid and gaseous fuels and 15% for gas turbines and gas engines."

Part 3 of Annex V of the IED sets out the following emissions monitoring requirements and provisions specific to compliance assessment of LCPs:

"1. The concentrations of SO_2, NO_x and dust in waste gases from each combustion plant with a total rated thermal input of 100 MW or more shall be measured continuously.

The concentration of CO in waste gases from each combustion plant firing gaseous fuels with a total rated thermal input of 100 MW or more shall be measured continuously.

2. The competent authority may decide not to require the continuous measurements referred to in point 1 in the following cases:

- *(a) For combustion plants with a life span of less than 10,000 operational hours;*
- *(b) For SO_2 and dust from combustion plants firing natural gas;*
- *(c) For SO_2 from combustion plants firing oil with known sulphur content in cases where there is no waste gas desulphurisation equipment;*
- *(d) For SO_2 from combustion plants firing biomass if the operator can prove that the SO_2 emissions can under no circumstances be higher than the prescribed emission limit values.*

3. Where continuous measurements are not required, measurements of SO_2, NO_x, dust and, for gas fired plants, also of CO shall be required at least once every 6 months.

4. For combustion plants firing coal or lignite, the emissions of total mercury shall be measured at least once per year.

5. As an alternative to the measurements of SO_2 and NO_x referred to in point 3, other procedures, verified and approved by the competent authority, may be used to determine the SO_2 and NO_x emissions. Such procedures shall use relevant CEN standards or, if CEN standards are not available, ISO, national or other international standards which ensure the provision of data of an equivalent scientific quality.

6. The competent authority shall be informed of significant changes in the type of fuel used or in the mode of operation of the plant. The competent authority shall decide whether the monitoring requirements laid down in points 1 to 4 are still adequate or require adaptation.

7. The continuous measurements carried out in accordance with point 1 shall include the measurement of the oxygen content, temperature, pressure and water vapour content of the waste gases. The continuous measurement of the water vapour content of the waste gases shall not be necessary, provided that the sampled waste gas is dried before the emissions are analysed.

8. Sampling and analysis of relevant polluting substances and measurements of process parameters as well as the quality assurance of automated measuring systems and the reference measurement methods to calibrate those systems shall be carried out in accordance with CEN standards. If CEN standards are not available, ISO, national or other international standards which ensure the provision of data of an equivalent scientific quality shall apply.

The automated measuring systems shall be subject to control by means of parallel measurements with the reference methods at least once per year.

The operator shall inform the competent authority about the results of the checking of the automated measuring systems.

9. At the emission limit value level, the values of the 95% confidence intervals of a single measured result shall not exceed the following percentages of the emission limit values:

Table 2: Maximum expanded uncertainty levels for LCPs

Pollutant	Maximum expanded uncertainty level (95% confidence interval expressed as a percentage of the ELV)
Carbon monoxide	10%
Sulphur dioxide	20%
Nitrogen oxides	20%
Dust	30%

10. The validated hourly and daily average values shall be determined from the measured valid hourly average values after having subtracted the value of the confidence interval specified in point 9."

Part 4 of Annex V of the IED relates specifically to assessment of compliance with emission limit values for LCPs, and states:

"1. In the case of continuous measurements, the emission limit values set out in Parts 1 and 2 shall be regarded as having been complied with if the evaluation of the measurement results indicates, for operating hours within a calendar year, that all of the following conditions have been met:

- *(a) No validated monthly average value exceeds the relevant emissions limit values set out in Parts 1 and 2;*
- *(b) No validated daily average exceeds 110% of the relevant emission limit values set out in Parts 1 and 2;*
- *(c) In cases of combustion plants composed only of boilers using coal with a total rated thermal input below 50 MW, no validated daily average value exceeds 150 % of the relevant emission limit values set out in Parts 1 and 2;*
- *(d) 95% of all the validated hourly average values over the year do not exceed 200% of the relevant emission limit values set out in Parts 1 and 2.*

The validated average values are determined as set out in point 10 of Part 3.

For the purpose of the calculation of the average emission values, the values measured during the periods referred to in Article 30(5) and (6) and Article 37 as well as during the start-up and shut-down periods shall be disregarded.

2. Where continuous measurements are not required, the emission limit values set out in Parts 1 and 2 shall be regarded as having been complied with if the results of each of the series of measurements or of the other procedures defined and determined according to the rules laid down by the competent authorities do not exceed the emission limit values."

Article 48 of the IED (Chapter IV) states:

"3. The competent authority shall determine the location of the sampling or measurement points to be used for monitoring of emissions.

4. All monitoring results shall be recorded, processed and presented in such a way as to enable the competent authority to verify compliance with the operating conditions and emission limit values which are included in the permit."

Article 49 of the IED (Chapter IV) states:

"The emission limit values for air and water shall be regarded as being complied with if the conditions described in Part 8 of Annex VI are fulfilled."

Part 3 of Annex VI of the IED sets air ELVs for waste (co-)incineration plants, and makes the following provision concerning reference conditions for calculating ELVs:

"1. All emission limit values shall be calculated at a temperature of 273.15 K, a pressure of 101.3 kPa and after correcting for the water vapour content of the waste gases.

They are standardised at 11% oxygen in waste gas except in case of incineration of mineral waste oil as defined in point 3 of Article 3 of Directive 2008/98/EC, when they are standardised at 3% oxygen, and in the cases referred to in Point 2.7 of Part 6."

Part 6 of Annex VI of the IED relates to monitoring emissions and sets out the following:

"1.1 Measurements for the determination of concentrations of air and water polluting substances shall be carried out representatively.

1.2 Sampling and analysis of all polluting substances including dioxins and furans as well as the quality assurance of automated measuring systems and the reference measurement methods to calibrate them shall be carried out according to CEN-standards. If CEN standards are not available, ISO, national or other international standards which ensure the provision of data of an equivalent scientific quality shall apply. Automated measuring systems shall be subject to control by means of parallel measurements with the reference methods at least once per year.

1.3 At the daily emission limit value level, the values of the 95 % confidence intervals of a single measured result shall not exceed the following percentages of the emission limit values:

Table 3: Maximum expanded uncertainty levels for waste incineration plants

Pollutant	Maximum expanded uncertainty level (95% confidence interval expressed as a percentage of the ELV)
Carbon monoxide	10%
Sulphur dioxide	20%
Nitrogen dioxide	20%
Total dust	30%
Total organic carbon	30%
Hydrogen chloride	40%
Hydrogen fluoride	40%

Periodic measurements of the emissions into air and water shall be carried out in accordance with points 1.1 and 1.2."

Part 8 of Annex VI sets out provisions concerning assessment of compliance with ELVs for waste incineration, including the following for emissions to air:

"1.1 The emission limit values for air shall be regarded as being complied with if:

a) none of the daily average values exceeds any of the emission limit values set out in point 1.1 of Part 3 or in Part 4 or calculated in accordance with Part 4;
b) either none of the half-hourly average values exceeds any of the emission limit values set out in column A of the table under point 1.2 of Part 3, or where relevant, 97% of the half-hourly average values over the year do not exceed any of the emission limit values set out in column B of the table under point 1.2 of Part 3;
c) none of the average values over the sampling period set out for heavy metals and dioxins and furans exceeds the emission limit values set out in points 1.3 and 1.4 of Part 3 or in Part 4 or calculated in accordance with Part 4;
d) for carbon monoxide (CO):

(i) in case of waste incineration plants:

- at least 97% of the daily average values over the year do not exceed the emission limit values set out in point 1.5(a) of Part 3; and,

- at least 95% of all 10-minute average values taken in any 24-hour period or all of the half-hourly average values taken in the same period do not exceed the emission limit values set out in points 1.5(b) and (c) of Part 3; in case of waste incineration plants in which the gas resulting from the incineration process is raised to a temperature of at least 1 100 °C for at least two seconds, Member States may apply an evaluation period of 7 days for the 10-minute average values;

(ii) in case of waste co-incineration plants: the provisions of Part 4 are met.

1.2 The half-hourly average values and the 10-minute averages shall be determined within the effective operating time (excluding the start-up and shut-down periods if no waste is being incinerated) from the measured values after having subtracted the value of the confidence interval specified in point 1.3 of Part 6. The daily average values shall be determined from those validated average values.

To obtain a valid daily average value no more than five half-hourly average values in any day shall be discarded due to malfunction or maintenance of the continuous measurement system. No more than ten daily average values per year shall be discarded due to malfunction or maintenance of the continuous measurement system.

1.3 The average values over the sampling period and the average values in the case of periodical measurements of HF, HCl and SO_2 shall be determined in accordance with the requirements of Articles 45(1)(e), 48(3) and point 1 of Part 6."

Part 8 of Annex VI also lays out the following provisions for emissions to water:

"2. The emission limit values for water shall be regarded as being complied with if:

a) for total suspended solids 95 % and 100 % of the measured values do not exceed the respective emission limit values as set out in Part 5;
b) for heavy metals (Hg, Cd, Tl, As, Pb, Cr, Cu, Ni and Zn) no more than one measurement per year exceeds the emission limit values set out in Part 5; or, if the Member State provides for more than 20 samples per year, no more than 5 % of these samples exceed the emission limit values set out in Part 5;
c) for dioxins and furans, the measurement results do not exceed the emission limit value set out in Part 5."

2.2.2 BREFs and BAT Conclusions

Emissions monitoring and some elements related to compliance assessment have also been captured in BREFs and some BAT conclusions. These typically cover specific definitions, averaging periods, reference conditions as well as monitoring requirements (e.g. periodic and frequency, continuous, standards etc.) for specific pollutants, media, BAT conclusions etc. Some BAT conclusions, such as those for LCPs, also define some Other Than Normal Operating Conditions (or reference appropriate definitions, e.g. Commission Implementing Decision 2012/249/EU on start-up and shut-down periods) and measures to reduce emissions during Other Than Normal Operating Conditions.

The BREF review process has also flagged and discussed a number of relevant issues; these include the following:

1. Differences between averaging periods caused many discussions during the LCP BREF review. The LCP BREF Annex III – 'Example tool for converting emission levels to different averaging periods', provides an example of a statistical tool for deriving daily and monthly averages from the 95th percentile of the hourly averages and the yearly averages.

2. During the Industrial Emissions Expert Group meeting held on 28 June 2018, a Background Paper on future Waste Incineration (WI) BAT conclusions implementation and current IED Chapter VI compliance assessment regime was discussed. In this context, interactions between the concept of Effective

Operating Time (EOT) and BAT-AELs that represent Normal Operating Conditions (NOC) were discussed.

3. During the WI BREF review, assessing compliance with emission limit values when these are set at lower concentrations was acknowledged as challenging. Chapter 7 'Concluding Remarks and Recommendations for future work' of the WI BREF states the following:

> *"For emissions to air of dust, HCl, HF, CO, TVOC, SO2, metals and metalloids including mercury, NH3, as well as PCDD/F and dioxin-like PCBs, the TWG highlighted the potential difficulty, at the time when the Waste Incineration BREF was under review, of assessing compliance with emission limit values when these are set around the lower end of the BAT-AEL ranges, due to the likely increase of the relative measurement uncertainty (i.e. the uncertainty expressed as a percentage of the measured value) with decreasing emission levels. In this context, the TWG recognised the ongoing CEN work to review and update measurement standards that are relevant for the implementation of the BAT conclusions for Waste Incineration."*

In addition to the IED itself and the activity focused BREFs, a Reference Report on Monitoring of Emissions to Air and Water from IED installations (ROM) has been developed by the EIPPCB[6]. The document summarises information on the monitoring of emissions to air and water from IED installations and is intended to provide practical guidance for the application of BAT conclusions on monitoring in order to help competent authorities to define monitoring requirements in the permits of IED installations. It is also intended to support the TWGs for specific BREFs and the development of BAT conclusions.

2.3 IED gap analysis

A high level review of the IED provisions as well as those in the BAT Conclusions has been undertaken in order to identify where the main gaps are in relation to compliance assessment. This includes both gaps as well as provisions that are not entirely clear and/or are left up to the Member States to implement which in turn has led to differences in implementation.

Whilst **Article 14(1)** introduces the requirement for compliance monitoring and assessment in permits, it **does not explicitly define the rules upon which compliance assessment should be based**. Rather, it simply requires Member States to include in permits "*conditions for assessing compliance with the emission limit values*" (Article 14(1)(h)), introduce measures in permits that include "*suitable emission monitoring requirements, specifying the methodology, frequency and evaluation procedures*" (Article 14(1)(c)) and, under Article 14(1)(d), and an obligation to supply the competent authority, on at least an annual basis, with information based on the results of the monitoring under Article 14(1)(c) that allows the competent authority to verify compliance with the emission limit values.

In particular, **Chapter II does not address how measurement uncertainty should be considered** when assessing the results of monitoring data obtained under Article 14(1)(c) against emission limits. Maximum levels of measurement uncertainty, expressed as a percentage of the emission limit value, are provided in Annex V and Annex VI for LCPs and WIs. The challenge, however, is that these requirements in the IED annexes do not apply to Chapter II IED compliance assessment, although some Member States do use them as reference for setting conditions in permits for installations under Chapter II (e.g. some Member States have indicated that they use the % values in Annex V Part 3 for calculating validated average values for other sectors).

Furthermore, there is a certain amount of **ambiguity in terms of how the maximum uncertainty levels in point 9, Part 3 of Annex V and point 1.3, Part 6 of Annex VI should be interpreted**. Whilst intended as a reference for assessing the reliability of a measurement or suitability of a monitoring procedure (i.e. these are intended to represent maximum levels of uncertainty above which any measured value should be rejected due to the magnitude of potential error in the data) several Member States are using these maximum levels as the basis for

[6] https://eippcb.jrc.ec.europa.eu/sites/default/files/2019-12/ROM_2018_08_20.pdf

subtracting measurement uncertainty from the measured value under point 10 of Annex V, Part 3 and point 1.2 of Annex VI, Part 8.

The ROM includes further discussion on measurement uncertainty, maximum permissible expanded uncertainty and compliance assessment. However, the terminology used is non-committal, i.e., "*For compliance assessment, the expanded uncertainty **may** be taken into account for each measurement result or for the average before comparing the value(s) with the ELV given in a permit*" (emphasis added) with the ROM itself acknowledging that "*With respect to the comparison, there are different approaches in the Member States*".

Article 15(3) of Chapter II establishes that the emission limit values set in permits apply under normal operating conditions (NOC), with Article 14(1)(f) requiring that permits include measures relating to conditions other than normal operating conditions (OTNOC) such as start-up and shut-down operations, leaks, malfunctions, momentary stoppages and definitive cessation of operations. However, **Chapter II does not provide a formal definition of NOC or OTNOC** with Member States largely responsible for defining such conditions for Chapter II installations. This can lead to variations in approaches with potentially different allowances made across the EU. In some cases, this may result in higher emission levels if one Member State defines an operating scenario as OTNOC (and, therefore, would not need to meet BAT-AELs), whilst another defines the same operating scenario as NOC.

Emissions monitoring and some elements related to compliance assessment are captured in BREFs and some BAT conclusions. These typically cover specific definitions, averaging periods, reference conditions as well as monitoring requirements (e.g. periodic and frequency, continuous, standards etc.) for specific pollutants, media, BAT conclusions etc. Some BAT conclusions, such as those for LCPs, also define some Other Than Normal Operating Conditions (or reference appropriate definitions, e.g. Commission Implementing Decision 2012/249/EU on start-up and shut-down periods) and measures to reduce emissions during other than normal operating conditions. However, for the **majority of Chapter II installations, there is no formal definition of normal operating conditions or other than normal operating conditions in either Chapter II or the BAT conclusions**.

BAT-AELs introduced under the LCP and WI BAT conclusions contain **different averaging periods** to those introduced under Annex V and Annex VI, or do not necessarily reflect the same coverage of averaging periods as those introduced under Annex VI and Annex VI. For example, for combustion gases from WIs, Annex VI provides emission limit values for daily averaged and 30-minute averaging periods, whilst the BAT-AELs for the same pollutants prescribe daily averaging periods only. With LCPs, Annex V introduces hourly averaging periods which are not reflected in the BAT-AELs. Conversely, the BAT-AELs introduce annual averaging periods which are not reflected in Annex V (the longest averaging period is a month). This can introduce uncertainty as to what limits and monitoring requirements should be reflected in permits and/or can lead to operators and Member State authorities needing to assess compliance for the same pollutants and processes multiple times.

The 'Example tool for converting emission levels to different averaging periods' developed by the Netherlands and referenced in Chapter 13.3 of the LCP BREF, provides methods for estimating daily and monthly averages from the 95th percentile of hourly averages and the annual average. However, this tool only provides estimated data (it is based on interpolation) and does not include methods for deriving 30-minute averaged data from daily averaged data, so is not suitable for WIs.

3 Member State challenges & approaches

3.1 Overview

A consultation with the Member States was conducted in order to gain an understanding of the different approaches and practices currently adopted in compliance assessment across the EU. A data collection proforma was developed structured around the three key areas of general compliance assessment provisions (relating to Chapter II of the IED), provisions specific to compliance assessment of LCPs (Chapter III and Annex V), and provisions specific to waste (co-)incineration (Chapter IV and Annex VI). The template proforma, presented in Annex 2, included questions on the legal requirements and/or guidance in place setting out provisions for compliance assessment in Member States, with particular focus on calculating validated average values and accounting for measurement uncertainty. In addition, the template sought to gain Member State perspectives on the challenges in implementing compliance assessment provisions of the IED.

In advance of sharing the proformas with the Member States, they were pre-filled based on a review of publicly available literature. This included previous EU-level studies looking at IED implementation, such as reports produced under the IED Implementation Support 2018-2020 work programme, which identified cross-cutting implementation challenges and some solutions across the EU. Subsequently, language experts within the project team conducted Member State-specific reviews of national literature, legislation and guidance to provide more detailed information on provisions and challenges relevant to each country. The level of information identified as part of this review and the extent to which the proformas could be pre-filled varied significantly across the EU. Sources consulted in pre-filling the Member State templates are displayed in Table 4. It should be noted that some of these sources are not publicly available e.g. some are only available to the Member States as part of the ongoing IED implementation support programme of work. A wider range of data sources were reviewed as part of the prefilling exercise but no relevant information was identified for inclusion.

Table 4: Information sources reviewed in prefilling Member State templates

Source	Scope of analysis
Ricardo (2020) Assessment of compliance with Emission Limit Values under the Industrial Emissions Directive: Current practices in Europe	EU-wide
Ricardo (2020) Permitting of emissions to water under the Industrial Emissions Directive: Current practices in Europe	EU-wide
Ricardo (2021) Implementation of BATC for Waste Incineration Webinar Presentation and Background Paper	EU-wide
Ricardo (2019) Background paper on implementation of BAT-AELs, AE(P)Ls and setting ELVs in permits	EU-wide
Ricardo (2020) Support to the evaluation of the Industrial Emissions Directive (Directive 2010/75/EU)[7]	EU-wide
KPMG (not yet published) Assessment of the permits of ex-TNP plants	14 Member States
Eunomia (not yet published) Assessment of BAT conclusions implementation in IED Permits	EU-wide
Frank Bold (2020) Industrial Emissions Directive: Measurement uncertainty issues (submitted as part of the IED evaluation stakeholder engagement activities)	EU-wide
National implementing legislation (e.g. Ireland's *S.I. No. 566/2012 – European Union (Large Combustion Plants) Regulations 2012*)	Member State level

[7] https://circabc.europa.eu/w/browse/df5b7d87-2bd9-47f3-b3d3-de41d402476d

Source	Scope of analysis
National and regional guidance (e.g. Ireland's *Environmental Protection Agency Office of Environmental Enforcement Air Emissions Monitoring Guidance Note AG2*)	Member State level (regional in some instances)
Presentations from CEWEP webinar held on 3 December 2021: "Challenges in the implementation of WI BAT Conclusions within the context of IED Review".	EU-wide and selected Member States

Member State respondents reviewed the pre-filled templates and returned them with feedback, clarifications and inputs. These were subsequently updated by the project team and shared with respondents once more to ensure that their feedback was accurately incorporated (all completed proformas are available in Annex 3). Due to the project team refocussing their efforts on providing the Commission with support and input to the draft staff working document for the IED revision, as well as time required to satisfactorily finalise templates (following prefilling by the language experts) across Member States with significantly varying levels of publicly available information, the finalisation and issue of proformas to the Member States was delayed relative to the original timetable. However, all Member State proformas were shared with the relevant authorities, and where responses were provided, these were finalised by early December (see Table 5).

Table 5: Status of engagement with the Member States

Member State	Response status
AT	Input provided for Chapter II installations (emissions to water) and waste incineration. After a follow up from the project team, some small additions were provided for Chapter II (emissions to air) and LCPs.
BE	Completed proforma returned to project team with contributions provided to most questions.
BG	Completed proforma returned to project team with most questions addressed. Some further comments were received after follow up questions from the project team and some clarifications requested by BG representative.
CY	No response received after multiple attempts to contact MS representative. Response is therefore based on a literature review by the project team, but much of the desired information was not identified.
CZ	Completed proforma returned to project team with contributions provided to most questions.
DE	Completed proforma returned to project team with contributions provided to most questions.
DK	Completed proforma returned to project team with contributions provided to most questions for emissions to air. After follow up from the project team, some additional input was provided for emissions to water for Chapter II installations.
EE	Completed proforma returned to project team with contributions provided to most questions.
EL	No response received after multiple attempts to contact MS representative. Response is therefore based on a literature review by the project team, but much of the desired information was not identified.
ES	Completed proforma returned to project team with most questions addressed. Some further comments were received after follow up questions from the project team.
FI	Completed proforma returned to project team with contributions provided to most questions.

Member State	Response status
FR	Completed proforma returned to project team with contributions provided to most questions.
HR	Completed proforma returned to project team with contributions provided to most questions.
HU	Completed proforma returned to project team with contributions provided to most questions, with some gaps in the response.
IE	Completed proforma returned to project team with contributions provided to most questions for emissions to air, with some gaps in the response and no information provided for emissions to water.
IT	Completed proforma returned to project team with contributions provided to most questions.
LT	No response received after multiple attempts to contact MS representative by email. Response is therefore based on a literature review by the project team, but much of the desired information was not identified.
LU	No response received after multiple attempts to contact MS representative by email. Response is therefore based on a literature review by the project team, but much of the desired information was not identified.
LV	Completed proforma returned to project team with contributions provided to most questions.
MT	Completed proforma returned to project team with contributions provided to most questions.
NL	Completed proforma returned to project team with contributions provided to most questions regarding emissions to air. Little information was provided related to emissions to water.
PL	Completed proforma returned to project team with contributions provided to most questions regarding emissions to air. Little information was provided related to emissions to water.
PT	Completed proforma returned to project team with contributions provided to most questions.
RO	Completed proforma returned to project team with contributions provided to most questions.
SE	Completed proforma returned to project team with contributions provided to most questions.
SI	Completed proforma returned to project team with contributions provided to most questions.
SK	Completed proforma returned to project team with contributions provided to most questions.

3.2 Member State challenges and approaches taken

3.2.1 Chapter II compliance assessment and horizontal issues

3.2.1.1 Key challenges

The key challenge faced by the Member States in relation to assessing compliance with ELVs for Chapter II activities relates to how measurement uncertainty should be taken into account. Other challenges faced by the Member States include dealing with measurements at low concentrations and how to define start-up/shut-down and OTNOC between and within sectors. These are discussed further below.

Measurement uncertainty

The 2020 evaluation[8] concluded that the IED has contributed to a more levelled playing field when compared to the IPPCD. However, it did identify a number of variations in implementation between Member States. In particular, the evaluation identified a number of specific issues related to the assessment of compliance and how measurement uncertainties are taken into account. Whilst there was limited information identified on the scale of the issue and exact approaches by each Member State it was clear that there is some variability across the EU which can lead to quite significant differences in implementation and compliance with permit conditions.

As part of the stakeholder engagement activities for the IED evaluation, information on how different Member States approach compliance assessment was gathered via interviews with permitting authorities and written feedback received from stakeholders. It found that the different Member State approaches for dealing with measurement uncertainty could broadly be split into two main categories: (i) real measurement uncertainty is subtracted; and (ii) fixed, maximum percentage of the measured value or ELV is subtracted irrespective of the actual measurement uncertainty. The IED evaluation concluded (with illustrative examples of the variation different approaches can lead to in environmental terms) that the first approach (i) leads to the best outcome for the environment as it is more accurate and representative of reality and should lead to the lowest emissions. This was because those Member States identified as applying the second approach (ii) were using higher maximum values to subtract from the measured value than the likely real measurement uncertainty.

A 2020 paper produced under the IED implementation support contract (2018-2020) looked specifically at how Member States assess compliance with ELVs under the IED based on a survey of Member State competent authorities as well as a review of relevant literature. Building on the IED evaluation, the paper further broke down the different Member State approaches for compliance assessment into four main categories:

1. Approach A: Subtraction of maximum allowed measurement uncertainty from measured value
2. Approach B: Subtraction of a fixed proportion of the ELV from the measured value
3. Approach C: Subtraction of the actual measurement uncertainty of the measurement system
4. Approach D: No subtraction of uncertainty

The table below, building on an illustrative example that was provided in the IED evaluation, demonstrates that when applied to an example ELV for a generic pollutant of 100 mg/Nm^3 using these different approaches can lead to the maximum measured value which is still considered to be compliant varying from 100 mg/Nm^3 (Approach D), 105 mg/Nm^3 (Approach C[9]), 120 mg/Nm^3 (Approach B[10]) up to 125 mg/Nm^3 (Approach A[11]). This clearly can have significant implications for emissions and lead to an uneven playing field across the EU.

[8] https://ec.europa.eu/environment/industry/stationary/ied/evaluation.htm

[9] Calculated from the identity $C_m - 0.05C_m = C_{ELV}$, i.e., max C_m to comply = C_{ELV} / (1-0.05) = 100 / 0.95 = 105.3

[10] Calculated from the identity $C_m - 0.2C_{ELV} = C_{ELV}$, i.e., max C_m to comply = $C_{ELV} + (0.2C_{ELV})$ = 100 + (0.2 x 100) = 120

[11] Calculated from the identify $C_m - 0.2C_m = C_{ELV}$ where C_m is the monitored concentration and C_{ELV} the emission limit value, i.e., max C_m to comply = C_{ELV} / (1-0.2) = 100 / 0.8 = 125

Table 6: Illustrative calculations of impacts of different approaches to dealing with confidence intervals for an example ELV for a generic pollutant of 100 mg/Nm^3 (building on Ricardo (2020), IED evaluation support contract)

Measured value [A]	90		100		110		120	
Approach	Reported value [A]	Value subtracted	Reported value [A]	Value subtracted	Reported value [A]	Value subtracted	Reported value [A]	Value subtracted
A: Subtraction of max measurement uncertainty from measured value (20% assumed)	72	18	80	20	88	22	96	24
B: Subtraction of a fixed proportion of the ELV from the measured value (20% assumed)	70	20	80	20	90	20	100	20
C: Subtraction of the actual measurement uncertainty (5% assumed)	85.5	4.5	95	5	104.5	5.5	114	6.0
D: No subtraction of uncertainty	90	0	100	0	110	0	120	0

[A] Assumes an emission limit value for a generic pollutant of 100 mg/Nm^3. Exceedances of the emission limit value after subtraction of measurement uncertainty (where relevant) are highlighted with red cells.

Evidence prepared and submitted by the Frank Bold Society for the purposes of the IED evaluation set out some specific examples where such approaches have enabled plants to remain in compliance through the subtraction of the maximum fixed uncertainty from the measured value or ELV.

Extract from Frank Bold Society submission to the IED evaluation process (2020)

Czech Republic: Počerady lignite power plant

The specific characteristic of the Czech version of this approach is that the IED has been transposed into a national regulation (no. 415/2012 Coll., § 9 sec. 7) in a way that does not leave any space for any other interpretation. This is different from other states applying the Czech approach only through methodological guidance. Elektrárna Počerady10 (1000 MWe) is a lignite power plant, one of the biggest national and even European polluters. The evidence shows that the power plant may have complied with its emission limits solely because of the Czech approach to emission uncertainty subtraction. Based on the IPPC permit compliance report for 2018, the power plant has reported the following NOx emission values for its units: B2: 194 mg/m^3, B3: 191 mg/m^3, B4: 181 mg/m^3. Thus, all the aforementioned units have complied with the emission limit of 200 mg/m^3. However, the measurement uncertainty of 20% of the emission limit (40 mg/m^3) has been subtracted from each value. It means that the raw measured values of NOx emissions would be: B2: 234 mg/m^3, B3: 231 mg/m^3, B4: 221 mg/m^3. Data on the real uncertainty of measurement are not available to the public, so it is therefore impossible to recalculate the emissions from Počerady power plant using the German approach[12]. However,

[12] The German approach is to subtract the actual measurement uncertainty rather than the maximum potential uncertainty.

assuming that the real measuring uncertainty is somewhat lower than the maximum allowed value, there is a significant possibility that if the German approach were applied in this case, the power plant would not comply with its emission limit.

Dealing with measurements at low concentrations

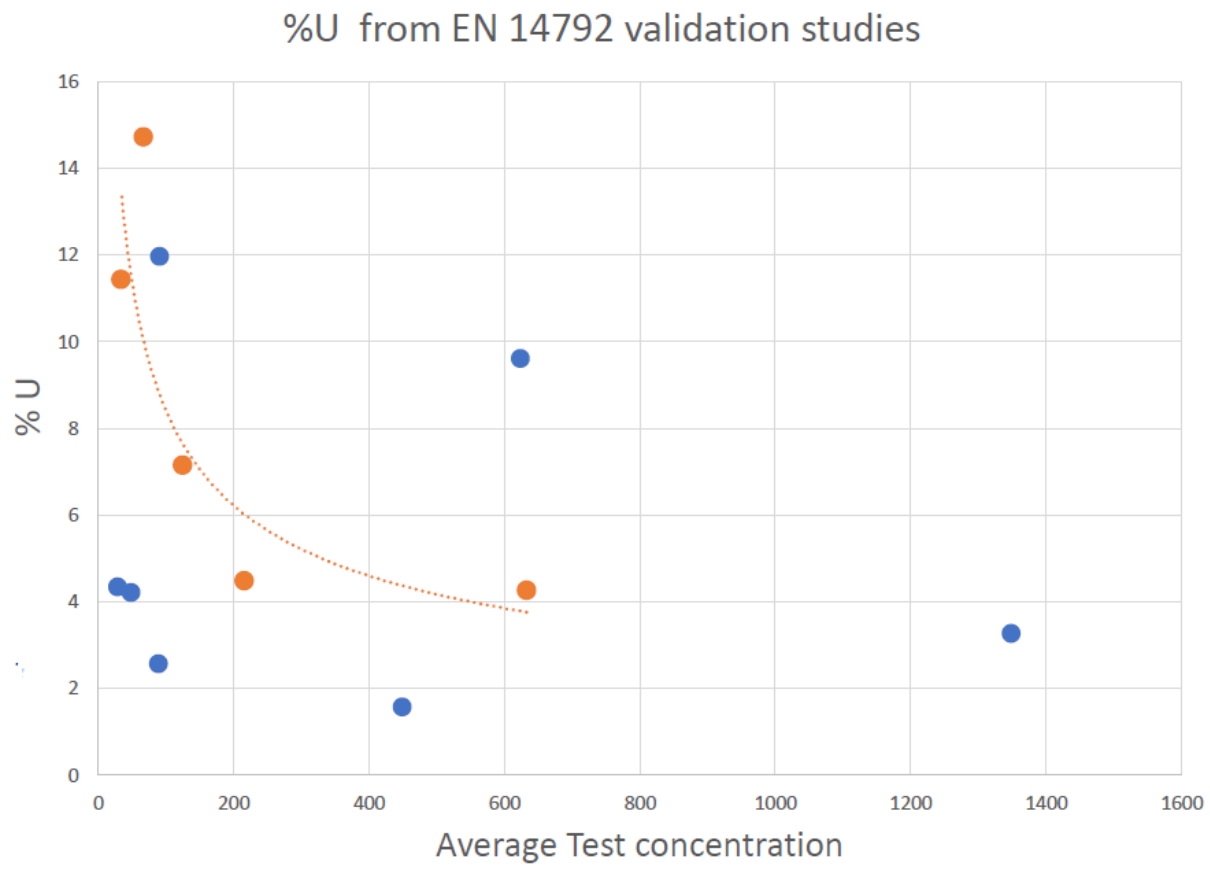
In general, the result of an emissions measurement is obtained using several components that each have an associated standard measurement uncertainty. The combined measurement uncertainty for an emissions measurement comprises the aggregated uncertainty contributions from each of the many individual devices or components used to obtain the final measured emission concentration. The overall measurement uncertainty, also referred to as the expanded measurement uncertainty, is the interval in which the value of the measured emission is believed to lie with a stated degree of confidence. It is calculated by multiplying the combined uncertainty with a coverage factor. In many cases, a coverage factor of 1.96 is applied to provide a 95% confidence interval.

Many of the standard reference methods and, indeed, Annex V and Annex VI, provide maximum permissible expanded measurement uncertainties that should be used as the basis for assessing the suitability of a measured value or monitoring technique. These maximum permissible expanded uncertainties are expressed as a percentage of the emission limit value.

However, many of the individual methods that contribute towards the expanded measurement uncertainty have an uncertainty level quoted as a fixed absolute value irrespective of the measured value; for example, the uncertainty of a thermocouple used to measure temperature may be expressed as ± X °C for any temperature range, or the uncertainty of a balance used to measure the weight of impinger solutions may simply be expressed as ± X g.

Due to the above, the **relative** measurement uncertainty, i.e., expressed as a percentage of the measured value, or expressed as a percentage of an emission limit value, increases with decreasing emission levels. For many methods, uncertainties at low levels will 'blow up' with any fixed uncertainty source becoming dominant. This effect is demonstrated in Figure 4. Consequently, when measured values or emission limit values are very low, it can be difficult to achieve maximum permissible expanded uncertainty values expressed as a percentage of an emission limit value. This is particularly the case where permit limits are introduced at the lower end of the BAT-AEL range and for pollutants where the BAT-AEL and/or measured value is very low.

Figure 4: Relative expanded uncertainty as a function of measured NOx emission concentration



Source: Robinson, R. (2022). 'Influence of implementation issues on standardisation'. Presentation at the CEWEP Workshop of WI BAT.

Notes: blue dots indicate results from a 'simulator' source, whereas orange dots present data from real world tests.

EN standards are created for certifying and calibrating measurement equipment and for developing Standard Reference Methods (SRM). The current EN standards were developed in response to the existing requirements of IED. However, technical progress with emission controls has resulted in increasingly more stringent emission limits introduced as part of new BAT Conclusions since IED was first introduced in 2010, and a corresponding requirement to monitor emissions at much lower concentrations. Consequently, in addition to difficulties in meeting the measurement uncertainty requirements at low concentrations, several of the SRM have not been validated at the lower range of the BAT-AELs (e.g., EN 1911 for HCl) and there is uncertainty in the ability of the standard reference methods to replicate accurate measurements at concentrations outside the validated range of the method. This is a focus of the ongoing review work by the CEN/TC 264 working groups (and discussed further in Section 4).

The ability to assess compliance with emission limit values when set at lower concentrations was discussed during the WI BREF review and reference was made in the 'Concluding Remarks and Recommendations for future work' section of the BREF to ongoing CEN work to review and update relevant measurement standards.

Defining start-up / shut-down and OTNOC

Chapter II applies to all installations and sectors covered by Annex I. The number and complexity of the different sectors is large and varied and, as such, it is more complicated to establish a universal definition of start-up and shut-down conditions that is applicable to all sectors within the confines of Chapter II.

Individual sectors will have different procedures and use different parameters for establishing the point at which a process transitions out of a start-up state to normal operating conditions, or transitioning from normal

operating conditions to a shut-down state. For example, a combustion plant generating electricity may define the cessation of the start-up phase once that plant has achieved the minimum load for stable generation, whilst a chemicals installation may define the cessation of the start-up phase once the necessary reaction temperatures and pressures have been achieved.

The same complication also applies to a definition of NOC and OTNOC except start-up and shut-down . Due to the variety of process taking place across Chapter II installations, there will be a large range of process measurements that act as trigger levels for identifying these conditions. These surrogate measurements may include e.g., temperature, pressure, pH, volumetric flows, feed rates etc.

Consequently, it is difficult to include prescriptive definitions of start-up, shut-down and OTNOC within the confines of Chapter II, and it is often at the discretion of individual Member States to interpret these requirements which can be challenging as it requires good technical knowledge of different processes and sectors and/or being reliant on the operators themselves to support such a definition.

Summary

Member States were invited to identify challenges they face in conducting Chapter II compliance assessment through the consultation. Challenges reported by Member States are presented in Table 7. The most frequently reported difficulty related to simultaneously applying BAT-AELs alongside limit values in national legislation, especially where averaging periods differ. Ambiguity over the definition of NOC and OTNOC was also highlighted as an issue by a number of Member States.

Table 7: Challenges reported by Member States for Chapter II compliance assessment

Challenge	Member State(s)
Given the wide ranges for BAT-AELs, it is not always clear on what basis the ELV should be set at the higher/lower end of the BAT-AEL range.	BE
Ambiguities in IED present challenges in determining NOC and OTNOC	EE, ES, SE
Difficulties in checking compliance of multi-fuel combustion where the mix of fuels and share of fuels are changing.	EE
Lack of compliance assessment guidance in BATCs.	ES
Ambiguity in IED over addressing measurement uncertainty.	ES
Uncertainty when considering OTNOC in installations that are in OTNOC for a significant percentage of their overall operating time.	ES
Lack of guidance on how to jointly implement IED and BATC requirements.	ES
Challenges faced in producing reliable calibration functions when measured emissions are very low compared to the ELV.	FI
Lack of guidance on accounting for measurement uncertainty for periodic measurements.	FI
Challenges in applying BATCs alongside the IED and existing national regulations, especially where different averaging periods are in question.	AT, CZ, DE, HU, PL, SI
Difficulties in harmonising and combining ELVs when multiple BREF / BATCs are applicable to the same installation (this is reportedly common with chemical plants).	PT

Challenge	Member State(s)
Difficulties in establishing ELVs for wastewater discharged into water bodies, given that in many cases they are not found in BATCs or setting the values according to "combined approach" according to WFD.	BG, RO
Challenges faced in determining averaging periods when performing discontinuous monitoring.	SK

3.2.1.2 Member State approaches

The review of Member State approaches for compliance assessment for Chapter II installations has focused primarily on the Member States approaches related to calculations of the validated average values. In particular:

- For installations under Chapter II, is the measurement uncertainty considered for the compliance assessment and how?
- How Member States are dealing with performing measurements at lower concentrations?
- How Member States are defining start-up / shut-down and OTNOC?

These are summarised in the table below. Most Member States did not provide information in response to the question on dealing with measurements at low concentrations. Responses were either not provided at all or focused on issues such as limits of detection of measurement equipment, rather than accounting for measurement uncertainty when assessing validated averages. This aspect has been left out of the summary table unless relevant information was provided.

Table 8: Summary of Member State approaches for Chapter II compliance assessment and horizontal issues

Member State	Summary of approaches
AT	• For emissions to air, detailed methodologies are provided in permits. Uncertainty is applied on the basis of maximum allowed measurement uncertainty as well as actual measurement uncertainty. • For emissions to water, a waste water measurement is considered greater than the ELV if it exceeds the value by more than the standard deviation of the analytical method used. This only applies to ELVs set out in the General Waste Water Emissions Ordinance (AAEV), it does not apply to ELVs based on sector-specific waste water ordinances. An emission value is considered compliant when 4 out of 5 consecutive measurements are below the ELV, and no single measurement exceeds the ELV by 50% or more. • Start-up / shut-down and OTNOC are not defined in national legislation. For emissions to air, details are set in permits but OTNOC can include start up and shut down, severe malfunction and periods of maintenance/repair. For emissions to water, OTNOC are not considered as compliance assessment already allows for short OTNOC conditions.
BE	• For emissions to air, in Flanders the sum of all errors may not exceed 30% of the result of the measurement. A fixed value of 30% of the measured value is subtracted. In Wallonia there is no legislation specifying that uncertainty should not exceed 30% of the ELV. In some cases permit conditions describe if/how measurement uncertainty can be considered, the most common approach is to subtract the measurement uncertainty from the result. • For emissions to water, in Flanders the uncertainty is considered but value varies (20%, 30%, 40% or 50%). No additional information was provided for water for Wallonia. • In Flanders, NOCs are defined in Article 1.1.2 VLAREM II as: operating conditions outside the start-up or shutdown procedures, unless stated otherwise. In Wallonia, OTNOC are defined in Arrêté du Gouvernement wallon du 4 juillet 2002 as start-up and shutdown operations, leaks, malfunctions, momentary stoppages and definitive cessation of operations.

Member State	Summary of approaches
BG	• Measurement uncertainty is not subtracted from measured values to calculate validated average values. The Member State response did not indicate whether this response was provided for emissions to air, water or both. • No formal definition of NOC/OTNOC was provided.
CY	• No information identified concerning application of measurement uncertainty for emissions to air. • For emissions to water, measurement uncertainty is taken into account to decide whether the limit has been exceeded or not. No further information was identified indicating how the measurement uncertainty is considered. • OTNOC / NOC are not defined in national legislation further than what is stated in the IED.
CZ	• Decree No. 415/2012 specifies fixed percentages of the ELV to be deducted from measurements to calculate validated average values. • No information was provided for emissions to water. • OTNOC / NOC are not explicitly defined, however the Act On Integrated Pollution Prevention and Control outlines a list of conditions which cannot be considered NOC.
DE	• Actual measurement uncertainty (i.e. the fixed standard deviation from the QAL 2 element of EN14181) which must not exceed the maximum allowed uncertainty, is deducted from measured values to calculate validated averages for emissions to air. • For emissions to water, measured values are used without consideration of uncertainty. • A general rule for determining 'operating conditions' for combustion installations is provided. For emissions to water, the concept of OTNOC is not applied or required as ELVs must be met at all times. • For emissions to air, the limit of detection of the measurement method should be smaller than one tenth of the emission limit to be monitored. In the case of cumulative limits, the sum of the individual detection limits for the determination of the components to be summed should be less than one tenth of the cumulative limit. Individual results below the respective detection limit are not included in the calculation of the sum.
DK	• For emissions to air, measurement uncertainty is not considered for compliance assessment for periodic or continuous measurements for Chapter II installations. Measurement uncertainty is considered for continuous monitoring of WI and LCP installations, where a fixed percentage of the ELV is applied. • The measurement uncertainty is considered for compliance assessment for all emissions to wastewater. No further information was provided on how uncertainty is considered for emissions to water. • There is no national guidance on how to define NOC, but it is stated that measurements should be made under representative operational conditions (maximum standard operation). • For monitoring of emissions to the air the detection limit of the method of measurement should normally be less than 10 % of the emission limit value. • For monitoring emissions to water, the method of measurement should be 1/10 of the limit value inspected and the method of measurement should be certified.
EE	• Standard reference methods and actual measurement uncertainty are taken into account for measurements/activities other than LCP/WI. The Member State respondent did not clarify whether this was for air, water or both.

Member State	Summary of approaches
	• The Industrial Emissions Act defines OTNOC.
EL	• No information identified concerning application of measurement uncertainty for emissions to air or water. • OTNOC / NOC are not defined in national legislation further than what is stated in the IED.
ES	• Measurement uncertainty is subtracted from measured values as a fixed percentage of the ELV to obtain the validated average. The Member State response did not indicate whether this was for emissions to air, water or both. • NOC are not specifically defined in national legislation, but OTNOC are defined on a case by case basis.
FI	• National legislation does not make any specific provisions for applying uncertainty in compliance assessment, this is detailed in permits. In practice for emissions to air, uncertainty is applied by subtracting the maximum allowed measurement uncertainty. • For emissions to waste water, based on national guidance, uncertainty is included in ELVs and is not additionally subtracted from the measured value. • No guidance is currently provided on how to deal calculating validated average values at low emission levels, but the Ministry of Environment indicated they are looking to explore this issue more. • NOC are not specifically defined in national legislation, but OTNOC are defined on a case by case basis.
FR	• For continuous monitoring of emissions to air, actual measurement uncertainty determined in line with reference standards are subtracted from validated averages. No subtraction of uncertainty for periodic measurements of emissions to air. • The method limit of detection should be no greater than 10% of the value of the emission limit for air emissions. For emission to water an expanded measurement uncertainty less than or equal to 50% of three times the quantification limit should be guaranteed. • For emissions to water, uncertainty is determined in accordance with the standard NF EN ISO 11352. • Generally, all emissions are considered NOC unless specified otherwise for special cases which may be outlined in national ministerial order (e.g. for LCPs) and/ or in individual permits.
HR	• Legislation sets out that actual measurement uncertainty, which must not exceed maximum allowed measurement uncertainty, is to be subtracted from measured values to calculate validated averages. • No additional information was provided by Member State representative for emissions to water. • No information was provided by Member State representative about how OTNOC / NOC are defined.
HU	• Measurement uncertainty is specified for different air pollutants and uncertainty is applied by subtracting the maximum allowed measurement uncertainty. • No additional information was provided by Member State representative for emissions to water. • No definition of OTNOC / NOC was provided by the Member State representative.
IE	• Assessment of compliance is initially made without subtraction of measurement uncertainty. Where a reported measurement is above the ELV, the Environmental Protection Agency may take account of actual measurement uncertainty by subtracting it from both continuous and periodic measurements. • Where measurements are below the limits of detection, it is acceptable to report 'less than' results provided that the method limit of detection is stated. The method limit of detection should be calculated using the laboratory limit of detection. For compliance monitoring, the method limit of

Member State	Summary of approaches
	detection should be no greater than 10% of the value of the emission limit unless otherwise agreed with the EPA • No additional information was provided by Member State representative for emissions to water. • OTNOC / NOC are not defined further than what is laid out in the IED.
IT	• In calculating validated averages, actual measurement uncertainty is considered. However, not all companies performing measurements deduct this value from measured values before assessing compliance. The Member State response did not indicate whether this is for emissions to air, water or both. • When considering measurements at low concentrations, IT defines measurement uncertainty in two ways for each compound – one relative to the absolute value, valid at low concentrations and the percentage, valid at higher concentrations. • OTNOC / NOC are not generally defined in national legislation and should be considered on a case by case basis.
LT	• No information identified concerning application of measurement uncertainty for air or for water. • No information identified concerning how OTNOC / NOC are defined.
LU	• Measurement uncertainty is not subtracted from measured values in calculating validated average values. It is unclear is this is relevant for emissions to air, water or both. • OTNOC are defined as: Start-up and shut-down operations, leaks, malfunctions, and momentary shut-downs.
LV	• Measurement uncertainty is considered and is prescribed in national legislation and it is applied by subtracting the maximum allowed measurement uncertainty. Measured values are classified as either (i) compliant (the measurement uncertainty added to the measured value does not exceed the ELV); (ii) intermediate (the difference between the measured value and the ELV is less than the measurement uncertainty); or (iii) non-compliant (where the measured value minus the measurement uncertainty exceeds the limit value. It is unclear if this is relevant for emissions to air, water or both. • NOC are prescribed in the guidelines by the State Environmental Service as 'the optimal operating conditions as specified by the equipment manufacturer - the operating conditions for which the equipment is designed'.
MT	• Measurement uncertainty is generally not taken into consideration for compliance assessment, except for CEMS monitoring of emissions to air. No further details were provided on how the measurement uncertainty is taken into account. • No further information was provided for emissions to water. • National legislation states that OTNOC are start-up, shut-down, leaks, malfunctions, momentary stoppages and definitive cessation of operations. In certain cases, additional OTNOC are stipulated in the permit.
NL	• For emissions to air, actual measurement uncertainty or reported uncertainty for periodic measurements is subtracted from measured values when calculating validated average values. • No additional information was provided for emissions to water. • NOC are defined on a case by case basis in permits.
PL	• For continuous monitoring compliance is assessed by subtracting actual uncertainty from measurements to calculate validated average values. Legislation sets out this procedure for ELVs set out in the IED. In

Member State	Summary of approaches
	the absence of defined measurement uncertainty procedures related to compliance assessment with BAT-AELs, a 'patch' is in place whereby procedures for ELVs are also applied to BAT-AELs. This will be addressed by the adoption of new regulation specifying measurement uncertainty procedures relating to BAT-AELs. The Member State response did not clarify whether this was for emissions to air, water or both. • There is no current procedures for measurements at low emissions, but PL are drafting a proposal which will consider the maximum permissible uncertainty as a fixed value for pollutants with very low AELs rather than a percentage of an emissions level. • OTNOC / NOC are not specifically defined, but there is reference in national legislation to 'periods of commissioning, breakdown and decommissioning of the installation or equipment'. Maximum allowed time for OTNOCs together with certain working parameters should be part of the permit conditions.
PT	• Measurement uncertainty is considered only in cases where the monitoring values are too close to the ELV. In this case, the maximum uncertainty of the method as calculated in a laboratory is subtracted. There is no mandatory approach, but the measurement is considered compliant if it is less than the ELV + uncertainty. The Member State response did not clarify whether this was for emissions to air, water or both. • Whenever possible, the operator must use monitoring methods whose detection limit is, at most 10% of the ELV set in the license. • OTNOC / NOC are not defined in national legislation.
RO	• Validated average values are calculated by subtracting actual measurement uncertainty from measured values. The Member State response did not clarify whether this was for emissions to air, water or both. • In general the measurement results are set as zero when multiple results for a pollutant are below the limit of detection and it is considered that the pollutant is not present. • OTNOC / NOC are not defined in national legislation beyond what is stated in the IED, but they exclude start up and shut down periods.
SE	• Uncertainty is not subtracted from measured values to calculate validated averages. Uncertainty is only considered at the prosecution stage to determine if an offence has been committed. The Member State response did not clarify whether this was for emissions to air, water or both. • The burden of proof lies on the operator regarding sufficient monitoring and providing results. • OTNOC / NOC are defined on a case by case basis. The Swedish EPA is currently working on updating and elaborating guidance concerning OTNOC, planned to be published in 2022.
SI	• Measurement uncertainty is not considered in compliance assessment. Member State response does not specify if this is for emissions to air, water or both. • Lower concentrations are measured by using measurement methods with lower thresholds of detection (LOD). In the case of waste water emission measurements, the method must have a level of detection at least 10 times lower than ELV for that pollutant. • OTNOC / NOC are determined on a case by case basis and are detailed in permits.
SK	• Measurement uncertainty is only considered in the case of continuous measurement using AMS, where it is based on the maximum expanded uncertainty (95% confidence intervals established by the IED for LCP and WID) which is applied as a fixed percentage of the daily ELV. • Low concentrations below the limit of quantification are not regulated by legal acts, but the EN standards state that in such cases the result of the blind field test is given as the measurement result. • OTNOC / NOC are not defined in national legislation.

3.2.2 Chapter III compliance assessment (Large Combustion Plants)

Like Chapter II, the key challenges faced by the Member States in relation to assessing compliance with ELVs for LCPs relates to how measurement uncertainty should be taken into account, how OTNOC can be defined consistently and how to assess measurements made at low concentrations. Other challenges include assessing compliance with ELVs from Chapter V and emission levels associated with BAT with different averaging periods, compliance assessment using continuous and periodic measurements, and calculation of operating hours for the purpose of assessing the basis for specific conditions for plants operating a limited number of hours per year.

These challenges are discussed below, where they have not already been covered under the Chapter II challenges above.

3.2.2.1 Key challenges

Application of maximum expanded measurement uncertainty

Point 9 of Annex V Part 3 requires that the 95% confidence interval (i.e., a measurement of the expanded uncertainty) of a single measured result should not exceed the percentages of the ELVs set out in Table 2. Point 10 of Annex V Part 3 then requires that the validated hourly and average values shall be "*determined from the measured valid hourly average values after having subtracted the value of the confidence interval specified in point 9*."

As previously discussed, the purpose of the maximum expanded uncertainty level is to act as a metric that allows the accuracy or suitability of a measurement or monitoring technique to be determined, i.e., if the 95% confidence interval exceeds this maximum level of uncertainty, the result should be discarded and/or an alternative monitoring technique adopted.

However, the key challenge for Member States arises from the ambiguity in the terminology used in point 10 that refers to subtraction of the value of the confidence interval specified in point 9. This can be interpreted by some Member States as meaning that it is the maximum expanded uncertainty level referred to in Point 9 that should be subtracted from the measured value, rather than using these data as a metric to assess the suitability of the measured data. The implications of the different approaches to applying measurement uncertainty have been discussed in earlier report sections.

Furthermore, while Point 10 specifies that measurement uncertainty must be subtracted from the measured value for the purposes of calculating validated hourly and daily averages, the same requirement is not explicitly stated for monthly averages, although in Point 1 of Part 4 monthly averages are included when referring to validated average values. This ambiguity can mean that some Member States may exercise their own discretion in defining the method for calculating monthly average values.

Defining start-up / shut-down and OTNOC consistently

Rules regarding the determination of start-up and shut-down periods for LCPs are provided in the Commission Implementing Decision Concerning the Determination of Start-up and Shut-down periods (2012/249/EU). These rules specify that the start-up period for combustion plants generating electricity ends at the point when the plant reaches the minimum load for stable generation and this minimum load (expressed as fixed percentage of the rated electrical output) shall be included in the plant's permit. For heat generating combustion plant only, the start-up period ends when the plant reaches minimum start-up load for stable generation and where the heat can be delivered to a distribution network, heat accumulator or used directly on-site. This minimum load is required to be introduced in permits as a fixed percentage of the rated thermal output of the combustion plant.

The shut-down period is considered to commence at the termination of the fuel supply after reaching the minimum shut-down load for stable generation from where on generated electricity is no longer available for the grid or generated mechanical power is no longer useful for the mechanical load (electricity generating plant) or reaching the minimum shut-down load for stable generation when heat can no longer be safely and reliably delivered to a network or used directly on a local industrial site (heat production only).

Whilst approaches for defining start-up and shut-down are provided in 2012/249/EU, there is still the opportunity for interpretation over what constitutes stable generation and the Implementing Decision does not extend to defining other OTNOC events. As a clear list of OTNOC (besides start-up and shut-down) does not exist in Chapter III or Annex V, it has been left to Member States to determine OTNOC in permits or in national legislation or guidance documents. This represents an obvious area for divergence in terms of how OTNOC are considered for compliance assessment. Additionally, a 2020 paper produced under the IED implementation support contract (2018-2020) identified that, even where OTNOC are defined at a Member State level, there are practical issues in terms of applying these definitions and procedures for compliance assessment, e.g., how can OTNOC be identified in monitoring data and how can OTNOC be distinguished between regular start-up and shut-down, maintenance or technical failures.

Assessing compliance with ELVs from Annex V and BAT associated emission levels with different averaging periods

Part 4 of Annex V describes the requirements for assessing compliance with the emission limit value for LCPs. Where compliance is assessed using continuous monitoring, Point 1 introduces three averaging periods with compliance over these averaging periods assessed as a certain proportion of the emission limit values:

- For monthly averages, no validated monthly average should exceed the relevant emission limit.
- For daily averages, no validated daily average should exceed 110% of the relevant emission limit (or, in the cases of combustion plants composed only of boilers using coal with a total rated thermal input below 50 MW, no validated daily average value should exceed 150 % of the relevant emission limit value).
- For hourly averages, 95% of all validated average values over the year should not exceed 200% of the relevant emission limit value.

Additional provisions apply in the LCP BAT conclusions. The provisions related to monitoring emissions to air and definition of the averaging periods are presented below.

Table 9: Definitions of averaging periods in the LCP BAT conclusions

Averaging Period	Definition
Daily average	Average over a period of 24 hours of valid hourly averages obtained by continuous measurement.
Yearly average	Average over a period of one year of valid hourly averages obtained by continuous measurement
Average over the sample period	Average value of three consecutive measurements of at least 30 minutes each.
Average of samples obtained during one year	Average of the values obtained during one year of periodic measurements taken with the monitoring frequency set for each parameter

Consequently, LCPs must comply with ELVs based on different averaging periods due to the differences between Annex V and the BAT Conclusions. This can introduce uncertainty as to what limits and monitoring requirements should be reflected in permits and/or can lead to operators and Member State authorities needing to assess compliance for the same pollutants and processes multiple times.

The 'Example tool for converting emission levels to different averaging periods' developed by the Netherlands and referenced in Chapter 13.3 of the LCP BREF, provides methods for estimating daily and monthly averages from the 95th percentile of hourly averages and the annual average. However, as evidenced in the 2020 paper produced under the IED implementation support contract several Member States still report challenges

regarding the application of different averaging periods. These challenges range from increased bureaucracy to reservations over the validity of the tool, since it is not reflected in the implementing BAT Conclusions.

Continuous vs periodic measurements

Annex V Part 3 Point 1 requires continuous monitoring of concentrations of SO_2, NO_x, CO (for gaseous fuels only) and dust from each combustion plant with a total rated thermal input of 100 MW, with other exclusions, such as those based on plant life span, type of fuel etc., defined in Point 2. Where continuous measurements are not required, measurements of these pollutants shall be determined periodically (at least every 6 months). The LCP BAT Conclusions also set out detailed monitoring provisions for LCPs for emissions to air and water in BAT 4 and BAT 5, respectively.

Annex V Part 4 provides requirements for the assessment of compliance with emission limit values using continuous measurements or periodic measurements. For compliance using continuous measurements, specific procedures for assessing compliance are detailed. These take account of the monitoring provisions in Part 3, such as the basis for calculating validated averages. However, under Part 4, periodic measurements are considered compliant where "…*the results of each of the series of measurements or of the other procedures defined and determined according to the rules laid down by the competent authorities do not exceed the emission limit values*"

Consequently, there is significant opportunity for interpretation of compliance assessment rules for periodic measurements and divergence across Member States. In the 2020 paper produced under the IED implementation support contract, some Member States reported challenges due to ambiguous interpretation of Annex V and, particularly, whether and how measurement uncertainty should be considered.

Operating hours

Annex V Part 1(2) allows for combustion plants using solid or liquid fuels which were granted a permit before 27 November 2002, or the operators of which had submitted a complete application for a permit before that date, provided that the plant was put into operation no later than 27 November 2003, to be subject to an alternative ELV as long as the combustion plant does not operate more than 1,500 operating hours per year as a rolling average over a five year period. This is otherwise known as the Limited Hours Derogation.

Although the IED clearly specifies that the calculation of annual operational hours should be based on a rolling average over a five year period, some Member States do not adopt a rolling average, instead using a basic annual average, whilst some Member States report there is uncertainty in terms of whether start-up or shut-down periods are excluded from the operating hours, and report challenges for operators in assessing which BAT-AELs are relevant due to the inconsistency in limited hours operation between Annex V and the BAT Conclusions.

Finally, challenges arise from the basis upon which the operating hours are calculated for combustion plant discharging through one or more separate flues within a common stack, with some Member States calculating operating hours at the individual combustion plant level rather than for the operating hours of the common stack upon which the LCP is defined. This inconsistency can arise due to how such aspects are framed in the BAT Conclusions, with these stating "*When a part of a combustion plant discharging flue-gases through one or more separate ducts within a common stack is operated less than 1 500 h/yr, that part of the plant may be considered separately for the purpose of these BAT conclusions*".

Summary

Challenges faced by Member States with regard to Chapter III compliance assessment were identified in the consultation; these are displayed in Table 10. The most commonly reported difficulty faced by Member States is the inconsistency between averaging periods in the IED and the BAT LCP. Six Member States also reported difficulties in defining OTNOC due to ambiguity in the legislation.

Table 10: Challenges reported by Member States for Chapter III compliance assessment

Challenge	Member State(s)
Issues reported in defining OTNOC.	BE, EE, ES, HU, SE, SK
Problems reported in differentiating between regular start-up and shut-down, maintenance and technical failures.	BE
Inconsistency between averaging periods for ELVs set out in IED and BAT-AELs set out in BAT LCP.	BE, BG, CZ, DE, ES, FR, PL, PT, SI, SK
Challenges identified in compliance assessment for multi-fuel firing combustion plant.	DK
Ambiguity over the correct application of IED Annex V Part 3 Points 9 and 10 concerning measurement uncertainty.	EE, ES, HU
Lack of guidance on accounting for measurement uncertainty for periodic measurements.	FI
No threshold defined in IED for the number of hours a plant must operate before averages can be calculated. This is an issue for LCPs with seasonal operating patterns or limited operating hours.	FI, SE
Problems in determining the correct sampling methods to achieve sufficiently precise data.	LV

3.2.2.2 Member State approaches

The review of Member State approaches for compliance assessment for Chapter III LCPs has focused primarily on the following:

- How points 9 and 10 of Annex V Part 3 are applied in the Member States? How the 'validated' values are calculated from the measured values (i.e. by subtracting the maximal percentage mentioned in Annex V or by subtracting another uncertainty value)? Whether this calculation may vary depending on the emission levels considering a correlation between measurement level and measurement uncertainty and, in this case, which elements are integrated in the calculation of the uncertainty.
- Whether the same rules are applied to assess compliance with ELVs in permits for LCPs that are in the scope of both Chapter III and LCP BAT conclusions?
- How many ELVs (averaging periods) are set in permits for LCPs that are at the same time in the scope of both Chapter III and LCP BAT conclusions?
- How Normal Operating Conditions are defined for LCPs in the Member States?

Very little information was provided by Member State representatives on whether the calculation of validated averages varied according to emission level, or for emissions to water for LCPs. This has not been included in the summary table except where information was provided in the Member State response and/or identified as part of the literature review.

These approaches are summarised in the table below.

Table 11: Summary of Member State approaches for Chapter III compliance assessment

Member State	Summary of approaches
AT	• Points 9 and 10 of Annex V Part 3 are incorporated in the Austrian Emission Measurement Regulation on Air (EMV-L). The measurement uncertainty is determined according to Standard ONORM EN ISO 20988. • No information was provided by Member State representative to clarify whether the same rules are applied for LCPs in Chapter III and LCP BAT conclusions. • Member State response states that stricter averaging periods apply in AT for LCPs than used in IED Annex V and the LCP BAT conclusions, and that the example tool in LCP BREF Annex III is not applied. It is not clear whether additional averaging periods apply on top of Chapter III and LCP BATC. • No definition for NOC and OTNOC are specified in the EG-K 2013 legislation or provided by Member State representative.
BE	• In Flanders, Points 9 and 10 of Annex V Part 3 are incorporated in legislation (VLAREM II, Article 5.43.3) which states that the 95% confidence intervals of individual measurements shall not exceed certain percentages of the ELVs (10% for CO; 20% for SO_2 and NO_x; 30% for dust). Validated average values are calculated by deducting the value of the confidence interval from measured values. In Wallonia, fixed values (10% for CO, 20% for Sox, 20% for NOx and 30% for dust) are subtracted from measured values. In Flanders, the calculation of validated averages does vary according to emission levels, but it does not in Wallonia. • In Flanders, section 5.43.3. VLAREM II regulates LCPs as defined by Chapter III and by the first category covered by the scope of the LCP BAT Conclusions. In Wallonia, the same rules apply. • Flanders considered recalculating monthly averages on daily and yearly averages in line with the Annex III Example Tool, but this was disregarded and is not currently done. Wallonia recalculates the daily, monthly and yearly averages based on validated hourly averages. • In Flanders, article 1.1.2 VLAREM II defines NOC as: operating conditions outside the start-up or shutdown procedures, unless stated otherwise. In Wallonia, The operating conditions are those outside of the start-up and shutdown procedures, which are defined case by case for each plant.
BG	• Points 9 and 10 of Annex V Part 3 are directly transposed in points 9 and 10 of Annex IV Part 3 the Ordinance for LCPs. Validated average hourly and daily average values are obtained by subtracting the value of the respective confidence interval specified in Point 9 from the measured valid average hourly values. The confidence interval is calculated by subtraction of standard deviation value for each individual pollutant, which must be less than or equal to the maximum confidence intervals for the relevant pollutants specified in Annex 1 of the Ordinance for LCPs. • No information was provided by Member State representative to clarify whether the same rules are applied for LCPs in Chapter III and LCP BAT conclusions. • Member State response indicated that averaging periods for ELVs are defined as set in LCP BAT conclusions for each different pollutant, but the response did not clarify whether IED monthly averages are used. • NOC are defined in the Ordinance for LCPs. Operating hours mean the time, expressed in hours, during which a combustion plant, in whole or in part, is operating and discharging emissions into the air, excluding start-up and shut-down periods.
CY	• No relevant information was identified on the application of Points 9 and 10 in Cyprian Law, or on how validated averages are calculated. • No information was identified clarifying whether the same rules are applied for LCPs in Chapter III and LCP BAT conclusions. • No information was identified clarifying how many ELVs are set for LCPs in the scope of both Chapter III and LCP BAT conclusions. • NOC are not defined in national legislation further than what is stated in the IED.

Member State	Summary of approaches
CZ	• Decree No. 415/2012 implements points 9 and 10 of Annex V Part 3. This specifies fixed percentages of the ELV to be deducted from measurements to calculate validated average values. The calculation of validated average values does not vary according to emissions levels. • The same rules are applied for LCPs in the scope of both Chapter III and LCP BAT conclusions. • The Air Protection Act does not allow the setting of more than one emission limit, which is set for the longest required period – BAT AELs are set in permits where required, if not a monthly limit is set in line with the IED. • NOC are not specifically defined for LCPs.
DE	• Points 9 and 10 of Annex V Part 3 are incorporated in the Thirteenth Ordinance on the Implementation of the Federal Immission Control Act (Ordinance on LCPs and gas turbine plants – 13. BImSchV), legislation stating that 95% confidence intervals of single measurements shall not exceed certain fixed percentages of the ELV. Validated average values are determined by deducting actual measurement uncertainty, as determined in calibration, from measured values. Annex 4 of the 13. BImSchV touches upon the correlation between low measurement levels and measurement uncertainty. It seeks to ensure that the applicable measured value for measurement calibration is situated within a manageable range. For example, for mercury, the better reference values for calibration are the higher daily average values rather than the lower yearly averages. • The Ordinance on Large Combustion Plants, Gas Turbines and Internal Combustion Engines (13th BImSchV) covers Chapter III installations and the provision of LCP BAT conclusions. • No indication that different rules are applied for LCPs in Chapter III and LCP BAT conclusions. • If continuous measurement is prescribed, limit values based on yearly averages, daily averages and half-hourly averages are set. Germany has not introduced monthly averages, as the ELVs in Annex V part 1 and 2 were interpreted as based on daily averages. • A general rule for determining 'operating conditions' for combustion installations is provided.
DK	• Points 9 and 10 of Annex V Part 3 are directly implemented in Bekendtgørelse om begrænsning af visse luftforurenende emissioner fra store fyringsanlæg (BEK nr 2120 af 13/12/2020). Validated average values are calculated by deducting maximum confidence intervals set out in Point 9 from measured values. The calculation of validated averages does not vary according to emission levels. • The same rules are applied for LCPs that are in the scope of both Chapter III and LCP BAT conclusions. • ELVs are set as either: Daily average ELV, cf. BAT-AEL, but not higher than monthly average ELV in IED Chapter III, and yearly average ELV, cf. BAT-AEL OR Daily average ELV, cf. BAT-AEL, yearly average ELV, cf. BAT-AEL and monthly average, cf. ELV in IED Chapter III. • OTNOC / NOC are not specifically defined.
EE	• Points 9 and 10 of Annex V Part 3 are implemented in the Industrial Emissions Act. which states that the 95% confidence intervals determined at the ELVs shall not exceed certain fixed percentages of the ELV. Validated average values are calculated after subtracting the value of the confidence interval, which shall not exceed the percentages set out in Annex V Part 3. However, the Ministry of Environment has drafted unofficial guidance which is under review, stating that percentages set out in points 9 and 10 of Annex V Part 3 should be automatically *added* to the ELVs for the purpose of determining compliance of measurements with ELVs. Measurement uncertainty is considered for LCP/WI according to the fixed percentage of the ELV. • No information was identified clarifying whether the same rules are applied for LCPs in Chapter III and LCP BAT conclusions. • The Member State response indicated that averaging periods are determined according to LCP BATC for the majority of installations, but did not clarify how many ELVs are set in permits. • The Industrial Emissions Act defines OTNOC, but conditions considered as OTNOC are defined.

Member State	Summary of approaches
EL	• Points 9 and 10 of Part 3, of Annex V are referenced within the Joint Ministerial Decision at Article 34, point 1. Measurement uncertainty is subtracted to obtain validated averages. • No information was identified clarifying whether the same rules are applied for LCPs in Chapter III and LCP BAT conclusions. • No information was identified clarifying how many ELVs are set for LCPs in the scope of both Chapter III and LCP BAT conclusions. • OTNOC / NOC are not defined in national legislation further than what is stated in the IED.
ES	• Annex II Part 7 of Order PRA/321/2017 implements points 9 and 10 of Annex V Part 3, and states that validated average values are to be calculated by subtracting the maximum value of the confidence interval from measured values. • At national level, the guidance in Order PRA/321/2017 only applies to chapter III of the IED. • If applicable, the ELVs set in permits are: Hourly ELV derived from IED (200% ELV base value IED), daily ELV derived from BAT Conclusions if lower than IED ELV, monthly ELV derived from IED (100% ELV value IED), yearly ELV derived from BAT Conclusions. • OTNOC / NOC are not defined in national legislation further than what is stated in the IED.
FI	• Government Decree limiting emissions from large combustion plants (936/2014), Annex 3 part 10 implements points 9 and 10 of Annex V Part 3, and states that validated average values are to be calculated by subtracting the maximum value of the confidence interval from measured values. The calculation of validated averages does not vary according to emission levels. • LCP BAT conclusions are taken into account in environmental permits, however the Member State response did not clarify whether the same rules are used for compliance assessment. • Daily and yearly averages are set, but the Member State response did not clarify whether other ELVs (including IED monthly averages) are set. • NOC are not defined in national legislation further than what is stated in the IED, but OTNOC are specified in permits on a case by case basis.
FR	• Article 35 of the Order of 3 August 2018 states that validated average values are to be calculated by subtracting the maximum value of the 95% confidence interval from measured values. • The same rules are applied to assess compliance with the ELV regardless of whether they are from Chapter III of the IED or the LCP BREF. • For installations within the scope of Chapter III and LCP BAT conclusion, the ELV is set based on the strictest value. • Permit conditions set: a daily average value, a monthly average value and an annual average value. The monthly and annual average values are the same. • All periods are considered NOC except specific points, including fuel shortage, use of a different fuel, start up and shut down periods and maintenance. These are managed on a case by case basis set out in permits.
HR	• Article 119 of the Ordinance on emission from stationary sources into air states that validated average values are calculated by subtracting the actual value of the confidence interval multiplied by the measurement value where the measurement value is below the ELV, or subtracting the actual value of the confidence interval multiplied by the ELV where the measurement exceeds the ELV. • The rules applied for LCPs in permits are set in accordance with Chapter III. The member state response did not specifically clarify whether the same rules are applied.

Member State	Summary of approaches
	• The averaging periods are set only according to LCP BAT conclusions. There has been no conversion between Annex V and Annex VI because there have been no relevant cases. • No information was provided by Member State representative about how OTNOC / NOC are defined.
HU	• Decree 110/2013 Annex 8 adopts the confidence intervals set out in Point 9 of Annex V Part 3, and states that validated average values are calculated by subtracting the maximum value of the confidence interval from measured values. The calculation of validated averages does not vary according to emission levels. • The Member State response did not specifically clarify whether the same rules are applied. • For large combustion plants, annual or daily averages are prescribed by the authorities based on the BAT conclusion. Conversely, hourly/daily/monthly and annual compliance with the emission limit value set in the IED should be ensured on the basis of continuous measurement requirements. • National legislation stipulates that start up and shut down periods should be excluded from measurements, but there is no further definition of NOC beyond this.
IE	• Points 9 and 10 of Annex V Part 3 are directly transposed into national legislation by S.I. No. 566/2012 Schedule 3. The approach to addressing measurement uncertainty is the same as for Chapter II activities but the maximum allowable uncertainty for emissions from LCPs is set out in permits. • There is no indication in S.I. No. 566/2012 and the EPA AG2 guidance document that different rules are applied. No input provided by Member State respondent to confirm this. • No information found in literature review regarding how many ELVs are set in permits. No further information was provided by Member State representative. • OTNOC / NOC are not defined in national legislation beyond what is already stated in the IED.
IT	• Validated average values are calculated by subtracting actual measurement uncertainty, which must not exceed the maximum value of the confidence interval specified in the IED, from measured values. • All LCPs must be assessed according to both BAT Conclusions and BAT AELs. • The Member State response does not specify how many ELVs are set. • NOC for LCPs are defined as the number of hours in which the plant is in operation, with the exclusion of start-up and shutdown periods and breakdown periods.
LT	• Points 9 and 10 of Annex V Part 3 are incorporated in national legislation (Valstybės žinios, 2001-10-17, Nr. 88-3100), which sets out maximum confidence interval values. Validated average values are determined by subtracting the value of the confidence interval from measured values. It is not clear in the legislation whether the value subtracted is the maximum value of the confidence interval. • Rules to assess compliance with the ELVs in permits for LCPs comply with those described in Chapter III Article 38, Annex V and Chapter III Article 39 part 4 of Annex V in the IED in the national legislation document. • No information found in literature review regarding how many ELVs are set in permits. • NOC are outlined in the national legislation document *Valstybės žinios, 2001-10-17, Nr. 88-3100.*
LU	• No information was identified on the application of Points 9 and 10 or whether measurement uncertainty is considered in compliance assessment. • No information found in literature review indicating that different rules are applied. • No information found in literature review regarding how many ELVs are set in permits. • No further definition is provided other than what is identified for Chapter II, where OTNOC are defined as: Start-up and shut-down operations, leaks, malfunctions, and momentary shut-downs.

Member State	Summary of approaches
LV	• Points 9 and 10 of Annex V Part 3 are incorporated in Cabinet Regulation No. 17 of 7 January 2021 "Provisions regarding the limitation of air pollution from combustion plants". Validated average values are calculated by subtracting the maximal value of the confidence interval. The correlation between measurement level and measurement uncertainty is not taken into account. • The Member State representative indicated that the same rules are applied. • The Member State response does not indicate specifically how many ELVs are set but states that the different averaging periods used in IED Annex V and Annex VI are not converted and are included in national legislation. • Member State response indicates that NOC is defined as the optimal operating conditions as specified by the equipment manufacturer - the operating conditions for which the equipment is designed.
MT	• Schedule XIII of the Industrial Emissions (Large Combustion Plants) Regulations states that validated average values are to be calculated by subtracting measurement uncertainty, established in line with EN14181, which must not exceed the maximum value of the 95% confidence interval from measured values. The calculation does not vary according to emission levels. • The Member State representative indicated that the same rules are applied to assess compliance with the ELVs in permits for LCPs that are at the same time in the scope of both Chapter III and LCP BAT conclusions. • The Member State representative did not specifically state how many ELVs are set, but indicated that the ELVs for LCP are included within the permit in line with Chapter III of the directive and the BAT conclusions. • NOC are not defined further than what is outlined for Chapter II installations: OTNOC are start-up, shut-down, leaks, malfunctions, momentary stoppages and definitive cessation of operations. In certain cases, additional OTNOC are stipulated in the permit.
NL	• Article 5.6 of Activities Regulation states that validated average values are to be calculated by subtracting the actual uncertainty, which must not exceed maximum value of the confidence interval from measured values. • The Member State respondent indicated that the same rules are applied to assess compliance with the ELVs in permits for LCPs that are at the same time in the scope of both Chapter III and LCP BAT conclusions. • Daily and annual averages in the BAT-conclusions are recalculated to the monthly ELVs which are used in Chapter III of the IED, hourly and daily ELVs are derived from the monthly ELV. • NOC are defined on a case by case basis in permits.
PL	• Points 9 and 10 are included directly in national legislation (Regulation of the Minister for the Environment of 30 October 2014). Actual measurement uncertainty is subtracted from measurement values. National legislation specifies maximum values of confidence intervals and actual measurement uncertainty must not exceed these levels. Calculation of the validated average values vary depending on the emission levels considering a correlation between measurement level and measurement uncertainty. • In theory, the same rules should be applied but PL have identified challenges and that it is not always possible to be consistent. • The ELV should take into account the daily average resulting from the BAT conclusions, the annual average based on the BAT conclusions and the IED Annex V ELVs (emission standard according polish legislation) together with compliance check criteria also described in the IED Annex V. ELV are set in the same units, and for the same (or shorter) averaging periods as in BAT AELs. • OTNOC / NOC are not defined in national legislation further than what is listed for Chapter II installations.

Member State	Summary of approaches
PT	• Points 9 and 10 of the Decree-Law 127/2013 directly transposes points 9 and 10 of Annex V Part 3. Validated averages are calculated by subtracting the actual value of the confidence interval from measured values. This must not exceed the maximum allowed uncertainty values. • In addition to compliance of the BAT-AEL's established in the BREF LCP, Portugal apply the same rules of compliance assessment as described for LCPs. • The Member State response does not indicate specifically how many ELVs are set in permits. The different averaging periods used in IED Annex V are not converted. • OTNOC / NOC are not defined in national legislation.
RO	• Points 9 and 10 of Annex V Part 3 of the IED are directly transposed in points 9 and 10 of Law no. 278/2013 Annex V, Part 3. The legislation states that validated average values are to be calculated by subtracting the confidence interval. Member State response does not clarify whether the value subtracted is the maximum value of the confidence interval. • The Member State respondent indicated that the same rules are applied to assess compliance with the ELVs in permits for LCPs that are at the same time in the scope of both Chapter III and LCP BAT conclusions. • Romania applies averaging periods provided in the IED (Law no. 278/2013) and LCP BAT conclusions. No conversions are applied. • NOC are not defined in national legislation beyond what is stated in the IED, but they exclude start up and shut down periods.
SE	• Section 29 of the Regulation (2013:252) on LCPs (RLCP) states that automatic measurement systems shall be constructed so that at a limit value over 24 hours, the measurement uncertainty does not exceed 10% of the limit value for CO; 20% for SO_2 and NO_x; 30% for dust. Section 30 of the RCLP states that validated average hourly, daily and monthly values will be determined by multiplying measured values by 0.9 (for CO), 0.8 (for SO_2 and NO_x), and 0.7 (for dust). However, compliance assessment is considered only at the prosecution stage and is not subtracted from measured values. • The Member State respondent indicated that the same rules are applied to assess compliance with the ELVs in permits for LCPs that are at the same time in the scope of both Chapter III and LCP BAT conclusions. • Chapter III IED is implemented through RLCP, which contains the ELVs to be applied. BAT conclusions are implemented through general binding rules which apply together with each operators permit licensed under the Swedish Environmental Code, so operators have to comply with ELVs found in BAT-AELs, ELVs found in RLCP and ELVs found in permit conditions. Both short-term average values and long-term average values in BAT-AELs apply as ELVs. For ELVs based on Chapter III IED, the same averaging periods apply. ELVs in permits averaging periods are set on a case-by-case-manner. • NOC are defined in national legislation Section 13, 40 and 42 of the RLCP. These do not include start-up and shut down, specific derogations, and malfunctions/breakdowns. The Swedish EPA is currently working on updating and elaborating guidance concerning OTNOC, planned to be published in 2022.
SI	• Points 9 and 10 of Annex V Part 3 are implemented in Article 19(1) and 19(2) of the LCP decree, and Article 13 paragraphs 9 and 10 of the Air Measurement Rules. Validated average values are to be calculated by subtracting the maximum value of the confidence interval from measured values. The calculation of validated averages does not vary according to emission levels. • The same rules are used to assess compliance for LCPs that are in the scope of both Chapter III and LCP BAT conclusions. • Member State response does not indicate exactly how many ELVs are set, but note that LCP permits contain all ELVs set in both the IED directive Annex V and LCP BAT conclusion. ELV and averaging periods in permits are set according to which is stricter.

Member State	Summary of approaches
	• NOC are not specifically defined in national legislation, but Member State response notes that start-up and shut-down periods are provided in Article 6 of LCP Decree and its associated Annex II.
SK	• Decree No. 410/2012 Annex 5 Part 3 incorporates points 9 and 10 of Annex V Part 3 of the IED. Validated average values are to be calculated by subtracting the maximum value of the confidence interval from measured values. The calculation of validated averages does not vary according to emission levels. • The rules for the LCP may differ based on the categorization of the combustion plants. When applying LCP BAT conclusions, the ELV compliance rules are set out individually in the integrated permit. It is recommended that the conformity assessment requirements of Annex V of the IED Directive apply. • The Member State response does not detail specifically how many ELVs are set in permits, but indicates that the requirements of the IED and the LCP BAT conclusions are applied meaning that several limit values are introduced. SK are looking for a compromise so that there is one emission limit where the requirements of the directive and the conclusions are met. • NOC are not defined in national legislation, but Member State response indicates that start up and shut down procedures are not included.

3.2.3 Chapter IV compliance assessment (Waste Incineration Plants)

Key challenges for compliance assessment with Chapter IV requirements for WI were presented in a background paper and discussed at a webinar with Member States on 9 July 2021 as part of the IED implementation support (2020 – 2024) contract. The key challenges raised include:

- Uncertainty in the requirements for measurement uncertainty with no uniform approach to the validation of continuous monitoring results.
- Uncertainty in the assessment of compliance with ELVs from Chapter IV and emission levels associated with BAT with different averaging periods.
- Defining NOC, OTNOC and the Effective Operating Time (EOT) consistently.

These challenges are discussed in more detail below, where they have not already been covered under the Chapter II and III challenges.

3.2.3.1 Key challenges

Application of measurement uncertainty

The principle challenge here is largely consistent with that described for Chapter III compliance assessment in that Annex VI, Part 3, Point 1.3 requires that the 95% confidence interval (i.e., a measurement of the expanded uncertainty) of a single measured result should not exceed a specified percentage of the emission limit value. These percentages are displayed in Table 3.

Point 1.2 of Annex VI Part 8 then requires that validated 30-minute averaged and 10-minute averaged values shall be determined from the measured values after subtracting "*… the value of the confidence interval specified in Point 1.3 of Part 6*". In doing so, it introduces the same ambiguity as that present for LCPs, with some Member States interpreting that the maximum expanded uncertainty level should be subtracted from the measured values to determine the validated averages.

Assessing compliance with ELVs from Annex VI and BAT associated emission levels with different averaging periods

Like LCPs, different averaging periods are expressed in the ELVs in Annex VI and the BAT-AEL averaging periods in the BAT conclusions. For example, whereas IED introduces both daily averaged and 30-minute averaged ELVs for combustion gases, the BAT conclusions only introduce a daily averaged BAT-AEL for these same species. The provisions related to monitoring emissions to air and definition of the averaging periods are presented below.

Table 12: Definitions of averaging periods in the WI BAT conclusions

Type of Measurement	Averaging Period	Definition
Continuous	Half-hourly average	Average value over a period of 30 minutes
	Daily average	Average over a period of one day based on valid half-hourly averages
Periodic	Average over the sampling period	Average value of three consecutive measurements of at least 30 minutes each
	Long-term sampling period	Value over a sampling period of 2 to 4 weeks

The main challenges are therefore consistent with those described for LCPs, i.e., confusion as to what values should be included in permits, in particular whether and how the 30-minute averaged ELV should be reflected in permits, and Member State authorities potentially needing to assess compliance for the same pollutants and processes multiple times.

Unlike LCPs, there is no tool available to convert measured values to different averaging periods.

Defining NOC, OTNOC and the effective operating time

Part 8 of Annex VI requires that validated 30-minute and 10-minute averaged values shall be determined within the “effective operating time” (EOT). However, other than stating in parentheses that the EOT excludes the start-up and shut-down periods if no waste is being incinerated, no formal definition for the EOT is provided in Chapter IV or Annex VI, nor do the parentheses clarify whether any other OTNOC scenarios may apply to the consideration of the EOT e.g., during an emergency shut-down where waste is not being charged but where residual waste remains on the grate, fluidised bed etc.

This introduces ambiguity and consequent difficulty in interpreting the requirements of IED, where ELVs have to be met whenever waste is being incinerated, and the BAT-AELs that apply during normal operating conditions only. Furthermore, there is no clarity on the type of operational scenarios that may be defined as OTNOC.

Consequently, like the challenges associated with defining NOC and OTNOC for Chapter III, there are interpretation challenges in terms of defining the EOT for the compliance assessment for Chapter IV plant and how to discount data outside of this time.

Summary

As part of the consultation, Member States identified challenges they face in conducting compliance assessment under Chapter IV. These are listed in Table 13. Eight Member States reported difficulties due to the lack of clear definitions of operating conditions, while three highlighted inconsistent averaging periods between the IED and the BATC WI as an issue. A further three Member States stated that a lack of detail in the BATC WI for addressing measurement uncertainty results in a divergence of approach in measurement validation.

Table 13: Challenges reported by Member States for Chapter IV compliance assessment

Challenge	Member State(s)
Lack of clear definitions for different types of operating conditions (NOC, OTNOC, EOT) and management plans.	AT, BE, EE, ES, FR, IE, SE, SI
Requirements for measurement uncertainty and for compliance assessment with limit values are not part of BAT conclusions. No uniform approach to validation of continuous emissions monitoring results.	AT, FR, IE
Difference in averaging periods for ELVs set out in the IED and BAT-AELs in BAT WI or in the LCP BATC (when waste is co-incinerated).	BE, CZ, ES, FR,IE, PL
Ambiguity over the meaning of *"where relevant"* in Point 1.1b) of IED Annex VI Part 8, and its implications for compliance assessment.	ES
Quality assurance of CEMS may be problematic if measured values are very low compared to the ELV.	FI
No threshold defined for number of hours a plant must operate before averages can be calculated.	SE
ELVs apply whenever waste is incinerated. Uncertainty over dealing with periods when the grate is partially covered.	NL
Challenges identified in monitoring emissions of dioxins and furans to air during OTNOC.	DK
Inconsistences in the monitoring frequency between the IED and LCP BATC	DE

3.2.3.2 Member State approaches

The review of Member State approaches for compliance assessment for Chapter IV waste (co-)incinerators has focused primarily on the following:

- How points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8 are applied in the Member States? How the 'validated' values are calculated from the measured values (i.e. by subtracting the maximal percentage mentioned in Annex VI or by subtracting another uncertainty value)? Whether this calculation may vary depending on the emission levels considering a correlation between measurement level and measurement uncertainty and, in this case, which elements are integrated in the calculation of the uncertainty.
- Whether the same rules are applied to assess compliance with ELVs in permits for waste (co-) incinerators that are in the scope of both Chapter IV and WI BAT conclusions?
- How many ELVs (averaging periods) are set in permits for waste (co-) incinerators that are at the same time in the scope of both Chapter IV and WI BAT conclusions?
- How Normal Operating Conditions are defined for waste (co-) incinerators in the Member States?

Very little information was provided by Member State representatives on whether the calculation of validated averages varies according to measurement level, or for emissions to water. These points have been left out of the summary table unless information on these topics was provided in a specific response.

These approaches are summarised in the table below.

Table 14: Summary of Member State approaches for Chapter IV compliance assessment

Member State	Summary of approaches
AT	• Points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8 are transposed in the Waste Incineration Ordinance (AVV). No response provided by Member State Representative clarifying how validated average values are calculated. Guidance found in literature review recommends that measurement uncertainty should be considered by subtracting from the measurement value when assessing compliance, however it is not clear whether this is for emissions to air, water or both. • The Member State respondent indicated that the same rules are applied to assess compliance with ELVs in permits for waste (co-) incinerators that are in the scope of both Chapter IV and WI BAT conclusions. • For continuously measured parameters, half hourly average values and daily average values are always set for the ELV. • For emissions to air, paragraph 7 of the AVV specifies some operating conditions but no formal definition of normal operating conditions is included. However, NOC are indirectly defined with the provisions of § 14 AVV. There is in principle no distinction between NOC and EOT. For emissions to water, there is no definition of normal operating conditions and OTNOC.
BE	• Points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8 are incorporated in VLAREM II in Flanders, and the Arrêté du Gouvernement wallon du 21 février 2013 in Wallonia. For both Flanders and Wallonia, legislation states that the 95% confidence intervals of individual measurements shall not exceed certain percentages of the ELVs (10% for CO; 20% for SO_2 and NO_x; 30% for dust and total organic carbon; 40% for HF and HCl). Validated average values are calculated by deducting the value of the confidence interval from measured values. No additional information was provided regarding emissions to water for waste (co-)incinerators. • In Flanders, the Vlarem II regulates WI's as defined by Chapter IV. In Wallonia, the same rules apply. • In Flanders, no information was provided about how many ELVs are set. In Wallonia, Several ELVs (averaging periods) are set in permits depending on the pollutant concerned. Some pollutants have only 1 ELV, whereas NOx has an ELV in daily average, an ELV in half- hourly average (100%), an ELV in half-hourly average (97%). • In Flanders, VLAREM II Article 1.1.2 defines NOCs as: operating conditions outside the start-up or shutdown procedures, unless stated otherwise, the start-up and shutdown should not involve incineration of waste. In Wallonia, the operating conditions are outside the start-up and shutdown procedure which are defined case by case for each installation.
BG	• Ordinance No 4 of 2013 on the conditions and requirements for the construction and operation of incineration plants and waste co-incineration plants implements adopts the confidence intervals set out in Point 1.3 of Annex VI Part 6. Annex I of Ordinance No. 4 states that validated average values are to be calculated by subtracting the value of the confidence interval from measured values. The calculation of validated averages does not vary according to emission levels. • The Member State response did not indicate whether the same rules are applied to assess compliance with the ELVs in permits for waste (co-)incinerators that are at the same time in the scope of both Chapter IV and WI BAT conclusions. • The Member State response does not indicate how many ELVs are set. • NOCs are not defined in Ordinance No 4 or in the Waste Management Act, but Member State response indicates that these are generally considered as the time period in which the installation is operational, except the start-up and shut-down operations during which no waste is incinerated.
CY	• No relevant information was identified on the application of Points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8, or how validated averages are calculated. • No relevant information was identified to determine whether the same rules are applied.

Member State	Summary of approaches
	• No relevant information was identified regarding how many ELVs are set in permits. • Normal operating conditions for waste (co-)incineration plant are defined within the Cypriot Law (184 (I) / 2013), par. 66, however the relationship between NOC and EOT is not defined.
CZ	• Decree No. 415/2012 specifies fixed percentages of the ELV to be deducted from measurements to calculate validated average values. The calculation of validated average values does not vary according to emissions levels. • The same rules are applied for waste (co-)incinerators that are in the scope of both Chapter IV and WI BAT conclusions. • For pollutants which are monitored by continuous measurement, values are determined at the level of daily, half-hour and 10-minute intervals. For pollutants which are determined by a single measurement, the emission limit is set at the monthly level. • NOCs are not defined in legislation.
DE	• The Seventeenth Ordinance on the Implementation of the Federal Imission Control Act (Ordinance on the Incineration and Co-incineration of Waste - 17th BImSchV) adopts points 1.3 of Annex VI Part 6 and 1.2 od Annex VI Part 8. The legislation adopts maximum values for the 95% confidence interval of individual measurements. Validated average values are determined by deducting the confidence interval determined during calibration (i.e. actual measurement uncertainty), which must not exceed the maximum values. • The same rules are applied for waste (co-)incinerators that are in the scope of both Chapter IV and WI BAT conclusions. • The Member State response does not indicate how many ELVs are set in permits for waste (co-) incinerators. • NOCs are not directly defined. There is a deviation from the IED with regard to effective operating time, as start-up and shut-down times are taken into account when calculating daily averages.
DK	• Points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8 are adopted in Bekendtgørelse om anlæg, der forbrænder affald (BEK nr 1271 af 21/11/2017). The legislation states that validated average values are to be calculated by subtracting the maximum value of the confidence interval from measured values. The calculation of validated averages does not vary according to emission levels. • The same rules are applied for waste (co-)incinerators that are in the scope of both Chapter IV and WI BAT conclusions. • ELVs in permit for waste (co-) incinerators that are at the same time in the scope of both Chapter IV and WI BAT conclusions are set as daily average, cf. BAT-AEL, half-hourly average, cf. IED Chapter IV and average over the sampling period, cf. BAT-AEL. • There is no further definition of OTNOC / NOC than what is included in the IED.
EE	• Points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8 are adopted by § 5(2) Regulation 49 issued by the Minister of the Environment. Validated average values are calculated after subtracting the value of the confidence interval, which shall not exceed the percentages set out in Annex V Part 3. However, the Ministry of Environment has drafted unofficial guidance which states that percentages should be added to ELVs when assessing compliance. • The Member State response did not indicate whether the same rules are applied to assess compliance with the ELVs in permits for waste (co-)incinerators that are at the same time in the scope of both Chapter IV and WI BAT conclusions. • The Member State response indicated that permits are based on WI BATC but did not indicate how many ELVs are set in permits. • The Industrial Emissions Act defines OTNOC.

Member State	Summary of approaches
EL	• No relevant information was identified on the application of Points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8. Validated averages are calculated by subtracting measurement uncertainty. • No relevant information was identified to determine whether the same rules are applied. • No relevant information was identified regarding how many ELVs are set in permits. • OTNOC / NOC are not defined any further in national legislation than what is already stated in the IED.
ES	• Points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8 are adopted by RD 815/2013. Measurement uncertainty is considered by subtracting the measurement uncertainty (set out in Annex 3 of RD 915/2013) from measured values to calculate the validated average, however the response did not clarify whether the maximum value was used. • Member State response considers that the same rules are be applied, but that there may be implementation issues not yet identified. • The ELVs in permits are set according to the most restrictive requirement so as to comply with both the IED Chapter IV and the WI BAT conclusions when they both contain requirements for the same averaging periods. The Member State respondent did not indicate how many ELVs are set in permits. • No further definition of NOC / OTNOC are provided other than what is defined in the IED.
FI	• Annex 5 of the Government Decree on waste incineration (151/2013) implements points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8. The maximum value of the confidence interval is subtracted from half-hourly and ten-minute measurement values to calculate the validated average value. Daily averages are then calculated from these values. The calculation of validated average values does not vary depending on emission levels. • WI BAT conclusions are considered when setting permits but Member State response did not clarify whether the same rules are applied to assess compliance. • ELVs are set for daily averages and averages over sampling periods, shorter 30 minute and daily averages may also be set to ensure compliance with IED ELVs. • No further definition of NOC are provided other than what is defined in the IED. OTNOC are specified in permits on a case by case basis.
FR	• Order of 20 September 2002 relating to incineration installations implements points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8. Validated average values are determined from the hourly/10 minute average values after having subtracted the maximum value of the 95% confidence interval from measurement values. • The same rules are applied to assess compliance with ELVs in permits for waste (co-)incinerators that are in the scope of both Chapter IV and WI BAT conclusions. • ELV for NOC periods are based on the WI BAT conclusions and are in daily average values. ELV for other-than-NOC periods are based on the chap. IV. Especially in EOT periods, ELV are set different average of period of time, for instance: 10-min average for the CO ELV; 30-min average for other pollutants; Also daily average for all pollutants. • There is no formal definition of OTNOC – each IED operator establishes and regularly updates a list of OTNOC specific to that installation.
HR	• Points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8 are implemented in the Ordinance on emission from stationary sources into air. Validated average values are calculated by subtracting the actual value of the confidence interval multiplied by the measurement value where the measurement value is below the ELV, or subtracting the actual value of the confidence interval multiplied by the ELV where the measurement exceeds the ELV.

Member State	Summary of approaches
	• The same rules should apply to assess compliance with ELVs in permits for waste (co-)incinerators that are in the scope of both Chapter IV and WI BAT conclusions. • The Member State response indicated that there are no cases where ELVs need to be set for installations in the scope of both Chapter IV and WI BAT conclusions. • No information was provided by Member State representative about how OTNOC / NOC are defined.
HU	• Points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8 are implemented by *FM rendelet a hulladékégetés műszaki követelményeiről, működési feltételeiről és a hulladékégetés technológiai kibocsátási határértékeiről* (29/2014). The confidence interval values specified in Point 1.3 of Annex VI Part 6 are subtracted from 10-minute and 30-minute average values to calculate validated average values. • The Member State response indicates that the same rules are applied. • The Member State response indicates that half-hourly and 10-minute averaged monitored values shall be determined within the effective operating time, excluding start-up and shut-down periods, and daily averages are calculated from that. • The Member State response stipulates that start-up and shut down periods should be excluded from measurements, but no further definition of NOC is provided beyond this.
IE	• The approach to addressing measurement uncertainty is the same as for Chapter II activities but the maximum allowable uncertainty for emissions from WI is set out in permits. • There is no indication in S.I. No. 566/2012 and the EPA AG2 guidance document that different rules are applied. No input provided by Member State respondent to confirm this. • No information found in literature review regarding how many ELVs are set in permits. No further information was provided by Member State representative. • OTNOC / NOC are not defined in national legislation beyond what is already stated in the IED.
IT	• Validated average values are calculated by subtracting actual measurement uncertainty, which must not exceed the maximum value of the confidence interval, from measured values. • Waste (co-)incinerators are assessed using the BAT-AELs defined in BAT conclusions, whereas any plant outside the scope of the BAT conclusions are assessed based on the requirements of Chapter IV. • No information found in literature review regarding how many ELVs are set in permits. No further information was provided by Member State representative. • EOT is defined as 'the time, expressed in hours, during which a plant, in whole or in part, is in operation and discharges emissions into the atmosphere, excluding start-up or shutdown periods'. No information provided on how EOT and NOC are related.
LT	• *Valstybės žinios, 2003-03-31, Nr. 31-1290* implements points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8. The legislation specifies maximum values of the confidence intervals but does not explicitly state that confidence interval values are subtracted from measured values to calculated validated averages. • No information identified to determine whether different rules are used to assess compliance with ELVs in permits for waste (co-)incinerators that are in the scope of both Chapter IV and WI BAT conclusions. • National legislation states that averaging periods used include a daily average, half-hour average, over a minimum period of 30 minutes and a maximum period of 8 hours and minimum period 6 hour and a maximum period of 8-hour period. • NOC are defined in national legislation *Valstybės žinios, 2003-03-31, Nr. 31-1290.*
LU	• No information was identified on the application of Points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8 or whether measurement uncertainty is considered in compliance assessment.

Member State	Summary of approaches
	• No information identified to determine whether different rules are used to assess compliance with ELVs in permits for waste (co-)incinerators that are in the scope of both Chapter IV and WI BAT conclusions. • No information found in literature review regarding how many ELVs are set in permits. • No further definition is provided other than what is identified for Chapter II, where OTNOC are defined as: Start-up and shut-down operations, leaks, malfunctions, and momentary shut-downs.
LV	• Cabinet Regulation No. 401 of 24 May 2011 "Requirements for Incineration of Waste and Operation of Waste Incineration Plants" implements points 1.3 of Annex VI Part 6 and Point 1.2 of Annex VI Part 8. Validated average values are calculated by subtracting the maximal value of the confidence interval from measured values. The calculation of validated averages does not vary according to emission levels. • The Member State representative indicated that the same rules are applied. • The Member State response does not indicate how many ELVs are set. • NOC are defined in national legislation (Cabinet Regulation No. 401 of 24 May 2011) by setting the basic operational principles of waste (co-)incineration plants.
MT	• The Industrial Emissions (Waste Incineration) Regulations adopts points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8. The legislation states that half-hourly and 10-minute averages are calculated by subtracting the value of the confidence interval. It is not clear if the maximum level is deducted. Daily averages are then calculated from these validated averages. The calculation of validated averages does not vary according to emission levels. • Compliance assessment for ELVs cater for both WI BAT conclusions and Chapter IV as compliance criteria for both are included in the permit. • The Member State response does not indicate how many ELVs are set. • NOC are not defined further than what is outlined for Chapter II installations: OTNOC are start-up, shut-down, leaks, malfunctions, momentary stoppages and definitive cessation of operations. In certain cases, additional OTNOC are stipulated in the permit.
NL	• Points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8 are implemented in the Activities Regulation. Validated averages are calculated by subtraction of the real uncertainty value, which cannot exceed that maximum value of the confidence interval, from measured values. • The Member State representative indicated that the same rules are applied. • The Member State response does not indicate how many ELVs are set. • NOC and EOT are defined on a case by case basis in permits.
PL	• "Regulation of the Minister for the Environment of 30 October 2014" adopts points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8. 30-minute and 10-minute average values are calculated by subtracting the value of the confidence interval (actual measurement uncertainty) from measured data. These validated average values are used to calculate daily average values. Calculation of the validated average values vary depending on the emission levels considering a correlation between measurement level and measurement uncertainty. • The Member State representative indicated that the same rules are applied to assess compliance with the ELVs in permits for waste (co-)incinerators that are at the same time in the scope of both Chapter IV and WI BAT conclusions. • The averaging periods in PL emission standards and Chapter IV and WI BAT conclusions are the same - half-hourly and daily averages. • OTNOC / NOC are not defined in national legislation further than what is listed for Chapter II installations.

Member State	Summary of approaches
PT	• Decree-Law 127/2013 implements points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8. Annex VI Part 7 point 1.2 of the Decree-Law states that half-hourly and ten-minute validated average values are to be determined by subtracting the actual measurement uncertainty, which must not exceed the maximum value of the 95% confidence interval, from the measurement values. The calculation of validated averages does not vary according to emission levels. • The Member State representative indicated that the same rules are applied. • For incinerators that are at the same time in the scope of both Chapter IV and WI BAT conclusions, PT uses the BREF values in setting ELVs in permits. At the same, ELVs must not exceed the values set out in Chapter IV. • OTNOC / NOC are not specifically defined in national legislation.
RO	• Law 278/2013 implements points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8. Actual measurement uncertainty, determined by laboratory analysis, is subtracted from measured values to calculate validated average values. Member State response does not clarify whether the value subtracted is the maximum value of the confidence interval. • The Member State representative indicated that the same rules are applied. • RO set daily and half-hourly averages and apply the associated averaging periods for incineration plants stipulated in Part 3 of Annex VI. • NOC are not specifically defined in national legislation beyond what is states in the IED, but they exclude OTNOC which is defined as including start-up and shut-down operations, leaks, malfunctions, momentary stoppages and definitive cessation of operations and other situations identified in WI BAT conclusions.
SE	• Regulation (2013:253) on the incineration of waste (RWIP) implements points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8. Section 41 of the RWIP states that automatic measurement systems shall be constructed so that at a limit value over 24 hours, the measurement does not exceed 10% of the limit value for CO; 20% for SO_2 and NO_2; 30% for dust and total organic carbon, and 40% for HCl and HF. Validated average ten-minute, half-hourly and daily values will be determined by multiplying measured values by 0.9 (for CO), 0.8 (for SO_2 and NO_2), 0.7 (for dust and total organic carbon), and 0.6 (for HCl and HF). However, compliance assessment is considered only at the prosecution stage and is not subtracted from measured values. • The Member State respondent indicated that the same rules are applied. • Chapter IV IED is implemented through RWIP, which contains ELVs. • OTNOC / NOC are not specifically defined in national legislation. The Swedish EPA is currently working on updating and elaborating guidance concerning OTNOC, planned to be published in 2022.
SI	• Points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8 are transposed into Annex III point 1.4 and Annex III point 1.5 respectively of the Decree on waste incineration and co-incineration plants (OJ Nr. 8/16 and 116/21). Validated average values are calculated by subtracting the maximum value of the confidence interval from measured values. For half hourly averages, confidence intervals are not used. The calculation of validated averages does not vary according to emission levels. • The same rules to assess compliance are used for the ELVs in permits for waste (co-) incinerators that are at the same time in the scope of both Chapter IV and WI BAT conclusions. • Member State response does not indicate exactly how many ELVs are set, but note that WI permits contain all ELVs set in both the IED directive Annex VI and WI BAT conclusion. ELV and averaging periods in permits are set according to which is stricter. • OTNOC / NOC are not specifically defined in national legislation.
SK	• Decree No. 410/2012 Coll. implements points 1.3 of Annex VI Part 6 and 1.2 of Annex VI Part 8. Validated average values are calculated by subtracting the value of the confidence interval from measured values.

Member State	Summary of approaches
	The calculation of validated averages does not vary according to emission levels. The Member State response does not clarify whether the value used is the maximum value of the confidence interval. • The Member State response indicates that the same rules apply, it is recommended that the conformity assessment requirements of Annex VI of the IED Directive apply. • The Member State response does not indicate specifically how many ELVs are set, but states that both Chapter IV and WI BAT conclusion must be considered in permits. • OTNOC / NOC are not defined in national legislation.

4 Available approaches to address identified issues

4.1 Overview

This section builds on the outputs of the review of IED provisions, Member State challenges and approaches and relevant literature (including approaches applied in selected non-EU countries) to identify potential solutions for addressing issues related to monitoring and compliance assessment. The terms of reference specified that at least the following should be addressed:

a) Rules for assessment of compliance with emission limit values for installations under Chapter II, III and IV of the IED.

b) Implications of Normal Operating Conditions in particular for LCPs and (co)- incinerators.

c) Conversion between the different averaging periods used in IED Annex V and VI and the LCP and WI BAT conclusions.

d) Addressing measurement uncertainty in compliance assessment for LCPs and waste (co)-incinerators.

Each of these issues can be further sub-divided to cover the sub-issues that will need to be addressed. For example, how to approach compliance assessment when dealing with measurements at lower concentrations.

The first step involved a horizontal review of Member State approaches to understand the way in which some of the challenges and issues identified (based on a review of existing provisions and literature) are being / have been addressed in the Member States (Section 4.2). This has then been supplemented with a review of the approaches taken in selected non-EU countries (Section 4.3). All of this information, together with any additional insights identified from relevant literature and the ongoing revision of the IED as well as direct engagement with CEN experts, has then been used to describe each of the key issues and identify potential solutions to resolve them (Section 4.4). In some instances there are multiple options for each issue whereas for others it is more limited. The potential impacts of the options have then been qualitatively screened against a series of criteria to understand the impacts that they may have, including the extent to which they would address the issue.

4.2 Horizontal review of Member State approaches

In advance of identifying approaches for addressing the key identified issues and challenges related to monitoring and compliance assessment, a horizontal review has been undertaken of the Member State approaches identified and described in the previous section. These have been matched to the key issues and challenges and categorised where possible so as to group similar approaches. This categorisation of approaches provides an EU level summary of the different approaches employed so that the potential options for addressing the solutions are clear.

Table 15: Summary of Member State approaches for compliance assessment broken down by key issue

Key issues	Summary of approaches
Compliance assessment for Chapter II installations	Measurement uncertainty: Approach A: Subtraction of the maximum allowed measurement uncertainty from the measured value Approach B: Subtraction of a fixed proportion of the ELV from the measured value before comparison with the ELV Approach C: Subtraction of the actual measurement uncertainty of the measurement system (measured method) Approach D: No subtraction of uncertainty (Approach E: Measurement uncertainty is reported but may be considered by the Authority only when measurements are reported above the ELV – ultimately this is

Key issues	Summary of approaches
	considered a slight variation of Approach C as measurement uncertainty is considered when there may be a risk of non-compliance)
Dealing with measurements at low concentrations	Approach A: Specifying requirements for AMS calibration to ensure that determined measurement uncertainty is representative of the range of measurement values. Approach B: No specific consideration of measurement uncertainty at low concentrations applied. Approach C: Accept reporting of emissions as < LOD without uncertainty, as long as the LOD is less than a certain percentage of the limit. Approach D: Express uncertainty as an absolute value at low concentrations, rather than a percentage of the ELV.
Defining start-up / shut-down, NOC/OTNOC/EOT	Approach A: OTNOC defined as start-up and shut-down only Approach B: OTNOC defined as start-up and shut-down, malfunction and periods of repair. Approach C: OTNOC defined as start-up and shut-down, malfunction and leaks. Approach D: OTNOC defined as start-up and shut-down, leaks, malfunctions, momentary stoppages, and definitive cessation of operations. Approach E: No consideration of OTNOC. Approach F: No uniform approach to defining (OT)NOC and/or EOT. Case-by-case approach adopted in permitting. Approach G: EOT defined as the hours during which the plant in whole, or in part, is in operation and discharges emissions, excluding start-up and shut-down periods. Approach H: EOT inclusive of all periods of operation, including start-up and shutdown.
Application of maximum expanded measurement uncertainty for LCPs and waste (co-)incinerators	Approach A: Subtraction of the maximum allowed measurement uncertainty from the measured value Approach B: Subtraction of a fixed proportion of the ELV from the measured value before comparison with the ELV Approach C: Subtraction of the actual measurement uncertainty of the measurement system Approach D: Measurement uncertainty is reported but may be considered by the Authority only when measurements are reported above the ELV
Correspondence between the different averaging periods used in IED Annex V and VI and the LCP and WI BAT conclusions.	Approach A: Inclusion of both Annex V/Annex VI ELVs and LCPs/WI BAT-AELs in permits and corresponding averaging periods Approach B: Inclusion of only LCPs/WI BAT-AELs in permits and corresponding averaging periods Approach C: Omission of one or more averaging periods set out in IED from permits

4.3 Non-EU approaches

A high level review has been undertaken of approaches applied for compliance assessment in selected non-EU countries including the US, South Korea and India. A review was also carried out for China but insufficient information was available publicly online to include within the report. This information is intended to help inform possible approaches for addressing the main challenges and issues related to compliance assessment alongside the information on the Member State approaches. A summary of the approach to compliance

assessment in these countries is provided below based on readily available information and within language constraints.

Table 16: Summary of approach to compliance assessment in selected non-EU countries

Nation	Approach to compliance assessment
United States	• Monitoring for compliance purposes is established under Title V amendments of the Clean Air Act, supported by Compliance Assurance Monitoring (CAM) regulations, guidance, defined monitoring methods and performance specifications. • Compliance assessment based on a combination of routine site inspections and through the application and review of periodic and annual compliance certification. • After initial performance tests to demonstrate compliance, ongoing monitoring using Continuous Emissions Monitoring Systems (CEMS) is mandatory on all combustion units covered by Title V permits that use solid fuels, including municipal waste incinerators, but alternative methods, including Predictive Emissions Monitoring Systems (PEMS), are permitted for gas or oil-fired boilers, gas-fired heaters and turbines, and ethanol plants. Periodic monitoring is used in other sectors or for activities that do not have a specific requirement to continuously monitor emissions. • CEMS monitoring gaseous pollutants such as NOx, SO_2 and CO must be calibrated against a reference method (RM) measurement at initial installation and undergo a Relative Accuracy (RA) test audit (RATA). Relative accuracy audits (RAA) are also required in three out of four quarters. The equivalent for particulate matter (PM) involves absolute correlation audits (ACAs), response correlation audits (RCA) and relative response audits (RRA). • PEMS must pass a RA test and accompanying statistical tests in the initial certification phase to be acceptable for use in demonstrating compliance with applicable requirements. Ongoing quality assurance tests also must be conducted to ensure the PEMS is operating properly. • Whilst measurement uncertainty does not appear to be explicitly considered in the annual compliance certification, the initial and ongoing QA/QC tests are used to determine whether a CEMS/PEMS is “out of control” with requirements to update calibration factors whenever this is demonstrated. • Data recorded during periods of start-up or shut-down are excluded from the compliance certification. However, data should still be recorded during these periods. Specific definitions of start-up and shut-down are provided for some sectors, e.g., electric utility steam generating units. • There does not appear to be any specific guidance for monitoring emissions at low concentrations.
India	• CEMS mandatory on prescribed industries • CEMS certification scheme and ongoing QA/QC of CEMS based on US EPA performance specifications and/or EN quality assurance standards (EN 14181). • Data from CEMS is required to be submitted in real-time to the state and central pollution control board using telemonitoring • Potential exceedances of limits should only be assessed during ‘operating hours’. These exclude start-up, shut-down or maintenance periods. • Any exceedance of values reported as an appropriate time-averaged value with respect to relevant emission limits is considered to be a ‘violation’. Measurement uncertainty is not explicitly considered in this determination. • For valid half hour values, any instances where data is lost/not available for more than 10 minutes in that half hour period shall result in that half hour value being rejected. Where more than five half hour periods of data are rejected in any given day, that full day of data should be rejected for the purposes of calculating daily average emissions.

Nation	Approach to compliance assessment
	• Any day in which more than three hourly average values are invalid due to malfunction or maintenance should result in that fully day of data being rejected for the purposes of calculating daily averaged emissions. • Minimum data capture rate of 85% must be demonstrated. Start-up, shutdown and calibration periods shall be excluded when calculating the data capture rate. • Phased alert levels and prescribed actions in place as part of a Compliance Reporting Protocol. • No specific guidance developed for monitoring emissions at low emission concentrations.
South Korea	• South Korea has developed the CleanSys system to remotely and continuously monitor emissions of particulate matter, sulphur dioxide, hydrogen chloride, hydrogen fluoride, ammonia and carbon monoxide from stacks of industries above prescribed thresholds. • The system automatically collects raw data from the continuous analysers and applies the relevant validation criteria to allow a near real-time assessment of compliance with emission limit values. • Online remote reliability checks and zero and span calibration checks can all be performed automatically and remotely. • Should emissions approach or exceed an emission limit value, the operator and local government are informed through SMS messaging, allowing immediate action to be taken to investigate the causes of the elevated emissions. • The validation criteria applied to the raw data for the purposes of the compliance assessment procedure could not be located within the public domain.

4.3.1 United States

In the United States, federal regulations in the form of the Code of Federal Regulations (CFR) 40 Part 70 require each major source of emissions to air to obtain an operating permit that consolidates all of the various pollution control requirements into a single, comprehensive document. These permits are often known as Part 70 or Title V Operating Permits, since they were introduced under the Title V amendments to the Clean Air Act in 1990. Title V was introduced to improve compliance by clarifying what facilities must do to control and monitor emissions to air.

Major sources are defined as those emitting more than 100 tons/yr of any pollutant. Lower thresholds apply in non-attainment areas, i.e., those areas that exceed the National Ambient Air Quality Standards (NAAQS), or for certain Hazardous Air Pollutants (HAPs). They are also mandatory for certain industrial processes, e.g., solid waste incinerators, chlor-alkali plants, primary copper smelters etc., regardless of capacity.

Most Title V Permits are issued by State and local permitting authorities. However, the United States Environmental Protection Agency (EPA) also issues Title V Permits in certain situations, such as for permits in tribal lands. Irrespective of whether the permit is issued by the State authorities or by the US EPA, Title V Permits are federally enforceable which means that EPA can enforce the terms of the permit, along with the State or local permitting authorities.

Title V Permits state how operators of facilities covered by the regulations should monitor, either periodically or continuously, their compliance with emission limits. Part 70 identifies the standard permit requirements that each permit shall include. The monitoring and reporting requirements are identified in CFR 40 Part 70.6 (a)(3) which state that:

"… each permit shall contain the following requirements with respect to monitoring:

A. All monitoring and analysis procedures or test methods required under applicable monitoring and testing requirements, including part 64 [Compliance Assurance Monitoring]…

B. Where the applicable requirement does not require periodic testing or instrumental or noninstrumental monitoring (which may consist of recordkeeping designed to serve as monitoring), periodic monitoring sufficient

to yield reliable data from the relevant time period that are representative of the source's compliance with the permit..."

Compliance requirements for Title V permits are mandated through CFR 40 Part 70.6 (c)(1):

"*Consistent with paragraph (a)(3) of this section, compliance certification, testing, monitoring, reporting, and recordkeeping requirements sufficient to assure compliance with the terms and conditions of the permit. Any document (including reports) required by a part 70 permit shall contain a certification by a responsible official that meets the requirements of § 70.5(d) for this part*."

The US EPA introduced regulations for Compliance Assurance Monitoring (CAM) in 1997 through 40 CFR Part 64. These regulations apply to major sources requiring a Title V permit or any major emission units that rely on pollution control equipment to achieve compliance. Part 64.3 provides monitoring design criteria that aim to ensure assurance of compliance with emission standards, whilst Parts 64.4(a) and (b) require operators to submit information on how compliance monitoring will be conducted, including justification for the proposed methods and performance criteria. These design requirements which form the required permit conditions include:

- the approved monitoring approach, including the performance indicators of the parameters to be monitored;
- the indicator range such that operation within the range provides a reasonable assurance of compliance;
- specifications for the monitoring system and monitoring location to ensure data is representative;
- quality assurance and quality control practices to ensure continuing validity of the data; and
- the frequency of monitoring and the averaging period.

To support the implementation of the CAM programme, technical guidance has been developed by the EPA[13]. The CAM guidance clarifies the CAM process, requirements for submittals under Part 64.4(b) and also supplies technical references for monitoring equipment and instruments. Appendix A contains detailed examples of CAM submittals for different combinations of pollutant specific emission units and add-on control devices, whilst Appendix B discusses key operating parameters and indicators of performance, and general monitoring approaches for each of the types of control devices.

Emission limits for new or modified emission sources are defined under 40 CFR Part 60 - *Standards of Performance for New Stationary Sources* (NSPS). These are federal (national) emissions standards that limit the amount of air pollution from new sources or modified existing sources. Additional national emission standards for HAPs (NESHAP) are introduced through 40 CFR Parts 61 and 63 which apply to new or existing sources, with the latter defining Maximum Achievable Control Technology (MACT) standards.

Each subpart of 40 CFR Part 60 is applicable to individual sectors or emission sources and each subpart contains the emission standard specific for that activity and the associated test methods and procedures for demonstrating compliance with the standard.

Monitoring methods have been developed by the EPA for individual pollutants or emission parameters (e.g., velocity) and types of emission sources for demonstrating compliance with the requirements of 40 CFR Parts 60, 61 and 63. Additional guidance and performance specifications for Continuous Emissions Monitoring Systems (CEMS) have also been developed by the EPA at a pollutant-specific level[14], whilst quality assurance procedures have been developed to assess the effectiveness of quality control (QC) and quality assurance (QA) procedures, and the quality of data produced by CEMS that are used for determining compliance with the emission standards.

Guideline Documents are also developed to clarify areas of technical uncertainty in the methods and performance specifications and to describe alternatives to sampling procedures within the methods or performance specifications[15]. These Guideline Documents include, for example, guidance on the preparation and

[13] https://www.epa.gov/air-emissions-monitoring-knowledge-base/compliance-assurance-monitoring-technical-guidance-document

[14] https://www.epa.gov/emc/emc-performance-specifications

[15] https://www.epa.gov/emc/emc-guideline-documents

review of site specific test plans (GD-042)[16], guidance on the preparation and review of emission test reports (GD-043)[17] and the Clean Air Act National Stack Testing Guidance[18] which aims to improve uniformity on how stack tests are conducted for determining and demonstrating compliance with 40 CFR Part 60, 61 and 63.

CEMS are mandatory on all combustion units covered by Title V permits that use solid fuels, including municipal waste incinerators, but alternative methods, including PEMS, are permitted for gas or oil-fired boilers, gas-fired heaters and turbines, and ethanol plants. Periodic monitoring is accepted for any source/sector not subject to the continuous emissions monitoring provisions.

CEMS monitoring gaseous pollutants such as NOx, SO_2 and CO must be calibrated against a reference method (RM) measurement at initial installation and undergo a relative accuracy (RA) test audit (RATA). The RATA must be performed when the emission source is operated at more than 50% of its normal load, with a minimum of nine reference method runs used; however, more than nine sets of RM tests may be performed. If this option is chosen, a maximum of three sets of the test results can be rejected so long as the total number of test results used to determine the RA is greater than or equal to nine. However, all data must be reported, including the rejected data.

The RA performance specification during the RATA differ by pollutant. Examples of the RA performance specifications for some common gaseous pollutants are provided in Table 17 below.

Table 17: United States relative accuracy performance specifications for common gaseous pollutants

Pollutant	Operating condition	RA criteria
NO_x and SO_2	Average emissions during the RATA ≥ 50% of the emission standard	≤ 20%
	Average emissions during the RATA < 50% of the emission standard	≤ 10%
	For SO_2 emission standards ≤ 130 but ≥ 86 ng/J	≤ 15%
	For SO_2 emission standards < 86 ng/J	≤ 20%
CO	Average RM value used to calculate RA	≤ 10%
	Emission standard used to calculate RA	≤ 5%
VOCs	Average RM value used to calculate RA	≤ 20%
	Emission standard used to calculate RA	≤ 10%

For gaseous pollutants, the CEMS calibration must not drift or deviate from the reference value of the gas cylinder or gas cell by more than 2.5% of the span value.

In terms of ongoing quality assurance requirements for gaseous CEMS, the applicable procedures mandate that a formal QA/QC programme is developed which includes written procedures on e.g., calibration of the CEMS, calibration drift and adjustment of the CEMS, preventative maintenance, data recording and reporting etc. Operators of gaseous CEMS must check, record and quantify the calibration drift at two concentration values at

[16] https://www.epa.gov/sites/production/files/2020-08/documents/gd-042.pdf

[17] https://www.epa.gov/sites/production/files/2020-08/documents/gd-043.pdf

[18] https://www.epa.gov/compliance/clean-air-act-national-stack-testing-guidance

least once daily and the CEMS calibration must be adjusted whenever the daily zero or span drift exceeds two times the applicable performance specification (in most cases this is a drift exceeding 5%).

CEMS are required to undergo a RATA every year and a relative accuracy test (RAA) in three out of four quarters. The RAA tests are largely equivalent to the RATA tests, except that only three reference method measurements are required. For the RATA tests, the allowable RA is as stated in the applicable performance specification, whilst for RAAs, the RA should be within ±15% of the three run average, or ±7.5% of the applicable emission standard, whichever is greater.

For particulate matter, the performance specifications mandate that an initial correlation test is performed against a manual reference method and a minimum of 15 manual reference method tests should be performed over the full range of normal operating conditions for that emission source. For a "low-emitting source"[19], the correlation co-efficient must be greater than or equal to 0.75. If a source is not a low-emitting source, the correlation co-efficient must be greater than or equal to 0.85. Additionally, the 95% confidence interval half range at the mean PM CEMS response from the correlation test must be less than 10% of the applicable emission standard.

In terms of ongoing QA/QC of particulate matter CEMS, like gaseous pollutants, operators are required to develop written QA/QC procedures and routinely check the zero and span drift of the analyser. The CEMS must be updated whenever the daily zero or span drift exceeds 4%. Absolute correlation audits (ACAs), response correlation audits (RCA) and relative response audits (RRA) are required to be performed each quarter. The CEMS is deemed to be "out of control" if any of the following conditions are met:

- ACA:
  - the results exceed ±10% of the average audit value, or 7.5% of the emission standard;
- RCA:
  - the PM CEMS response value is greater than the greatest PM CEMS response value used to develop the correlation curve;
  - more than 25% of a minimum 12 measurements 2 sets of PM CEMS and reference method measurements fall outside a specified area on a graph of the correlation regression line.
- RRA:
  - the PM CEMS response value is greater than the greatest PM CEMS response value used to develop the correlation curve;
  - any one of three sets of PM CEMS and reference method measurements fall outside the same specified area on a graph of the correlation regression line as required for the RCA.

If the CEMS is found to be out of control, the operator must take necessary corrective action to eliminate the problem and perform tests, as appropriate, to ensure that the corrective action was successful, and repeat the previously failed audit.

The use of PEMS is permitted for certain combustion activities (principally for NOx emissions from turbines, boilers and heaters) either for precise quantification of emission levels or to provide an indication as to whether an exceedance of a regulatory threshold has occurred. The US EPA has developed a performance specification and test procedures for PEMS applied to stationary sources (PS-16)[20]. Under PS-16, PEMS must pass a RA test and accompanying statistical tests in the initial certification phase to be acceptable for use in demonstrating compliance with applicable requirements. Ongoing quality assurance tests also must be conducted to ensure the PEMS is operating properly. An ongoing evaluation procedure must be in place before the PEMS certification is complete. The amount of testing and data validation that is required depends upon the regulatory needs, i.e., whether precise quantification of emissions will be needed or whether an indication of an excess emission above

[19] This is a source that operated at no more than 50 percent of the emission limit during the most recent performance test, and, based on the PM CEMS correlation, the daily average emissions for the source, measured in the units of the applicable emission limit, have not exceeded 50 percent of the emission limit for any day since the most recent performance test.

[20] https://www.epa.gov/sites/default/files/2017-08/documents/performance_specification_16.pdf

some regulatory threshold will suffice. Performance criteria are more rigorous for PEMS used in determining continual compliance with an emission limit than those used to measure excess emissions.

PEMS that are used for excess emissions reporting must run a minimum of nine RA tests against a reference method, whilst PEMS used for the purpose of continual assessment against compliance standards must perform a minimum of 27 RA tests. Additionally, the data must be evaluated to other statistical tests for bias, F-tests and correlation analysis. Operators of PEMS are required to conduct quarterly relative accuracy audits (RAA) and yearly relative accuracy test audits (RATA) to assess ongoing PEMS operation.

Continuous monitoring and centralised data collection (at city or state level) of ambient air pollution has been undertaken for many years in the USA. However, whilst use of CEMS has also been common on industrial installations, real-time collection of CEMS data by regulatory authorities is not undertaken. Instead, information from CEMS is periodically reported electronically by the operator rather than collected in real time or near real time. Recent regulations and proposals have facilitated e-reporting of emission data including an electronic reporting tool and associated guidance[21] but there is no centralised monitoring of CEMS outputs. The US EPA Enforcement and Compliance History Online makes data available to the public on facility emissions and compliance information but not real-time emission data.

Different programs and different regulations are in place for the monitoring of different pollutants. In addition, there are differences in requirements among individual States. Some States may require higher levels of CEMS data availability or use standby monitoring equipment for some or all monitoring parameters. To maximise data availability, operators are also encouraged to include a back-up recording device, or other appropriate redundancy within the data acquisition system.

In terms of compliance assessment, monitoring data and a comparison against the emission standards is submitted on a periodic basis, with an annual compliance certification process. Measurement uncertainty is not explicitly addressed in this process[22], although the performance and accuracy of the CEMS is demonstrated through the regular RA, RATA, ACA, RCA and RRA audits.

Monitoring data during periods of start-up and shut-down are excluded for compliance purposes, but emissions monitoring data must still be recorded and reported to state and federal regulators. Specific definitions for start-up and shut-down are provided for some sectors. For example, for coal and oil-fired electric utility steam generating units, the following definitions are provided:

*"**Startup** means:*

(1) Either the first-ever firing of fuel in a boiler for the purpose of producing electricity, or the firing of fuel in a boiler after a shutdown event for any purpose. Startup ends when any of the steam from the boiler is used to generate electricity for sale over the grid or for any other purpose (including on-site use). Any fraction of an hour in which startup occurs constitutes a full hour of startup; or

(2) The period in which operation of an EGU is initiated for any purpose. Startup begins with either the firing of any fuel in an EGU for the purpose of producing electricity or useful thermal energy (such as heat or steam) for industrial, commercial, heating, or cooling purposes (other than the first-ever firing of fuel in a boiler following construction of the boiler) or for any other purpose after a shutdown event. Startup ends 4 hours after the EGU generates electricity that is sold or used for any other purpose (including on site use), or 4 hours after the EGU makes useful thermal energy (such as heat or steam) for industrial, commercial, heating, or cooling purposes (16 U.S.C. 796(18)(A) and 18 CFR 292.202(c)), whichever is earlier. Any fraction of an hour in which startup occurs constitutes a full hour of startup.

***Shutdown** means the period in which cessation of operation of an EGU is initiated for any purpose. Shutdown begins when the EGU no longer generates electricity or makes useful thermal energy (such as heat or steam) for industrial, commercial, heating, or cooling purposes or when no coal, liquid oil, syngas, or solid oil-derived fuel is being fired in the EGU, whichever is earlier. Shutdown ends when the EGU no longer generates electricity or makes useful thermal energy (such as steam or heat) for industrial, commercial, heating, or cooling purposes,*

[21] https://www.epa.gov/electronic-reporting-air-emissions/electronic-reporting-tool-ert

[22] For instance, the standard report format for *Preparation and Review of Emission Test Reports Guideline Document GD-043* just requires an operator to provide the monitored result and not the associated uncertainty.

and no fuel is being fired in the EGU. Any fraction of an hour in which shutdown occurs constitutes a full hour of shutdown."

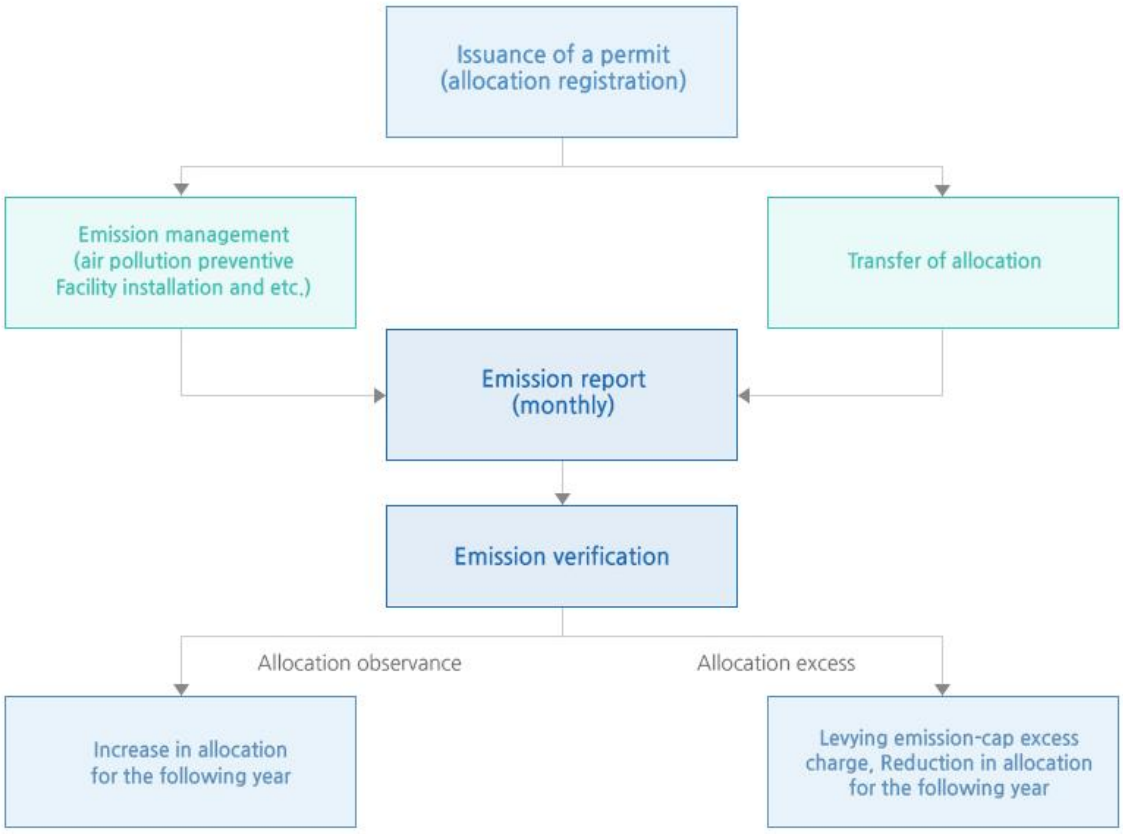
Whilst the US EPA's Emission Measurement Center (EMC) has produced a large series of guideline documents, there does not appear to be guidance specifically directed to monitoring emissions at low concentrations.

4.3.2 South Korea

South Korea introduced national emission standards for industrial facilities as part of the Clean Air Conservation Act of 1990. The Act addresses 61 designated "air pollutants" and 35 "specified air pollutants" (including e.g., dioxins, benzene, chromium and cadmium).

These emission standards can be made more stringent by designating an "air quality control area" under a municipal ordinance. For example, industrial installations emitting air pollutants in the Seoul Metropolitan Area are regulated by the 2003 Special Act on the Improvement of Air Quality in Seoul Metropolitan Area. This Special Act established an emission cap management system for NO_x and SO_2 emissions the entire Seoul Metropolitan Area.

The Seoul Metropolitan Area emission cap management system allocates yearly emission allowances to large industrial facilities emitting more than 10 tons per year of an air pollutant, requiring them to maintain their emissions within the allowances and allowing them to trade any surplus allocations. Fines are imposed on any facility that exceeds its cap and where it has not purchased adequate allowances to cover the excess emissions. This emission cap system has recently been extended to other metropolitan regions and expanded to include emissions of particulate matter. The structure of the emission cap management system is illustrated below:



Source: https://www.keco.or.kr/en/core/climate_air2/contentsid/1947/index.do

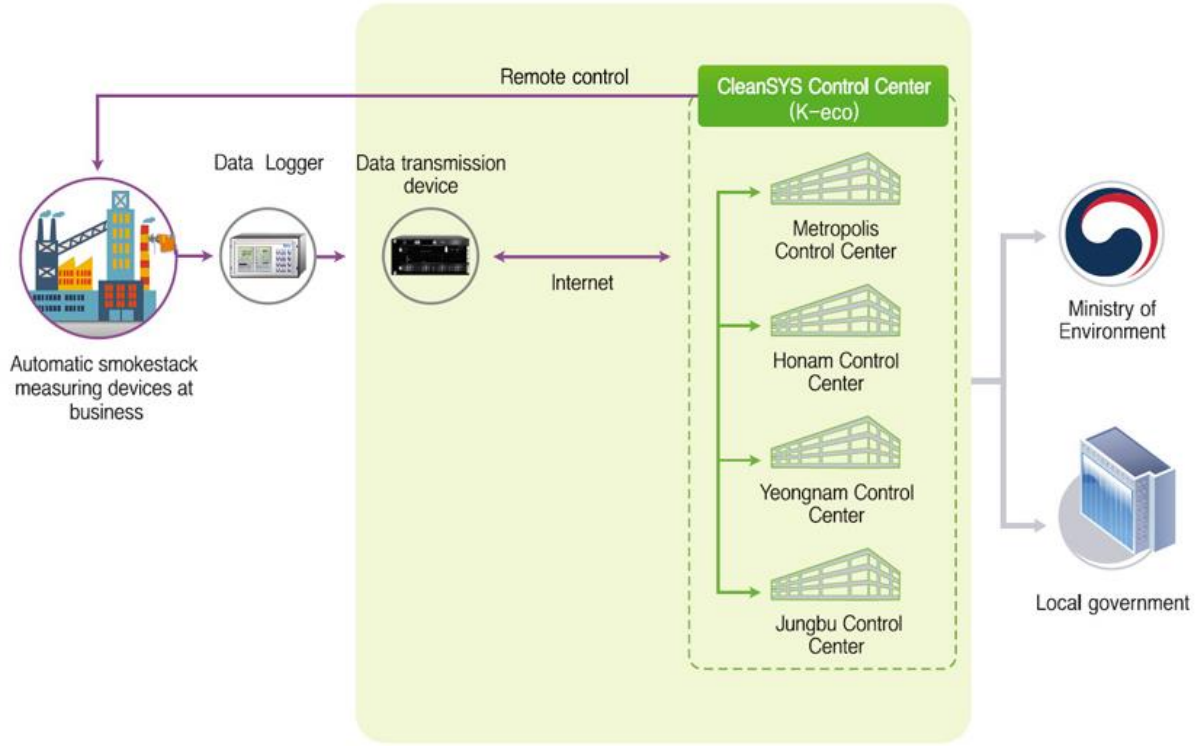
To support the assessment of compliance and reporting against emission standards and the emissions cap system, a central real-time emissions monitoring and data acquisition and handling system (DAHS) has been

developed. This system (CleanSys) remotely and continuously monitors emissions of particulate matter, sulphur dioxide, hydrogen chloride, hydrogen fluoride, ammonia and carbon monoxide from stacks of industries above prescribed thresholds.

The system automatically collects raw data from the continuous analysers and applies the relevant validation criteria to allow a near real-time assessment of compliance with emission limit values and generation of monthly reports for the purposes of discharging the reporting requirement of the emission cap management system. However, documentation providing the validation criteria and procedures supporting the compliance assessment could not be located.

The CleanSys DAHS system at four control centres allows the Ministry of Environment and local government to continuously monitor the performance of the emissions monitoring equipment. Online remote reliability checks and zero and span calibration checks can all be performed automatically and remotely.

Should emissions approach or exceed an emission limit value, the operator and local government are informed through SMS messaging, allowing immediate action to be taken to investigate the causes of the elevated emissions.



In addition to continuously monitoring emissions to air, emissions to water (pH, temperature, flow rate, DO, BOD, COD, SS, TN, TP) and ambient air quality are also recorded. The stack emissions, emissions to water and ambient air telemonitoring is managed by different authorities operating under the Ministry of Environment.

In recent years, South Korea has been working to implement integrated regulation of industrial facilities based on the principles of IED and application of BAT. The intention is to implement legislation changes to allow a more integrated approach to permitting of industrial facilities so that all emission media, the local environment and BAT are considered.

4.3.3 India

Emission standards in India are set and regulated by the Central Pollution Control Board (CPCB) of the Ministry of Environment, Forest and Climate Change (MoEFCC) under the Environment (Protection) Rules 1986 and

associated amendments. The amendments introduce sector specific emission standards and monitoring requirements. For example, the Environment (Protection) Amendment Rules 2015 establish new emission standards for thermal power plants. The monitoring requirements include a combination of continuous and periodic extractive monitoring dependent on the industry sector and capacity.

The CPCB has mandated the installation of a telemonitoring system which covers 17 industrial sectors and more than 40,000 installations:

- Primary aluminium smelters
- Caustic soda production
- Caustic soda production;
- Cement manufacture;
- Non-ferrous metals;
- Distilleries;
- Manufacture of dyes and dye intermediates;
- Fertiliser manufacture;
- Iron and steel production
- Tanneries;
- Chemical industries;
- Pulp and paper;
- Oil refineries;
- Sugar refineries;
- Thermal power plants

Both emissions to air (PM_{10}, $PM_{2.5}$, SO_2, NO_x) and water (pH, TSS, TDS, COD, BOD) are monitored using the telemonitoring system.

To support operators in performing emission measurements using continuous monitoring methods, the CPCB has produced Guidelines for Continuous Emission Monitoring Systems[23] providing descriptions of CEMS technologies acceptable for use in specific industries, ELVs, quality assurance of data and suitable locations for CEMS. A number of standards and practices relating to the use of CEMS were considered in developing this guidance. These include the development of a CEMS certification scheme and the adoption of the US EPA performance specifications, or EN quality assurance standards, for the verification of CEMS.

For telemonitoring, data collection systems must enable collection of real time data and undertake remote calibrations to verify the condition of the CEMS. It is the responsibility of the operator to ensure that raw data are provided continuously to at least four locations including CPCB and state pollution control board servers and secure back-ups at each location. For most CEMS, data collection is set to every 15 seconds with these data transmitted to a cloud server in an encrypted form.

In determining whether an exceedance of a limit has occurred, the following approach is provided in the CPCB guidelines:

[23] https://cpcb.nic.in/openpdffile.php?id=TGF0ZXN0RmlsZS9fMTUzNTUzMzAyMl9tZWRpYXBob3RvMzAyNDUucGRm

- Potential exceedances of limits should only be assessed during 'operating hours' which are defined as "*the time expressed in hours during which the plant in whole or in part is operating and discharging emissions into the air, excluding start up and shutdown periods*"
- Any exceedance of values reported as an appropriate time-averaged value with respect to relevant emission limits is considered to be a 'violation'. Measurement uncertainty is not explicitly considered in this determination.
- For valid half hour values, any instances where data is lost/not available for more than 10 minutes in that half hour period shall result in that half hour value being rejected. Where more than five half hour periods of data are rejected in any given day, that full day of data should be rejected for the purposes of calculating daily average emissions.
- Any day in which more than three hourly average values are invalid due to malfunction or maintenance should result in that fully day of data being rejected for the purposes of calculating daily averaged emissions.
- Values recording during calibration and preventative maintenance shall not be considered in the compliance assessment.
- Minimum data capture rate of 85% must be demonstrated. Start-up, shutdown and calibration periods shall be excluded when calculating the data capture rate.

In the case of exceedances of an emission standard, or when data is not received servers at the CPCB and state pollution control board send automated message alerts to industries for operators to respond to and implement corrective action. If the number of message alerts sent exceeds a certain limit, CPCB or the state pollution control board may visit the industrial facility to inspect the facility and review the emission control equipment or the water treatment facilities.

Four alert levels are provided in CPBC's Compliance Reporting Protocol for the real time reporting of emissions. These range from yellow (lowest level of alert) through to purple (highest level of alert) and are summarised below for emissions to air of PM, SO_2, NOx and CO.

Table 18: Alert Levels and Actions in CPCB Compliance Reporting Protocol for Emissions to Air

Deviation for emissions to air	Alert Level	Action to be taken by the Operator	Action to be taken by the Regulator
15-minute average emissions exceed emission standard by >25% 8 times in any given day. **Internet / power connectivity / sensor error for more than four hours for a maximum of six times during any 30 day period.** **Parameters are observed to be consistent without deviation of ±2% for more than 48 hours.**	Level I	Cancellation of yellow alert if exceedance is due to start-up, shut-down or other maintenance event. SMS alert for internet/power failure should be configured in the system. Where data is not showing on the CPCB server but is being recorded by the Operator, the Operator is permitted to send proof of this and the subsequent data via email.	Auto generated email/letter alert.
More than 36 yellow alerts issued during any 30-day period. **Internet / power connectivity / sensor error for more than four hours**	Level II	Immediately take action to correct the deviation during each yellow alert e.g., air pollution control device or process correction required. Record deviation and inform CPCB and state	Auto generated email/letter alert. Reply to be submitted to CPCB / state pollution control board.

Deviation for emissions to air	Alert Level	Action to be taken by the Operator	Action to be taken by the Regulator
for a maximum of 12 times during any 30 day period. **Internet / power connectivity / sensor error for 72 hours.** **Parameters are observed to be consistent without deviation of ±2% for more than 72 hours.**		pollution control board about the deviation and correction action taken. Check the internet / power / sensor defect and restore accordingly. Inform CPCB and state pollution control board.	
More than 72 yellow alerts in any 30-day period. **Internet / power connectivity / sensor error for more than four hours for a maximum of 18 times during any 30 day period.** **Parameters are observed to be consistent without deviation of ±2% for more than 144 hours.**	Level III	Take corrective action and inform CPCB and state control board. Record observations on the emission characteristics during the previous 24 hours. Check the internet / power / sensor defect and restore accordingly. Inform CPCB and state pollution control board.	Auto generated email/letter alert. Reply to be submitted to CPCB / state pollution control board.
More than one red category alert during any 30 day period. **Internet / power connectivity / sensor error for more than four hours more than 24 times during any 30 day period.** **Internet / power connectivity / sensor error for more than 7 days.** **Parameters are observed to be consistent without deviation of ±2% for more than 7 days.**	Level IV	Process should shut down immediately until corrective actions implemented. Root-cause analysis and action taken report (ATR) submitted to CPCB and state pollution control board	Auto generated letter seeking explanation within 15 days. Site investigation by CPCB / state pollution control board or any appointed third party.

4.4 Approaches for addressing key issues

There are a number of different high-level options that could be considered, both legislative and non-legislative, to address some of the issues identified related to compliance assessment. These include the following:

- Stand-alone guidance to support MSs with implementation.
- Further capacity building e.g. expansion of the support provided via the IED implementation support contract and platform.
- Commission FAQs / legal opinion on specific issues.
- Further details to be captured in future BREFs and BAT Conclusions (activity specific and/or horizontal i.e. ROM).

- Legislative change in IED potentially with further details in delegated or implementing acts.

Building on these generic approaches, specific options have subsequently been identified for the key challenges and issues identified in this work, based on the Member State approaches, primarily, although consideration has also been given to approaches used elsewhere as well as expert input e.g. via direct engagement with CEN experts.

These options have then been assessed against the following criteria:

- **Economic impacts:** how would the option impact on administrative costs, operating costs and conduct of business, competitiveness (sectoral) of business, position of SMEs, innovation and research as well as public authority impacts?
- **Environmental outcome:** how does the option impact on overall environmental outcomes?
- **Extent to which they would address the issue:** does the option address the issue concerned and resolve the challenges that Member States have faced? This considers the certainty of delivery as well as the extent to which the option would contribute to achieving a level playing field across the EU.
- **Political feasibility / acceptability:** are there likely to be any barriers to implementation of the option e.g. opposition from the Member States and/or industry?
- **Technical feasibility:** are there any technical challenges with implementing the option? e.g. limitations of measurement equipment, lack of measured methods, lack of technical knowledge.
- **Coherence with existing rules and practices:** is there any potential for contradictions with national legislation specifically addressing this issue and/or within BATC rules, the BREF revision rules or other EU legislation. How would the option impact on Chapters III, IV or V compliance assessment?
- **Proportionality**: whether the options respect the principle of the proportionality, i.e. whether the approach and its intensity match the identified issue. This will be judged using selected – and tailored – questions from the Better Regulation Toolbox #5.

No specific **social impacts** (e.g. on employment) are anticipated with any of the options bar the potential health benefits associated with any reductions in emissions.

The following grading and colour coding has been used to summarise the impacts qualitatively, referring to the direction (positive or negative) and likely scale of any impacts.

Key:					
Strongly negative	Weakly negative	Neutral	Weakly positive	Strongly positive	Unclear impacts

4.4.1 Common rules for assessing compliance with emission limit values under Chapter II of the IED

The potential options for addressing the issues identified in relation to compliance assessment for Chapter II installations (namely a lack of details on how to undertake compliance assessment and, in particular, take measurement uncertainty into account) are set out below.

- **Option #01: Introduce guidance on how compliance assessment should be undertaken including how measurement uncertainty should be taken into account.**
- **Option #02: Introduction of a specific article (or revised article) within Chapter II of the IED setting out compliance assessment rules supplemented with further detail in delegated or implementing acts.**

Considering the potential scale and importance of the issue, as identified in the IED evaluation and since confirmed as part of the ongoing IED revision, a non-legislative option (i.e. guidance to clarify compliance assessment) is not considered realistic as it would not provide any certainty that it would lead to improvements and consistency across the EU. Therefore Option #01 has not been described or assessed further below.

Option #02 would require an amendment to Chapter II to introduce specific, common rules for assessing compliance with emission limit values and validation of measured levels for both air and water emissions (i.e. taking into account measurement uncertainty).

The measure will improve legal certainty and eliminates varied interpretation of enforcement and insufficient guidance. It will aim to help level the playing field and lead to emission reductions in those cases where currently less stringent compliance assessment practices are deployed.

The evaluation of the IED concluded there was variation in compliance assessment approaches for Chapter II installations, (as well as variation in interpretation of the compliance assessment elements of IED Annexes V and VI for Chapter III and Chapter IV plants respectively). These elements are important to redress due to the continued need to achieve a high level of protection of the environment as a whole (i.e. avoiding cases where interpretation of the legislation is not achieving the intended environmental benefits) as well as to continue to level the playing field for commercial entities operating across the EU27.

Special provisions for Large Combustion Plants and Waste Incinerators are included in Chapters III and IV, respectively, and Annex V/Annex VI for the calculation of validated limit values for compliance assessment by the subtraction of measurement uncertainty. While mandatory for LCP and WI sectors, this topic is also relevant to Chapter II installations in other IED sectors. In work previously undertaken (Ricardo, 2018), Member States provided examples of other flexibilities implemented for compliance assessment of Chapter II installations. This has demonstrated the variation across Member States and the potential for benefit in levelling the playing field. Some areas where a common approach to the assessment rules would be beneficial have been identified in previous studies[24]. These include further clarifications on the role of measurement uncertainties in determining compliance with ELVs and also a more structured approach towards compliance with ELVs for combined waste water streams from different processes or installations.

Different application of measurement uncertainty in compliance assessment leads to an inconsistent assessment of environmental performance, and in some cases the underestimation of actual emissions at an installation.

The implementation need(s) would be as follows:

- EU to develop and publish (e.g. as a Commission Decision) the compliance assessment rules based on relevant consultations with Member States.
- EU to develop additional guidance and supporting mechanisms to aid implementation of the measure across Member States.
- Member States to enact on the proposed new approaches to be considered in their national laws.

Importantly, clarity should be provided that measurement uncertainty is to be calculated for the specific measured value and should not be based on application of the maximum uncertainty associated with a particular monitoring method or maximum uncertainty expressed as a percentage of an ELV. The maximum uncertainty is a metric that should be used to determine whether a measured result is acceptable from a methodological accuracy perspective and not to be used as the basis for subtraction from the measured value. The actual measurement uncertainty for that specific test should be used as the basis for the compliance assessment as this leads to the best outcome for the environment as it is more accurate and representative of reality and should lead to the lowest emissions. This approach is consistent with the treatment of monitoring uncertainty in a number of Member States including Croatia, Estonia, Germany, Italy, Netherlands, Poland and Romania.

Given the complexity associated with the fundamental concepts introduced in the calculation of the measurement uncertainty, any amendment to reflect these requirement within IED itself should only provide a basic framework/signposting for the compliance assessment, with more detail on how to calculate measurement uncertainty itself, contained within a delegated or implementing act.

The associated implementing decision should provide further guidance and instruction to competent authorities on how measurement uncertainty should be calculated, as well as defining maximum expanded measurement uncertainty values for continuous and periodic monitoring, and describe specific compliance outcomes.

[24] Ricardo. (2020). Assessment of compliance with Emission Limit Values under the Industrial Emission Directive.

This implementing decision should provide definitions for key parameters (e.g., measurement uncertainty, expanded measurement uncertainty etc.,) and describe the procedures that can be used to calculate the measurement uncertainty making reference to definitions and equations established by the Joint Committee for Guides in Metrology in the *Guide to the Expression of Uncertainty in Measurement* (GUM), ISO 20988:2007 *Air quality – Guidelines for estimating measurement uncertainty* and the Eurachem/CITAC *Guide for Quantifying Uncertainty in Analytical Measurement.*

It should also define the maximum expanded uncertainty for individual pollutants monitored during continuous and periodic testing making reference to e.g., values in Annex V and VI for large combustion plant and waste incineration plant, respectively, and standard reference methods such as EN 15058:2017, EN13284-1:2017, EN 14792:2017 etc. The implementing decision should clarify that, when the expanded measurement uncertainty exceeds the maximum expanded measurement uncertainty, this should be reported as a deviation and competent authorities should consider the impact of such deviations when determining compliance with an emission limit.

The required approach to assessing compliance with emission limit values in the context of measurement uncertainty should also be defined. A good example of that is in the Ireland EPA Air Emission Monitoring Guidance Note 2, replicated in the box below.

Measurement uncertainty and assessing compliance with emission limit values

1. Determine the expanded measurement uncertainty. The required level of confidence must be 95% using a coverage factor (*k*) of 1.96

Expanded measurement uncertainty = (measured value x % uncertainty) / 100

% uncertainty = (combined standard uncertainty x 1.96) / measured value

Note: the measured value should already be corrected to the appropriate reference reporting conditions.

2. Adjust the measured result by subtracting the expanded measurement uncertainty:

Adjusted value = measured value – expanded measurement uncertainty

3. Compare the adjusted data versus the appropriate emission limit value to assess compliance.

Dependent on the results from the above procedure, the delegated or implementing act could introduce specific compliance outcomes, for example:

- Validated result from continuous monitoring data over the relevant temporal averaging period, or a single result over the sampling period from a periodic test less than the relevant ELV before subtraction of expanded measurement uncertainty = fully compliant
- Validated result from continuous monitoring data over the relevant temporal averaging period, or a single result over the sampling period from a periodic test above ELV but less than ELV after subtraction of expanded measurement uncertainty = compliant but approach to limit (may require additional monitoring or further intervention in the future)
- Validated result from continuous monitoring data over the relevant temporal averaging period, or a single result over the sampling period from a periodic test above ELV after subtraction of expanded measurement uncertainty = non-compliant (additional monitoring and/or further intervention required)

Procedures for calculating the validated result from continuous monitoring data could also be established for different averaging periods. The existing procedures in Annex V and Annex VI could form the basis for this and expanded, as relevant, to cover other time periods.

Development of an implementing or delegated act could take place in tandem with the actions that the CEN/TC 264 working groups are currently investigating with respect to dealing with measurement uncertainty at low

concentrations (Option #03). It would be advisable that CEN are consulted on the development of an implementing act.

It will be important that these changes do not result in inconsistency in application of compliance assessment for Chapter III and Chapter IV installations. Furthermore, the potential to consider introducing a provision in Chapter II of the IED that sets out that the compliance assessment rules for Chapter II installations take precedent over other compliance assessment provisions for those installations. Whilst this would simplify the approach in particular some potential environmental risks due to the shorter averaging periods for some ELVs for Chapter III and IV installations need to be investigated. These factors are considered in more detail under Options #07 and #09.

A qualitative assessment of the likely impacts associated with Option #02 are provided in the table below.

Table 19: Assessment of Option #02 to introduce common compliance assessment rules for Chapter II installations

Criteria	Qualitative assessment	Commentary
Economic impacts	Weakly negative	Implementation of common rules for compliance assessment would only impact on those Member States who currently take a different approach i.e. those that do not mandate the subtraction of measurement uncertainty of the relevant equipment from the measured values. Those Member States (e.g. Sweden) that do not allow the subtraction of measurement uncertainty are unlikely to be affected on the basis that they apply a more stringent approach (assuming that the common rules are worded in such a way as to allow for such deviation). For those Member States where a change in compliance rules would have an impact, the following economic impacts may be realised. **Administrative costs:** a change in compliance rules would lead to a need for changes in national (regional and/or local) legislation, guidelines and/or general binding rules. The burden of such a change is expected to be limited (some time for updating the documentation, engaging with stakeholders etc.). The primary impacts could relate to any changes required to individual permits to reflect the new rules. Whilst in some Member States changes at a permit level may not be required (as such a change would be captured in legislation etc.), in others there may need to be an update which would incur both competent authority and operator time to process the update. This would lead to a weakly negative impact on administrative costs. Analysis completed for the ongoing IED revision has estimated the impacts of this measure for operators to be (in the short term for one or two years) from €0.1m/year to €5.8m/year with a central estimate of €3.8m/year for the EU27. For public authorities, it has been estimated that there could be one-off costs of developing such common rules of between €0.3m and €0.4m and annual costs (in the short term for the first one or two years) of €0.2m/year to €5.8m/year with a central estimate of €4.6m/year for the EU27. **Operating costs and conduct of business:** the potential impacts on operating costs will vary considerably between installations and Member States depending on how close they are currently operating to the ELVs in their permits i.e. if a change in the rules would subsequently lead to an operator being in non-compliance with one or more ELVs. In such cases, then the operator may be required to take additional actions to reduce emissions to stay in compliance. This could incur significant costs if new abatement equipment were to be required although in practice it is more likely that less costly process changes and/or changes to existing abatement equipment could be sufficient to reduce emissions to the requisite levels. The overall impacts are highly uncertain but would be expected to lead to a weakly negative impact on operating costs overall. **Competitiveness of business:** introducing common rules for compliance assessment should contribute towards a more level playing field for business across the EU and therefore have

Criteria	Qualitative assessment	Commentary
		a weakly positive impact on competitiveness within the EU. Competitiveness in the global context may be negatively affected for some operators, as there may be additional costs if further measures to meet emission limits based on the revised compliance assessment procedure are required. **Position of SMEs:** no specific impacts for SMEs are foreseen with a change in the rules for compliance assessment, not least as for most IED activities (and associated activity thresholds) there are very limited numbers of SMEs included within the scope of the Directive. **Innovation and research:** no specific impacts for innovation and research are foreseen. **Public authority impacts:** the primary impacts for public authorities are as described under administrative costs above.
Environmental outcome	Weakly positive	**Climate**: the introduction of common compliance rules is unlikely to impact specifically on climate although could indirectly result in energy and resource efficiency improvements for some plants (but such impacts would be very specific to individual plants, their circumstances, actions that might be required if non-compliant etc.). Overall impacts for climate are expected to be neutral. **Air quality**: the introduction of common compliance rules should lead to reductions in emissions for some installations in those Member States where more lenient rules apply (i.e. where maximum levels of uncertainty can be subtracted and a change in rules requires operators to take further actions to abate emissions). Overall impacts for air quality are expected to be weakly positive. **Water quality and resources:** the introduction of common compliance rules should lead to reductions in emissions for some installations in those Member States where more lenient rules apply (i.e. where maximum levels of uncertainty can be subtracted and a change in rules requires operators to take further actions to abate emissions). Overall impacts for water quality are expected to be weakly positive. **Soil quality or resources:** the introduction of common compliance rules is unlikely to impact specifically on soil quality or resources. Overall impacts for soil quality or resources are expected to be neutral. **Waste production, generation and recycling / Efficient use of resources:** the introduction of common compliance rules is unlikely to impact specifically on waste and resources although could indirectly result in resource efficiency improvements for some plants (but such impacts would be very specific to individual plants, their circumstances, actions that might be required if non-compliant etc.). Overall impacts for waste and resources are expected to be neutral.
Extent to which the issue is addressed	Strongly positive	The introduction of a new or revised Article in Chapter II of the IED supported by a Commission Implementing Decision would provide strong legal certainty to Member States and operators. If worded sufficiently detailed then this should help to ensure a more level playing field in relation to compliance assessment, certainly much more so than if only guidance were to be published.
Political feasibility / acceptance	Neutral	The overall acceptability of -and desire for – such a change will likely vary significantly between different stakeholder types (e.g. Member State competent authorities vs industry). All stakeholders were strongly in favour of options that contribute to a more level playing field across the EU (based on TSS feedback) but with mixed views from industry on the extent to which common compliance assessment rules would specifically contribute.

Criteria	Qualitative assessment	Commentary
		Furthermore, the majority of industry respondents expected no to slight improvement to the implementation of the IED as a result of introducing common assessment rules with emission limit values under Chapter II of the IED. This contrasted to the majority of respondents from environmental NGOs and Member State authorities who expect it could result in moderate or significant improvement in IED implementation including simpler interpretation and better compliance control. The level of acceptability will vary between Member States depending on the approaches they currently employ. Those that take a more stringent approach and only allow for the subtraction of the measurement uncertainty of the monitoring equipment (or not at all) are likely to be highly supportive whereas those that take a more lenient approach less so.
Technical feasibility	Strongly positive	The introduction of common compliance assessment rules should be relatively straight forward in that uncertainty levels can be established as part of the periodic or continuous monitoring e.g. by the equipment supplier and/or accredited company performing the periodic emissions test or calibration of continuous monitoring equipment.
Coherence	Strongly positive	The key issue here would be to explicitly clarify the link (where relevant) between chapters II and III, IV, V and VI (and associated annexes) to avoid any coherence issues. This is considered as part of options #07 and #09.
Proportionality	Strongly positive	The option is aimed at addressing a clear gap in the IED which has been confirmed as part of the 2020 IED evaluation. EU action is required to ensure consistent and timely implementation across the EU. An amendment to the IED and supporting implementing act is the most appropriate mechanism for implementing common compliance assessment rules.

4.4.2 Dealing with measurements at low concentrations.

The challenges associated with assessing compliance with measurements at low concentrations are described in Section 3.2.1.1. The key issue is that the relative measurement uncertainty, i.e., expressed as a percentage of the measured value, or expressed as a percentage of an emission limit value, increases with decreasing emission levels. Consequently, when measured values or emission limit values are very low, it can be difficult to achieve maximum permissible expanded uncertainty values expressed as a percentage of an emission limit value. This issue was discussed in the WI BREF review where the TWG recognised the ongoing CEN work to review and update measurement standards that are relevant for the implementation of the BAT conclusions for Waste Incineration. Further challenges result from the fact that some of the emission limit values are set at levels outside the range at which the reference methods have been validated and whether existing reference methods are able to meet the performance requirements at these levels.

The project team have reached out to CEN for an update on their work in this area and a discussion was convened between the project team and the chair of the CEN/TC 264 working groups[25]**.** In the context of dealing with measurements at low concentrations, this area was initially explored in a report produced by the French National Institute for Industrial Environment and Risks (Ineris) on behalf of the Confederation of European Waste-to-Energy Plants (CEWEP), European Suppliers of Waste-to-Energy Technology (ESWET) and the European Federation of Waste Management and Environmental Services (FEAD)[26]. Authors of this report included members of the CEN/TC 264 emissions task force and leads of two of the TC 264 working groups.

[25] Personal communication between AQC and CEN/TC 264 chairperson, 06 December 2021.

[26] https://www.cewep.eu/wp-content/uploads/2017/12/DRC-17-168319-02463-B_final.pdf

Amongst many other areas, the report identified that the uncertainty of an individual measurement from an automated monitoring system that is calibrated through application of a QAL2 calibration factor does not take account of the intra and inter laboratories' variabilities, potential bias linked with data transfer from the monitoring system to the associated data handling system, and uncertainty linked to data handling itself (e.g., measurements of supporting determinants used to correct emissions to a standard reference condition (e.g., temperature, pressure etc.,) are not always calibrated). Furthermore, it was noted that, whilst EN 14181 provides a variability test to ensure the uncertainty at the daily average emission limit value is lower than the maximum uncertainty allowed under IED, because of the nature of the variability test formula, when the measured concentrations are low, the variability test always passes even if the data are very scattered.

Subsequent to the Ineris report, CEN/TC 264/WG9 (Quality Assurance of Automated Measuring Systems) established a new three part European Standard (EN 17255-1:2019; EN 17255-2:2020 and EN 17255-3:2021) that specifies procedures for the conversion of raw data from an automated measuring system to reported data by a data acquisition and handling system. The new standard supports the requirements of EN 14181 and legislation such as IED. EN 17255-1:2019 specifies:

- requirements for the handling of data;
- requirements for the reporting of data; and
- calculation procedures required.

Whilst EN 17255-1:2019 provides a standard framework for the calculation and reporting of e.g., validated averages, percentage of values complying with the ELV etc., it does not explicitly address the treatment of uncertainty in the context of compliance assessment, nor does it address the challenges resulting from measuring and reporting measurements at low concentrations.

The CEN/TC 264 task force on emissions is in the process of establishing new procedures for the treatment of monitoring uncertainty at low measured concentrations. The current working basis is that, below a certain threshold, uncertainty will be considered in terms of an absolute value, rather than as a percentage of a monitored value or limit. For example, below a certain measurement level, uncertainty would be applied or expressed as a fixed absolute value (i.e., in units of mg/m^3) rather than calculated as a percentage. This procedure is still being developed and it is unclear when, and by what mechanism, any updated procedure will be introduced.

Other issues that are currently under review by the various CEN/TC 264 working groups include:

- clarification of, and procedures for, determining the limit of detection and limit of quantification;
- review of existing monitoring standards in the context of reduced BAT-AELs
- development of standards for new compounds that were previously not regulated (e.g., ammonia).

In the absence of a formal standard or guidance on assessing measurements at low concentrations, some Member States have developed their own procedures. For example, in Ireland, the EPA's AG2 guidance provides specific procedures for reporting measurement results when pollutant values are low. The EPA AG2 guidance document states that, where measurements are below the limits of detection, it is acceptable to report 'less than' results provided that the method limit of detection is stated. The method limit of detection should be calculated using the laboratory limit of detection. For compliance monitoring, the method limit of detection should be no greater than 10% of the value of the emission limit unless otherwise agreed with the EPA. This metric of 10% is also used in other Member States such as Denmark, France and Germany. When considering measurements at low concentrations, Italy defines measurement uncertainty in two ways for each pollutant – one relative to the absolute value, valid at low concentrations, and the percentage, valid at higher concentrations. This would appear consistent with how the CEN/TC 264 task force on emissions appears to be approaching the issue of measuring emissions at low concentrations.

It would appear the only realistic option identified for dealing with this particular challenge would be the **review and revision of measurement standards and their subsequent application across the EU (Option #03)** which

should be completed by CEN. As this is already ongoing no further actions are required at this stage although further guidance, support or investment may be required in the future to support its application. For example, feedback from CEN/TC 264 suggests a dedicated CEN standard or, alternatively, Technical Specification or Technical Report, that addresses monitoring uncertainty, principles and compliance assessment at low emission levels would be advantageous if resourcing constraints can be overcome.

4.4.3 Implications of Normal Operating Conditions in particular for LCPs and (co)-incinerators

The main options available related to defining normal operating conditions (and conversely OTNOC) and effective operating time (for waste (co-)incinerators) are set out below:

- **Option #04 to define NOC/OTNOC/EOT in more detail for LCPs, waste (co)-incinerators and/or other sectors in the IED and delegated or implementing acts.**
- **Option #05 to define the key principles in the IED for defining and minimising start-up and shut-down and OTNOC periods with NOC/OTNOC/EOT to be defined for each sector in the BREFs as they are reviewed in the future.**

Option #04 would entail a significant amount of work to be able to develop definitions for (and interactions between) NOC/OTNOC/EOT for key sectors within the IED and is not considered feasible or realistic to do so and include within the IED and delegated or implementing acts at this stage. There is significant complexity and variation both within and between sectors and the IED itself is not considered the right place for its inclusion. Therefore, this option has been screened out at this stage.

In contrast, Option #05 would be a lighter touch approach whereby some key principles for defining and minimising start-up and shut-down and OTNOC periods could be developed and included within the IED and NOC and OTNOC (and EOT where relevant) could then be defined for each sector in the BREFs as they are reviewed and revised in the future. This would be simpler to implement and could build on some of the materials available from the Member States, industry and other sources. It would also spread the workload over a longer period of time which is considered more realistic.

Whilst some existing provisions in IED do make reference to further details being providing in the BAT conclusions, this is not in the specific context of defining EOT, NOC and OTNOC. For example, Article 15(3) only establishes that, under normal operating conditions, emissions do not exceed emission levels associated with BAT as laid out in the BAT conclusions. It does not, in itself, define normal operating conditions, nor mandate that NOC are defined in the BAT Conclusions. Whilst some BREFs and BAT Conclusions do already contain some measures that need to apply during OTNOC including minimisation of OTNOC periods (e.g. LCP BATC BAT 10), there is potential for making these more explicit and, in particular, providing clear(er) definitions of OTNOC / NOC / EOT in the BREFs and BAT Conclusions as they are reviewed in the future.

A qualitative assessment of the potential impacts of the option is provided in the table below.

Table 20: Assessment of Option #05 to define the key principles in the IED for defining and minimising start-up and shut-down and OTNOC periods with NOC/OTNOC/EOT to be defined for each sector in the BREFs

Criteria	Qualitative assessment	Commentary
Economic impacts	Unclear impacts	Inclusion of key principles for defining and minimising OTNOC periods within the IED and then requiring BREFs to define NOC/OTNOC/EOT for each sector would not entail a significant change in the current situation but would potentially improve the overall consistency of application across the EU and within a sector.

Criteria	Qualitative assessment	Commentary
		The potential economic impacts of the option are uncertain and will depend on the way in which Member State permitting authorities currently define NOC/ OTNOC/EOT for different sectors and installations. **Administrative costs:** a change in defining OTNOC/NOC/EOT could lead to a need to make some changes to local, regional and/or national guidance and/or legislation if it is already defined and needs to be updated. The burden of such a change is expected to be very limited (some time for updating the documentation, engaging with stakeholders etc.). It is assumed that any changes to permits could occur during the normal permit review and revision timescales thus no additional costs would be foreseen. **Operating costs and conduct of business:** the potential impacts on operating costs will vary considerably between installations and Member States depending on how NOC/OTNOC/EOT are currently defined and whether or not a change in definition would lead to changes in operation e.g. reduced period of OTNOC. In such cases, then the operator may be required to take additional actions to reduce emissions to stay in compliance although this is considered unlikely. The overall impacts are highly uncertain. **Competitiveness of business:** developing common definitions for NOC/OTNOC/EOT within the BREFs should contribute towards a more level playing field for business across the EU and therefore have a weakly positive impact on competitiveness within the EU. **Position of SMEs:** no specific impacts for SMEs are foreseen, not least as for most IED activities (and associated activity thresholds) there are very limited numbers of SMEs included within the scope of the Directive. **Innovation and research:** no specific impacts for innovation and research are foreseen. **Public authority impacts:** the primary impacts for public authorities are as described under administrative costs above.
Environmental outcome	Weakly positive	**Climate**: the introduction of common definitions for NOC/OTNOC/EOT is unlikely to impact specifically on climate. Overall impacts for climate are expected to be neutral. **Air quality**: the introduction of common definitions for NOC/OTNOC/EOT could potentially lead to reductions in emissions for some installations in those Member States where more lenient rules/definitions apply. Overall impacts for air quality are expected to be weakly positive although this is unclear and would vary between Member States and sectors. **Water quality and resources:** the introduction of common definitions for NOC/OTNOC/EOT could potentially lead to reductions in emissions for some installations in those Member States where more lenient rules/definitions apply. Overall impacts for water quality are expected to be weakly positive although this is unclear and would vary between Member States and sectors. **Soil quality or resources:** the introduction of common definitions for NOC/OTNOC/EOT is unlikely to impact specifically on soil quality or resources. Overall impacts for soil quality or resources are expected to be neutral. **Waste production, generation and recycling / Efficient use of resources:** the introduction of common definitions for NOC/OTNOC/EOT is unlikely to impact specifically on waste and resources. Overall impacts for waste and resources are expected to be neutral.
Extent to which the issue is addressed	Weakly positive	The introduction of key principles for minimising OTNOC periods and developing common definitions for NOC/OTNOC/EOT in the BREFs should provide useful guidance to Member States and operators. As definitions would only be developed as the BREFs are revised then it would take a number of years before it is completed for most sectors.

Criteria	Qualitative assessment	Commentary
Political feasibility / acceptance	Neutral	The overall acceptability of -and desire for – such a change will likely vary significantly between different stakeholder types (e.g. Member State competent authorities vs industry). The level of acceptability will vary between Member States depending on the approaches they currently employ.
Technical feasibility	Weakly negative	Defining NOC/OTNOC/EOT for all sectors and sub-sectors is considered technically challenging due to the significant variation between and within sectors e.g. fuels, processes, abatement technologies.
Coherence	Neutral	No coherence issues are foreseen.
Proportionality	Weakly negative	The option is aiming to close a gap / challenge identified in previous work and to provide support for the Member State permitting authorities to ensure more consistent permitting. Defining NOC/OTNOC/EOT within the BREF process is considered as the most appropriate as the TWG includes representatives from both industry and the Member States (as well as other stakeholders) with technical knowledge of the sectors concerned. However, it is recognised that based on previous experience this can be difficult to achieve.

4.4.4 Correspondence between the different averaging periods used in IED Annex V and VI and the LCP and WI BAT conclusions

As described previously in this report, Member State authorities and operators have faced challenges related to implementation and demonstrating compliance with the ELVs in IED Annexes V and VI and the BAT-AELs in the LCP and WI BAT conclusions due to differences in averaging periods used.

Based on the responses from Member States, it would appear that, by majority, most Member States either reflect both the Annex V/VI ELVs and the LCP/WI BAT-AELs in permits, or simply include the BAT-AELs without reference to the Annex V/VI ELVs. For example, for WI, Belgium includes both a daily average emission limit based on the BAT-AEL and two 30-minute averaged emission limits (at 100% compliance and 97% compliance) in permits, whereas, in Bulgaria only the BAT-AELs are included for LCPs, but the BAT-AELs and Annex VI ELVs included for WI.

In Germany, for LCPs, if continuous measurement is prescribed, limit values are set based on yearly averages, daily averages and half-hourly averages. Germany did not introduce limit values based on monthly averages when implementing the IED. Rather, each emission limit value laid down in IED Annex V part 1 and 2 was regarded as being based on the daily average. In Germany's response, they state that, in their opinion, the Ordinance which transposes IED is in line with the requirements of IED even though monthly averaged emission limit values are not reflected in permits (in effect, procedures introduced are more stringent than the provisions of IED). Thus, Germany has avoided the complications of different averaging periods set out in Annex V and Annex VI.

In France, for WI, emission limits in permits for NOC only reflect the daily averaged BAT-AEL. The Annex VI ELVs are only included as limits for OTNOC within the EOT. However, for LCPs, emission limits seem to reflect both the requirements of the BAT-AELs and Annex V ELVs.

There does not appear to be widespread use of the 'Example tool for converting emission levels to different averaging periods' for LCPs. Belgium reported that the tool was initially considered but was subsequently discarded due to increased bureaucracy and reservations on the validity of the method, since the recalculation is not part of the BAT conclusions.

The survey responses indicate there are a variety of methods used by different Member States resulting in significant inconsistency. The potential options to address these issues are set out below:

- **Option #06: Development of guidance/ toolkit to support conversion between different averaging periods.**
- **Option #07: Option #02 plus an additional provision in Chapter II of the IED that sets out that compliance assessment rules for Chapter II installations take precedent over other compliance assessment provisions for those installations**
- **Option #08: Harmonisation of averaging periods.**

Option #06 would entail the development of a guidance document setting out how to convert between the different averaging periods. For LCPs this could build on the 'Example tool for converting emission levels to different averaging periods' developed by the Netherlands and referenced in Chapter 13.3 of the LCP BREF which provides methods for estimating daily and monthly averages from the 95th percentile of hourly averages and the annual average. For waste (co-)incinerators a similar toolkit / guidance would need to be developed.

The implementation need(s) would be as follows:

- EU to develop a guidance document setting out how to convert between the different averaging periods.

Option #07 proposes the introduction of a new set of Chapter II compliance rules (as per Option #02). However, this measure proposes that these Chapter II rules also take precedence over existing Annex V and VI provisions, i.e. leading to increased efficiency from the harmonisation of compliance assessment rules for Chapter II installations. ELVs contained in Annex V and VI can still be an important environmental backstop for combustion plants that have received an Article 15(4) derogation, as such plants would not be required to comply with BAT-AELs. The measure would, therefore, instil a provision that gives the new Chapter II rules a clear precedent for compliance assessment, whilst retaining the "safety net" of ELVs from Annex V and VI, to ensure that there is no development of gaps in coverage. This could be achieved by including an additional sub-article in the new article on compliance assessment introduced as part of Option #02 saying that compliance assessment rules for Chapter II installations take precedent over other compliance assessment provisions for those installations. Whilst this would simplify the approach (i.e. leading to increased efficiency from the harmonisation of compliance assessment rules for Chapter II installations) there are some potential environmental risks due to the shorter averaging periods for some ELVs for Chapter III and IV installations.

The implementation need(s) would be as follows:

- EU to introduce new text that sets out the precedent of Chapter II provisions for Chapters III and IV.

Option #08 would require a change in the averaging periods to harmonise them. As the LCP and WI BAT Conclusions have only recently been implemented and the IED revision is ongoing, it is considered most realistic to convert the averaging periods for the ELVs within Annexes V and VI to align with those in the BAT Conclusions. This would require a change in values for the ELVs themselves to reflect such a change e.g. for LCPs this could be converted using the 'Example tool for converting emission levels to different averaging periods' developed by the Netherlands and referenced in Chapter 13.3 of the LCP BREF which provides methods for estimating daily and monthly averages from the 95th percentile of hourly averages and the annual average. However, this option is not considered realistic for the following reasons (and has not been assessed further):

- Aligning the averaging periods removes the value that the Annex V and VI ELVs provides as the BAT-AELs in the LCP and WI BAT Conclusions are typically more stringent.
- Member State competent authorities have implemented these requirements in operator permits and operators will have had to achieve compliance for some time already.
- Removing the shorter term averaging periods would remove the safety net that they provide for preventing short term spikes in emissions.

A qualitative assessment of Options #06 and #07 are provided in Table 21 and Table 22.

Table 21: Assessment of option #06 to develop a guidance document setting out how to convert between the different averaging periods

Criteria	Qualitative assessment	Commentary
Economic impacts	Neutral	Development of a guidance document setting out how to convert between the different averaging periods could potentially reduce the burden on operators to demonstrate compliance with the Annex V and VI ELVs and for the Competent Authorities to have to check compliance although this is expected to be very limited. **Administrative costs:** this measure could have weakly positive impacts on administrative burden on businesses if it supports operators with demonstrating compliance with the BAT-AELs and the Annex V and VI ELVs. Impacts for public authorities may also be weakly positive although in practice are likely to be limited. **Operating costs and conduct of business:** no impacts on the costs of doing business are expected. **Competitiveness of business:** no impacts on competitiveness are anticipated. **Position of SMEs:** no specific impacts for SMEs are foreseen. **Innovation and research:** no specific impacts for innovation and research are foreseen. **Public authority impacts:** the primary impacts for public authorities are as described under administrative costs above.
Environmental outcome	Neutral	No environmental impacts of the measure are expected. The primary aim of this measure is to improve the efficiency of the compliance assessment processes, whilst the ambition of these processes will remain as is.
Extent to which the issue is addressed	Weakly negative	The development of guidance to support conversion between averaging periods would provide some support to operators and, potentially, competent authorities but would not change the key issue which relates to having to demonstrate compliance for different averaging periods.
Political feasibility / acceptance	Weakly positive	Guidance to support the conversion between averaging periods is likely to be of some limited value for stakeholders.
Technical feasibility	Strongly positive	No technical issues are foreseen with implementing such a provision. Whilst there may be technical challenges in the development of the guidance, as demonstrated by the 'Example tool for converting emission levels to different averaging periods' for LCPs, such challenges should not be insurmountable.
Coherence	Weakly positive	Such a provision would improve coherence within the Directive and support some of the challenges that have been faced.
Proportionality	Strongly positive	As the issue relates to the requirements of the IED for some installations to have to comply with both the BAT Conclusions and the ELVs in Annexes V and VI, the development of guidance to support implementation and address a known challenge is considered appropriate.

Table 22: Assessment of option #07 to introduce a provision in Chapter II of the IED that sets out that the compliance assessment rules for Chapter II installations take precedent over other compliance assessment provisions for those installations

Criteria	Qualitative assessment	Commentary
Economic impacts	Weakly positive	Inclusion of a provision in Chapter II of the IED that sets out that the compliance assessment rules for Chapter II installations take precedent over other compliance assessment provisions for those installations would reduce the burden on operators to demonstrate compliance with the Annex V and VI ELVs and for the Competent Authorities to have to check compliance. This should lead to weakly positive economic impacts primarily due to a reduction in administrative burden. **Administrative costs:** this measure is likely to have weakly positive impacts on administrative burden on businesses as operators would only have to demonstrate compliance with the BAT-AELs and not the Annex V and VI ELVs. As part of the IED revision estimates have been made of the potential impacts if this measure were implemented for LCPs. It is assumed that **operators** reconsider and/or update the permits once every ten years (in line with the baseline BREF cycle), in general, or 2 times in a period of 20 years. Further expert input suggests that around 10% or 5 000 installations may be affected by the proposed amendment to the IED, by benefitting from lower administrative burden when compared to the baseline. The extent to which baseline costs for operators would be reduced is uncertain. Drawing primarily on the outputs of the TSS, an assumption has been made that savings could range from 0% to 5%, with a central estimate for this reduction of 2%. This would mean that on average over 20 years, savings to operators would range between €0 to €0.8 million each year, with a central estimate of €0.1 million per year. Stakeholder input via the TSS suggests that the reduction in administrative burden from these amendments to the IED could range between 0%-15% of the permit review costs when compared to the baseline, whilst the vast majority of stakeholders have indicated little (+/- 5%) or no impact is expected. The central estimate for this reduction is, therefore, around 2% when compared to the baseline. This measure is expected to have weakly positive impacts on public authorities as it should reduce administrative burden. As part of the IED revision estimates have been made of the potential impacts for **public authorities** if this measure were implemented for LCPs based on the same assumptions as for operators described above. The extent to which baseline costs for public authorities would be reduced is uncertain. Drawing on the outputs of the TSS, an assumption has been made that savings could range from 0% to 15%, with a central estimate for this reduction of 5%. This would mean that on average over 20 years, savings to public authorities would range between €0 to €1 million each year, with a central estimate of €0.3 million per year. A third of national authorities and a quarter of local authorities responding to the TSS indicated that a 5%-15% decrease in administrative costs could result from the harmonised averaging periods for Chapter II. For public authorities, stakeholder input via the TSS suggests, therefore, that the reduction in administrative burden from these amendments to the IED could range between 0%-15% of the permit review costs when compared to the baseline, whilst the majority of stakeholders have indicated little (+/- 5%) or no impact is expected. The central estimate for this reduction is, therefore, around 5% when compared to the baseline. No quantitative estimate has been made for waste (co-)incinerators. **Operating costs and conduct of business:** This measure is likely to lead to limited to no impacts on the costs of doing business, as no substantial changes in the operation and or

Criteria	Qualitative assessment	Commentary
		investment decisions of operators or other businesses would be expected as a result of this measure. **Competitiveness of business:** This measure is likely to lead to limited to no impacts on competitiveness, and a weakly positive impact on levelling the playing field by ensuring approaches and associated administrative costs for operators are similar. **Position of SMEs:** no specific impacts for SMEs are foreseen. **Innovation and research:** no specific impacts for innovation and research are foreseen. **Public authority impacts:** the primary impacts for public authorities are as described under administrative costs above.
Environmental outcome	Weakly negative	The environmental impacts of the measure are likely to be limited, although they remain uncertain. The primary aim of this measure is to improve the efficiency of the compliance assessment processes, whilst the ambition of these processes will remain as is. Unifying averaging periods may have some impacts on air quality due to longer averaging periods being more tolerant of periods of elevated emissions. Should the use of the Annex V and VI ELVs as a safety net only be retained for those installations that have secured derogation(s) from the Chapter II requirements (i.e. Annex V and VI ELVs would not apply to installations that have not received a derogation) this does potentially increase the risk of elevated air quality impacts over shorter duration averaging periods. For example, a 250 MWth coal-fired power station operating with hourly averaged NOx emissions of 450 mg/Nm3 for 5% of the year and hourly averaged emissions of 170 mg/Nm3 for the remaining 95% of the time. The annual average level of emission (184 mg/Nm3) would be compliant with the Chapter II annual average BAT-AEL (200 mg/Nm3) but would exceed the Annex V hourly average ELV (400 mg/Nm3). However, as both averaging periods are required for compliance assessment currently, it is not expected that changes will lead to a change in environmental performance.
Extent to which the issue is addressed	Strongly positive	The introduction of a provision in Chapter II of the IED that sets out that the compliance assessment rules for Chapter II installations take precedent over other compliance assessment provisions for those installations would remove the issues current encountered in relation to assessing compliance against ELVs in Annexes V and VI and with the BAT-AELs.
Political feasibility / acceptance	Neutral	The overall acceptability of -and desire for – such a change will likely vary both between and within different stakeholder types (e.g. Member State competent authorities and industry). The majority of stakeholders that participated in the TSS indicated that there would be little or no impacts on the environment from the harmonisation of averaging periods that would take precedence as a result of the proposed measure. 97% of industry stakeholders who responded to this question indicated that there would be +/-5%, i.e. little or no impact, of harmonising averaging periods.
Technical feasibility	Strongly positive	No technical issues are foreseen with implementing such a provision.
Coherence	Strongly positive	Such a provision would improve coherence within the Directive and remove some of the challenges that have been faced.

Criteria	Qualitative assessment	Commentary
Proportionality	Strongly positive	As the issue relates to the requirements of the IED for some installations to have to comply with both the BAT Conclusions and the ELVs in Annexes V and VI, the inclusion of such a provision to address the issue within the IED is considered appropriate.

4.4.5 Addressing measurement uncertainty in compliance assessment for LCPs and waste (co)-incinerators

As set out above in Section 4.4.1, Option #02 would involve the introduction of compliance assessment rules for Chapter II installations. It will be important these changes do not result in inconsistency in application of compliance assessment for Chapter III and Chapter IV installations. Furthermore, from a review of Member State approaches it is clear that some Member States apply the maximum expanded uncertainty levels from Annexes V and VI for LCPs and waste (co)-incinerators when assessing compliance with the IED ELVs rather than the actual measurement uncertainty. The rules to be introduced in Chapter II on how to take measurement uncertainty into account could remain independent of the requirements in Chapters III and IV or could also apply to Chapters III and IV thus clarifying how to interpret and use the maximum measurement uncertainties in Annexes V and VI. The option considered for addressing this issue is as follows:

- **Option #09: Option #02 plus a provision in Chapter II of the IED that sets out rules related to measurement uncertainty that should also apply to Chapters III and IV.**

Option #09 could be implemented in conjunction with Option #02 and include provisions within the IED on tackling interactions between chapters II and III/IV just focused on how measurement uncertainty should be taken into account i.e. the actual measurement uncertainty should be applied (essentially a lighter touch approach to tackling interactions between Chapter II and III and IV than option #07 described in the previous section).

The most logical method of implementing this option would be to introduce a minor amendment to point 10 of Part 3 in Annex V, and a similar amendment to point 1.2 of Part 8 of Annex VI.

In addition (or alternatively), the new or revised article proposed in Option #02 for Chapter II could be expanded to explain that the compliance assessment rules for Chapter II installations should also be applied for compliance assessment for Chapters III and IV.

An assessment of the potential implications of this option is provided in the table below.

Table 23: Assessment of option #09 to introduce a provision in Chapter II of the IED (alongside Option #02) that sets out that the compliance assessment rules for Chapter II installations in relation to measurement uncertainty should also be applied for compliance assessment for Chapters III and IV

Criteria	Qualitative assessment	Commentary
Economic impacts	Weakly negative	Implementation of common rules for compliance assessment in relation to measurement uncertainty for Chapter III and IV installations (in line with those that would potentially apply for Chapter II installations) would only impact on those Member States who currently take a different approach i.e. those that allow for the subtraction of the maximum measurement uncertainty from Annexes V and VI from the measured values. For those Member States where a change in such rules would have an impact, the following economic impacts may be realised.

Criteria	Qualitative assessment	Commentary
		Administrative costs: a change in how measurement uncertainty is applied for Chapter III and IV installations may require changes in national (regional and/or local) legislation, guidelines and/or general binding rules. The burden of such a change is expected to be limited (some time for updating the documentation, engaging with stakeholders etc.). The primary impacts could relate to any changes required to individual permits to reflect the new rules. Whilst in some Member States changes at a permit level may not be required (as such a change would be captured in legislation etc.), in others there may need to be an update which would incur both competent authority and operator time to process the update. This would lead to a weakly negative impact on administrative costs. **Operating costs and conduct of business:** the potential impacts on operating costs will vary considerably between installations and Member States depending on how close they are currently operating to the ELVs in their permits i.e. if a change in the rules would subsequently lead to an operator being in non-compliance with one or more ELVs. In such cases, then the operator may be required to take additional actions to reduce emissions to stay in compliance. This could incur significant costs if new abatement equipment were to be required although in practice it is more likely that less costly process changes and/or changes to existing abatement equipment could be sufficient to reduce emissions to the requisite levels. The overall impacts are highly uncertain but would be expected to lead to a weakly negative impact on operating costs overall. **Competitiveness of business:** introducing such rules for compliance assessment should contribute towards a more level playing field for LCPs and waste (co-)incinerators across the EU and therefore have a weakly positive impact on competitiveness within the EU. Competitiveness in the global context may be negatively affected for some operators, as there may be additional costs if further measures to meet emission limits based on the revised compliance assessment procedure are required. **Position of SMEs:** no specific impacts for SMEs are foreseen with a change in the rules for compliance assessment, not least as for LCPs and waste (co-)incinerators there are very limited numbers of SMEs included within the scope of the Directive. **Innovation and research:** no specific impacts for innovation and research are foreseen. **Public authority impacts:** the primary impacts for public authorities are as described under administrative costs above.
Environmental outcome	Weakly positive	**Climate**: the introduction of such rules is unlikely to impact specifically on climate although could indirectly result in energy and resource efficiency improvements for some plants (but such impacts would be very specific to individual plants, their circumstances, actions that might be required if non-compliant etc.). Overall impacts for climate are expected to be neutral. **Air quality**: the introduction of such rules should lead to reductions in emissions for some LCPs and/or waste (co-)incinerators in those Member States where more lenient rules apply (i.e. where maximum levels of uncertainty can be subtracted and a change in rules requires operators to take further actions to abate emissions). Overall impacts for air quality are expected to be weakly positive. **Water quality and resources:** the introduction of such rules should lead to reductions in emissions for some LCPs and/or waste (co-)incinerators in those Member States where more lenient rules apply (i.e. where maximum levels of uncertainty can be subtracted and a change in rules requires operators to take further actions to abate emissions). Overall impacts for water quality are expected to be weakly positive.

Criteria	Qualitative assessment	Commentary
		Soil quality or resources: the introduction of such rules is unlikely to impact specifically on soil quality or resources. Overall impacts for soil quality or resources are expected to be neutral. **Waste production, generation and recycling / Efficient use of resources:** the introduction of such rules is unlikely to impact specifically on waste and resources although could indirectly result in resource efficiency improvements for some LCPs and/or waste (co-)incinerators (but such impacts would be very specific to individual plants, their circumstances, actions that might be required if non-compliant etc.). Overall impacts for waste and resources are expected to be neutral.
Extent to which the issue is addressed	Strongly positive	The introduction of such a provision would provide strong legal certainty to Member States and operators. This should help to ensure a more level playing field in relation to compliance assessment, certainly much more so than if only guidance were to be published.
Political feasibility / acceptance	Neutral	The overall acceptability of -and desire for – such a change will likely vary significantly between different stakeholder types (e.g. Member State competent authorities vs industry). The level of acceptability will vary between Member States depending on the approaches they currently employ. Those that take a more stringent approach and only allow for the subtraction of the measurement uncertainty of the monitoring equipment (or not at all) are likely to be highly supportive whereas those that take a more lenient approach and allow for the maximum uncertainty to be subtracted less so.
Technical feasibility	Strongly positive	The introduction of such rules should be relatively straight forward in that uncertainty levels can be established as part of the periodic or continuous monitoring e.g. by the equipment supplier and/or accredited company performing the periodic emissions test or calibration of continuous monitoring equipment. Based on discussions with the CEN/TC 264 working group, and based on the survey responses, it is understood a similar procedure is already in place in Germany for quantifying measurement uncertainty from continuous monitoring where annual tests are performed to quantify the uncertainty in the continuous monitoring system.
Coherence	Strongly positive	Such an approach would tackle the coherence issues that currently exist with compliance assessment between Chapter II and III/IV.
Proportionality	Strongly positive	The option is aimed at addressing a gap in the IED which has been confirmed as part of the 2020 IED evaluation and subsequent support studies. EU action is required to ensure consistent and timely implementation across the EU. An amendment to the IED is the most appropriate mechanism for implementing such rules and would ensure coherence if Option #02 were to be taken forward.

4.5 Summary

The table on the following page provides a summary of the options described and assessed in the previous sections. The three options considered most beneficial from an environmental perspective are options #02 (introduction of compliance assessment rules for Chapter II installations), #05 (including key principles in the IED for defining and minimising start-up and shut-down and OTNOC periods) and #09 (extending Chapter II rules related to measurement uncertainty to Chapters III and IV). Options #02 and #09 are also considered positive from a technical feasibility, coherence and proportionality perspective. The same is true for Option #07 (option #02 plus compliance assessment rules for Chapter II installations taking precedent over other compliance

assessment provisions); however, unlike Options #02 and #09, there is a potential weakly negative environmental outcome (risk) associated with Option #07.

Table 24: Summary of options

Option	Economic impacts	Environmental outcome	Extent to which issue is addressed	Political feasibility / acceptance	Technical feasibility	Coherence	Proportionality
Option #01: Introduce guidance on how compliance assessment should be undertaken including how measurement uncertainty should be taken into account.	Considering the potential scale and importance of the issue, a non-legislative option (i.e. guidance to clarify compliance assessment) is not considered realistic as it would not provide any certainty that it would lead to improvements and consistency across the EU. Therefore Option #01 was not assessed further.						
Option #02: Introduction of a specific article (or revised article) in Chapter II of the IED that sets out compliance assessment rules supplemented with further detail in implementing acts.	Weakly negative	Weakly positive	Strongly positive	Neutral	Strongly positive	Strongly positive	Strongly positive
Option #03: Review and revision of measurement standards and their subsequent application across the EU	Option not assessed as this is already ongoing. No further actions are required at this stage although further guidance, support or investment may be required in the future to support its application.						
Option #04 to define NOC/OTNOC/EOT in more detail for LCPs, waste (co)-incinerators and/or other sectors in the IED and delegated or implementing acts.	Option #04 has been screened out and not assessed as it would entail a significant amount of work to be able to develop definitions for NOC and OTNOC for key sectors within the IED and is not considered feasible or realistic to do so and include within the IED and delegated or implementing acts at this stage. There is significant complexity and variation both within and between sectors and the IED itself is not considered the right place for its inclusion.						
Option #05 to define the key principles in the IED for defining and minimising start-up and shut-down and OTNOC periods with NOC/OTNOC/EOT to be defined for each sector in the BREFs as they are reviewed in the future.	Unclear impacts	Weakly positive	Weakly positive	Neutral	Weakly negative	Neutral	Weakly negative
Option #06: Development of guidance/ toolkit to support conversion between different averaging periods.	Neutral	Neutral	Weakly negative	Weakly positive	Strongly positive	Weakly positive	Strongly positive

Option	Economic impacts	Environmental outcome	Extent to which issue is addressed	Political feasibility / acceptance	Technical feasibility	Coherence	Proportionality
Option #07: Option #02 plus additional provisions in Chapter II of the IED that sets out compliance assessment rules for Chapter II installations take precedent over other compliance assessment provisions for those installations.	Weakly positive	Weakly negative	Strongly positive	Neutral	Strongly positive	Strongly positive	Strongly positive
Option #08: Harmonisation of averaging periods.	Option is not considered realistic for the following reasons (and has not been assessed further): • Aligning the averaging periods removes the value that the Annex V and VI ELVs provides as the BAT-AELs in the LCP and WI BAT Conclusions are typically more stringent. • Member State competent authorities have implemented these requirements in operator permits and operators will have had to achieve compliance for some time already. • Removing the shorter term averaging periods would remove the safety net that they provide for preventing short term spikes in emissions.						
Option #09: Option #02 plus a provision in Chapter II of the IED that sets outs rules related to measurement uncertainty that should also apply to Chapters III and IV.	Weakly negative	Weakly positive	Strongly positive	Neutral	Strongly positive	Strongly positive	Strongly positive

Annex 1 IED provisions

See separate file.

Annex 2 Member State data collection proforma

See separate file.

Annex 3 Member State profiles

See separate files.