European Union Network for the Implementation and Enforcement of Environmental Law

STRATEGIES FOR VERIFICATION OF SELF-MONITORING AND REPORTING ON AIR EMISSIONS WORKSHOP

28 September and 11 October 2021

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Introduction to IMPEL

The European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL) is an international non-profit association of the environmental authorities of the EU Member States, acceding and candidate countries of the European Union and European Economic Area (EEA) countries. The association is registered in Belgium and its legal seat is in Brussels, Belgium.

IMPEL was set up in 1992 as an informal Network of European regulators and authorities concerned with the implementation and enforcement of environmental law. The Network's objective is to create the necessary impetus in the European Community to make progress on ensuring a more effective application of environmental legislation. The core of the IMPEL activities concerns awareness raising, capacity building and exchange of information and experiences on implementation, enforcement and international enforcement collaboration as well as promoting and supporting the practicability and enforceability of European environmental legislation.

During the previous years IMPEL has developed into a considerable, widely known organisation, being mentioned in a number of EU legislative and policy documents, e.g. the 7th Environment Action Programme and the Recommendation on Minimum Criteria for Environmental Inspections, and more recently and more recently in the General Union Environment Action Programme to 2030 and EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil'.

The expertise and experience of the participants within IMPEL make the network uniquely qualified to work on both technical and regulatory aspects of EU environmental legislation.

Information on the IMPEL Network is also available through its website at: www.impel.eu

Title of the report: Strategies for verification of self–monitoring and reporting (Air emissions workshop)	**Number report:** 2021/01-WG6
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Executive Summary

Environmental Compliance and Governance, an Initiative from the European Commission includes in its work programme 2020-2022 among the "Actions for the practitioners' networks with the Commission and the EU Member States", Action n.9: Strategies for verification of self – monitoring and reporting, to be leaded by IMPEL. This action aims at exploring, supporting and further strengthening mechanisms and methods to optimise the informed use of self-monitoring data from duty-holders, as a fundamental step in assuring environmental compliance by Member State authorities, together with permitting, surveillance, inspection and enforcement.

Online Workshop on Operator self-monitoring air emissions was held on 28th September and 11th October 2021 (Agenda and Presentation in Annex I; Summary of the results of the survey in Annex I), as part of the IMPEL Project Supporting IED Implementation 2021-2024, jointly organised by ARPA Sardegna (Italy) and IGAMAOT (Portugal). The workshop focused on Operator self-monitoring, on air emissions, continuous and non-continuous, in particular on the reliability of self-monitoring and its reporting by operators (duty-holders).

Self-monitoring and reporting should be used more effectively to improve the environment, inspections and ensure a more robust compliance chain. The project will continue in 2022 so participants were encouraged to email the project team if they wished to be involved in these activities.

Disclaimer

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1. INTRODUCTION

The Environmental Compliance and Governance, an Initiative from the European Commission includes in its work programme 2020-2022 among the "Actions for the practitioners networks with the Commission and the EU Member States", Action n.9: Strategies for verification of self – monitoring and reporting, to be leaded by IMPEL. This action aims at exploring, supporting and further strengthening mechanisms and methods to optimise the informed use of self-monitoring data from duty-holders, as a fundamental step in assuring environmental compliance by Member State authorities, together with permitting, surveillance, inspection and enforcement.

A credible self-monitoring scheme would decrease burdens of inspection, improve chances for a swift detection of breaches and thus help to limit environmental damages making authorities action more efficient. Timely and effective data evaluation by competent authorities, permitters and inspectors could lead to targeted action, to ensure correction, prevention and sanctioning of offences, but also revisions, suspensions and revocations of permits.

Self-monitoring and reporting are already in legislation and should be used more effectively in compliance monitoring and assessment, for the benefit of a better environment and to support authorities for a more robust compliance chain. A reliable self-monitoring scheme from sampling to its analysis and reporting decreases burden of inspection. Timely and effectively data evaluation by competent authorities (permitters and inspectors) can lead to targeted action to ensure correction, prevention and sanctioning of offences. It is necessary for a better environmental, in the present case air quality, but also to ensure fair competition between operators.

The Best Available Techniques (BAT) reference documents (BREFs) put focus on self-monitoring and reporting. The inclusion of Action 9 (ECA) dedicated to operator self-monitoring is a very important step.

The informed use of self-monitoring data is an important tool for environmental compliance monitoring which can help improve efficiency in compliance assurance. The use of this data for inspections is referred to in several directives (e.g. Industrial Emissions Directive (IED), Waste Framework Directive). The Recommendation of minimum criteria for environmental inspections and several IMPEL works (on operator self-monitoring and "Doing the Right Things for IED Permitting and Inspections") recognise its potential use; while the IMPEL Survey on practitioners' views about implementation challenges points out issues and challenges

This is not the first time IMPEL is working on this issue. Two other dedicated reports were published previously:

- IMPEL report on Operator Self-Monitoring. February 1999
- IMPEL report on Supporting Implementation of the Industrial Emissions Directive. October 2016

The drivers of the work of this subgroup are:

- Rules and procedures used or proposed to transfer self-monitoring data to competent authorities and from competent authorities to inspectors;
- General quality criteria for the generation, aggregation and verification of such data on the suppliers (duty holders) side, including on representative samples and laboratories´ methods and standards and intercalibration;
- General criteria on reception, processing, evaluating and verifying data on the competent authority's side and communication of results to duty holders, including how to deal with (potential) detected non compliances, their prevention and correction and sanctioning of offences.

2. WORKSHOP

An online Workshop on Operator self-monitoring air emissions was held on 28th September and 11th October 2021 (Agenda in Annex I), as part of the IMPEL Project Supporting IED Implementation 2021-2024, jointly organised by ARPA Sardegna (Italy) and IGAMAOT (Portugal). The workshop focused on Operator self-monitoring, on air emissions, continuous and non-continuous, in particular on the reliability of self-monitoring and its reporting by operators (duty-holders).

The workshop had 138 registered participants from 25 countries and was attended by representatives from National and Regional Environmental Agencies, National and Regional Environmental Inspectorates, Ministry of Environment, Environmental Polices, Public Prosecutors, University and Hidrometeorological Services. It had speeches and presentations from IMPEL, European Commission – DG ENV (Directorate - General for Environment) and EIPPC Bureau (European Integrated Pollution Prevention and Control Bureau), OECD (Organisation for Economic Co-operation and Development), INECE (The International Network for Environmental Compliance and Enforcement), and Experts from Austria, Chile, Croatia, Finland, Germany, Italy, and Portugal.

In the following sections there is a summary of the content presentations from the workshop on self-monitoring of air emissions.

Session 1: Self-monitoring and reporting on air emissions: legislative and regulatory aspects

The first presentation from the **Portuguese Environment Agency** was on the Portuguese current legislation on air emissions is based on the transposition of Directive (EU) 2015/2193 of the European Parliament and of the Council of 25 November 2015 on the limitation of emissions of certain pollutants into the air from medium combustion plants. Portugal put it together with some other rules applicable for air emission sources. In Figure 1.1 we can see the main Portuguese legislation related on air emissions.

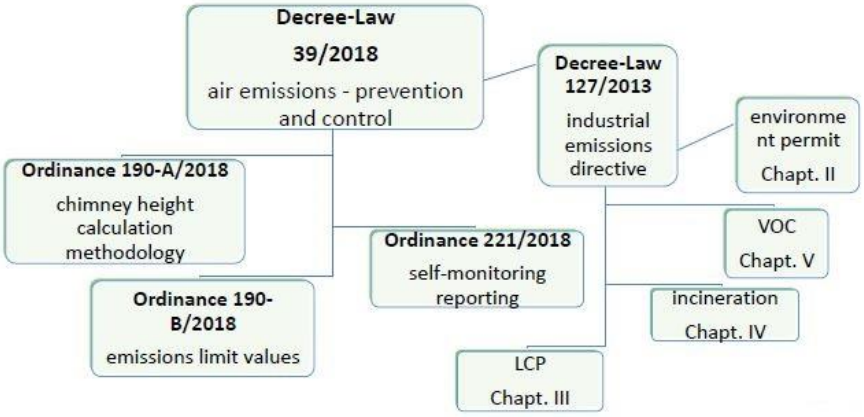

Figure 1.1 - Portuguese legislation on air emissions (Credit: APA)

The aim of the decree law is the establishment of an air emissions permit – the decision that allows the operation of activities with significant air emissions, as a part of the single environmental permit. There is an electronic platform (Figure 1.2) to support the permitting procedures.

The Single Environmental Permit (LUA) regime was designed to simplify, harmonize and articulate the various licensing regimes in the environmental field. This regime translates into a procedure for issuing a Single Environmental Title (TUA), which is a single title where all environmental licensing decisions are registered, condensing all the information on the environmental requirements applicable to the establishment, activity or project.

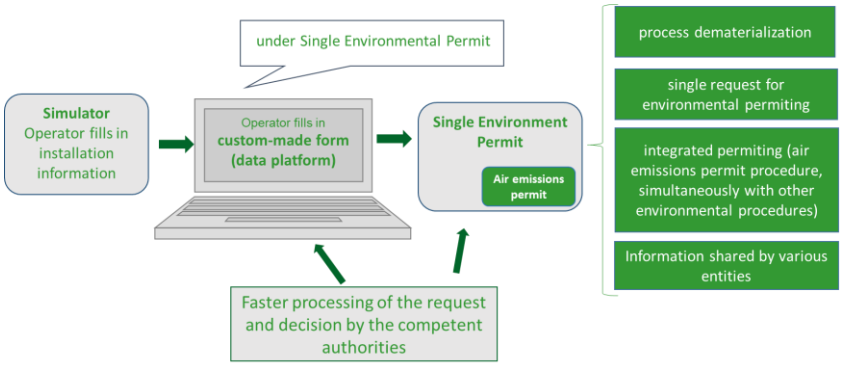

Figure 1.2 - Dematerialized permitting platform (Single Environment Permit – LUA) (Credit: APA)

Self-monitoring of the emissions subjected to Emission Limit Values (ELV) is mandatory and it is the responsibility of the operator. The rules that are applicable are listed in the permit. The specific rules depend on the characteristics of the installation such as the processes, equipment, raw materials, fuels. Monitoring regime depends on mass flow of the emissions (Figure 1.3). If there is continuous measurement, then Portuguese Environmental Agency (APA) is responsible for analysing the results, for other installations, with only periodic measurement (usually twice a year) the regional entities (CCDR) have this responsibility.

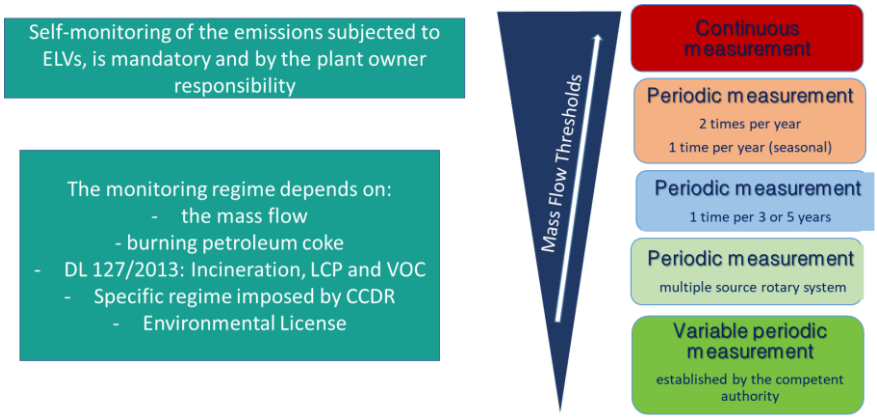

Figure 1.3 - Measurement Frequency (Credit: APA)

Ordinance 221/2018 determines the conditions for Operators on reporting of emissions. There are different rules for periodic and continuous monitoring.

For continuous monitoring, the data acquisition systems (Figure 1.4) collect the information produced by the measuring equipment that must have a consultation interval for these sensors equal to or less than 1 minute.

Data processing software is designed to handle information complying with reporting requirements: Conversion of the electrical signals into air emissions concentration values, conversion to Standard Temperature and Pression (STP) conditions and O_2 reference content, uncertainty correction and statistical validation.

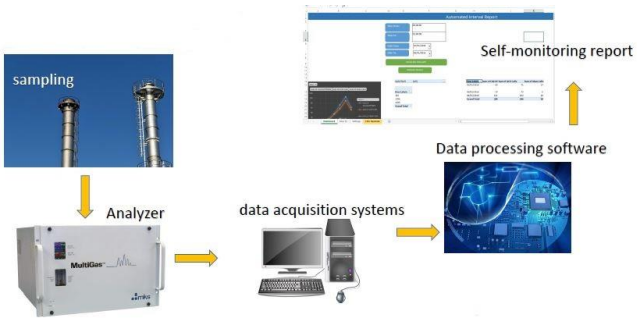

Figure 1.4 - Data acquisition systems (Credit: APA)

Calibration is an important issue in self-monitoring. The European Standard (EN 14181 - Stationary source emissions - Quality assurance of automated measuring systems) that defines the rules for the calibration of these kinds of systems (Figure 1.5), with quality assurance levels and annual surveillance test (AST):

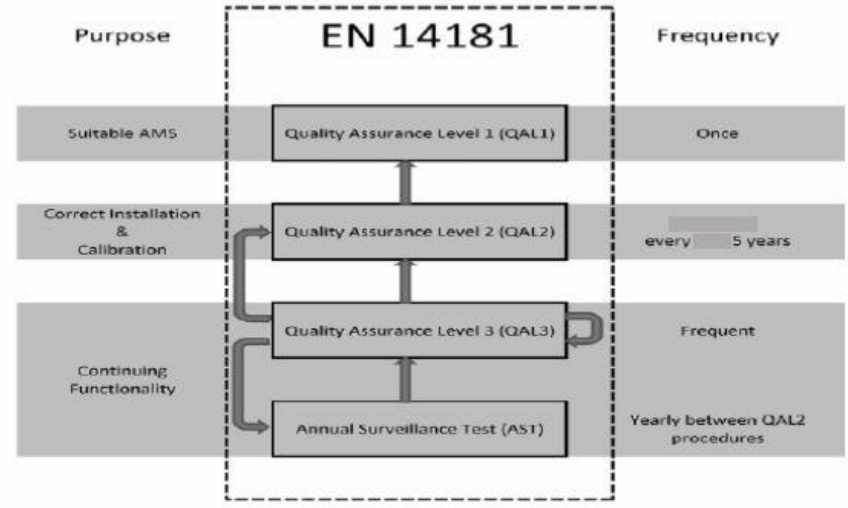

Figure 1.5 - EN 14181 (Credit: APA)

When continuous monitoring system breaks down or is under maintenance, there is a limit for hours for these circumstances: A valid daily average value has no more than three hourly average values excluded on the same day due to measuring system malfunction/maintenance, and no more than 10 days in a year.

Some remarks regarding self-monitoring in Portugal:

- Monitoring data is used not only to control companies' performance but also for managing risks and accidents;
- The obtained information is relevant for the improvement of pollutant emission estimates for national and regional inventories and to the PRTR -Pollutant Release and Transfer Register;
- The measured data from emission sources are necessary inputs to the atmospheric dispersion and air quality assessment models used in the management processes like municipal plans and actions.

Next steps are:

- Development of a module for continuous monitoring data management with raw data provided by data acquisition systems with specific rules for data validation procedures;
- Integrated assessment of all provided information by the data platform, then sent to the competent and supervisory entities.

The second presentation focused on the **Sevilla Process of European IPPC Bureau (EIPPCB)**, established in 1997 and steers the information exchange between stakeholders to draw up/review Best Available Techniques (BAT) reference documents (BREFs). Sevilla Process is an evidence-based process (Figure 1.6). The BREFs produced by the European IPPC Bureau cover large-scale agro-industrial activities included in Annex I to the Industrial Emissions Directive (2010/75/EU) (IED), i.e. some 52 000 installations EU-wide. Each BREF contains a specific chapter on BAT conclusions, which comprise a short description of the best available techniques identified, their applicability and associated emission or consumption levels. BAT conclusions are subsequently adopted by a Committee procedure and published in the Official Journal of the European Union. They provide the reference for setting emission limit values and issuing operating permits for industrial installations in EU Member States. The Process is as follows:

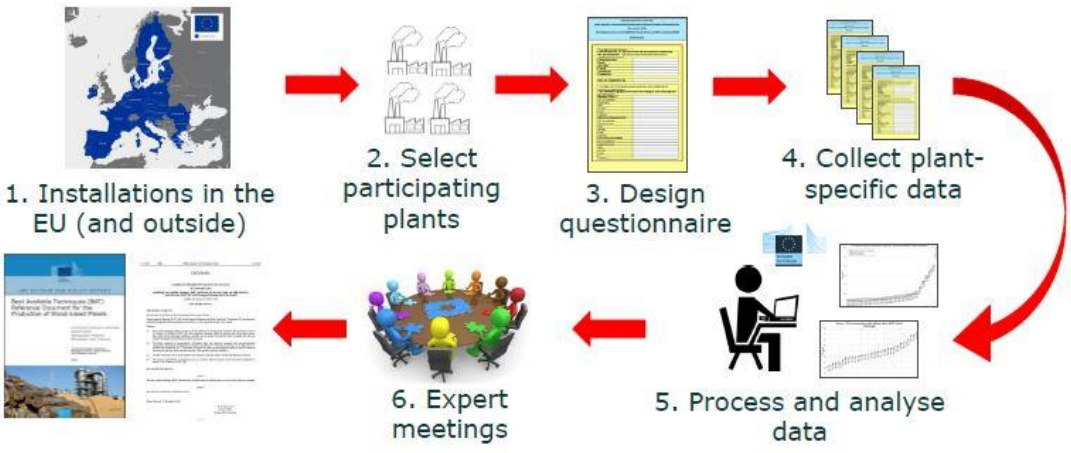

Figure 1.6 - Sevilla Process of EIPPCB (Credit: EIPPC Bureau)

Monitoring data is very important. Following information is collected during the Sevilla process: frequency of measurements, standard method used, sampling period etc. EIPPCB was, at the time of the workshop, working on 8 BREFs, as shown in Table 1.1.

Table 1.1 - BREFs – State of play (October 2021)

BREF	State of play
Ferrous Metals Processing Industry	Final meeting – November 2020-February 2021
Textiles Industry	Final meeting – May-June 2021
Common Waste Gas Management and Treatment Systems in the Chemical Sector	Final meeting – June-July 2021
Slaughterhouses an Animals By-products Industries	Draft 1 – June 2021
Smitheries and Foundries Industry	Draft 1 expected – Q4 2021
Ceramic Manufacturing Industry	Kick-off Meeting – February 2021
Surface Treatment of Metals and Plastics	Reactivation Technical Working Group – June 2021
Large Volume Inorganic Chemicals	Activation foreseen – Q4 2021

There are some challenges faced during Sevilla Process with respect to monitoring, namely:

- BAT-Associated Emission Levels (BAT-AELs) - parameters without EN monitoring standards (e.g. phenol, formaldehyde);
- Applicability and performance of monitoring standards, e.g. with regard to the measurement uncertainty.

Industrial Emissions Directive (EID) states the following:

- Information exchange to draw up/review BAT reference documents (Art.13(1));
- Describe BAT, associated emissions performance, reference conditions and monitoring (Art.13(2));
- Permits shall contain monitoring requirements, specifying measurement methodology, frequency, and evaluation procedure (Art.14(1c,d));
- BAT conclusions on monitoring are the basis for monitoring requirements in permits (Art.16(1));
- Competent authorities to make available results of emission monitoring (Art. 24(3b)).

Monitoring provisions, also in BAT conclusions, were detailed in the presentation, as the reference for defining monitoring requirements in permits, and include:

- General requirements (e.g. Environmental Management Systems (EMS), operation other than normal operating conditions (OTNOC), processes, consumptions);
- General considerations (e.g. reference conditions, type of measurement, averaging period)

- Definition of pollutants;
- Monitoring channelled emissions to air (e.g. pollutants, standards, processes, frequencies)
- BAT-associated emission levels (BAT-AEL);
- Sector- and pollutant-specific requirements;
- Reference Report on Monitoring provides guidance.

The Joint Research Centre from the European Commission (JRC) published a Reference Report on Monitoring of Emissions to Air and Water from IED Installations, in 2018, which aims to:

- informs competent authorities and operators on monitoring of emissions from IED installations;
- informs Technical Working Groups on the monitoring of emissions for the development of BREFs and related BAT conclusions;
- summarises available information on key issues and relevant European standards.

This Report covers general aspects of monitoring, e.g.:

- Monitoring objectives; general information on direct and indirect measurement methods, monitoring frequency, costs;
- Quality assurance and data treatment (averaging, measurement uncertainty, outlier, limits of detection and quantification, reference conditions);
- Monitoring of normal and other than normal operating conditions;
- Air pollutants, relevant EN / ISO and other standards, continuous and periodic measurements;
- Indirect methods, monitoring of diffuse emissions and odour.

The third presentation, from **OECD**, stated the increasing number of countries use BAT as a tool to establish evidence-based environmental permit conditions for industrial installations, in order to prevent and control industrial pollution, and thus to ensure a high level of human health and environmental protection. BAT are state-of-the-art techniques that are developed at a scale that enables implementation under economically and technically viable conditions.

Countries spend significant resources on designing, developing and implementing policies for BAT-based permitting. Therefore, there is an added value in sharing experience, knowledge and best practices on this topic amongst OECD member and partner countries.

The OECD report on *Value chain approaches to determining Best Available Techniques (BAT) for industrial installations* demonstrates that more systematic consideration of value chain aspects in the BAT determination process can help mitigate overall environmental impacts.

The objectives of OECD's Best Available Techniques (BAT) Project are:

- Exchange best practices across countries that already have a BAT-based permitting system
- Provide guidance to countries that seek to adopt a BAT-based approach for the first time

- Achieve progress towards the SDGs, notably Target 12.4 on the environmentally sound management of chemicals

The first phase of the project started in 2016 and ended in 2020. The project has delivered four reports till 2020 (Figure 1.7). Here are the deliverables of the project:

- Activity 1: Policies on BAT or Similar Concepts Across the World, 2017;
- Activity 2: Approaches to Establishing BAT Around the World, 2018;
- Activity 3: Measuring the Effectiveness of BAT Policies, 2019;
- Activity 4: Determining BAT, BAT-AEPL and BAT-Based Permit Conditions, 2020;

And, more recently,

- Activity 5: Value chain approaches to determining Best Available Techniques (BAT) for industrial installations, 2022.

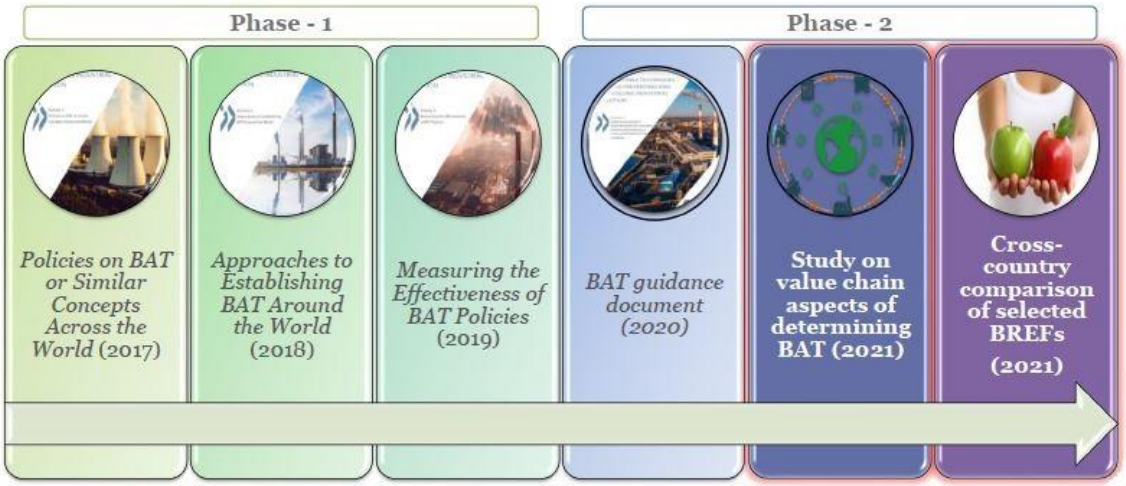

Figure 1.7 - Deliverables of the project (Credit: OECD)

Activity 6 of the project is the cross-country comparison of BREFs. BATs and BAT-AELs across those countries are compared in this activity. Thermal power plants, cement manufacturing and textile were selected for the study. The scope of the study is coal and gas-fuelled installations for thermal power plants focusing on emissions to air (Nitrogen Oxides (NO_X), Sulfur Oxides (SO_X), Mercury, Particulate Matter (PM)). The focus for cement manufacturing installations is also on their air emissions (NO_X, SO_X, PM). 6 BREFs are being assessed. Information on Carbon Dioxide emissions is also collected for both sectors. This information will also be included in the report.

Figure 1.8 explains the Comparison criteria, used in BREF issues, BAT Techniques and Emission and Performance levels. BAT are the state-of-the-art and proved techniques for preventing and controlling

industrial emissions and the wider environmental impact caused by industrial installations. The BAT concept has evolved as one of the key elements (KEIs) for setting emission limit values (ELVs) and other permit conditions in environmental permits for the installations.

Figure 1.8 - Comparison criteria (Credit: OECD)

Monitoring is one of the technical BATs being implemented in other than European countries. However, this is not included in all the BREFs as a major criterion.

Session 2: Self-monitoring and reporting on air emissions: Good Practices and Bottlenecks

The first presentation was from CCDR, **Portuguese Alentejo Region,** where pollution related to Volatile Organic Compounds (VOC), Particles/ odour is very significant in specific areas, mainly due to activities of extracting oil from olive pomace. There is no specific legislation on odour in Portugal. In the region there are many complaints due to odour. In contrast to other air pollutants, odours can be very difficult to measure.

The complaints presented at CCDR Alentejo are not limited to the populations that live near the activities of extracting oil from olive pomace. Complaints from neighbouring municipalities are also received. This demonstrates that the emissions travel many kilometres and affect many populations.

There is a set of variables that influence the ability to smell odours:

- The distance at which the emitting source is located in relation to population agglomerates,
- The existence of physical obstacles that counteract its dispersion,
- The typical atmospheric conditions of the place and those that occur punctually.

Recurrently, the results of the atmospheric emission self-control reports are within the legal limits:

- the concentration values of the pollutants Particles, NOx and Volatile Organic Compounds (VOC) are lower than the respective Emission Limit Values (ELV) provided for in national Ordinance No. 190-B/2018, of 2 July;
- in the values of the observed mass flow rates, when compared with the values set out in national Decree-Law No. 39/2018, it is verified:
    - Particles and NOx pollutants lie between the respective mean and maximum mass thresholds;
    - the CO pollutant lies between the respective minimum and average mass thresholds.
    - the pollutant VOC is below the respective minimum mass threshold established
- When measured within localities, the average daily concentration of PM10 was never higher than the daily limit value established by law.

In the future, cleaner solutions will have to be found for the oil extraction industry, which respect the rights of the populations, and which are at the same time economically viable.

The second presentation, from CCDR, **Portuguese Center region, that** covers an area of 28,405 km^2 and includes 77 municipalities. There are 1716 installations in the region. The type of installations in the region are very diverse, and include glass, cement, ceramics and metals.

There is an informatic system, a database that is used to manage and store all the information on air emissions from this region and was developed by CCDR-Centro. Each industry has an individual process in the system, that enables the management, control and evaluation of each installation and respective stack emissions. Furthermore, it enables the following functionalities:

- warnings whenever a specific pollutant concentration is above its Emission Limit Value and when it is not compliant with its monitoring frequency;
- the possibility to make notice reports when an infringement is detected;
- the production of the annual regional atmospheric emissions inventory;
- consistency verification of the stack emissions periodic monitoring reports;
- control and assess the installations covered by Chapter V of IED (installations and activities using organic solvents) of the Industrial Emissions Directive.

In national terms, the main challenges are:

- all measurements should be done with accredited laboratories, but the quality, representativeness and accuracy of the samples is sometimes a problem, so as ensuring measurements according to European norms.
- ensuring harmonized procedures in five regions. There are operators which have installations in two different regions and their requirements are different. The national management system, has been a bottleneck, is being developed and will help the regions to overcome this problem.
- finding specific technical knowledge because it is difficult to find staff to work on this area.

- Good Information and Technology (IT) systems needed to manage all the data collected from installations, which also help authorities with scarce resources.

The presentation of the Finnish experience about self-monitoring and reporting on air emissions, showed 4 permitting authorities and 13 regional supervisory authorities for IED installations, and national legislation, namely on self-monitoring in the Environmental Protection Act (527/2014):

- Section 6 Knowledge requirement: Operators shall have knowledge of the environmental impacts and risks of their operations, and of the management of these impacts and risks and ways to reduce adverse impacts;
- Section 8: the operator shall, prevent environmental pollution by thr the emissions caused by the activity and their impacts are monitored and the authorities are provided with the necessary information about these emissions;
- Principle of caution and care and principle of best environmental practice are taken into account.

The permit includes compliance with regulations on the monitoring of emissions and includes regulations on measurement methods and frequency of measurements. It also specifies how the results of monitoring and control are assessed and submitted to the supervisory authority (Figure 2.1).

At least once a year, the operator shall submit to the supervisory authority the results of emissions monitoring and other information necessary for supervision, as provided by the environmental permit in more detail. The operation in practice works as indicated in the figure.

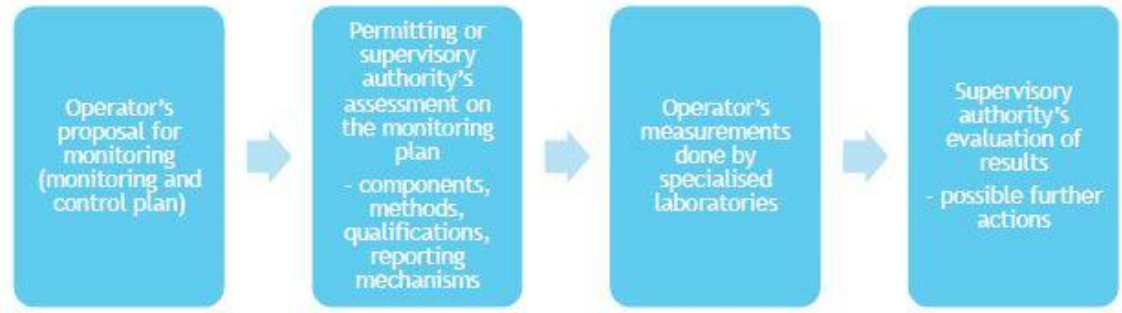

Figure 2.1 - Diagram of the operation in practice (Credits: Finish Environment Ministry)

Most of the installations have their measurements done by specialised laboratories. A few installations have their own measurement teams.

In Finland, all air emission measurements are done by the operators. So self-monitoring principle has been put into practice. This is not the case for monitoring the discharges to water.

Use of accredited methods is a basic requirement. EN standard or at least ISO standards are in use, and the use of national standard is possible, but not common.

Several intercomparison measurement activities took place during past years, and the last one took place in 2019 at a waste incineration plant, and Accredited laboratories could attend these measurements. and VTT Technical Research Centre of Finland provided a calculation exercise for the laboratories in 2019. It is important to mention that processing the results is considered as important as doing the measurement. Operators do their yearly reporting on emissions electronically and the data is stored in a national database. Conclusions show that reporting mechanisms may vary, but supervisory authorities have great confidence in laboratories' measurement results.

Concerning **Continuous Emission Monitoring Systems (CEMS) in Chile**, the Environmental Superintendency of Chile is responsible for promoting compliance, delivering technical guidance, reporting to community, sanctions and control of the environmental regulations. Air quality needs to be improved and to do this, measurements must be done.

Continuous emission monitoring obligations are shown below (Figure 2.2) for different sectors:

Source		Parameter	CEMS
	Cooper melters	SO_2	12
	Power generation	MP, NOx and SO_2	32
	Pulp	H_2S	26
	Incinerators, co-incineration, cement kiln	NOx, SO_2, MP and CO	7
	Others	NOx, SO_2, MP, CO	52

Figure 2.2 - Continuous emission monitoring systems (Credits: Environmental Superintendency of Chile)

It is also important to mention that:

- Distributed Network Protocol 3 (DNP3) connection protocol is used.
- CEMS should pass a two-stage validation process: 1. Initial validation (based on part 75 of Volume 40 of the Code of Federal Regulations (CFR) – US EPA), 2. Routine tests.
- For the installations that don't have an obligation for CEMS such as boilers, turbines, power generators, the goal is to estimate the emissions.
- Data from CEMs is used to evaluate compliance and green tax.

Lessons learnt are:

- Flexible deadlines: It is a big number of different sources, so you have to consider that in your deadline choice (for instance during the pandemic period, the deadline was extended to end of the year);
- Connection Flexibility: In accordance with the different sources, size and production process;

- Technical Flexibility: the solution of the connection is on the company's side;
- Talk to the regulated: several workshops and specific meetings allows to be regulary in contact with the regulated

Session 3: Quality and representativeness of the samplings and analysis/Reliability and reporting of data

The reports for the European Commission on **"Assessment of compliance with Emission Limit Values (ELV) under the IED. Current practices in Europe**" and **"Technical assistance on industrial emissions – online real-time monitoring of industrial emissions"** that cover current practices in EU member states and UK and Norway, were presented.

The reports which aimed to identify good practices and recommendations on compliance assessment, focus in:

- General for all industrial installations (Chapter II IED);
- Large Combustion Plants (LCP) (Chapter III and Annex V IED);
- Waste Incineration (WI) (Chapter IV and Annex VI IED).

The impact of differences in approaches, different application of measurement uncertainty in compliance assessment leads to inconsistent assessment of environmental performance, and in some cases to underestimation of actual emissions.

Different approaches have been adopted in Europe with regard to subtraction of uncertainty from measurements for the purpose of checking compliance with ELV (Figure 3.1):

- Approach A: subtraction of maximum allowed measurement uncertainty (measured value x maximum allowed uncertainty in %) from the measured value;
- Approach B: subtraction of fixed proportion of ELV (ELV x maximum allowed uncertainty in %) from the measured value;
- Approach C: subtraction of the actual measurement uncertainty of the measured value;
- Approach D: no subtraction of uncertainty; validated value = measured value.

For example, on NOx with a 20% confidence interval and ELV = 100 mg/Nm^3

Compliance assessment										
Illustration of impact of differences in approach										
Example for NOx with 20% confidence interval										
	Measured value	90 mg/Nm^3		100 mg/Nm^3		110 mg/Nm^3		120 mg/Nm^3		
	measurement uncertainty	Reported value to assess compliance	Value subtracted	Reported value to assess compliance	Value subtracted	Reported value to assess compliance	Value subtracted	Reported value to assess compliance	Value subtracted	Maximum to comply with ELV
	20% of measured value	72	18	80	20	88	22	96	24	**125**
	20% of ELV	70	20	80	20	90	20	100	20	**120**
	20% of measured value up to ELV, 20% of ELV above it	72	18	80	20	90	20	100	20	**120**
	actual measurement uncertainty (assume 5%)	85.5	4,5	95	5	104.5	5,5	114	6	**105.26**
ELV	100									

Figure 3.1 – Calculation for NOx with a 20% confidence interval and ELV = 100 mg/Nm^3 (Credits: presentation IED evaluation Stakholder Workshop 2019)

Maximum measured emission values to comply with ELV vary a lot with the different approaches.

Other approaches include use of uncertainty intervals only at the prosecution stage to determine if an environmental offence has been committed, the increase of sampling time close to the ELV, the subtraction of the measurement uncertainty only if the measured value is above the ELV or a combined approach. Clarification from the European Commission was provided in a letter that such deduction possibility must be used as restrictive as possible and that the practice of deduction maximum fixed values regardless of the accurateness of the instrument therefore does not sit well with the Directive (https://www.grienlinks.nl/wp-content/uploads/2018/10/Brief-EC-directoraat-milieu-20-07-2017-1.pdf)

Recommendations from the report include using a more uniform approach across Europe, and that validated measured values should be calculated using Approach C: subtracting the actual measurement uncertainty of the measured value.

The results of the report on Online real-time monitoring were also presented.

FINDINGS OF TELEMONITORING REPORT

- Telemonitoring is more advanced in non-European countries;
- Described systems outside the EU: China, India, South Korea, Malaysia, USA;
- Described systems in the EU: Austria (Linz), Croatia, France, Germany, Italy (Lombardy), Spain;
- Different approaches:
    - Approach 1 – periodic manual submission of data (Croatia, Spain (Madrid, Galicia));
    - Approach 2 – periodic automatic submission of data (USA, Spain (Andalusia), Italy (Lombardy));
    - Approach 3 – near real-time periodic automatic submission of data (China, Germany);
    - Approach 4 – fully automated real-time data collection with access to CEMS (India, South Korea, Malysia, Austria (Linz)).

KEY REPORTED DRIVERS AND BENEFITS

- Faster processing of citizens' complaints and better confidence in competent authorities;

- Faster identification of exceedances of emission limit values;
- Easier process in the revision of emission limit values;
- Public access to information;
- Deterring effect for non-compliance;
- Higher quality of industrial emission datasets;
- Streamlining reporting requirements;
- Overall faster decision-making process;
- Lower workload for inspections.

Information on the **approaches used in Croatia regarding accreditation** were highlighted the and the extra confidence and practical benefits that recognised accreditation gives.

The first example focussed on a big petrochemical plant, located in a small town, that has a laboratory accredited for testing properties of technical chemicals, water, waste and testing of ambient air quality and pollution emissions into the air from the stationary sources, including determination of Amonia (NH_3) by spectrophotometry – in-house method accredited, 4 EN standardized methods for other pollutants. There is a local air monitoring station but general public use the monitoring data from the factory as this is well known and reliable. Lessons learnt were identified: company cooperates with local authorities, informs the citizens about production and environmental activities; trust building in local community; raising awareness of citizens; knowledge sharing; building capacities; no complaints.

The second example was a large industrial site that performed wastewater analysis every day, although legal requirements are less stringent (required 4 times a year). An oil spill occurred near the site but the company could demonstrate that it wasn't from their factory due to the monitoring. Lessons learnt were identified: self-monitoring can provide important leverage in process control; costs of analysis are small compared to potential incidents and harms; useful tool for inspection; preservation of water resources.

In some cases insurance companies require additional security mechanisms, which may include additional self-monitoring accredited methods and/or certification systems like EMAS, ISO 14000, OSHAS or other available best practices.

Cooperation and transparency. There is a discussion in Italy about not just accreditation of installations but also other methods and Sandra responded that one accreditation per method could be a good approach.

The **Italian experience on interlaboratory comparisons for air emission measurements** was presented.

ISPRA is part of a network of 21 agencies called the **National System for Environmental Protection (SNPA)** (Figure 3.2)**.** Duties include environmental control and monitoring and support to public administrations.

Figure 3.2 – National System for Environmental Protection (SNPA) (Credits: ISPRA)

There are about 80 laboratories for environmental control in Italy with hundreds of thousands of samples analysed and Millions of measurements providing results that have to be comparable and fit for the purpose. A laboratory has to measure physical and chemical quantities and to provide accurate environmental data reproducible in space and time and Interlaboratory comparison is a key tool for quality control (requested by EN ISO/IEC 17025). Specific examples of technical standards and activities related with intercalibrations, including operating conditions, assigned values, results and performance evaluation were presented.

As conclusions: Definition of a PT protocol for air emission measurement tested in a 2-years PT experimental activity; Systematic annual program of PT reserved to the SNPA labs; Need to improve the definition of the assigned value and progressive revision of the target standard deviation of the PT on the basis of the experiences carried out; More parameters to be tested in the future; Need to evaluate the effect of some interferences (variable operating condition) on the measurement results; Inter Laboratory Comparison (ILC) allow to reduce the influence of non-analytical error (quality control) and to harmonize the implementation of the measurement methods/procedures between the laboratories.

The **activities of the Regional Continuous Emissions Monitoring Systems (CEMS) network and the plants managed by ARPA Lombardia** (Figure 3.3) were presented, namely on the reliability and representativeness of the data and also actions carried out by ARPA Lombardia and owners.

Various plants have access the regional CEMS Network and emissions data is recorded every day and processed. This data provides information on emissions trends in relation to the ELV, mass flows and failures to the plant and purification devices. The data acquisition system requires continuous updating and supervision as it is a dynamic system.

Figure 3.3 - CEMS Network (Credits: ARPA Lombardia)

Multiple factors are: IT security (for data download); signed Acquirer and Data Processor Open Source (AEDOS) files (not to allow any data changes); Specific reference laws (national laws and regional decrees); Data comparison between Regional CEMS network and Owner's CEMS (Very important because it allows to have a reference about the quality of data); Alerts (Download failed and Instrument status).

For the certification that the sample being analysed represents the normal operation conditions there are codes for different conditions defined by regional laws, whose are submitted with the samples.

Session 4: Enforcement of self-monitoring and reporting of air emissions

The **Portuguese enforcement experience related situation on balance between continuous and periodic monitoring** on verifying the reliability of continuous atmospheric emission monitoring systems, was described, including the legal framework and regulation, measurements, methods and measuring systems. Were presented the Portuguese installations that carry out continuous measurements, per activity, pollutant measured and monitoring methods, as well the number and the results (infringements) of the inspections.

Continuous atmospheric emission monitoring systems are of crucial importance because they are applied in facilities that have high emission levels and allows more collected data. However, the useful of the collected data is intrinsically associated with their reliability, constituting the calibration one of the key points of this issue. In this ways, when inspecting facilities that have AMS, we should check whether the installation has adopted following Quality Assurance Levels (QAL).

It was emphasised that it is best practice to assess the overall risk posed by potential emissions from an installation and to match the frequency and scope of monitoring regime to the risk. Was also presented the procedures for *in-situ* and *ex-situ* inspections.

Strategies for **verification of self-monitoring and reporting on air emissions in Italy,** include an annual report of inspections in Italy which showed just over 32% of installations had inspections for IED and Environmental Impact Assessment (EIA). Therefore, it was clear other approaches needed to be considered to ensure compliance.

The responsibility for environmental compliance is shared between the operator and the regulator (Figure 4.1). Self-monitoring plans set the rules for monitoring between the two and check that they installation is complying but also check the environmental compliance.

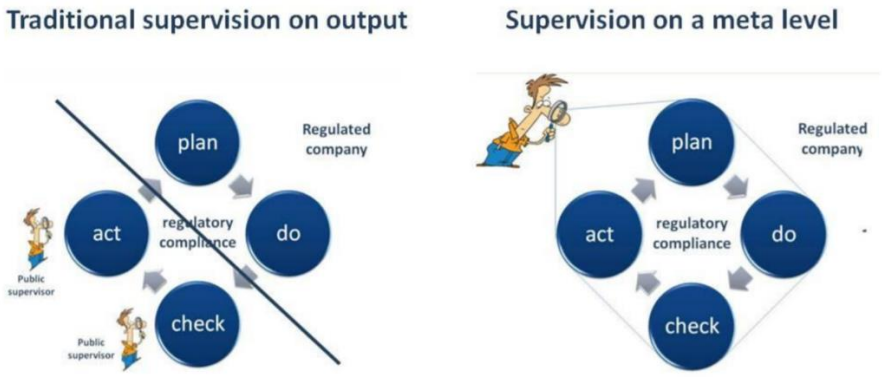

Figure 4.1 - Types of supervision (Credits: Sardinian Environmental Protection Agency)

Within the Italian Network of EPAs they have developed a guideline for minimum content of self-monitoring plans for IED installations, including: A) Tool for operators (compliance promotion); B) Tool for inspection authority to check compliance (inspections & checks). The main goal is to establish a level playing field across regions of Italy but also across members states.

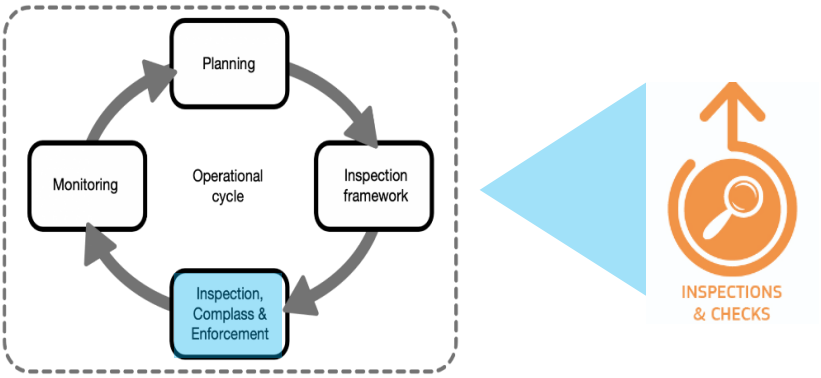

Figure 4.2 - Self-monitoring Plan (Credits: Sardinian Environmental Protection Agency)

BREF monitoring includes Objectives of monitoring; air emission section (SCOPE; GENERAL ASPECTS OF MONITORING; MONITORING OF EMISSIONS TO AIR – Overview, Air pollutants, Continuous/periodic measurements, Indirect methods, Diffuse emissions, Odour, Biomonitoring and Costs)

It was explained how IED inspections are organised in Italy and Sardinia, which organisations are involved and how the inspections are performed. Local inspection carried out by provincial authorities and there is analysis of self-monitoring reports sent on a yearly basis, *In-situ* inspections, sampling and lab analysis (of water emissions, air emissions, waste, groundwater, noise) and Auditing of sampling activities performed by the operator or by external lab on their behalf (e.g. discontinuous air emissions) and Quality checks of Continuous Emission Monitoring System (Figure 4.3).

Figure 4.3 Continuous Emission Monitoring System (Credits: Sardinian Environmental Protection Agency)

CMS is one of the tools that can be used to assess the exceedances of permit conditions, but it must meet several conditions. Self-monitoring results do not in themselves constitute automatic evidence of the violation (There will be a criminal offence if the operator has not complied with prescriptions within the set deadline, after reporting exceedance from self-monitoring).

Were given some practical examples of how this has been applied, for example in a waste incineration plant, where there occurs a communication of exceedance of Dioxin ELV during periodic self-monitoring.

The **situation on Cologne and the 4 main requirements for emission monitoring relevant for permits** was presented. Additional relevant regulations for emission monitoring and remote emissions monitoring systems. There are 600 large combustion plants in Germany and 40,000 medium facilities. A new regulation will enter into force at the start of December 2021 relating to glass factories, paper production etc. Single measurements normally happen every three years. Continuous measurements normally where it is prescribed by law or where certain thresholds are exceeded.

Each facility requiring a permit (according to the basic emission law) emitting a relevant amount of pollutants into the air must report via the internet application BUBE the amounts of pollutants emitted for the previous year for each individual installation every 4 years. The data are the basis for the North Rhine-Westphalia emission register "Emissionskataster" and are checked for plausibility by a specialised environmental authority.

The authority has the possibility to see the data from the continuous monitoring of emissions on the computer in the office. Currently, there still have a modem and parallel an Internet application- step by

step, the existing connections will be converted to the Internet application (Figure 4.4). Data on local installations is publicly available.

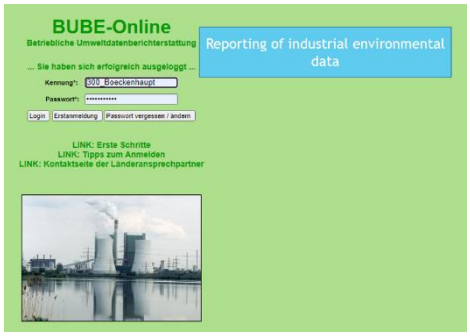

Figure 4.4 - internet application BUBE (Credits: Cologne Government Regional Office)

In Germany monitoring works well however with single measurements it is always possible the installation is running cleaner than normal so continuous monitoring is more accurate. It may be possible to reduce the effort by using operational parameters (e.g. from the process control system) instead of monitoring emissions in order to draw conclusions about emissions (Predictive Emissions Monitoring System (PEMS).

When an exceedance of ELV is detected, quite often this is not an exceedance but a problem with the technical device. Then the details need to be looked into further. CMS is not a tool to check compliance but can check what is going on and can intervene and understand the problem.

In Cologne normally the installations are not checked as the authority is notified in advance when a periodic measurement is happening so an inspector may be on site, normally they trust the external experts.

In Lombardy there is a specific system that collects information from self-monitoring and when it is exceeded there is a plant specific alert and they can see the critical aspects.

3. CONCLUSIONS

A Self-monitoring Plan should be built in agreement between competent authority and the operator. Tips for an effective Self-monitoring Plan are:

- Role of EMS (BATc n.1);
- Set of parameters;
- Defining frequencies;
- Defining rules for compliance assessment with ELV's;
- Uncertainties of measurements;
- Performance indicators; building trends;
- Environmental performance;
- Laboratory accreditation;
- Continuous monitoring systems;
- Reporting;
- BATc minimum requirements.

Project team is now collecting ideas from the practitioners for the future of the project. These ideas are:

- Self-monitoring in water emission;
- Continuous self-monitoring system;
- Self-monitoring in running projects (Waste treatment and Waste incineration BAT Conclusions) ;
- General quality criteria for the generation, aggregation; and verification of such data on the suppliers (duty holders) side;
- sampling by an accredited laboratory is sufficient for the reliability of the sample.

The problematic areas identified in the survey were the following: Quality and representativeness of the samplings and analysis (85); Reliability of data (71); Dealing with non-compliances detected in self-monitoring (55); Representativeness of the samples (operating/capacity conditions, fuel and materials used (76); Behaviour of the Operator (59); IED self-monitoring requirements (BREFs REFerence documents BAT Best Available Techniques)/ Permits requiring very specific conditions (56); Accreditation of sampling and analysis methods/ Probability and quality of random external checks) (54). Other areas were mentioned of interest, such as: Self-monitoring in wastewater emission; Odour emissions; Fugitive emissions; co-responsibility (operator and laboratory accredited) for the representativeness of the samples; importance of self-monitoring analysis and IED reporting; deal with no compliance in self-monitoring and criminal relevance.

Annexes

Annex I. AGENDA

European Union Network for the Implementation and Enforcement of Environmental Law

STRATEGIES FOR VERIFICATION OF SELF-MONITORING AND REPORTING ON AIR EMISSIONS WORKSHOP

(28 September and 11 October 2021, 13h30 CET)

Local: virtual meeting (via ZOOM)

Day 1 – 28 September

Moderator: **Ana Garcia** – IGAMAOT, Portugal; Rapporteur: **Pinar Topkaya Gokbayrak** - IMPEL Secretariat

13h30 Opening and welcome
Paula Matias - Subinspector-General – IGAMAOT, Portugal
Kristina Rabe - IMPEL Chair
Benoit Zerger - European Commission - DG ENV - C4

14h00 Analysis of the survey results
Mário Grácio – IGAMAOT, Portugal

14h20 IMPEL Supporting IED Implementation Project 2021-2024 ("umbrela" Project)
IMPEL Self-monitoring Project
Marinus Jordaan - IMPEL Project Leader
Romano Ruggeri - ARPA Sardegna, Italy

Session 1: Self-monitoring and reporting on air emissions: legislative aspects
Moderator: **Romano Ruggeri** - ARPA Sardegna, Italy; Rapporteur: **Pinar Topkaya Gokbayrak**

14h45 Self-monitoring and reporting on air emissions – Implementation of European legislation
Paula Meireles / Abel Martins - Portuguese Environmental Agency (APA), Portugal
15h05 Monitoring provisions in BAT conclusions
Martin Weiss / Maria José Cruz Gómez - European Commission – European IPPC Bureau
15h25 OECD's BAT project
Berrak ERYASA - OECD
15h45 Coffee / tea break

Session 2: Self-monitoring and reporting on air emissions: Good Practices and bottlenecks
Moderator: **Ana Garcia**; Rapporteur: **Pinar Topkaya Gokbayrak**

15h55 Self-monitoring and reporting on air emissions: Portuguese experience
"Good practices and bottlenecks – Experience from Alentejo and Center regions – Portugal"
Commissions for Coordination and Regional Development (CCDRs)
Patrícia Gomes da Silva - CCDR Alentejo, Portugal
Ana Sofia Morais / Cristina Seabra - CCDR Centro, Portugal
16h25 Self-monitoring and reporting on air emissions: Finnish experiences
Juha Lahtela - Ministry of the Environment, Finland
16h45 Continuos emission monitoring systems implemented in Chile, CEMS and others
Juan Pablo Rodriguez Fernandez - Enviromental Superintedency of Chile – INECE
17h05 PLENARY DISCUSSION

17h30 Closing day 1
Ana Garcia – IGAMAOT, Portugal

European Union Network for the Implementation and Enforcement of Environmental Law

STRATEGIES FOR VERIFICATION OF SELF-MONITORING AND REPORTING ON AIR EMISSIONS WORKSHOP

(28 September and 11 October 2021, 13h30 CET)

Local: virtual meeting (via ZOOM)

Day 2 – 11 October

13h30 Opening, agenda Day 2 and wrap-up of Day 1
Ana Garcia – IGAMAOT, Portugal

Session 3: Quality and representativeness of the samplings and analysis/Reliability and reporting of data
Moderator: **Romano Ruggeri**; Rapporteur: **Will Fawcett** - IMPEL Secretariat

13h45 ***"Methods for applying measurement uncertainty. Current practices in Europe – EC reports 2020"***
Brigitte Winter - Umweltbundesamt / Environment Agency Austria

14h05 SELF-MONITORING - EXAMPLES FROM CROATIA: Quality and representativeness of the samplings and analysis/Reliability of data
Sandra Pezelj Meštrić - Ministry of Environment and Sustainable Development, Croatia

14h25 Interlaboratory comparisons for air emission measurements: the Italian experience
Paolo De Zorzi – ISPRA, Italy

14h45 The "Regional CEMS network" as a monitoring tool: the reliability and the representativeness of data
Andrea Pagani - ARPA Lombardia, Italy

15h05 PLENARY DISCUSSION

15h20 Coffee / tea break

Session 4: Enforcement of self-monitoring and reporting of air emissions
Moderator: **Ana Garcia**; Rapporteur: **Will Fawcett**

15h30 Verifying the reliability of continuous atmospheric emission monitoring systems
Patrícia Mingacho – IGAMAOT, Portugal

15h50 Enforcement of breaches from self-monitoring data in Italy
Romano Ruggeri - ARPA Sardegna, Italy

16h10 Enforcement of self-monitoring and reporting of air emissions in Germany
Wulf Boeckenhaupt - Cologne District Government, Germany

16h30 PLENARY DISCUSSION

17h00 Conclusions and closing of the Workshop
Romano Ruggeri - ARPA Sardegna, Italy

Annex II. SUMMARY - ANALYSIS OF THE SURVEY RESULTS

ANALYSIS OF THE SURVEY RESULTS

Together with the registration of the participants, 5 questions were asked to characterise the audience and preview the expectations of the Workshop.

Participants

There was considerable interest in the workshop, with 138 registered participants (21 of whom were speakers), representing 25 countries including in the European, American and Asia Continents.

Armenia	6
Austria	1
Azerbaijan	6
Belarus	2
Belgium	3
Chile	1
Croatia	3
Estonia	8
Finland	3
France	6
Georgia	1
Germany	3
Iceland	2
Ireland	3
Italy	14
Kosovo	1
Latvia	1
Portugal	41
Slovak Republic	3
Slovenia	2
Spain	16
Sweden	5
The Netherlands	3
Turkey	2
UK	2
Total	**138**

Figure A.1 – Registered participants, by country

Organizations

The Workshop was jointly organised by the Agenzia Regionale per la Protezione dell'Ambiente (ARPA) Sardegna - Italy and the Inspeção-Geral da Agricultura, do Mar, do Ambiente e do Ordenamento do Território (IGAMAOT) - Portugal, with presentations involving the European Commission - European IPPC Bureau, the Organisation for Economic Co-operation and Development (OECD), the International Network for Environmental Compliance and Enforcement (INECE) and environmental authorities, namely from Austria, Chile, Croatia, Italy, Finland and Germany.

Survey questions

Which is the area related to operator self-monitoring your Agency has to tackle the most relevant problems?

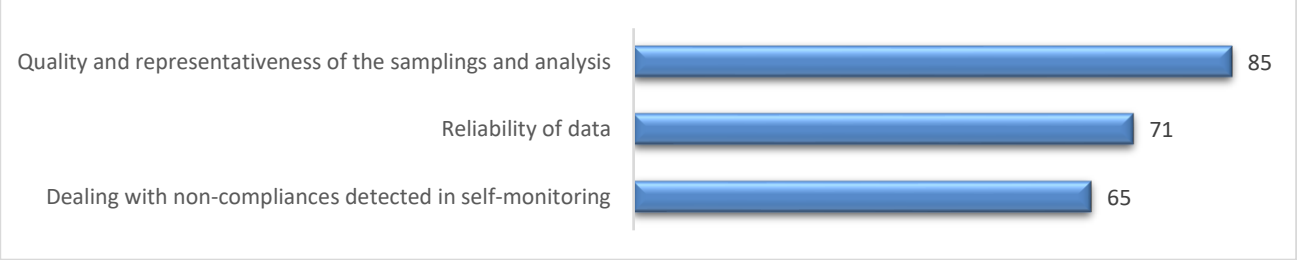

Figure A.2 – Main problems related to operator self-monitoring

Other ad hoc answers:

- BAT conclusions / Best Available Techniques;
- Enforcement / Oversight;
- Compulsory data availability;
- Continuous Emission Monitoring System compliance check;
- Reporting;
- Legislative interpretations / Guidance;
- Networking and exchange of best practice.

Where do you think the main bottlenecks related with Operator self-monitoring air emissions can be found?

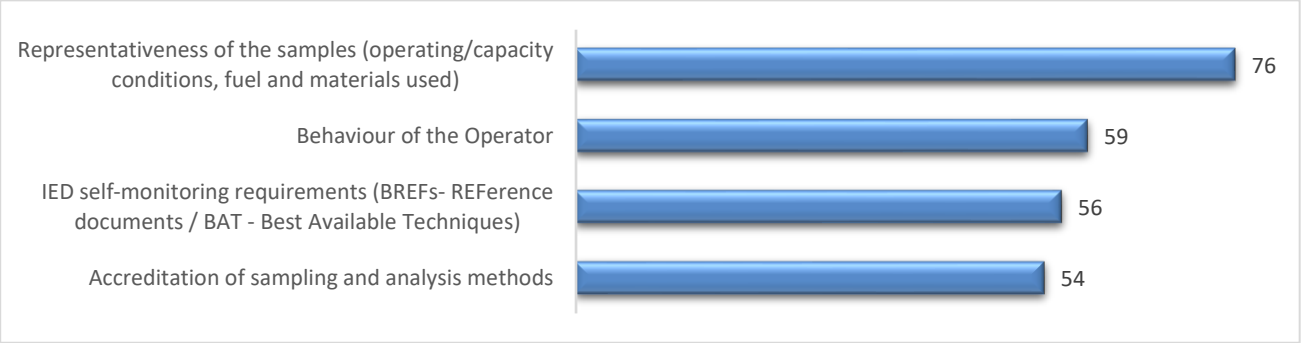

Figure A.3 – Main bottlenecks related with Operator self-monitoring air emissions

Other ad hoc answers:

- Permits requiring very specific conditions;
- Probability and quality of random external checks.

Which other topic related to operator self-assessment (not only related to air emissions) the ToR 2022 of the IMPEL IED Implementation Project should, in your opinion, cover?

The mains topics are related to: Operator, Self Monitoring, Conditions, Permit, Plans, Samples, Methods, Accredited, Trust, Wastewater, Inspection. Below are indicated the ad hoc answers.

Figure A.4 – Main suggestions for the ToR 2022 (operator self-assessment)

Ad hoc answers:

- Expand self-monitoring project to wastewater, also continuous monitoring system;
- How can the operator and the laboratory accredited to carry out tests be made co-responsible for the representativeness of the samples? ;
- How to ensure that self-monitoring analysis and IED reporting is as important as authorization and inspection (to place the burden of proof on operators, ensuring early screening and detection of the infringements)? ;
- More focus on enforcement related to operator self-assessment… on operator behaviour;
- How to deal with no compliance in self-monitoring? … Criminal relevance;

- Fugitive emissions
- Building trust between operator and inspection body
- How to deal with the footnote mentioned in the BAT for monitoring?
- Template of self-monitoring on all environmental topics

In which of the following activities, related to operator self-monitoring, is your Agency involved?

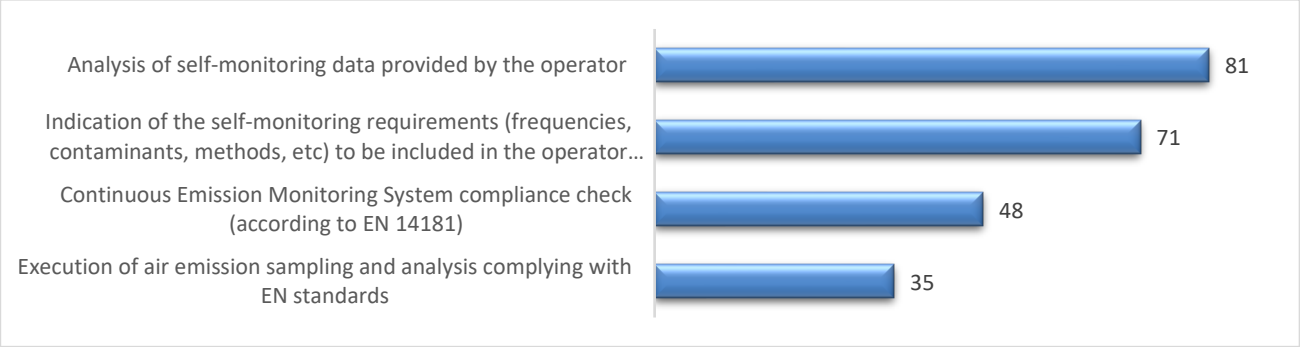

Figure A.5 – Kind of involvement activities, by the participants Agencies

Other ad hoc answers:

- Law Enforcement / Inspections;
- Permitting / Permit compliance;
- Preparation of legislation / guidance;
- Compliance networking.