



# Emissions Trading in Mexico

Recommendations for a Monitoring, Reporting and Verification (MRV) system for a future Mexican emissions trading system (ETS)



Alexander von Humboldt  
Stiftung/Foundation

Umwelt   
Bundesamt

DEHSt  
Deutsche  
Emissionshandelsstelle

## Editorial information

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Status: May 2017

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This study was produced as part of the International Climate Protection Fellowship under the auspices of the Alexander von Humboldt-Foundation and hosted by the German Emissions Trading Authority. This document does not represent the opinion of the Mexican government.

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## Foreword

The present document contains recommendations concerning a Mexican monitoring, reporting and verification system and is part of a one year research conducted at the German Emissions Trading Authority (DEHSt) in the Section “Economic Aspects of Emissions Trading, Monitoring, Evaluation” under the auspices of the Alexander von Humboldt Foundation.

The objective of this research was to learn about the basics of the European Emissions Trading System and its implementation in Germany with a main focus on monitoring, to make a comparative analysis of the monitoring, reporting and verification methodologies between operator’s greenhouse gas data collection in Mexico and in the European Emissions Trading System, to perform a comparative analysis of the institutional structure between Mexico and Germany and to identify the challenges and good practices for developing a cap and trade monitoring approach in Mexico.

## Summary

Mexico intends to implement an Emissions Trading System (ETS) and a sound monitoring, reporting and verification (MRV) system is the foundation for the integrity and the success of it. The operational structure of a MRV system provides the framework for the methodical and technical design. The Mexican Greenhouse Gas Register Regulation (RENE, per its acronym in Spanish) defines this operational structure for the energy, transport, industrial, agriculture, residues, commerce and service sectors.

By conducting a comparison of the RENE and the MRV structure of the European Emissions Trading System (EU ETS), the recommended improvements as

- ▶ the creation of an ETS monitoring regulation specifying existing RENE monitoring requirements,
- ▶ the creation of a legal hierarchical framework of monitoring requirements for which the operator must show evidence that he is compliant with,
- ▶ a structured MRV system based on sources streams,
- ▶ the introduction of a mandatory monitoring plan (MP) prepared by subject to report, to be agreed with a verifier before the reporting period [reconsidering the role of the verifier after the training phase],
- ▶ modifications of the compliance cycle,
- ▶ accreditation of verifiers according to the scope of expertise,
- ▶ creation of a verification regulation,
- ▶ an annual verification process to assure the quality of reported emissions, the implementation of an information exchange mechanism between the participants,
- ▶ adaptation of the COA Web<sup>1</sup> (per its acronym in Spanish (Annual Operation Certificate)) to develop a consistent database of information,
- ▶ the creation of additional guidance documents for monitoring and reporting requirements, once the decision of an ETS is established and
- ▶ the introduction of a training phase where involved parties can gain experience with the adapted MRV system to be ready for a full ETS,

may lead to a complete, consistent, accurate and transparent MRV system.

For the MRV training phase data for indirect emissions can be further monitored and reported, but they should be separately designated. For a later full ETS, it is recommended for the sake of simplification and transparency that instead of implementing a complex mechanism to avoid double counting of emissions and therefore also double surrendering of allowances on both ends - supplier and end users -, should only consider direct emissions.

<sup>1</sup> A platform that is used to input the release and transfer of pollutants to the air, water, soil and wastes and the greenhouse gas emissions.

By considering the emissions derived from fossil fuel combustion of 1,546 establishments, 97 to 99 % of the emissions of the 3,000 installations subject to federal jurisdiction are covered. If the 25,000-ton threshold remains as it is currently considered in the RENE, the size of the market would be composed of 419 installations. In emissions, the size of the market would represent almost 140 million tons of CO<sub>2</sub>. This represents 23 % of the emissions from the 1,546 establishments<sup>2</sup>.

On the technical design, it is recommended to introduce a hierarchical structure consisting on a

- ▶ “high level approach”, that covers the direct measurement approaches and recommends adaptations and on a
- ▶ “standard level approach” that covers the standard emission factor approach and recommends adaptations.

Both approaches have to be carried out by the establishments based on its average emissions

- ▶ category “B” establishments emit more than 100,000 t CO<sub>2</sub>/year and
- ▶ category “A” establishments emit equal or less than 100,000 t CO<sub>2</sub>/year;

which represents an amount of 218 installations category “A”, while 201 installations are considered category “B”. The threshold is deemed to be reasonable because the value represents the median of the calculated emissions from the selected industries.

Also it is proposed to introduce two different kinds of source streams, categorized in minor and major source streams. Major source streams in category B shall apply the high-level approach. Minor source streams in category B establishments as well as all source streams in category A establishments shall apply at least the standard level approach.

## 1 Introduction

In Mexico, bottom up reporting was born in 1994 due to the environmental requirements derived from the North American Free Trading Agreement (NAFTA, per its acronym in English). The first proposal of substances<sup>3</sup> that should be reported by the glass, cement, metal, oil and gas, electricity generation, chemical and paper industry in Mexico was published in 1997. One of these substances was carbon dioxide (CO<sub>2</sub>). However, reporting was voluntary until 2001 with a change in article 109 of the “General Law of Equilibrium and Protection to the Environment” (LGEEPA, per its acronym in Spanish), requiring obligatory reporting.

The General Law of Climate Change (LGCC, per its acronym in Spanish) in 2012 sets higher regulatory requirements to control the emissions to the atmosphere, which have effects on a global scale, such as the greenhouse gas (GHG) emissions. The LGCC claims the creation of a Greenhouse Gas Register Regulation (RENE, per its acronym in Spanish).

Per art. 7 of the RENE, it is an obligation of the energy, transport, industrial, agricultural, residues, commerce and service sectors to report their GHG emissions in the Annual Operational Certificate (COA). The COA is the main bottom up environmental reporting instrument used by the industries to report the substances<sup>4</sup> that affect the environment in a negative way. As a consequence, data sets of GHG emissions based on an entity level from several industrial sectors are available.

Mexico intends to implement an ETS. Its success will rely on the number of affected stakeholders. Therefore, stakeholders’ awareness raising is an utmost important objective. To reach this objective, the Mexican Ministry of Environment and Natural Resources (SEMARNAT), the Mexican stock exchange (Grupo BMV), and MEXICO<sub>2</sub> (the voluntary carbon platform at the Mexican Stock Exchange BMV), signed a memorandum of understanding on 15/08/2016 to implement a voluntary simulation Register. The simulation consists of a voluntary web-based simulation of a Register in order to introduce clarity to the ETS transaction cycle of allowances.

<sup>2</sup> Research and calculations of the author, based on historical fuel consumption from the LAU.

<sup>3</sup> Substances subject to federal reporting: chemical elements or compounds, which according to the criteria of environmental persistence, bioaccumulation, toxicity, teratogenicity, mutagenicity or carcinogenicity and, in general, for their adverse effects on the environment, are issued or transferred by establishments subject to federal reporting and must be integrated into the database according to the specifications and thresholds established in the Official Mexican Norm. Art. 3 (Mexical Official Gazette, 2004)

<sup>4</sup> Under the substances has to be understood air, water, soil, wastes pollutants and GHG emissions.

Besides the possibility for transactions of allowances, a sound MRV system is the foundation for the integrity and the success of an ETS scheme. The objective of this research was to learn about the approaches used for MRV in the EU ETS and its practical implementation in Germany. In this regard, the operational and organizational structure of the annual compliance cycle as well as the methodical and technical requirements for emission determination are examined and compared in the Mexican and the European system. Based on that, recommendations for adjusting and improving MRV approaches in the RENE are derived.

EU ETS monitoring and reporting is built, among others, on the principle of accuracy. This implies that installation-specific data of a defined quality has to be reported for most of the emissions covered by the scheme. In this sense, operators are asked to provide evidence that the required level of quality (tier) for every parameter needed for determining the installation's emissions is reached. However, the design of ETS provides the possibility for simplification for smaller parts of emissions (e.g. less strict requirements for installations with low emissions or source streams with low emissions) and takes into account the cost and the proportionality of measures. Mexico is looking forward to improve data quality. However, a full adoption of the European MRV system in Mexico in the short term would lead to high effort both on establishment's as well as on the side of the involved authorities and will most possibly be prone to a poor acceptance by stakeholders. Therefore, the following proposals are built on the existing monitoring regulations in the RENE and supplement them by elements of the European MRV system.

Time is an underestimated factor and stakeholders need to get acquainted with the rules for MRV. In the EU ETS the 2004 emissions level had been overestimated, mainly due to time restrictions, missed preparation of profound regulations and - as a consequence - a lack of precise verified emissions for installations (Bellasen, Stephan, & Jacquier, 2015, p. 143). Hence, it is suggested to introduce a training phase (e.g. of two years) where involved parties can gain experience with the adapted MRV system and rules can be further improved in order to be ready for a full ETS.

## 2 Operational structure

The operational structure of the MRV system provides the framework for the methodical and technical design. It defines which stakeholder is doing what (tasks and responsibilities) at which time. In Mexico the RENE mandates this operational structure. In the EU ETS, these administrative elements are laid down in the EU ETS Directive 2003/87/EC and also in various regulations, such as the regulation on the monitoring and reporting of greenhouse gases 601/2012 (MRR) or the regulation on the verification of greenhouse gases and the accreditation of verifiers 600/2012 (AVR). The so-called "compliance cycle" displays the essential steps of the annual process.

### 2.1 Description of Compliance Cycles

#### Compliance cycle in Mexico

Four actors represent the compliance cycle in Mexico: the subject to report, two competent authorities – SEMARNAT and the Environmental Agency (Procuraduría Federal de Protección al Ambiente, PROFEPA, as per its acronym in Spanish) – and a verifier.

As it was mentioned in the introduction, the subjects to report are using the COA as reporting instrument to report their GHG emissions (among many other environmental pollutants). Under the COA the COA Web has been developed in 2015, which is a web-based electronic tool for the reporting procedures described in COA.

The subject to report must monitor and report its direct and indirect emissions of the previous year (period 01/01 to 31/12) within an emissions report using COA Web between 01/03 and 30/06 of each year. Then, SEMARNAT, acting through its Climate Change Directorate, will have 20 working days from the date of the reception of the emissions report through COA Web to check the information. It is important to mention, that another Directorate under SEMARNAT is receiving the notification that the report was submitted. This Directorate is called "Air Quality Management and Register and Transfer of Pollutants General Directorate".

During 20 days' time SEMARNAT may request to the subject to report to complete, rectify, or confirm any information within a period not exceeding 15 working days from the date of notification. If this requirement is not attended, it will be considered as if the subject to report would not have presented any emissions report (see chapter 2.2.4).

PROFEPA is allowed anytime during the compliance cycle to inspect the subject to report and ensure consistency and accuracy on the reports and the correct application of methodologies.

Every third year, an accredited third party must verify the establishment's emissions report and submit a verification opinion to SEMARNAT during 01/07 to 30/11; i.e. the verification of 2018 emissions will take place in 2019 and the next verification will be in 2022 for the reporting year 2021. Emissions of 2019 and 2020 will not be verified.

The Figure 1 represents the current compliance cycle in Mexico:

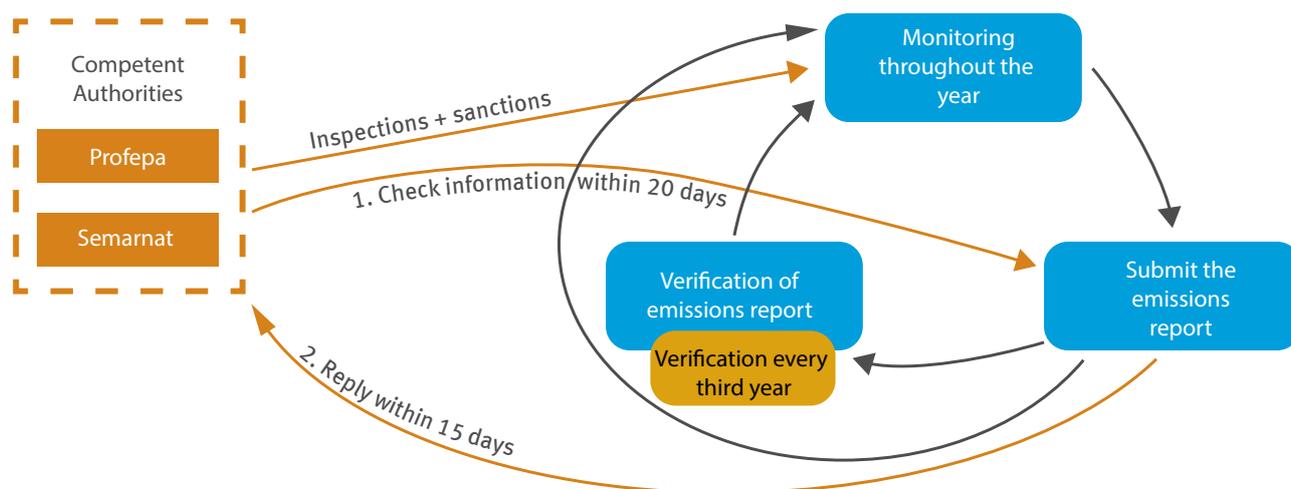


Figure 1: Compliance Cycle in Mexico

### Compliance cycle in EU ETS

Three actors are part of the compliance cycle in the EU ETS: an operator, a competent authority (CA) and a verifier.

Different to Mexico, a document is prepared by the responsible operator of every installation in which he describes the way the monitoring of the installation's emissions is carried out. This document is called monitoring plan (MP) and is the basis of the EU ETS compliance cycle. The competent authority approves the MP before the trading period or before the operation of an installation. Such as in Mexico, the monitoring period starts the 01/01 and finishes on the 31/12. In the EU ETS, the results of annual monitoring are captured in an emissions report, which is verified by a third party (verifier) commissioned by the operator. In contrast to Mexico every emissions report has to be verified every year. The operator must submit the verified annual emissions report (AER) until the 31/03 to the competent authority. Until the same deadline of 31/03 the operator or the verifier enters the figure of the verified emissions into the European Union Registry where it has to be confirmed by the verifier if the operator entered the figure. The Union Registry is comparable to a banking system within which operators as well as European Member States have a bank account. Until 30/04 the operator has to surrender allowances<sup>5</sup> in the Union Registry system by transferring them from his account to a Union central deletion account. The quantity of allowances to surrender is determined by the amount of emissions recorded in the verified emissions report. The CA may carry out further checks on submitted AER, require changes of the emissions data and require the surrender of additional allowances, if applicable. If the operator is not able to meet the requirements set by the Monitoring and Reporting Regulation (MRR) or if the verifier recommends improvements, the operator has to submit a report on possible improvements. Figure 2 represents the compliance cycle in EU ETS:

<sup>5</sup> An allowance is equal to one ton of CO<sub>2</sub> equivalent

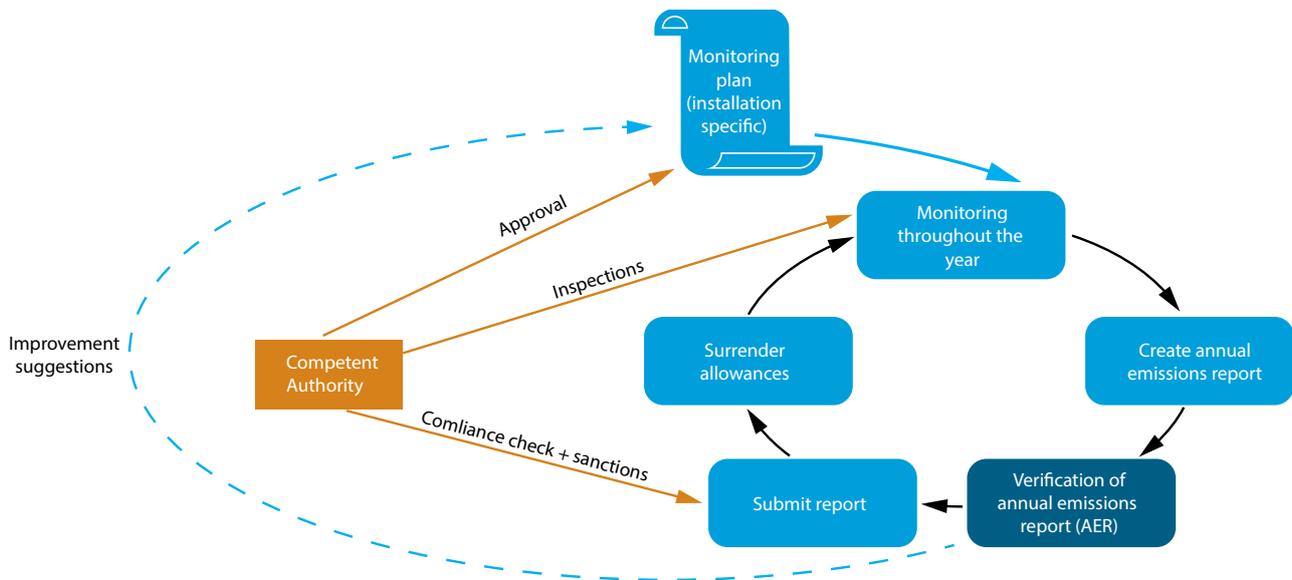


Figure 2: Compliance Cycle in the EU ETS

## 2.2 Possible Improvements of the Mexican compliance cycle

The described compliance cycles of both systems give a first overview of the operational structure. Within this research by conducting a comparison of the two operational systems and taking into consideration that EU ETS MRV structure successfully functions since 2005, some improvement potential within the Mexican MRV has been discovered. The following subchapters present recommendations for adjusting the Mexican compliance cycle.

### 2.2.1 Importance of a Monitoring Plan in the EU ETS

As processes and conditions in installations are different and it would be very complex to define every individual case in a legal document, the EU ETS regulations on Monitoring and Reporting and Accreditation and Verification set up a framework for a MRV system. Based on this framework the MP plays an important role. The MP elaborated by the operator describes the methods used for the determination of GHG emissions and explains how the requirements of the regulation are fulfilled or declares deviations thereof. It is developed once, ahead of the trading period<sup>6</sup> and updated during the trading period if necessary (e.g. because of new source stream). The most important aspects of a monitoring plan are (derived from author based on (European Commission (a), 2012, p. Annex I)):

- ▶ Non-technical description of the installation and its activities
- ▶ Flow chart (simple diagram) which shows:
  - ▶ Source streams used (specific fuel type, raw material or product giving rise to GHG emissions or containing carbon and included in the calculation of GHG emissions e.g. coal, natural gas, steel etc.)
  - ▶ Emission sources (separately identifiable part of an installation or a process within an installation, from which relevant GHG are emitted of e.g. boilers)
  - ▶ Measuring instruments determining the amount of the source streams
  - ▶ Location of sampling points
- ▶ List of source streams and emission sources
- ▶ Description of determination methods used to determine the parameters relevant for GHG calculation of a source stream/emission source (e.g. quantity, net calorific value, emission factor, carbon content, biomass fraction etc.)
- ▶ List of additional management procedures (title and reference, e.g. procedure for internal reviews)

<sup>6</sup> Period for which emission allowances are issued under the EU Emissions Trading Directive. Currently three trading periods are defined: 2005-2007, 2008-2012 and 2013-2020.

Thus, the MP serves as the basis for the annual emissions report. If the described methods in the MP are in compliance with the rules of the regulation, the competent authority approves the MP. The verifier is using the approved MP as a point of reference to judge and verify the emissions report.

### 2.2.2 Adjustments of the Compliance Cycle in Mexico

In Mexico, there has not been a requirement to create an installation specific MP so far. The reason for this is probably that there has been no need so far for a robust installation based GHG reporting as basis for a market-based instrument and there is also no hierarchical framework of monitoring requirements for which the operator has to show evidence that he is compliant with for the individual establishment. For instance, also the California Greenhouse Gas Cap and Trade Program (CTP) requires that an operator has to complete and retain a MP. As it is recommended that Mexico aims at a structured MRV system based on sources streams/ emissions sources, Mexico should think about introducing a requirement for developing a document such as a MP in CTP or the EU ETS. Through the descriptions in the MP the involved parties get an overview of the processes and monitoring activities in the installation and can assess if the requirements are fulfilled. Moreover, it can serve the establishment's staff members (particularly new ones) as guideline for implementing necessary procedures and take necessary actions throughout the year.

Taking into consideration the pillars of the compliance cycle in Mexico, Californian CTP and in the EU ETS, the establishments have to hire a third party verification body for verification of emission reports and face compliance deadlines. Currently in Mexico, as it was described in chapter 2.1, the verification opinion is given every third year. In order to assure the quality of reported emissions and to create a robust GHG reporting system it is recommended to establish a verification process every year.

As verifiers play an important role within the quality assurance and quality control (QA/QC) process, a further recommendation would be that the verification process should take place before the submission of the AER to the COA Web. In the EU ETS this is a regulated requirement, i.e. verified emission reports reach CAs until the end of March. This change will avoid a double effort from SEMARNAT, as within the current compliance cycle, even every three years, SEMARNAT revises the emissions report before and after verification process. At the same time, this measure will provide security for the subject to report being compliant with the requirements. In addition, it will simplify the compliance check for SEMARNAT. However, CTP follows for unknown reasons a different route: submission of the emissions reports either on 10/04 or on 01/06 (depending on the type of the facility) and verification opinions on 1/10 for operators subject to the April reporting deadline and on 01/12 for all others. (California Environmental Protection Agency, 2011, p. 8)

The proposed changes also lead to adjusted deadlines necessary for a modified compliance cycle, especially for verification:

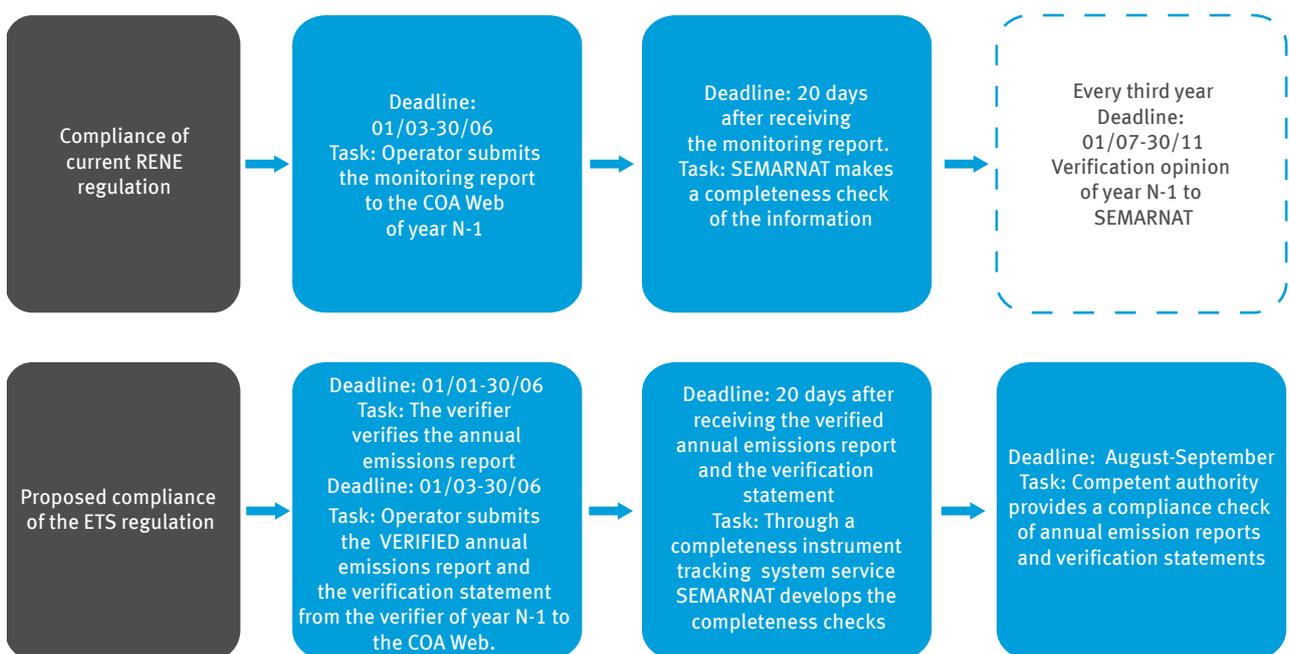


Figure 3: Proposed deadlines for a Mexican MRV system

It is proposed that after the subject to report inputs the verified AER (including the verified opinion) into the COA Web, SEMARNAT will have 20 working days to check the information and may request to complete, rectify, or confirm any information. The subject to report will then have 15 working days to provide an answer. If the requirement from SEMARNAT is not attended, it will be considered as if the subject to report wouldn't have presented any verified emissions report and verification statement. After the completeness checks have been fulfilled it is recommended, that SEMARNAT will carry out some additional compliance checks of verified AERs with the RENE within August and September.

In Mexico, the management of the COA Web is provided by the Air Quality Management and Register and Transfer of Pollutants General Directorate which is able to confirm the submission of the AER by subject to report so far. This Directorate is different from the Climate Change Directorate; the latter manages the RENE and provides the compliance check of the submitted AER. It is suggested to implement an information exchange mechanism that covers a procedure in which the Climate Change Directorate is informed that the subject to report has finished to input its verified AER and verification statement in the COA Web.

Moreover, an information mechanism between SEMARNAT and PROFEPA is recommended. Both SEMARNAT - which receives the verified emission reports and the verification statement - and PROFEPA - which is the authority in charge to make the inspections - have to be aware of the conditions of an installation from their different perspective. To avoid double work, it is suggested that clear responsibilities and information exchange requirements are set in the RENE.

Another suggestion is that the verifiers should be accredited according to the scope of expertise for the particular sector (activity), as in the CTP or the EU ETS (Article 43 and Annex I AVR). For the QA/QC process and the integrity of reported GHG data, the verifiers' knowledge and the reliability is of great importance. Therefore, the verifier should be qualified in the scope of the establishment subject to verification.

An additional consideration should be made concerning the role of the MP in the compliance cycle. As an approved or verified MP provides security for the operators monitoring activities, the verifier could check compliance of the MP with the regulation requirements before the reporting period and has to verify emission reports after the reporting period. This is different to CTP, where the CA may carry out checks during the reporting period and verifiers verify MPs together with the emissions report (California Air Resources Board, 2014, p. §95105 c)). However, it would provide Mexican operators with necessary information, security after a change in the legal MRV requirements and would be already a quality assurance at the beginning of the reporting period. That means, the verifier would check the completeness of the MP, relevant measurement, calibration procedures as well as relevant sources of primary data and evaluate the QA/QC processes in the installation. On the other hand, for the emissions report, the verifier would have to identify non-conformities' and material misstatements<sup>7</sup>. This is probably an adequate and efficient approach for the MRV training phase in the current Mexican setting. Thinking of the establishment of market-based GHG reduction instruments, the experience should be evaluated because the impartiality and independence of a verifier, which verifies the MP and the emissions report of the same installation, is probably questionable. For example in the EU ETS, a CA is in charge to approve MPs officially and hence legally secure for the operator.

The Figure 4 represents a new structure of the compliance cycle in Mexico:

<sup>7</sup> A material misstatement is a "misstatement that, in the opinion of the verifier, individually or when aggregated with other misstatements, exceeds the materiality level [...]. Materiality level is different from the maximum uncertainty allowed on the monitoring of activity data (fuel and material consumption for example). The materiality level of the verification is more a tolerance of small unintended misstatements and does not exempt the operator from correcting them as soon as possible" (Bellasen, Stephan, & Jacquier, 2015, p. 169).

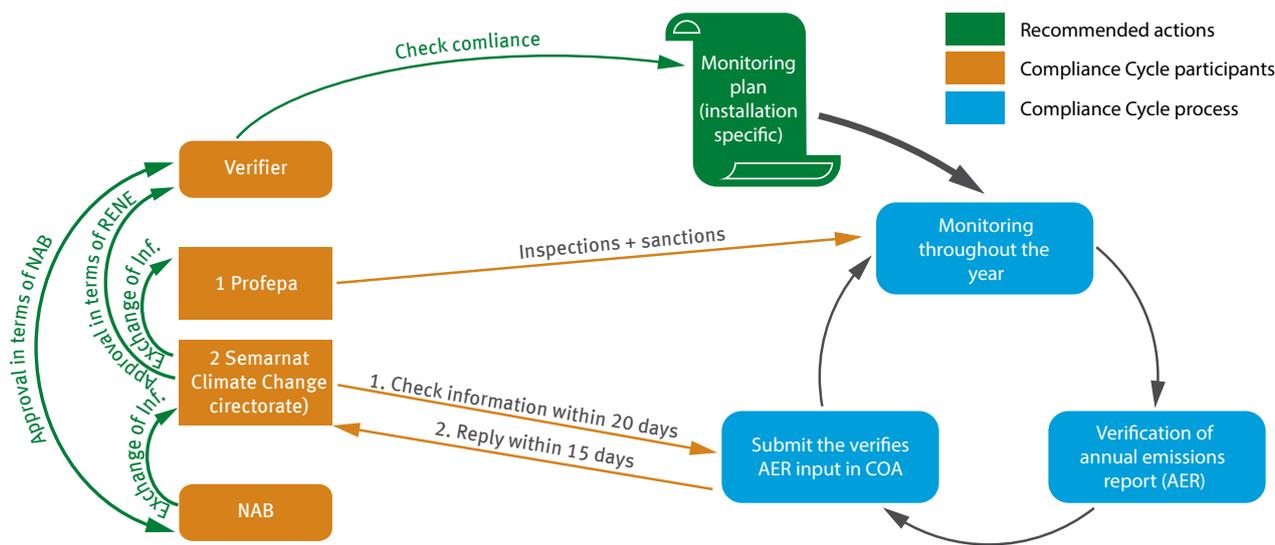


Figure 4: Recommended Compliance Cycle for a Mexican ETS

### 2.2.3 Accreditation and approval of verifiers

In Mexico, the accredited verifiers additionally need to be approved by the SEMARNAT for the purposes of verifying the emissions report according to the RENE. For the approval, they shall submit an application containing the requirements in Article 15 on the Federal Law of administrative Procedure, which contains a copy of the company certification as a verifier, documentation supporting the curricular information of the staff and a statement that its staff has not been sanctioned for violations of environmental laws in any other activity performed, or punished under criminal law for committing environmental crimes (Federación, Diario Oficial de la Federación, 2012). The approval will be valid for five years, counted from the date of notification. Only bodies that are accredited by the Mexican Accredited Entity (Entidad Mexicana de Acreditación, national accreditation body, EMA per its acronym in Spanish) and approved by SEMARNAT, can issue a verification opinion for the purposes of RENE.

The accreditation from the EMA is based on Mexican standards<sup>8</sup>, which have been elaborated by the Mexican Institute of Normalization and Certification (Instituto Mexicano de Normalización y Certificación, IMNC, per its acronym in Spanish) based on the ISO standards. To date, the following standards have been established:

- ▶ NMX-SAA-14064-1-IMNC-2007 Greenhouse Gases - Part 1-2006 based on ISO 14064-1: Specification with guidance, at the organizational level, for the quantification and reporting of greenhouse gas emissions and GHG removals.
- ▶ NMX-SAA-14064-2-IMNC-2007 Greenhouse gases - Part 2 based on ISO 14064-2 2006: Specification with guidance, at project level, for the quantification and reporting of emissions and GHG removals.
- ▶ NMX-SAA-14064-3-IMNC-2007 Greenhouse gases - Part 3 based on ISO 14064-3 2006: Specification with guidance for validation and verification of GHG declarations.
- ▶ NMX-SAA-14065-IMNC-2008 based on ISO 14065: 2007 Greenhouse Gases - Requirements for performing greenhouse gas validations and verifications.

In the EU ETS scheme, an AVR regulates the requirements for verifiers in order to get an accreditation (e.g. various procedural/organizational requirements and competence requirements) and the tasks of the verifier.

As the verifiers are playing an important role in terms of compliance checks of the MP and verification of the AER, it is recommended that a verification regulation is created in Mexico. These regulations should contain the following aspects:

<sup>8</sup> Mexican standards (NMX) are voluntary and are developed by national standards bodies and can be based on international standards (source: art. Articles 38 and 51-A of the LFMN)

- ▶ It is the task of the verifier to assess compliance of the MP with the monitoring requirements.
- ▶ It is the task of the verifier to assess the AER. This assessment will look for data transparency, actions taken to prevent errors, misstatements or omissions.
- ▶ A verifier needs to be competent for the specific sector (activity), independent and impartial. This should be proven in order to get an approval for verification in terms of RENE by SEMARNAT.
- ▶ A specification of the materiality level for the verification process.
- ▶ Requirements for a specific harmonized format (template) of the verification opinion should be introduced. This measure will secure verifier of fulfilling the requirements of the verification regulation and will simplify the compliance check for the CA. Nowadays every verifier uses its own format of the verification opinion.

For the implementation of a future full ETS, the conflict of interest when one and the same verifier is checking both the MP and verifying the AER should be solved by requiring that either the CA approves the MP or that there are two different verifiers, one for MP and one for the AER.

## 2.2.4 Sanctioning possibilities

Proper compliance with reporting obligations is a prerequisite for a functioning MRV system. In the EU ETS Article 16 of the EU ETS Directive 2003/87/EC says that “Member States shall lay down the rules on penalties applicable to infringements of the national provisions adopted pursuant to this Directive and shall take all measures necessary to ensure that such rules are implemented. The penalties provided for must be effective, proportionate and dissuasive [...]”. Germany implemented rules in its national emission trading law (TEHG, per its acronym in German) in order to be able to enforce e.g. the reporting duty and the surrendering duty.

Currently, Mexico already established fines and penalties by Articles 114 and 115 of the LGCC, as shown in the following figure:

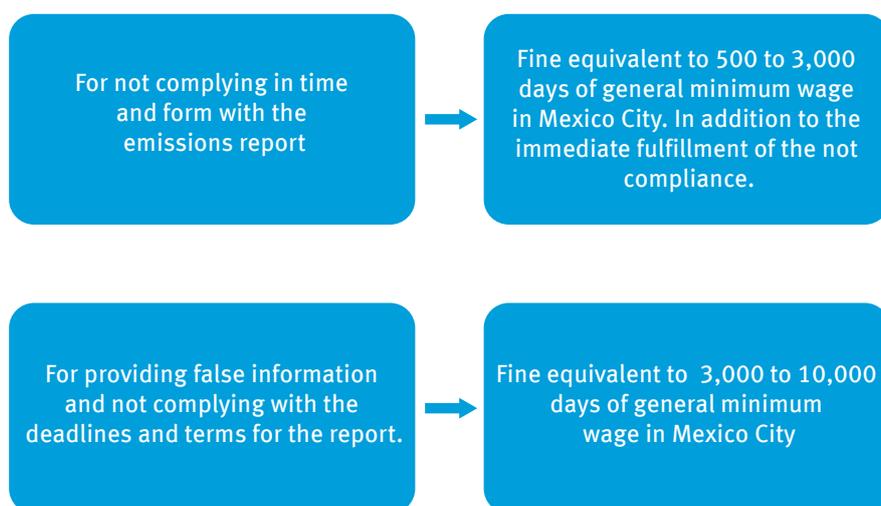


Figure 5: Fines in Mexico for different cases<sup>9</sup>

These fines seem to be appropriate for a MRV training phase concerning formal infringements like:

- ▶ no submission of an emissions report
- ▶ the emissions report wasn't submitted before or at the latest at the given deadline
- ▶ the emissions report doesn't comply with the requirements or the required form (e.g. submission of incomplete emissions report)

These infringements can be determined relatively easily as clear criteria are set (emissions report was submitted on time: yes or no). On the contrary, it would be more difficult to evaluate if the information and data provided with the emissions report is correct, as it requires a technical assessment of the report. But, as the data collected in the proposed MRV training phase are suggested to be used for other purposes (e.g. cap setting), the rules on penalties for incorrect emission reports should stay in order to be prepared in case of possible further compliance checks carried out by SEMARNAT.

<sup>9</sup> Wage in Mexico City in 2016 per day: 73.04 MXN (3.4 EURO). Source: [http://www.conasami.gob.mx/bol\\_salario\\_minimo\\_2016\\_11122015.html](http://www.conasami.gob.mx/bol_salario_minimo_2016_11122015.html)

At the same time, it is recommended to specify the structure of fines for the inconsistencies and non-compliance in the reported data. Figure 5 demonstrates the necessity for the more detailed structure after the training phase.

## 2.3 Information exchange between Competent Authority and National Accreditation Body

In the EU ETS, the NAB is responsible for the surveillance of the national verifiers (European Commission (d), 2012). According to the AVR a mutual information exchange between CA and NAB is instructed. The NAB prepares an accreditation work program, where CA gains an overview of accreditation details of newly accredited verifiers including scope, any changes regarding accreditation scopes of verifiers, anticipated time and place of verification, information on activities planned for the verifiers (surveillance and reassessment activities) and information on witnessing audits planned for the assessment of verifier. After the verification process, the NAB prepares a management report that contains summarized results of surveillance, reassessment activities and of extraordinary assessments including reasons for their initiation, any complaints filed against verifiers and actions taken by the NAB. The CA, on the other hand, has to communicate to the NAB the relevant results from checking the emission reports and verification reports and the relevant results from inspections. This allows exchanging information about the performance of the verifiers. Based on that, NABs could e.g. suspend or withdraw an accreditation.

It is recommended that there is an information exchange established between SEMARNAT and the EMA. The recommendation is that EMA prepares an yearly *accreditation work program* where following details are given: details of newly accredited verifiers and details of the accredited verifiers, anticipated time and place of verification, information on activities planned for the verifiers (surveillance and reassessment activities), and information on witnessing audits planned for assessment of verifiers. It is also recommended that EMA prepares a *management report* that contains accreditation details of newly accredited verifiers and any administrative measures on verifiers, for example who has been accredited, which verifiers have requested their accreditation, any complaint received to EMA about the verifier e.g. by SEMARNAT. Based on that and in case of severe issues, SEMARNAT could decide not to approve a verifier in terms of carrying out activities for the purpose of RENE. SEMARNAT will communicate relevant results from checking the verified emission reports, from inspections made by PROFEPA and in the case the verifier is not approved by SEMARNAT, will justify why the accredited verifier was not compliant with the requirements in Article 15 on the Federal Law of administrative Procedure (such as a copy of the company certification as a verifier).

## 2.4 IT infrastructure

In the EU ETS not every Member State implemented its own IT-infrastructure for collecting, processing, storing and evaluating relevant data. In some Member States, especially with a lower number of installations than Germany<sup>10</sup>, Excel templates are used for setting up MPs and AER. These templates are provided by the European Commission and published on its webpage.

In the Mexican approach, there is one platform that is used to input the release and transfer of pollutants to the air, water, soil and wastes and the GHG emissions. It is called the COA Web. Reporting obligations according to the RENE is one part of the COA. A recommendation is to adapt the COA Web, so that data collection for the MRV training phase and, if applicable, for the future ETS could be performed via the COA Web.

For this purpose, each installation should have an account in the COA Web where both, the AER and the MP can be placed. A crosscheck mechanism that compares the amount of emissions reported to the estimated amount of emissions from fuel combusted and outputs declared in the COA and the Unique Environmental License (LAU per its acronym in Spanish), respectively, is recommended. The LAU, available electronically, could be used to set the maximum production amount of a subject to report and therefore estimate the maximum amount of process emissions. Moreover, it is suggested that the COA Web revises if the emission factors used for any calculation are plausible in units (example: MJ or m<sup>3</sup>) with the units used as activity data. This is called a dimensional analysis. It is recommended that the COA Web acts as a web interface to input data as it is currently used for and in addition it will also serve to help the users to develop a consistent database of information.

<sup>10</sup> In Germany there are around 1,900 installations subject to EU ETS

This way, the Mexican government can make use of an instrument that is already in practice. Concerning data evaluation by the CA, Mexico could for a first step export the data from the COA Web to an Excel file and evaluate them there.

## 2.5 Support for operators

Mexico has one Guideline available, which introduces the user to the legal framework of the RENE, national GHG emissions, objective of the RENE, identification of the entities that are obliged to report to the RENE, type and source of emissions, reporting and verification calendar, sanctions and examples of calculation of emissions according to the methodologies established in the RENE. Nevertheless, this guideline does not cover a detailed explanation on the monitoring approaches in terms of the quality of the data that should be used. Therefore, once the decision of an ETS is established, Mexico would need to create guidance for the monitoring and reporting requirements. In addition to the guidelines, it is important to consider that in the MRV training phase, involved parties can gain experience with the adapted MRV system and rules through capacity building in the different associations and industry chambers.

## 3 Methodical and technical design of the MRV system

For a robust MRV system, a structure of methodical and technical rules is needed to ensure that most of the emissions covered by the scheme are determined based on accurate data. At the same time it should provide the possibility for simplifications for small parts of emissions and take into account the cost and the proportionality of measures.

Although the scope of an ETS (covered sectors and gases) is generally not an MRV specific issue it has implications on the methodologies used to determine the emissions. Hence, this issue is also discussed in the following.

### 3.1 Covered gases, emission sources and sectors (activities)

The EU ETS had focused for the first two trading periods on CO<sub>2</sub> only for the sake of simplicity because it is the most important anthropogenic GHG and because of the large monitoring uncertainty in different sectors, as in the waste sector (European Commission, 2006). For the third trading period, nitrous oxide (N<sub>2</sub>O) emissions from fertilizer manufacturing, perfluorcarbone (PFC) emissions from primary aluminum production and further activities emitting CO<sub>2</sub> were introduced. Based on the experiences in the EU, it is suggested that Mexico also starts with monitoring and reporting of CO<sub>2</sub> emissions of liable entities. Moreover, as operators subject to EU ETS only have to surrender allowances for emitted fossil CO<sub>2</sub>, emissions from biomass<sup>11</sup> don't count for the installation's overall emissions. However, the quantity of used biomass has to be reported. If Mexico starts with a training phase for MRV (before introducing a full ETS) the CO<sub>2</sub> emissions from biomass could be continued to be monitored and reported as before.

The inclusion of emission sources differs between Mexico and Germany. In Mexico, both, emissions from fixed and mobile sources are considered. In the EU ETS, emission source refers to "a separately identifiable part of an installation or a process within an installation" (e.g. a boiler) (European Commission (a), 2012). Mobile sources in installations (such as forklifts) are not considered (European Commission, 2010, p. 7). In contrast to Mexico, where both direct emissions from fix and mobile sources, as well as indirect emissions associated with the consumption of electric and thermal energy are considered, the EU ETS system doesn't include indirect emissions. For the MRV training phase, data for indirect emissions can be further monitored and reported, but they should be separately designated. For a later full ETS, it is recommended for the sake of simplification and transparency that instead of implementing a complex mechanism to avoid double counting of emissions and therefore also double surrendering of allowances on both ends - supplier and end user -, the ETS scheme in Mexico should only consider direct emissions. It is recommended that the ETS scheme is designed in such a way that relevant electricity, heat or steam producers are subject to the scheme and therefore monitor and report their emissions themselves.

11 When source stream consists exclusively of biomass and is not contaminated with other materials or fuels. (Art. 38 (1) MRR)

The sectors recommended to be subject to the MRV training phase cover the “federal jurisdiction” industries, which also can be found in the recent Mexican phase of a voluntary simulation register. It covers the following activities: electricity, oil and gas, cement, glass, iron and steel, petrochemicals, aviation and pulp and paper.

## 3.2 Definition of entities and scope

### Definition of an entity

The entity of all stationary sources subject to EU ETS is called installation. According to Article 3 (e) of the EU ETS Directive 2003/87/EC “installation means a stationary technical unit where one or more activities listed in Annex I are carried out and any other directly associated activities which have a technical connection with the activities carried out on that site and which could have an effect on emissions and pollution.” In practice, the boundaries of an ETS installation are usually those defined in the GHG emissions permit issued by a competent authority in a Member State and the interpretation may vary between Member States. In some Member States, industrial sites (e. g. in the chemical industry) receive one overarching GHG emissions permit for the total site and are thus regarded as a single installation, whereas in other Member States, the same site could receive separate GHG emissions permits and thus be more than a single installation. Currently, according to the RENE Mexico is collecting data from entities called “establishments”. An establishment is a set of fixed and mobile sources with which a productive, commercial or service activity is performed, whose operation generates direct or indirect GHG emissions. The limits of an establishment subject to federal jurisdiction are defined per limits of the productive unit, settled in a permanent place, that carries out activities of transformation, processing, elaboration, assembly or maquila<sup>12</sup> (total or partial), of one or several products. (Federación, AVISO por el que se dan a conocer al público en general, el Instructivo General para obtener la Licencia Ambiental Unica, el Formato de solicitud de Licencia Ambiental Unica para Establecimientos Industriales de Jurisdicción Federal y el Formato de Cédula, 1997). It would be recommended that the considerations of an entity in a possible Mexican ETS shall be clear and transparent.

### Determination of the scope

The definition of thresholds for particular activities defines the scope of the system, because it defines which entity is subject and which is not subject to the system. A threshold could base on different criteria. In principle following approaches can be identified:

- ▶ Threshold based on production capacity
- ▶ Threshold based on annual production data
- ▶ Threshold based on annual emission level

In the EU ETS, most activities are defined based on a capacity threshold to decide which installation takes part in the ETS. The capacity threshold for the combustion activity is expressed by the total rated thermal input and the capacity threshold for industry activities is expressed by the production capacity. As the capacity is usually part of the Industrial Emission Directive (IED) permit of an installation or can at least be derived from manufacturer specification, no additional reporting effort is required to proof that an installation is or is not covered by the scheme. According to Art. 4 EU ETS Directive 2003/87/EC an emission permit is necessary: “Member States shall ensure that, from 1 January 2005, no installation carries out any activity listed in Annex I resulting in emissions specified in relation to that activity unless its operator holds a permit issued by a competent authority[...]”. In Germany for installations approved before 01/01/2013 (“existing installations”) under the provisions of the Federal Emission Control Act (Bundes-Immissionsschutzgesetz) the IED permit has the effect of an emissions permit. However, operators of existing installations can apply for a separate emissions permit (e.g. to clarify the installation boundary and the scope of application in order to gain legal certainty). New installations (entered into operation after 01/01/2013) receive a separate emissions permit issued together with the IED permit. National law in Germany has devolved responsibility for emission permits to the Federal State authorities, i.e. the authorities responsible for IED implementation.

In the current situation in Mexico, an emission permit is not compulsory. There is an environmental license that is given to the industries, called the Unique Environmental License (LAU per its acronym in Spanish) for the prevention and control of atmospheric pollution.

12 <http://www.investopedia.com/terms/m/maquiladora.asp>

LAU is granted by SEMARNAT and is required for the operation of federal jurisdiction industries. Although this license doesn't cover a greenhouse gas emissions permit, it could be referred for the capacity thresholds. In the LAU, the operator must specify the annual quantity generated of each product, as well as the direct and indirect inputs.

Currently, the reporting threshold established by the RENE is given by the amount of CO<sub>2</sub> emitted (>25,000 t CO<sub>2</sub>/year) (Mexican Official Gazette, 2014). When the threshold is given in terms of emission, a consequence is that the participation of the installation lies in the operation in the respective year. Although an installation may be exempted from the system, monitoring and reporting would still be necessary in order to prove each year that the installation complies with the threshold. This would lead to administrative costs for both the operator and those bodies verifying the data.

Despite the type of the threshold, the value of the threshold is important, because the selected threshold influences the costs of the system. Hence, it would be necessary to evaluate the costs of having a lower or higher threshold. For example, in the CTP, setting the threshold at 10,000 t CO<sub>2</sub>e/year would have increased costs by 35 % and cover only 1 % more emissions. To the contrary, increasing the inclusion threshold to 100,000 t CO<sub>2</sub>e/year could have saved 23 % of the costs and would cover 2.5 % fewer emissions (Bellasen, Stephan, & Jacquier, 2015, p. 533). This is difficult to compare with the EU ETS where the inclusion thresholds depends on rated thermal input in MW and production capacities, rather than emissions in t CO<sub>2</sub>e/year. Interestingly however, during phase II of the EU ETS, 64 % of installations had average emissions below 25,000 t CO<sub>2</sub>e/year (Bellasen, Stephan, & Jacquier, 2015, p. 177). For this reason, setting an appropriate threshold is important.

### Activities to be included

A result of this research is that by considering the emissions derived from fossil fuel combustion of 1,546 establishments, 97 to 99 % of the emissions of the 3,000 installations subject to federal jurisdiction are covered. If the 25,000 ton threshold remains as it is currently considered in the RENE, the size of the market would be composed of 419 installations. In emissions, the size of the market would represent almost 140 million tons of CO<sub>2</sub>. This represents 23 % of the emissions from the 1,546 establishments<sup>13</sup>.

## 3.3 Monitoring System

In Mexico, the RENE implements a bottom-up approach to determine the establishment's emissions. The given monitoring approaches are based on two types of methodologies: one is the "**standard emission factor approach**" and the other one is the "**direct measurement approach**". The standard emission factor approach is basically comparable to the determination of emissions for the national inventory according to 2006 IPCC guidelines except that it doesn't involve aggregating or extrapolating information. "[...] the 2006 IPCC guidelines are mostly based on a standard estimation method based on the consumption of fuels or materials or the amount of a produced product and multiply the consumption or production with specific emission factors." (Herold, Anderson, & Jörß, 2016) This means that in case of the standard emission factor approach, the establishment's emissions are determined in case of electricity producers by multiplying the quantity of a consumed fuel with its net calorific value and its standard emission factor. In case of other industry sectors the emissions are determined by multiplying the quantity of a produced product with a standard emission factor. The standard emission factors are set in the RENE and are taken from IPCC Guidelines. For fuels, also calorific values are needed to determine the emissions. They can be measured individually or be adopted from the resources provided by SEMARNAT. The latter is usually preferred by the entities. The quantity of fossil fuel used and the amount of produced product in the industry are determined by company records.

The direct measurement approach covers "**continuous emission monitoring system**" (CEMS) and "**balance of materials**". Different to the standard emission factor approach the calculation parameters have to be determined on an individual basis. For CEMS the concentration and the volumetric flow rate of the flue gas have to be determined in the stack. For balance of materials the emission factor and the net calorific value have to be determined via sampling and analyses and the quantity of the fuel or material entering or leaving the entity has to be measured.

<sup>13</sup> Research and calculations of the author, based on historical fuel consumption from the LAU.

According to the RENE, CEMS and balance of materials have to be used when it is technically not possible to apply the standard emission factor approach, when the carbon content of the materials or substances can't be determined or when the standard variation of the carbon content of the fossil fuel is greater than 10 %.<sup>14</sup> Due to the simplicity of the standard emission factor approach, due to a missing hierarchy of approaches and due to missing requirements that the entity has to provide evidence that the required approach cannot be carried out, there is no reason for putting a lot of effort in data monitoring. Hence, it is understandable that the direct measurement based approach hasn't been used so far by Mexican entities.

Different to Mexico, the EU MRR basically doesn't allow a standard emission factor approach<sup>15</sup>, where emissions are determined by production data multiplied with an emission value associated to that product. In fact, the monitoring and reporting in EU ETS either bases on the emission determination

- ▶ of the various source streams entering and - in case of mass balance - leaving the installation (calculation-based methodology) or
- ▶ of the installation's emission sources (continuous emission measurement methodology, CEMS).

According to the amount of the installation's total emissions and the amount of emissions associated with a source stream or an emission source, different data quality levels (so called "tiers") are required for the source stream/emission source and its parameters by the regulation. While installations with emissions of more than 50,000 t CO<sub>2</sub>e/year must fulfill highest tiers, an installation with emissions of equal or less than 50,000 t CO<sub>2</sub>e/year may use lower tiers. The higher the tier the more ambitious the requirement concerning the determination of the parameters and the more difficult and costly it is to meet the tier. In terms of the calculation based approach and the determination of the parameter "quantity of a source stream" higher tiers mean that the quantity has to be determined with a maximal uncertainty required by the regulation. The evidence that the maximal uncertainty is not exceeded has to be provided by an uncertainty assessment accompanying the MP. In the case of calculation factors, tiers represent the way calculation factors are derived. Lower tiers are usually associated with standard factors from different sources (international or national standard factors), higher tiers are associated with the determination based on sampling and analyses of the individual source stream. For the latter, the operator has to provide evidences together with the MP like a sampling plan agreed with the analyses laboratory.

Following table gives a very basic overview of the meaning of tiers within a calculation based approach (derived from Author, based on MRR):

**Table 1: Overview of tiers within a calculation based approach**

Tier	Quantity	Calculation factors
1	≤ ± 7.5 %	International standard factors
2	≤ ± 5 %	National standard factors
3	≤ ± 2.5 %	Individual determined based on sampling and analyses of the source stream
4	≤ ± 1.5 %	Not relevant

For installations emitting less than 25,000 t CO<sub>2</sub>e/year (so-called installations with low emissions) simplifications can be applied (e.g. determination of the source stream quantity based on purchasing records and estimated stock changes without providing an uncertainty assessment).

As cost effectiveness is an important concept in the EU ETS, it is generally possible for the operator to get approval from the competent authority to deviate from a specific MRR requirement based on the evidence of unreasonable costs or technical infeasibility.

### 3.3.1 Monitoring approaches

In order to rely on more accurate data in future and to avoid that all entities will proceed with choosing the standard emission factor approach, it is recommended to introduce a hierarchical structure to the existing RENE approaches:

<sup>14</sup> According to art. 2 of the "ACUERDO por el que se establece la metodología para la medición directa de emisiones de bióxido de carbon"(AGREEMENT establishing the methodology for the direct measurement of emissions of carbon dioxide) of the RENE.

<sup>15</sup> Exceptions for small installations e.g. subject to the ceramic activity (lower data quality requirements)

- ▶ “high level approach”: this approach covers the direct measurement approaches and recommends adaptations
- ▶ “standard level approach”: this covers the standard emission factor approach and recommends adaptations

### High level approach: Direct measurement approach

For the high level approach all necessary parameters have to be determined individually. The subject to report can use a calculation-based methodology (e.g. classic methodology or balance of materials methodology) or a methodology based on CEMS to determine the installation’s emission. Analogue to the definitions of methodologies in the MRR (Art. 23 MRR), RENE could define following:

For the classic methodology the operator shall calculate:

- ▶ combustion emissions per source stream by multiplying the activity data related to the amount of fuel combusted with the net calorific value (NCV), with the corresponding emission factor (EF) and with the corresponding oxidation factor,
- ▶ process emissions per source stream by multiplying the activity data related to the material consumption, throughput or production output with the corresponding emission factor (EF) and the corresponding conversion factor (CV).

For the balance of materials methodology the operator shall calculate:

- ▶ CO<sub>2</sub> quantity corresponding to each source stream included in the balance by multiplying the activity data related to the amount of material entering or leaving the boundaries of the balance with the material’s carbon content multiplied by 3.664 t CO<sub>2</sub>/t C.

Following requirements should be fulfilled for the respective parameter of a source stream:

- ▶ Activity data shall be determined based on measuring instrument(s):
  - ▶ all measuring instruments must maintain minimum accuracy of 5 %, as currently stated by the RENE,
  - ▶ measuring instrument(s) have to be installed and are operated in accordance with the manufacturer’s operational specifications
  - ▶ measuring instruments must be calibrated according to the procedures established by the manufacturer or methods used in the official Mexican standards or internationally known standards.
  - ▶ measuring instrument(s) are regularly calibrated by an ISO/IEC 17025 accredited institution<sup>16</sup> or by laboratories or personnel approved under the Federal Law on Metrology and Standardization.
- ▶ Calculation factors shall be determined based on sampling and analyses:
  - ▶ representative sampling has to be performed according to suitable ISO standards or national standards,
  - ▶ analyses have to be performed according to suitable ISO standards or national standards,
  - ▶ analyses have to be carried out by an ISO/IEC 17025 accredited laboratory or an equivalent non-accredited laboratory.

In case of CEMS relevant parameters (GHG concentration and flue gas volume) for the emission source have to be determined according to a suitable ISO standard or national standard.

### Standard level approach: Standard emission factor approach

Necessary calculation parameters can be taken from international or national lists of standard factors. The activity data of a source stream can be determined based on invoice data without providing any evidence of the measuring instruments’ quality. CEMS is not possible on this level.

## 3.3.2 Hierarchy of requirements based on different categories

For the purpose of distinguishing which entity has to carry out which approach it is suggested to introduce two categories of establishments based on the size of the establishment’s average emissions. Fossil fuel combustion historical data and process emissions calculations from the LAU could be useful to determine the average emissions of an establishment. Category “B” establishments emit more than 100,000 t CO<sub>2</sub>/year and category “A” establishments emit equal or less than 100,000 t CO<sub>2</sub>/year.

<sup>16</sup> ISO / IEC 17025 is the worldwide quality standard for test and calibration laboratories.

This represents an amount of 218 installations category “A”, while 201 installations are considered category “B”<sup>17</sup>. The threshold is deemed to be reasonable because this value represents the median of the calculated emissions from the selected industries (chemical industry, electricity, mining industry, paper industry, oil & gas, cement and glass).

In addition, based on the concept in the EU ETS where source streams are distinguished according to their associated emissions<sup>18</sup>, it is proposed also to introduce two different kinds of source streams to the RENE. In this proposal, streams are categorized in minor and major source streams. It is recommended that emissions of minor source streams jointly correspond to less than 5,000 tons of fossil CO<sub>2</sub>/year or to less than 10 % of establishment’s total emissions, up to a total maximum contribution of 100,000 tons of fossil CO<sub>2</sub>/year, whichever is the highest in terms of absolute value. All other source streams would be classified as “major source streams”.

Major source streams in category B establishment shall apply the high level approach. Minor source streams in category B establishments as well as all source streams in category A establishments shall apply at least the standard level approach.

### 3.3.3 Providing evidence

The setting of requirements in a regulation like the RENE is not sufficient if there is no third party checking compliance with the monitoring requirements. For this purpose, operators of establishments should be aware of the evidences needed to show that the data reported reaches the required quality (see chapter 3.3.2). These evidences should be provided together with the MP.

In the following table possible evidences are listed for the example of a calculation-based methodology in the high level approach. This could serve as a first suggestion for a future Mexican guidance that explains to the operators how to show evidence that the requirements are fulfilled:

**Table 2: Possible evidences for fulfilling the requirements (high level approach/calculation based methodology)**

Parameter	Requirement	Possible evidence
Activity data	All measuring instruments must maintain minimum accuracy of 5 %	Manufacturer’s specification
	Measuring instrument(s) have to be installed and operated in accordance with the manufacturer’s operational specifications	Manufacturer’s specification plus a description of measures for adhering to manufacturer’s specifications
	Measuring instruments must be calibrated according to the procedures established by the manufacturer or methods used in the official Mexican standards or internationally known standards.	Calibration certificate
	Measuring instrument(s) are regularly calibrated by an ISO/IEC 17025 accredited institution or by laboratories or personnel approved under the Federal Law on Metrology and Standardization.	Calibration certificate where the accredited laboratory is named (and a copy of institution’s accreditation certificate, as appropriate)
Calculation factor	Representative sampling has to be performed according to suitable ISO standards or national standards	Sampling plan agreed with the analysis laboratory
	Analyses have to be performed according to suitable ISO standards or national standards	Reference to the used standard
	Analyses have to be carried out by an ISO/IEC 17025 accredited laboratory or an equivalent non-accredited laboratory	Laboratory’s accreditation certificate, as appropriate

17 Derived by Author based on historical data and process emissions calculations from the LAU

18 MRR Art. 19:

**de-minimis source streams:** source streams selected by the operator jointly correspond to less than 1,000 tons of fossil CO<sub>2</sub>e/ year or less than 2 % , up to a total maximum contribution of 20, 000 tons of CO<sub>2</sub>e/year, whichever is the highest in terms of absolute value

**minor source streams:** source streams selected by the operator jointly correspond to less than 5,000 tons of fossil CO<sub>2</sub>e/year or less than 10 % , up to a total maximum contribution of 100, 000 tons of CO<sub>2</sub>e/year, whichever is the highest in terms of absolute value

**Major source streams** (all others source streams)

In Mexico, the RENE indicates that the precision and accuracy of measurements shall be established in a program of control and quality assurance. RENE commands that precision and accuracy of measurements shall be contained in an internal control system called *program of quality assurance*, but the regulation is not clear about what should be the content of this program. The importance of this document should not be underestimated and it is recommended that this program is added to the COA Web so that it can be accessible to the verifier and the competent authority. Moreover, as the verifier will revise this program of control and quality assurance, a procedure of revision and content of the program should be created.

## 4 Impact of the recommendations for possible linking option with the CTP in California

The Californian CTP has a threshold coverage of 25,000 t CO<sub>2</sub>/year and considers direct and indirect emissions (California Air Resources Board, 2014, p. §95101 b) 1)). Currently, the reporting threshold established by the RENE is also 25,000 t CO<sub>2</sub>/year considering direct and indirect emissions (Mexican Oficial Gazette, 2014). Emissions in the Californian CTP and in the recommended Mexican ETS may be calculated or measured and the process is done every year. This way, the structure of the CTP fits with the existing reporting system in Mexico and could facilitate the linking.

In terms of the operational structure at the CTP, a written MP has to be elaborated by the entity and retained for review by a verifier or the California Air Resource Board (California Air Resources Board, 2014, p. §95105 (c)). As recommended before, introducing a MP as a requirement in Mexico would be another useful instrument and facilitate linking. As an *approved or verified* MP provides security for the operators MRV activities, the verifier could check compliance of the MP with the regulation requirements before the reporting period and has to verify emission reports after the reporting period. This is different to CTP. However, it would provide Mexican establishments with necessary information and security after a change in the legal MRV requirements and would be already a quality assurance at the beginning of the reporting period in the MRV training phase. For a later stage, an evaluation of the compliance cycle should ensure a robust and integer GHG reporting system (see chapter 2.2.2).

Data quality is also very important. CTP and the recommended Mexican ETS also consider tiers (data quality levels). Mexican ETS proposes a two level tier approach (higher and standard approach). If desired, it is believed that it would be relatively easy to link this approach to the Californian Monitoring approach. In the case of accuracy level of measuring instruments, both, the Californian and proposed Mexican approach must maintain minimum accuracy of 5 % (California Air Resources Board, 2014, p. §95103 k) (10)). This is a less stringent requirement than in the EU ETS.

In California, regardless the compliance obligation of entities, there is a mandatory reporting of annual emissions for cement, lime, nitric acid production, petroleum refineries, injection of CO<sub>2</sub>, and sequestration of CO<sub>2</sub> entities. Moreover, there are other entities enquired to report when their emissions are higher than 10,000 t CO<sub>2</sub> per year<sup>19</sup> (California Air Resources Board, 2014, p. §95101). The recommended scenario for Mexico states that it is possible to continue reporting despite the ETS threshold could be different.

In Mexico, the reporting entity must obtain a third-party verification service, which gets an accreditation from the NAB and an approval from the CA that consists on an administrative revision. This is different in California, where the CA serves as an accreditation body and has outlined specific provisions (i.e. mandatory attendance of training, auditing of site visits and company QA/QC measures) under its *verifier accreditation program* (California Air Resources Board, 2017). This difference is only formally based as the Californian Air Resource Board acts similar to a NAB.

Also for better linking conditions, Mexico should consider to accredit verifiers according to the scope of expertise for the particular sector (activity) as in the CTP (California Air Resources Board, 2014, p. §95131 (a) (2)). For the QA/QC process and the integrity of reported GHG data, the verifiers' knowledge and the reliability is of great importance. Therefore, the verifier should be qualified in the scope of the establishment subject to verification.

19 Stationary combustion, glass, hydrogen, iron and steel production, pulp and paper manufacturing, petroleum and natural gas systems geothermal electricity generation.

## 5 Closing Remarks

Monitoring process provides data to generate information that gives the metrics for policy makers to take decisions. As good decisions are always backed up by appropriate and reliable data, the implementation of an MRV training phase in Mexico that will allow the so called “subject to report” to gain experience with an MRV system is suggested. Moreover, data collected in the proposed MRV training phase could be used by the competent authority for the cap setting. Recommendations for adjusting and improving MRV approaches in the RENE as well as methodical and technical considerations as providing threshold recommendations and the introduction of a hierarchical emission determination were derived. Further recommendations consist in adjusting the current compliance cycle, the modification of the verification process, as well as information exchange between the CA and the rest of the market participants. In addition the proposed recommendations and an analysis of California CTP allowed to provide first view to the possibility of linking the California CTP and recommended Mexico ETS.

## 6 Abbreviation table

AER	Annual emissions report
AVR	Accreditation and Verification Regulation
BMV	Bolsa Mexicana de Valores, per its acronym in Spanish (Mexican Stock Exchange)
CA	Competent authority
CEMS	Continuous emission measurement system
COA	Cédula de Operación, per its acronym in Spanish (Annual Operation Certificate)
CO <sub>2</sub>	Carbon dioxide
CTP	Cap and Trade Program
DEHSt	Deutsche Emissionshandelsstelle (German Emissions Trading Authority)
EMA	Entidad Mexicana de Acreditación, per its acronym in Spanish (Mexican National Accreditation Body)
ETS	Emission Trading Scheme
EU	European Union
EU ETS	European Union Emission Trading Scheme
GHG	Greenhouse gas
IED	Industrial Emission Directive
IMNC	Instituto Mexicano de Normalización y Certificación, per its acronym in Spanish (Mexican Normalization and Certification Institute)
ISO	International Organization for Standardization
LAU	Licencia Ambiental Única, per its acronym in Spanish (Unique Environmental License)
LGCC	Ley General de Cambio Climático, per its acronym in Spanish (General Climate Change Law)
LGEEPA	Ley General de Protección al Ambiente, per its acronym in Spanish (General Environmental Protection Law)
MP	Monitoring plan
MRR	Monitoring and Reporting Regulation
MRV	Monitoring, reporting and verification
NAB	National Accreditation Body
NAFTA	North American Free Trading Agreement
NCV	Net calorific value
N <sub>2</sub> O	Nitrous oxide
PROFEPA	Procuraduría Federal de Protección al Ambiente, per its acronym in Spanish (Federal Environmental Authority)
PFC	Perfluorcarbone
QA/QC	Quality assurance and quality control
RENE	Reglamento Nacional de Emisiones, per its acronym in Spanish (National Emissions Registry Regulation)
SEMARNAT	Secretaría de Medio Ambiente y Recursos Naturales, per its acronym in Spanish (Environmental Ministry)
TEHG	Treibhausgas-Emissionshandelsgesetz, per its acronym in German (German GHG Emissions Act)

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