THE WORLD BANK PARTNERSHIP FOR MARKET READINESS

CHILE PMR ACTIVITY 1
MRV, COMPLIANCE AND REGISTRY

Report
An Input to the Chilean Market Readiness Proposal (MRP)
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1. INTRODUCTION

Quantifying greenhouse gas emissions using robust systems for their monitoring/measurement, reporting and verification of (MRV) are an indispensable pre-requisite to the monetization of greenhouse gas emissions reductions and the creation of carbon markets. MRV is to carbon markets what the introduction of (gauged) weigh scales to ancient goods markets was. It is only with the introduction of common standards that market participants can trust in the traded goods and that markets can develop and flourish.

MRV in carbon markets is critical to setting baselines, and measuring performance against baselines, as well as for developing reliable company wide, city or provincial level or national carbon inventories. For all crediting mechanisms, MRV is an indispensable requisite to assure the economic value of credits and their environmental integrity.

In general, different MRV systems do not differ fundamentally in their approach. Usually emissions are calculated as the product of activity data (e.g. tonnes of fuel oil consumed) times an emissions factor (e.g. 3.14 ton of CO\textsubscript{2} per ton of fuel oil consumed). Monitoring, reporting and verification is all about how to obtain reliable data on activity data (and to a lesser extent on emission factors). Experience shows that building robust MRV systems is as much about process design and institutional setting as about technical issues of monitoring.
Objective and approach

The main objective of the study on Activity 1 is the development of a draft roadmap for MRV, compliance and registry systems in Chile that follows international best practice and builds on existing MRV related capacities in Chile.

The study starts with a short overview on the different aspects of MRV (Chapter 2). It then provides stock taking of key features of MRV, compliance and registry systems for (i) crediting mechanisms and (ii) emissions trading systems as well as lessons learned from existing systems and defines MRV requirements for these two strands based on international best practice in many countries (Chapter 3). This is followed by an overview on main existing MRV systems and related technical and institutional capacity and legal framework in Chile (Chapter 4). A gap analysis compares the existing MRV capacity to the identified best practices and identifies the relevant gaps on technical, institutional and regulatory levels. This forms the basis to formulate a draft MRV roadmap for both (i) crediting mechanisms and (ii) emissions trading (Chapter 5).
2. SETTING THE SCENE ON MRV

During the last year, Measurement (M), Reporting (R) and Verification (V) have taken an increasingly prominent role in climate change negotiations (UNEP 2012a). UNEP (2012a) outlines different approaches of MRV, which have been adopted in different kind of international treaties such as e.g. the Montreal Protocol or in institutions like the International Atomic energy Agency (refer also to Table 1). Especially under the Clean Development Mechanism (CDM) MRV has become a very important element. The common aspect of all these examples is that a baseline or base case is defined, from which a deviation is desirable, as well as a measurement and reporting system and a verification system.

2.1. WHAT IS MRV?

MRV of greenhouse gas emissions (GHG) has been implemented in a variety of ways in different kinds of systems and on different levels. The key objective of a sound MRV system is to provide credibility to any kind of agreement.

**Monitoring/Measurement** can be defined as a means “to describe a phenomenon in reasonably precise, objective terms, that is, in terms of an established standard or unit of measurement” (Breidenich, C. and Bodansky, D. 2009). In most cases, greenhouse gas emissions are not directly measured (i.e. by putting sensors in a chimney), but they are calculated from activity data and emission factors (IPCC 2006). An example for activity data is the amount of fuel (coal, fuel oil, natural gas, wood) used.

**Reporting** refers to the transparent provision of measured data and information. Key success factors for a reporting include the precision and reliability of the reported information, as well as the transparency and standardised way of reporting, which then allows the comparison between different reporting activities (Breidenich, C. and Bodansky, D. 2009).

**Verification** generally refers to the process of independently checking the accuracy and reliability of reported information or the procedures used to generate information. Within the climate policy community, two systems of verification are common: the verification by independent experts (e.g. the UNFCCC and Kyoto Protocol’s expert review team process for country compliance) and the verification by accredited private third-parties (e.g. the Designated Operating Entities DOEs, which are accredited by the CDM Executive Body for verifying CDM projects) (Breidenich, C. and Bodansky, D. 2009).
2.2. LEVELS OF MRV

MRV systems are relevant on different levels. Table 1 provides an overview:

<table>
<thead>
<tr>
<th>MRV ON DIFFERENT LEVELS</th>
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</thead>
<tbody>
<tr>
<td><strong>Level of MRV</strong></td>
</tr>
<tr>
<td>National GHG Inventory</td>
</tr>
<tr>
<td>Energy Balance IEA</td>
</tr>
<tr>
<td>NAMA</td>
</tr>
<tr>
<td>Emissions Trading Scheme (EU - Downstream)</td>
</tr>
<tr>
<td>Crediting Mechanisms</td>
</tr>
</tbody>
</table>

Table 1 Source: INFRAS

**Factors determining the choice of an MRV system**

When implementing a MRV system three questions may be answered in advance; what is the subject for MRV? What is the objective of MRV? What is the level of accuracy required for MRV? A possible differentiation of existing MRV systems and their objectives can be summarized as following:
### OBJECTIVES OF MRV AND EXISTING EXAMPLES

<table>
<thead>
<tr>
<th>What is the subject?</th>
<th>Existing MRV systems on different levels</th>
</tr>
</thead>
</table>
| MRV of GHG emission in absolute levels | - National level: National GHG inventory (NIR-CRF system)  
- Sectoral level: IEA  
- Entity level: JVETS, Climate registry, Carbon Disclosure Project (CDP)  
- Installation level: EU-ETS, RGGI |
| MRV of GHG emission reductions/removals i.e. emissions relative to baseline (reference) emissions path | - Policy level: e.g. NAMAs  
- Project level: CDM, JI |
| MRV of GHG emission intensity i.e. emissions relative to output (e.g. t CO₂ per ton of steel produced, or t CO₂ per GDP) | - National level, e.g. 2020 emission reduction pledges of some countries  
- company level, e.g. early UK emissions trading scheme |
| MRV of GHG mitigation policies and measures | - National Communication under the UNFCCC |

Table 2 The overview is adapted from IGES 2011.

### 2.3. POINT OF OBLIGATION

Furthermore, the design of a MRV system depends on the chosen approach regarding the *point of obligation*. In terms of an Emissions Trading System (ETS), this means that one has to define the entities that will have the legal requirement to surrender allowances against the emissions for which they are held responsible. This can either be up- or downstream. For instance, in the European ETS (EU ETS), points of obligations are essentially downstream at the point of fuel use (e.g. coal use for steel production is measured at the installation level). On the other hand, in the NZ ETS, points of obligations in the energy sector are essentially upstream (e.g. at the point when fossil fuels are introduced into the economy) (EU ETS, PMR 2012).

### 2.4. TYPES OF EMISSION SOURCES

MRV approaches differ for different types of emission sources. The following sources may be distinguished:

a. **Point sources:** In this case, large GHG emissions result from “one stack”. An example is a coal fuelled power plant or the N₂O emissions from a chemical production plant for nitric acid. Monitoring is centralized and limited to one specific plant.
b. **Dispersed sources:** In this case, large emissions result from a large number of small dispersed emission sources. An example here are emissions from coal based space heating in households or from passenger cars. Here, monitoring of every individual emissions source (e.g. household or car) may be too expensive. Therefore the monitoring has to use different approaches, including:

a. *Upstream monitoring:* Emissions calculations are based on the aggregated fuel consumption of the population of emission sources. E.g. the amount of coal sold to a specific municipality by fuel suppliers is recorded, or the total amount of gasoline used for a company fleet is recorded.

b. *Random sampling:* In this approach the consumption of individual emission sources is sampled randomly with a statistically representative procedure (e.g. by interviewing households about their coal bills). From this, the total emissions of a population can be extrapolated.

c. *Modelling:* In this case the consumption of fuels is calculated based on model calculations, e.g. building models that simulate the heat demand and efficiency of space heating. Also in transport, modelling is often used to estimate fuel consumption, with varying success.

d. *Heterogeneous approach:* In many cases, a combination of approaches a) to c) is used, e.g. a transport model builds on samples of traffic volumes and is cross checked by city-wide (upstream) fuel consumption estimates.

Strengths and weaknesses differ among different source types and monitoring approaches. Great challenges arise when MRV shall be conducted for emissions from AFOLU (Agriculture, Forestry and Other Land Use), which are not analysed in detail here.
3. REQUIREMENTS FOR AN MRV SYSTEM

3.1. GENERAL REQUIREMENTS FOR MRV

An important goal of a MRV system is reaching **environmental integrity**. This will be reached if the system ensures high levels of completeness, accuracy and consistency (see e.g. Castro et al. 2011). Meaning that all GHG emissions from all sources covered by the respective scheme, need to be monitored and reported and that emission determination should be systematic and thus resulting in data neither under, nor overestimation of emissions. Furthermore, uncertainties should be reduced as far as practicable and quantified to the extent possible. In the interest of environmental integrity, wherever uncertainties in determining emission levels are remaining, conservative assumptions should be taken (i.e. if there exists a range in the resulting emission reductions, the lower boundary should be taken). Also, emissions data should be comparable over time by using consistent monitoring methodologies; monitoring methodologies should only be changed if the new methodology ensures improved completeness or accuracy.

**Data availability** is a further criterion to be considered while developing a MRV system. All data required to determine baseline and actual emissions shall be available within reasonable transaction cost. Data availability may also be limited if some data is considered as sensitive or confidential.

The **transparency** aspect is determined by the questions whether one is able to make the gathered emission data publically available for any interested person or bodies.

**Cost-efficiency** of the MRV system might be a further key criterion to consider. The system should be balanced against the additional costs and shall not result in unreasonably high costs (see also data availability above).

Special focus shall also be given to the **institutional feasibility**. It is normally easier not to re-invent the wheel. One has to consider to which extent already existing bodies can be mandated with the required tasks in data collection, processing, verification, aggregation etc.

Last but not least one should think about **adjustability**. The system shall be designed in a way that the methodologies may be adjusted if more accurate data, measurements or methodologies become available.

Under the current PMR Study, two different systems are being analysed in more detail:

› **Crediting Mechanisms** (that are further developed in PMR Activity 3) and

› **Emissions Trading Systems** (PMR Activity 2).
The following chapter thus provides stock taking of MRV features along these two strands as well as lessons learned from existing systems.

3.2. MRV FOR CREDITING MECHANISMS

The objective of this section is to aid the Chile policy makers to familiarize and facilitate with a better understanding of the MRV already deployed under Kyoto and voluntary crediting mechanisms. Two existing strands of MRV can provide lessons for designing a new system for crediting: MRV of project based market mechanisms such as the Clean Development Mechanism (CDM) under the Kyoto Protocol and MRV of national climate change mitigation actions and greenhouse gas inventories (Oko Institut et al, 2011). This section provides an overview of the modalities and procedures related to MRV for project based mechanisms (crediting scheme). The evolution of the mechanisms at UNFCCC level is described 3.2.1. A snapshot of the proposed standards and protocols for NAMAs and NMMs is also covered along with the existing mechanism in Table 1. The design requirements of the core components along with the regulatory and institutional options are discussed for the crediting mechanisms. The essential part of any mechanism, capacity building requirements is covered in this section as well.

3.2.1. OVERVIEW OF CREDITING MECHANISMS

The UNFCCC successfully launched the Kyoto track in 1997 followed by the establishment of Modalities and Procedures for the Kyoto Protocol’s flexible mechanisms (namely the Clean Development Mechanism (CDM), Joint Implementation (JI) and International Emissions Trading (IET)) at COP7 in Marrakesh (2001). The modalities and procedures defined how the MRV of project based offsets would take place.

The MRV of project based offsets such as the CDM, with its established methodologies, rules and institutions can provide lessons for designing a possible future MRV system in Chile. As an effort to scale up CDM projects and simplify the MRV requirements of each project, the commencement of Programme of Activities took place at COP13 (2007), which signified a major theoretical step to scale GHG emission reductions in developing countries. Despite the “weak” climate change agreement outcome in late 2009 at COP15 in Copenhagen (2009), the negotiations were a breakthrough on several fronts addressing market based crediting mechanisms: the prospects increased for a new mechanism that aims at Reducing Emissions from Deforestation and land Degradation (REDD) and the procedures for autonomous (self-
funded) and supported (Annex I sponsored) Nationally Appropriate Mitigating Actions (NAMA) for developing countries were outlined. The development of REDD and/or NAMA crediting mechanisms would likely require alterations to the current MRV system, which is designed specifically for the project-by-project approach.

Given the strong emphasis by UNFCCC in evolving the crediting based market mechanisms, both the existing and the new crediting mechanisms require MRV systems that enable a transparent accounting of their contribution to GHG emission reductions. Such a MRV system has two main components:

- Baseline determination, i.e. the emissions that would occur in absence of the crediting mechanisms
- Determination of project emissions

A brief overview of current and potential future crediting mechanisms and their MRV requirements is presented in Table 3 below. The table compares CDM/JI with other crediting mechanism concepts that are currently being conceptualised and that could theoretically serve as a blueprint for a Chilean crediting mechanism and it outlines the respective MRV requirements:
### MRV REQUIREMENTS OF CURRENT AND POTENTIAL FUTURE CREDITING MECHANISMS

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Basic Principles</th>
<th>Requirements on MRV</th>
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<tbody>
<tr>
<td><strong>Existing UNFCCC Crediting Mechanisms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDM/JI (including PoAs):</td>
<td>- Allows emission-reduction projects in developing countries (CDM) and projects in Annex-1 countries (JI), to earn credits, each equivalent to one tonne of CO2. These credits can be used by Annex-1 countries to meet a part of their emission reduction targets under the Kyoto Protocol. - The mechanisms offer Parties a flexible and cost-efficient means of fulfilling a part of their Kyoto commitments, while the host Party benefits from foreign investment and technology transfer to stimulate sustainable development and emission reductions that are additional to what would otherwise have occurred. - The PoA procedure provides a framework for implementing one or more interrelated types of programme activities (CDM or JI) and it is aimed at achieving economies of scale for project participants.</td>
<td>- i) Monitor GHG reductions ii) compile monitoring reports, and iii) submit reports for external verification by UNFCCC accredited third party(ies). - MRV does not account for sustainability effects of projects though can be monitored, if developed under additional criteria. - Emission reductions against the baseline emissions and project emissions and leakage are estimated for CDM/JI.</td>
</tr>
<tr>
<td><strong>Possible blueprints for a sectoral crediting mechanism</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NAMAs, and other crediting mechanisms</td>
<td>- A NAMA specifies voluntary activities of GHG emissions mitigation in developing countries that are not subject to mitigation commitments and can be supported by industrialized country financing, technology or capacity building. - Potential measures under a NAMA are various and can become a mix of actions over various sectors, policies, measures, programmes. – There are different kinds of NAMAs: those funded with domestic resources (“unilateral NAMAs”) and those requesting international support (“supported NAMAs”). However, the concept of credited NAMAs is not currently officially defined under the UNFCCC.</td>
<td>- Mitigation actions by developing countries shall be communicated every two years via biennial update reports and through national communications every four years. The Subsidiary Body for Implementation (SBI) will be conducting international consultations and analysis (ICA) of these biennial reports to improve transparency of mitigation actions, which should be measured, reported and verified. - MRV of unilateral NAMAs will be conducted domestically. According to agreements so far, the general guidelines for domestic MRV are to be developed by Subsidiary Body for Scientific and Technological Advice (SBSTA). - Supported NAMAs are subject to ICA according to guidelines by the COP. - Credited NAMAs would be subject to more strict MRV re-</td>
</tr>
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</table>
The new market mechanisms could generate carbon credits that can be used to meet part of developed countries targets under the UNFCCC. The new market mechanisms namely the “Sectoral Trading” mechanism (e.g. a cap-and-trade scheme) and “Sectoral Crediting” (e.g. based on a baseline-and-credit approach) intends to cover a whole sector or sub-sector in a developing country (rather than individual projects such as the CDM does).

MRV will be based on the outcome of the climate negotiations, depending mainly whether these mechanisms are governed internationally coordinated or not. Common rules accounting would largely ensure environmental integrity. The underlying elements of MRV in the CDM process may still play a significant role, though new elements would need to be developed in order to recognize sector wide measures.

Implement joint projects between developed and developing countries. These credits are meant to become an integral part of the developed country’s efforts to globally reduce GHG.

There is no common MRV-methodology developed for bilateral offset mechanisms as of yet. The rules are currently defined by countries involved and may also differ accordingly.

REDD is an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands. “REDD+” goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stock.

A combination of remote-sensing and ground-based assessments including reference levels and forest inventories could be one suitable approach for estimating and monitoring reductions in emissions. Different methodologies and tools exist that can be used to estimate emission reductions, as well as carbon stock changes associated; new methodologies and tools are emerging.

<table>
<thead>
<tr>
<th>Sectoral approaches / New market based mechanisms</th>
<th>Bilateral (offset) mechanisms</th>
<th>REDD+</th>
</tr>
</thead>
<tbody>
<tr>
<td>- The new market mechanisms could generate carbon credits that can be used to meet part of developed countries targets under the UNFCCC. - New market mechanisms namely a “Sectoral Trading” mechanism (e.g. a cap-and-trade scheme) and “Sectoral Crediting” (e.g. based on a baseline-and-credit approach) intends to cover a whole sector or sub-sector in a developing country (rather than individual projects such as the CDM does).</td>
<td>- Implement joint projects between developed and developing countries - These credits are meant to become an integral part of the developed country’s efforts to globally reduce GHG.</td>
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</tr>
</tbody>
</table>

Table 3 Overview of current and potential future crediting mechanisms and their MRV requirements.
Project level MRV has centred on projects proposed by developing countries under the CDM, which require detailed emissions reporting and verification. Accredited verifiers go to each project site in order to evaluate emission reduction activities and consult with project stakeholders. Sector wide MRV would possibly be used to track and report the implementation and success of actions and progress for both autonomous and supported types. A visit to all project sites in an industry sector wouldn’t be feasible. Therefore Sectoral MRV may involve sampling methods and all more flexibility in the MRV approach. It may also have parameters beyond emission reductions for monitoring, namely sustainable development indicators, capacity building levels, domestic investments related etc, as these have been factors that receive a significant amount of domestic and international attention. The quantitative aspects of measuring and reporting at both project and sectoral levels are similar. Although, the comparability of the outcome of the MRV between countries for sectoral level depends on how targets and baselines are established, and whether they differ between countries.

At the project level, besides CDM, voluntary crediting mechanisms exist. Amongst various voluntary standards, Voluntary Carbon Standard (VCS) is the most prominent and offers more flexibility and is less stringent than the CDM. MRV in VCS is largely based on the ISO 14064-3 and does not review the project submitted for registration, unlike the CDM Executive Board. VCS relies only on the completeness check carried out during the validation and verification by its accredited independent third party. Unlike CDM, VCS is built on pre-approved project protocols making the emission reductions calculations more straightforward and verification activities less dependent on project specific situations. With VCS, if the project is suitable for the protocol then additionality has already been achieved through the underlying activity, whereas with the CDM, the additional test is applied to an activity. CDM was built on bottom up approach and evaluates the eligibility on a project by project basis, stipulating a detailed and comprehensive MRV structure.

3.2.2. CORE TECHNICAL COMPONENTS AND OPTIONS FOR MRV STANDARDS

This section provides a detailed account of the core technical components and options for the domestic and international MRV standards for crediting mechanisms. The procedural aspects of MRV for the crediting mechanism are also covered in this section with specific exemplification based on CDM experiences. The differences between CDM and voluntary mechanisms are further elaborated in this section. It also includes a brief account of the ongoing discussions and development for the sectoral MRV.
1) Main MRV components

The two main components of MRV are the baseline determination and the determination of emission level.

**Baseline determination**: The estimation of the emissions that would occur in absence of the crediting mechanisms is termed as “baseline” and such emissions are baseline emissions. Baseline estimates are needed to determine the effectiveness of any emissions reduction programs.

The baseline (scenario and emissions) for a CDM project activity is the scenario that reasonably represents GHG emissions that would occur in the absence of the proposed project activity (UNFCCC 12g). In other words, a baseline for a CDM project activity is a hypothetical reference case, representing the volume of greenhouse gases that would have been emitted, if there would be no CDM. Therefore, the baseline can be used to determine:

› whether a CDM project activity is additional; and
› the volume of additional greenhouse gas emission reductions achieved by a CDM project activity.

Baselines must cover emissions from all gases, sectors and source categories listed in Annex A to the Kyoto Protocol that occur within the project boundary.

Baselines for CDM projects are established using a baseline methodology already approved by the CDM Executive Board (CDM EB). These methodologies allow project participants to quantify the estimated emissions in the most plausible alternative scenario to implementation of the project activity (the baseline scenario). The methodologies are aided by tools that directly facilitate the calculation of emission factors, upon selection of a specific baseline scenario. These
tools include generic approaches to emissions estimation and provide often options for different levels of data availability. The tools may be used for the build-up of standardized approaches. There exist several approaches for the baseline determination (Füssler 2012) which are outlined as following:

› Historical performance on project site
› Name plate performance
› Default values
› Operating and built margin
› Reference system or modelling of baseline
› Current performance
› Conservativeness and uncertainty
› Applicability of methodology

The above principles for establishing the baseline for a CDM project comprehensively applies for any crediting mechanism (at project or at sectoral level). The process in establishing the baseline has to be stringent, transparent, conservative and consistent enough to ensure that the MRV framework is established on solid grounds.

**Determination of emission level after crediting mechanism implementation:** The determination of emission level after crediting mechanism implementation is primarily based on the monitoring methodology selected along with the baseline scenario and the methodology to estimate the baseline emissions. Both the baseline methodology and the monitoring methodology must be specified in the project design document (PDD) of a CDM project. Additional requirements post-implementation are related to estimation of project emissions and emissions due to leakage. These two emissions are required to be deducted from the emission reductions generated by the project activity after implementation.

**MRV of project emissions:** A monitoring methodology sets out how project proponents should develop and implement a monitoring plan for a particular project type, in order to gather the data required to calculate emission reductions from the project.

Application of the monitoring methodology for a CDM project after implementation determines whether the project achieves emission reductions after considering the project emissions and the leakage based on the methodology. It is the means to calculate the actual emission reductions from the project, taking into account any emissions from sources within the project boundary.
Independent verification of the monitoring report (prepared by project participants) by the UNFCCC accredited Designated Operational Entity (DoE) will enable the project participants to claim the issuance of certified emission reductions (CERs) from the CDM EB. The monitoring report will provide a detailed account of the calculations used for estimating the ex-post baseline emissions, project emissions and leakage (if applicable). The project emissions and the leakage emissions must be deducted from the emission reductions generated by the project activity and CERs are only issued in respect of the net reduction in emission brought about by the project, once these emissions are taken into account (The CDM Rulebook).

The determination of emission level after crediting mechanism implementation hinges on the development of a robust monitoring plan and preparation of the monitoring report based on it and in compliance with the applicable choice of monitoring methodology/approach.

An illustration of a typical baseline and project emissions and the resultant emission reductions for a GHG mitigation project is provided in Box 1 below.

**Box 1. Illustration of a typical GHG mitigation project – Baseline Vs Project Emissions**

Project participant A decided to implement a fuel switch project in its industry from furnace oil to natural gas under the Clean Development Mechanism. The project is developed as a small scale CDM project (maximum emission reductions of 60 kilotons of CO$_2$/year) and belongs to Type – III category (Other activities).

**Baseline Scenario:** The baseline scenario is continued use of furnace oil for energy generation and consumption in the industry. Thus the fuel switch (from furnace oil to natural gas) will replace the furnace oil.

**Baseline Emissions (BEy):** Based on the selected baseline scenario, the baseline emissions will be those GHG emissions generated by the combustion of furnace oil for energy generation. The major parameters required to estimate the exact quantity of the baseline emissions are the carbon emission factor (CEF), net calorific value and the quantum of the furnace oil consumed in the baseline scenario.
Baseline Methodology: The baseline methodology will be AMS-III.B which is one of the approved methodologies by CDM EB for small scale CDM projects under the Type – III. AMS-III.B provides the procedure for estimating the baseline emissions in the project boundary.

Monitoring methodology: The monitoring methodology outlines the parameters which must be monitored after project implementation namely the natural gas and energy output.

Project Emissions (PEy): The project emissions in this project are those emissions generated by the combustion of natural gas in the project activity.

Leakage: There is no leakage emissions to be calculated under the methodology AMS-III.B

Emission Reductions (ERy): The emission reductions achieved by the project activity will be calculated as the difference between the “baseline emissions” and the “project emissions”

\[ ERy = BEy - PEy \]

However, it has to be noted that when moving from the project to the sectoral level, new MRV elements and procedures will likely be necessary to be developed. MRV protocols that fit the sector context and can be operated at reasonable costs should be applied. Hence, standardisation is a very important element for sector wide MRV.

Moreover, the role of national MRV institutions will become more important with regards to sectoral crediting mechanisms, as countries traverse from a project-by-project approach to more economy wide measures. The risks of miscalculation increases as sampling and flexibility are employed. However, carbon markets can only price carbon appropriately when stringent GHG data underpins the system, so high quality data gathering and monitoring systems must be in place if project based mechanisms are used or NAMA crediting becomes more prominent.

2) Main MRV approaches used in the CDM

The basis of MRV in CDM is determined by the following layers:

1) Approved Methodology
2) Monitoring Plan
3) Monitoring Report

As discussed in the following.
Layer 1: General methodological approach as pre-scribed in the approved Methodology

The CDM requires application of a baseline and monitoring methodology in order to determine the amount of Certified Emission Reductions (CERs) generated by a mitigation project in a project host country.

The methodology provides a vivid list of activities that are eligible to use it and specifies the distinct boundary for qualifying projects. The formulas, default values and the procedures for estimation of baseline emissions, project emissions and leakage emissions are further detailed in the methodology for estimating the emission reductions.

The monitoring methodology is a means to calculate the actual emission reductions from the project, taking into account any emissions from sources within the project boundary. A monitoring methodology sets out how project proponents should develop and implement a monitoring plan for a particular project type, in order to gather and archive the data required to calculate emission reductions from the project. The list of parameters required to be monitored post-project implementation is enumerated under the monitoring methodology. References to allowing combination with other approved methodologies are also specified. Additional considerations for applying the methodology if used for PoAs are also listed in the methodology.

Above all, the methodologies are also guided by tools for estimating emissions from specific activities or sources and to determine additionality.

Baselines setting and data needs: A consistent assessment and determination of a baseline is crucial since overestimated baselines can result in fake CERs being issued, leading to a reduced integrity for the whole CDM (Sugiyama and Michaelowa 2001). It is also necessary as the notion of a hypothetical baseline introduces perverse incentives for project developers to keep it high in order to claim more CERs. The calculation of baselines on a project-by-project basis involves significant data collection and information requirements.

The methods described in the methodology as regards use of data for estimation of emissions can cause discrepancies. The major challenge is to carryout check and balances to avoid situations where different baseline calculations are possible, even if applying the same methodology for the CDM projects, thereby increasing the subjectivity of the process.

The complexity of the baseline directly reflects on the data needs to estimate the baseline emissions. The data needs may refer to historical situations, continuous performance assessment, benchmarks, default values, nameplate details, discounted values, deemed values etc. Striving to simplify the data needs may lead to trade-offs / compromising on the accuracy, the integrity as the time (delay) and costs prohibit a comprehensive search, retrieval and application of data for...
calculations. Hence a cautious and a well-balanced approach is emphasized while deciding on the type and the extent of data requirements. While the data availability is a major concern in many developing countries its authenticity poses another level of challenge. A successful endeavour by several developing countries in establishing their country’s (and regions’) grid (carbon) emission factor is seen as a leading example for simplifying the process of baseline setting and access to right data needs. The project participants and the consultants have significantly benefitted by using such data in estimating the baseline emissions (and therefore the emission reductions) for their grid connected renewable energy projects.

**Layer 2: Monitoring Plan** for the specific CDM project as part of the Project Design Document

According to the Marrakech Accords, a project’s monitoring plan should include a description and justification of the project boundary, identification of data that needs to be collected, quality assurance/control procedures and a list of potential sources of leakage. Implementation of the monitoring plan is a condition for verification, certification and issuance. Thus the monitoring plan serves as a cookbook for a successful MRV framework.

The data to be monitored and recorded as per the monitoring plan ultimately is used for determining the emissions from various GHG sources within the project boundary, baseline emissions, project emissions, leakage and the emission reductions. The monitoring plan should also essentially provide an outline of any training to be offered to project operators to carry out the related monitoring and reporting activities.

Monitoring is implemented through the monitoring plan which is normally included in the project design document submitted for registration. The number of CERs to be issued to the project is calculated based on the data obtained from the monitoring plan, applying the registered methodology, subtracting actual emissions and adjusting for leakage.

A well prepared monitoring plan increases the transparency, predictability and comparability of CERs generated from CDM projects. At the same time it also facilitates smooth verification and reduces the costs of verifying emission reductions.¹

¹ Information Paper: Developing guidance on monitoring and project boundaries for greenhouse gas projects, OECD, 2002
Layer 3: Monitoring Report as a basis for verification and issuance for CERs from CDM projects

The monitoring report is the key and the only document prepared post registration and implementation of a CDM project activity for claiming GHG emission reductions. The project participants will have to submit a monitoring report to the DOE contracted to conduct verification and certification of the emission reductions from the project.

The monitoring report has to be prepared in line with the monitoring plan as mentioned in the registered PDD with the CDM EB. As discussed earlier the monitoring report will provide a detailed account of the calculations used for estimating the ex-post baseline emissions, project emissions and leakage (if applicable). The monitoring report prepared by the project participate is published by the DOE on the CDM website. Subsequently corrective actions raised by DOE need to be addressed by the project participant. The revised version of the monitoring report should then be submitted along with the request for issuance of CERs to the CDM executive Board. The success of a CDM project in issuance of the CERs depends on the ability of the project participant to complete the monitoring report and report the emission reductions in compliance with the approved monitoring plan.

Ex-ante and Ex-post MRV: Emission calculations can be broadly divided into two categories:

- Ex-post: Emission calculations that will be monitored and recalculated ex-post, i.e. after the actual emission reductions have taken place and therefore will be verified during periodic verification. Draft calculations are carried out for reference purposes and the actual calculations will be carried after the project implementation. The data and assumptions used should be reasonable, conservative and realistic.

- Ex-ante: Emission calculations that are determined ex-ante (i.e. before the emission reductions take place), and remain fixed during the crediting period of the project. These are therefore verified during validation. The calculations will remain valid throughout the crediting period and used for estimating the baseline emissions and emission reductions. The data and assumptions in this case need to be accurate and available from specific sources. Under ex-ante several parameters need not be monitored after project implementation as the critical data need collected and analysed will be validated by the DOE during validation.

2 www.cd4cdm.org
Monitoring of markets for benchmark and standardized approaches

Besides the project-by-project determination of baselines that is used in the “conventional” CDM above, there are also standardized approaches. A standardized baseline is established for a Party or a group of Parties to facilitate the calculation of emission reduction and removals and/or the determination of additionality for CDM project activities, while providing assistance for assuring environmental integrity (UNFCCC2012h). Standardized baselines can be developed for a given country as well for a region. The three main “families” of standardized approaches with some overlap (Juerg Fuessler 2012) are positive lists, performance benchmarks, and cap-and-trade systems with crediting. The efforts towards developing positive lists requires the performance benchmark for the sectors under consideration. At the same time, the regional cap and trade schemes with crediting are initiated in rapidly developing economies viz., China, South Korea and Mexico.

The MRV requirements (Table 4 below) for the above three main families are different in terms of the vintage, coverage, complexity and interpretation of the parameters/data to be monitored. Positive lists related parameters relate to penetration level of new technologies to demonstrate first of its kind and not a common practice.

| MRV REQUIREMENTS FOR STANDARDIZED BASELINES/APPROACHES |
|-----------------------------------------------|-----------------|------------------|-----------------|
| MRV requirements level | Positive List | Performance benchmark | Cap and Trade |
| Vintage | Historical | Current | Historical |
| Coverage | Specific to technologies / sectors | Specific to industry/appliances | Specific to the industries under compliance |
| Complexity | Low (once established but needs frequent updating) | High (once established but with stringent guidelines) | High (once established but stringent annual verification) |

Table 4 MRV requirements for standardized baselines / approaches

Performance standards/benchmarks have also been used in CDM methodologies, though to a limited extent, so far. Benchmark approaches in CDM methodologies set baseline emissions on the basis of performance benchmark of the entire sector in a given country or region.

The broad approach is mainly due to the difficulty in collecting extensive data for performance comparison or data on technologies used in specific sector or industry. Such data is often confidential and particularly difficult to obtain if competitors are to be included among the comparison peers. Further, there is a split incentive in that benefits from standardised approaches could be globally accessible, while the data collection burden is put solely on a project develop-
er. Therefore, such a bottom-up approach to data collection has not been successful. However the top-down initiatives where government and government institutions themselves create the database have been successful for reference and application under the CDM. However such initiatives are limited to sectors where the government requires the private sector to share such data for assimilation and publication. Therefore, the existing standardised CDM methodologies based on a performance standard have focused on sectors where a large body of data is already available (e.g., power, aluminium, cement).

Key methodological issues for performance comparison are: 1) Aggregation level (i.e. process, product, temporal or spatial aggregation), 2) Data requirements, 3) Stringency and 4) Updating frequency.

Chile can greatly benefit from adopting standardized baselines as the associated MRV requirements will help establish a strong link between the public and the private sector. The private sector can benefit from low transaction costs in accessing centralized database though the government has to meet the one time upfront and a nominal recurring transaction costs for creating it. The policy makers in different sectors can use the database for evaluating and fine tuning the GHG mitigation policies and pave way for more active participation by the industries towards achieving the endeavour.

Verification

Essentially, verification is the process of confirming the authenticity of reductions in GHG emissions by a CDM project over a defined period of time. Verification is then done by an independent third party (DOE) based on a monitoring report. It has to include an on-site audit to review records, interview project participants and local stakeholders and test accuracy of monitoring equipment. During the verification stage, the verification of the authenticity of the uncertainty levels and instruments are to be undertaken by the DOE. Moreover, recommendations have to be made to change monitoring for subsequent crediting periods. A verification report has to be published on which the quantity of emissions reductions achieved is to be certified.

3) Main MRV approaches in the voluntary markets

Voluntary carbon markets exist outside of any government structured mandate, and are in that sense unregulated. They are self-regulated by the use of specific standards to which buyers and sellers choose to adhere so as to be able to participate in the markets.

MRV is a key feature of all the main standards in the voluntary market, but its requirements depend on the specific standard. For sectors such as power generation or industrial processes, MRV approaches are typically similar across standards and may have common framework, e.g.
the GHG Protocol by the World Resource Institute (WRI) and World Business Council on Sustainable Development (WBCSD) or the ISO 14064 standards. In other cases, e.g. the treatment of smaller scale projects or projects in the forestry and land-use sectors, individual standards provide own customised approach to strike an appropriate balance between rigour and transaction costs.

The voluntary carbon market provides a broad choice in terms of MRV approaches. Standards with less stringent MRV will lack credibility in the market and affect the reputations of buyers. For example in addressing this credibility point, leading voluntary carbon standards will need to have panels of experts and stakeholder groups working in a transparent manner to assist them with rigour in the development of robust methodologies, including those for MRV. The flexibility that the voluntary carbon standards provide for MRV requirements vary considerably. As opposed to the mandated regulatory approvals for CDM projects’ monitoring and verification reports (for issuance of CERs), most of the voluntary carbon standards have delegated the independent third party verifiers to verify and approve the such monitoring reports for them to issue voluntary credits. Thus submission and publication of monitoring reports are done away by most of the voluntary carbon standards. At the same time the baseline and the additionality determination have been made so flexible that the MRV requirements have been less onerous for the voluntary carbon projects. On the other hand the lower stringency of additionality requirements led also to criticism of the environmental integrity of some voluntary projects, which is mirrored in low prices.

It may be concluded that the main difference between the CDM approach and voluntary offsetting is in baseline/additionality determination and to a lesser degree of a difference in “monitoring”.
4) MRV systems for NAMAs

Figure 3 outlines possible coverage of a reporting mechanism for NAMAs.

**POSSIBLE COVERAGE OF REPORTING MECHANISM**

![Diagram showing possible coverage of reporting mechanism for NAMAs]

*Source: Ellis, J., Moarif, S. and Kim, J. (2009)*

Mitigation actions by developing countries shall be communicated every two years via biennial update reports and through national communications every four years. The SBI will be conducting international consultations and analysis (ICA) of these biennial reports to improve transparency of mitigation actions, which should be measured, reported and verified. Although how exactly monitoring, reporting and verification of NAMAs will be done is still undecided (e.g. the recently launched UNFCCC NAMA registry does not specify any requirements), it can be expected that MRV requirements will distinguish between different types of NAMAs, as outlined in the following Table 5.
<table>
<thead>
<tr>
<th>NAMA Type</th>
<th>Expected MRV Requirements</th>
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| Unilateral | - MRV conducted domestically  
|           |   - Requirements to be elaborated by Subsidiary Body for Scientific and Technological 
|           |   - Reflection of national circumstances and priorities expected |
| Supported  | - Domestic MRV with international oversight  
|           |   - International MRV can be required by donors  
|           |   - Tracking of financial (and technical) support |

**Table 5 Different types of NAMAs**

The necessary MRV approach will also depend on the sector and the measures chosen for the NAMA as well as donor requirements.

Useful MRV frameworks to be possibly used for NAMA MRV include CDM, The Gold Standard Foundation, voluntary carbon market methodologies and the WRI and WBCSD Greenhouse Gas Protocol. However, if referring to CDM, Gold Standard and/or voluntary market monitoring parameters, the parameters in the methodologies should be adapted to be feasible for implementation regarding the NAMA. For instance, monitoring parameters in methodologies could be adapted to be monitored less frequently, to be monitored on a sampling basis and/or default values for certain monitoring parameters could be applied.

**5) MRV considerations for sectoral approaches and New Market Mechanisms**

MRV for sectoral mechanisms should allow to overcome the flaws of project-based mechanisms such as 1) high transaction costs due to necessary registration, monitoring and verification procedures, 2) lack of environmental integrity due to a high risk of carbon leakage and/or inflated baselines and 3) limitations in the mitigation potentials which could be addressed by them (e.g. closure of activities without replacement at the same site). If this is achieved, sectoral approaches could provide a bridge for the transition towards a global carbon market and for the transition from a non-Annex I to an Annex I country, as it is the development goal of Chile to become a developed country by 2020.

A New Market Mechanism (NMM) that can be categorized as sectoral crediting or a cap-and-trade mechanism will likely require a different level of MRV requirements. While both the mechanisms can be construed to be implemented and regulated by Federal Government in developing countries, sectoral crediting can still seek international investments/support for implementation thereby requiring stringent MRV framework. On the other hand a cap and trade scheme could be implemented domestically by the federal government and involve no MRV for reporting to international community.
A key aspect of the relationship between the NMM and the host country’s low emissions development strategy would thus be to establish a close link between procedures followed in national GHG inventories and national communications and the MRV of sequestration/mitigation of GHG emissions achieved in the same country under the NMM (The World Bank 2012).

The right coverage of the parameters and aspects with a view to incorporate international best practices on MRV will support the host country to link NMM with the international schemes in the long run.

6) MRV approaches under the Japanese Bilateral Offset Credit Mechanism (BOCM)

The Japanese government has not yet developed a MRV-methodology for the bilateral offset mechanism. However, they state that BOCM methodologies should: a) be simplified, objective and practical, while lowering uncertainty and ensuring environmental integrity, b) accelerate the deployment of low carbon technologies, products and services, taking into account the national circumstances in host countries and c) facilitate the NAMAs in host countries. One possible basis for MRV that has been mentioned by the Japanese government themselves is the ISO 14060 series or comparable standards, which are process standards but do not define a specific performance.
3.2.3. REGULATORY AND INSTITUTIONAL SETTING: CORE COMPONENTS AND OPTIONS

The success of crediting mechanisms in developing countries will depend on the regulatory and institutional environment in which they operate. As most experience worldwide has been gained through the CDM, most learnings can be drawn from this mechanisms. In the case of the CDM, several national and international institutions appear throughout the project cycle.

Institutional setting, key actors and their roles

<table>
<thead>
<tr>
<th>ROLES OF KEY ACTORS IN MRV IN CDM</th>
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<tbody>
<tr>
<td><strong>Actor</strong></td>
</tr>
<tr>
<td>Legislative Body (UNFCCC)</td>
</tr>
<tr>
<td>Supervisory Body (CDM EB)</td>
</tr>
<tr>
<td>Designated Operating Entities (DOE)</td>
</tr>
<tr>
<td>Methodological Bodies</td>
</tr>
<tr>
<td>Registration and Issuance Team (RIT)</td>
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<tr>
<td>Accreditation Panel</td>
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<tr>
<td>Designated National Authority (DNA)</td>
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</table>

Table 6 Key Institutional Actors and their Role in MRV

UNFCCC Secretariat: National GHG inventories are reported to the UNFCCC annually by Annex I Parties following reporting guidelines agreed by the Conference of the Parties (COP) and methodology developed by the Intergovernmental Panel on Climate Change (IPCC). They are reviewed annually following agreed review guidelines. The National Inventory Report includes qualitative and qualitative information, such as a description of methodologies used, emission factors, activity data and emission trends and analysis thereof, uncertainties, quality assurance and quality control. The CRF tables include data and results from inventory estimates. The fundamental difference between the reporting and review system under the Convention and under the Kyoto Protocol is that the latter is linked to compliance. Given the binding nature of emission targets, e.g. QELROs, any problem relating to these targets, identified through the
reporting and review system, should be considered by the Enforcement Branch of the Compliance Committee. A large number of guidelines underpin the operationalization of the reporting and review requirements under the current climate change regime, which are primarily applicable to Annex I Parties. For GHG emission inventories the guidelines usually include reference to the guidelines prepared by the IPCC as a methodological basis for GHG inventory preparation.

The UNFCCC Secretariat also provides institutional support of the CDM Executive Board and its panels and working groups. This includes administrative support and strategic and legal advice to the Board and its panels and working groups. Furthermore, the Secretariat assess the compliance of proposed and registered CDM project activities and DOEs with established requirements and provides recommendations regarding technical aspects (standards, guidelines and clarifications) of the CDM process. Last, the Secretariat also helps the Board coping with its broader supervisory role. It ensures interaction with stakeholders, develops the network with relevant stakeholders, provides capacity building services and informs the Board on trends in the global carbon market (UNFCCC 2012b, p.2&3).

**Clean Development Mechanism (CDM):** The governance structure of the Clean Development Mechanism is hierarchical: The as the Meeting of the Parties (COP/MOP) is the legislative body and supervises the Executive Board. The Executive Board is supported by various supporting entities. Besides the UNFCCC entities, the Designated National Authorities (DNAs) and the Designated Operational Entities (DOEs) are also involved in the process as external actors.

The CDM Executive Board (CDM EB) supervises the CDM under the authority and guidance of the COP/MOP. More specifically, the EB can make recommendations regarding CDM rules and definitions. It approves baseline and monitoring methodologies, is in charge of the DOE accreditation process and performs spot checks on their performance. The CDM EB has also created tools for DOEs to reference throughout the validation and verification processes, currently known as the Validation and Verification Standard (VVS). Depending on the outcome it can also suspend DOEs with immediate effect. By virtue of these responsibilities, the CDM EB has ultimate authority on how MRV has been run under the CDM.
Methodological Bodies (Methodologies Panel, SSC Working Group, A/R Working Group and CCS Working Group): According to the Terms of Reference for the supporting bodies of the CDM EB, the Methodological Bodies consider draft recommendations regarding the establishment, revision or withdrawal of methodological standards, guidelines and clarifications and methodological requirements for CDM project activities. Furthermore, they provide advice and recommendations to the Board regarding the need and priority areas for methodological guidance (UNFCCC, 2012b, p.1). Different Methodological Bodies exist for small-scale project activities, large-scale project activities, afforestation/reforestation project activities and carbon capture and storage project activities.

Accreditation Panel: The Accreditation Panel is in charge of the accreditation of DOE (see below). It considers the results of assessments of operational entities regarding their compliance with accreditation requirements and provides advice to the Board on the accreditation process and accreditation requirements (UNFCCC 2012b, p.2).

Registration and Issuance Team (RIT): The registration and issuance team consisting of at least 20 members supports the CDM EB in issues related to registration and issuance. RIT members prepare assessment reports on compliance of CDM projects after DOE validation, DOE verification and submission for renewal of crediting period. If RIT members identify policy issues during their work, they also have to be communicated to the EB. (UNFCCC 2012c)

Designated operational entities (DOEs): A DOE is an independent auditor that is accredited by the CDM EB. The DOE performs two different tasks: It assess whether CDM project proposals meet the eligibility requirements and request registration (validation) and it verifies whether these projects have achieved emissions reductions and make recommendation on CER issuance the CDM EB (verification) (UNFCC, 2012d)

Designated National Authorities (DNAs): A designated national authority (DNA) is the body granted responsibility by a Party to authorise and approve participation in CDM projects. Establishment of a DNA is one of the requirements for participation by a Party in the CDM. The main task of the DNA is to assess potential CDM projects to determine whether they will assist the host country in achieving its sustainable development goals and to provide a letter of approval to project participants in CDM projects. This letter of approval must confirm that the project activity contributes to sustainable development in the country. It is then submitted to CDM Executive Board to support the registration of the project (UNFCCC 2012e).
Institutional setting of 3rd party involvement

Independent 3rd party validation of monitoring plans
Under the CDM scheme, validation is the process of determining that a project meets the requirements of the CDM. This process is outsourced to private entities DOEs, here as 'validators'). In carrying out its validation work, the DOE shall ensure that the monitoring plan (and all other aspects of the project) complies with the CDM requirements.

These operational entities will typically be private companies such as auditing and accounting firms, consulting companies and law firms capable of conducting credible, independent assessments of emission reductions. In some other domestic offsets and emissions trading schemes, this validation or project approval process is carried out by a central scheme administrator or regulator.

Independent 3rd party verification of emission reductions
Verification is the process of confirming the authenticity of reductions in GHG emissions by a CDM project over a defined period of time (a verification period). In order to do this, a CDM project's emission reductions are monitored and the monitoring data for a verification period is reviewed and assessed. The process of verification is performed by an independent DOE and it is a matter for the project participants to decide which accredited DOE to engage and on what commercial terms. Where it is discovered that monitoring has not been carried out in accordance with the registered monitoring plan, DOEs are required to make the most conservative assumptions theoretically possible when conducting verification.

Uncertainty and Quality assurance/quality control (QA/QC)
The data required for quantifying baseline GHG emissions in a particular project/sector include data on activities in a country or a group of countries such as energy usage, industrial production statistics, production technologies, demographic data, process-related characteristics and mitigation-related practices. Some data might already be available to national authorities (e.g. DNAs) but in many cases it entails the process of data collection from data providers. The collection of data from multiple sources can lead to inconsistencies in levels of details, data formats and data quality. It also poses difficulties in achieving data integrity, data validity and completeness. The best practice to ensure data quality is twofold:

› Proactively preventing potential risks that could cause quality deterioration, with a well-designed data management system, well-trained personnel and the culture of data quality; and
Identifying and formulating data problems and implementing corrective actions, through regular reviews and continuous improvement processes.

The use of a measurement based methodology (i.e. metering devices) to monitor the GHG emissions of an installation should be implemented only if the output is more accurate than the calculation based methodology. The accuracy of measurement is determined based on the level of uncertainty associated with metering equipment, calibration and any additional uncertainty connected to how the metering equipment is used in practice. Quality Control (QC) is a system of routine technical activities to be conducted to assess and maintain the quality of the datasets as the data are being compiled. Quality Assurance (QA) is a system developed to ensure that the QC system is designed to meet the data quality objectives and implemented effectively.

The role of DNAs in the QC/QA procedures for standardized baselines under the CDM is a good illustration for the role that national authorities that set up MRV systems for crediting mechanisms need to take on and how they could ensure QA/QC of data.

Box 3: Role of DNAs in the QC/QA procedures for standardized baselines [EB66 Annex49]

For standardized baselines, DNAs should develop a QA/QC system that outlines QA/QC activities, processes, schedule and responsibilities of the personnel involved as well as the institutional arrangement.

Quality control

› Develop QC procedures that address how to ensure the data quality from pre-submission QC activities to the finalization of a QC report.
› Conduct a pre-submission quality check by establishing a “data delivery protocol” for data providers that describes specific rules and procedures for the collection and delivery of the requested data. The data delivery protocol should be distributed to the entire target population of data providers.
› Define the scope of the population in a particular sector, based on the definition of the “sector” established by the EB.
› Conduct a post-submission quality check by assessing the credibility of the data sources and the accuracy of the data, based on primary data and secondary data as well as documents submitted by data providers.
› Identify whether risks exist and take appropriate actions to prevent or solve them through internal review, when compiling the data in the data template.
Identify key causes of uncertainties, such as a lack of completeness, limited data availability, missing data, misclassifications, non-systematic process of collecting data and misreporting.

Quantify such uncertainties and take corrective actions to address them.

Document (in a QC report) how the QC procedures were implemented and how the data quality objectives and the general provisions were met.

**Quality assurance**

DNA develops QA procedures for the systematic identification, formulation and analysis of risks of not meeting quality objectives/provisions for the datasets and for defining and implementing activities that mitigate the identified risks.

The DOE contracted by the DNA should check whether the QA/QC system is put in place and assess the QA/QC system against the data quality objectives and general provisions established in this document. It also includes assessing whether the QA/QC system has been implemented as designed.

The results of the QA activities should be documented and included in an assessment report by the DOE.

### 3.2.4. CAPACITY REQUIREMENTS WITH PUBLIC AND PRIVATE SECTOR PROJECT PARTICIPANTS

Capacity and monitoring skills (i.e. monitoring technology and operation, data logging, IT, QA/QC) is needed to enhance measurement ability, support use of broader MRV metrics, and improve data breadth and quality on crediting mechanisms. Capacity assistance can also support improved program evaluation efforts, improving the effectiveness of the mechanisms and shifting MRV from a perceived burden to a valuable asset. As some of the emitting entities will not have the capacity to monitor and report their emissions on their own, local governments, emitters or consultants will have to collect data. Moreover, as the national coordinating entities may not have the outreach or capacity to assure accurate and complete data countrywide, capacity building or even technical intermediaries may be needed in aggregating local data and assuring data quality.

Depending on the national circumstances, these technical intermediaries can be private and/or public, split in many institutions or unified in one body. Therefore, the capacity requirements are different for public and private project participants according to the different crediting mechanism to be implemented as outlined in Table 7:
### Domestic crediting system – options for Chile

The monitoring, reporting and verification system for Chile’s potential crediting mechanisms should be designed to fit the current and future needs of the overarching emissions reduction programme. For example, if the system is linked to an emissions trading scheme, then emission reductions made under the crediting scheme should be comparable to emission reductions made within the “capped” or “traded” sectors.

MRV systems for credits can be developed over time, so that lessons learned are adopted and integrated appropriately, as has been done with the CDM. New methodologies can be adopted which broaden the reduction scope and technologies that potentially receive carbon finance. However, MRV systems should be designed with foresight in order to avoid major overhauls during the lifetime of the reduction programme. A stable and transparent MRV system upholds environmental integrity should safeguard against large realignments of a market’s supply and demand balance and can be used as a bridge between similar reduction programmes in other jurisdictions, paving the way towards market linkages.

The ability to transact Certified Emission Reductions at an international market price has been the driving force behind the use and popularity of the CDM’s MRV system. CERs have historically traded above prices for credits verified against the VCS, ISO, GHG Protocol or other jurisdiction-specific credit systems to date. This however may change in the future.

After having developed processes for approving CDM projects, Non-Annex I countries have several options for the construction of a domestic MRV system for issuing credits:

1. use the same MRV system for domestically generated credits as for the CDM,
2. design an entirely unique MRV system for credits, or
3. leverage certain aspects of the CDM’s MRV system while tweaking or adding to the process.

These three paths and the regulatory implications of each are outlined below.

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<thead>
<tr>
<th></th>
<th>Public sector</th>
<th>Private sector</th>
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<tr>
<td>CDM, JI (incl. PoAs)</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>CDM with standardized base-lines</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>NAMAs</td>
<td>+++</td>
<td>+</td>
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<tr>
<td>Sectoral Approaches</td>
<td>+++</td>
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<tr>
<td>Bilateral (offset) mechanisms</td>
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*Table 7 Capacity and monitoring skills requirements.*
**Option 1: Maximize the use of existing carbon credit issuing infrastructure**

The CDM has been built using a bottom-up approach, where the project proponents need to prove project additionality and define project baselines on a project by project basis. These programs need a detailed and comprehensive MRV structure. This structure will stay intact throughout the Kyoto Protocol’s second commitment period and possibly thereafter.

DNA offices in NAI countries can keep issuing LOAs to project proponents, whereby DOEs, who validate and verify project data, and the CDM EB will play major roles in the MRV system. This structure is reliant on the CDM’s Modality and Procedures, and the system will only issue Certified Emission Reductions (CERs) over time.

**Option 2: Design a unique credit issuing system**

Designing a unique MRV system for domestic credits would likely require the setting up of institutional systems and teams for developing methodologies, accrediting verifiers and registering and issuing credits. An oversight institution would also be necessary in order to run the overall process for project approvals. This option will take time to implement but could eventually allow regulators to define their own rules, processes and regulatory regime. It however runs a risk of becoming inharmonious with international developments and regulations. This could cause problems if the country were to want to sell emission reductions abroad in the future.

Some governments may be enticed to develop individual MRV systems and regulatory procedures in order to have the autonomy to create methodologies and regulatory processes that specifically suit the country. However, offset issuances in this case would also be entirely distinctive.

Developing a unique MRV system presents both opportunities and risks for regulators of such a regime.

**Option 3: Regulators can leverage existing infrastructure with adjustments**

Additional methodologies could be added to the existing CDM infrastructure, allowing developing country’s governments to expand their remit while also giving them more autonomy than currently under the UNFCCC programme. DNA offices could accept project documentation from other standards/protocols, such as the VCS, CAR, etc. Projects would thereby need to be verified according to either the CDM’s system or the particular methodology or protocol used.

In this situation the DNA could cherry pick the standards and methodologies that have been developed through various sources, keeping the procedures, accreditation and approval processes outsourced to the organizations that manage each particular standard. The DNA office wouldn’t likely need to develop new MRV tools, since the organizations that operate each standard usually provide all the necessary tools and processes. However, if NAI governments were to take this route, there would likely be the need to setup an overarching project approval
Board, which would decide which standards too accept domestically and also make sure that project outcomes were as intended.

In this example, the ability of the regulator to transact domestic emission reductions to international buyers is largely dependent on the environmental integrity of the selected methodologies as well as the technical make-up of the offset issuance. Issuing domestic versions of CERs or VCU/VERs is also a possibility but may or may not receive the highest bid in a community of emission reduction buyers.

Regulators can decide which system is most suitable for their country and most neatly aligns with the objectives and needs of the country’s emission reduction programme. Some of the most important factors in determining the MRV approach will be determined by the desire or not of the regulator to sell emission reduction credits in an international market, either in the near-term or in the future.

The above described options and their institutional requirements are summarised in the table below.

<table>
<thead>
<tr>
<th>Options</th>
<th>Description</th>
<th>Institutional Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Option 1</strong>: Maximize the use of existing carbon credit issuing infrastructure</td>
<td>Continue utilizing the CDM process, the resulting credit will be issued out of the CDM Registry as a CER</td>
<td>Would not require the development of significant new regulatory processes and procedures may require the addition of staff over time</td>
</tr>
<tr>
<td><strong>Option 2</strong>: Design a unique credit issuing system</td>
<td>Develop a truly unique GHG offset system: own methodologies, accredited verifiers, and registration and issuance of credits</td>
<td>Develop systems and teams for developing methodologies, accrediting verifiers and registering and issuing credits as well as establish broader approval processes that cover the functionality of the whole system</td>
</tr>
<tr>
<td><strong>Option 3</strong>: Leverage the existing CDM infrastructure with adjustments</td>
<td>Utilize current know-how, infrastructure and staff to tweak standards that are already developed</td>
<td>Expand capacity slightly in order to fully understand non-CDM methods, procedures, functionality and standard requirements.</td>
</tr>
</tbody>
</table>

Table 8 Potential MRV options and their institutional requirements.
3.2.5. PROJECT TRACKING SYSTEM FOR CREDITING MECHANISMS: CORE COMPONENTS

A carbon registry keeps track of credits and are vital in minimizing the risk of double-counting (that is, to have multiple stakeholders take credit for the same credit.) Registries also clarify ownership of credits. A serial number is assigned to each verified credit. When a credit is sold, the serial number and credit for the reduction is transferred from the account of the seller to an account for the buyer. If the buyer uses the credit by claiming it as a credit against their own emissions, the registry retires the serial number so that the credit cannot be resold.

CERs are only issued out of the CDM Registry, which is governed and maintained internationally by the CDM Executive Board. Credit credits from VCS, CAR, etc. are also internationally governed and maintained. If a regulator would like to issue their own credit then they would need to develop, govern and operate the registry system domestically.

Registration and Enforcement Systems for units under crediting mechanisms must include the following pillars, which are very similar to those outlined for emissions trading in chapter 3.3.3.

- A registry with publicly available information to uniquely identify credit projects.
- Serial numbers for each credit generated by each project.
- A system to transparently track ownership of credits which makes it possible to track each credit to the project from which it originated.
- A system to easily check on the status of a credit (i.e., if a credit has been retired).
- A system with digital security measures in place, i.e. methods to protect against and react to cyber-security threats.
- A system for recording detailed personal information of who has access to the registry or login information.
- Settlement procedures for project proponents that transact directly with the registry.
- A legal classification for emission reduction units.
- Contractual or legal standards that clearly identify the original owner of emission reductions.
- Contractual or legal standards that spell out who bears the risk in case of project failure or partial project failure (e.g. who is responsible for replacing the credits that should have been produced by the failed project).

Overview of international and national crediting registries

Many countries have advanced the concept of a registry for the recognition and potential transfer of emission permits issued under NAMAs, which would be used to record the mitigation efforts of developing countries in the international framework and to prioritise the distribution...
of financial and technology support from developed countries. While the idea of a registry has widespread support in principle, the way it would operate is still subject to ongoing negotiation with the MRV requirements potentially varying depending upon the type of NAMA, the market mechanism used and the national circumstances of the developing country. Further to the international registries for international crediting schemes, national crediting schemes will require national registries.

Case Study: China is leveraging the UNFCCC system to issue domestic offsets

On 13 June 2012, the National Development and Reform Commission (NDRC) of the People’s Republic of China issued “Tentative Measures for the Administration of Voluntary GHG Emission Reduction Trading”. According to official documentation the purpose of domestic voluntary emission trading scheme is to get China prepared for an upcoming mandatory emission trading scheme. The Chinese government and emitters are encouraged to use this opportunity to accumulate their knowledge and experience of emission trading.

Some preliminary MRV related details of the scheme are as follows:

1. The applicable methodologies shall be approved by NDRC. NDRC will review all CDM methodologies as well.
2. The resulting carbon credit will be called a CCER (Chinese Certified Emissions Reduction).
3. The validation, registration, monitoring and verification procedures are similar with CDM.
3.3. MRV FOR EMISSIONS TRADING SCHEMES

An ETS may cover one or more sectors as well as either all (Kyoto-) GHGs or only CO\textsubscript{2}, depending on the intended objective of the scheme, the availability and quality of data as well as costs and benefits of different options. Often, sectors with the greatest potential for abatement and ability to respond to price signals are covered, starting with sectors that are relatively easy to MRV (e.g. power plants). Furthermore, political acceptability of an inclusion of a sector or an emission source shall be considered when designing MRV for an ETS. Last but not least, a set of technical, regulatory, institutional and capacity requirements are to be considered. As the EU ETS is the largest and technically most advanced ETS worldwide it can provide important lessons for the setup of institutions and MRV of data (e.g. Castro, P. et al. 2011). This is the reason why most references in this chapter are made to the EU ETS. However, also lessons learned from other systems such as e.g. the New Zealand Emissions Trading System (NZ ETS) help to crystallize core elements to be addressed, considered or implemented in Chile in order to set-up an MRV system for a possible implementation of an ETS. Nevertheless it has to be considered, that national circumstances regarding e.g. data availability and capacity for accomplishing MRV functions will be different in developing countries (Castro, P. et al. 2011).

3.3.1. CORE TECHNICAL COMPONENTS OF A MRV SYSTEM IN AN EMISSIONS TRADING SYSTEM

![Diagram](figure4.png)

**Figure 4** Requirements for MRV: from most essential (basis) to essential (top)
Main differences between MRV for ETS and crediting systems

Downstream MRV on installation level is not fundamentally different from MRV in crediting mechanisms (as described in Section 3.2). Both are about quantifying emissions and emission reductions. The main differences include:

› The considered system boundaries of MRV in the ETS usually encompasses the entire installation (e.g. the entire refinery including all related processes) whereas MRV for crediting mechanisms usually only covers the boundaries of the system where a mitigation activity has been implemented (e.g. it looks only at the generation of waste heat in a specific part of a refinery and what kind of heat sources are replaced by the waste heat recovery that comes with the crediting (project) activity).

› In both MRV for ETS and crediting, the actual emissions in each year of the installation (ETS) or the project (crediting mechanisms) is monitored.

› In an ETS, the actual emissions are compared to the allocated emission quote (“cap”). Different allocation processes require the monitoring of different parameters. Most allocation procedures (e.g. “grandparenting” and “product benchmarking”) require historic production data (e.g. tons of steel produced) and data on historic GHG emissions. If the ETS has an absolute cap, the allocation will in general not change later. In crediting systems, actual emissions are compared to a “baseline scenario” that is often dynamic and e.g. follows the plant output or other activity data that needs to be monitored over the crediting period.

Key elements of a downstream MRV system for ETS

Key features and components of a MRV system in an ETS are outlined below (based on EU 2007, Wang 2011):

Monitoring: This relates to the collection and processing of key parameters (see Table 9). It is important to clearly define the boundaries from the outset and include all relevant GHG emissions within the project boundaries. Describing the monitored installation/site (including the description of the installation and activities, responsibilities for monitoring, emission sources and streams of each monitored activities) as well as the monitoring method and the required data are also key. Emissions can either be calculated or measured.

Technical requirements regarding measurement and monitoring for an emissions trading system may (in contrast to usual in-house measurement of energy and mass flows) require higher quality and calibrated instruments. Also the scope and coverage of measurement may need adjustment to be suitable for MRV for an ETS. It may become necessary to monitor not only the input and output of an industrial process, but also intermediate flows and emissions.

The following data are required for the calculation and the measurement approach:
DATA REQUIREMENTS

<table>
<thead>
<tr>
<th>Calculation approach</th>
<th>Measurement approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Activity data;</td>
<td>- Tiers;</td>
</tr>
<tr>
<td>- Emissions factors;</td>
<td>- Sampling rates;</td>
</tr>
<tr>
<td>- Oxidation factor (for combustion);</td>
<td>- Instrument calibration;</td>
</tr>
<tr>
<td>- Conversion factor (for process emissions);</td>
<td>- Missing data;</td>
</tr>
<tr>
<td>- Tiers (different choices of parameters for CO₂ emissions calculation for installations with different scales. The bigger the installation the stricter the criteria for accounting for uncertainties);</td>
<td>- Supporting calculation of emissions for verification reasons.</td>
</tr>
<tr>
<td>- Fall-back approach (in case of technical difficulty unreasonable costs).</td>
<td></td>
</tr>
</tbody>
</table>

Example: Emissions from a coal fired power plant are calculated as the product of (i) activity data (tons of coal consumed) times (ii) emission factor (tonnes of CO₂ per tonne of coal) times (iii) oxidation factor (99% of coal input is actually burnt).

Example: Amount of HFC-23 released to the atmosphere is monitored by online measurement 24/7.

Table 9 Source: Adapted from Wang (2011).

Furthermore, the installation operation has to justify the uncertainties and describe the procedures for data acquisition, handling and control activities.

**Reporting:** The above mentioned information shall be included in the reporting and submitted to the competent authority of the ETS. The reporting period covers usually one calendar year of the respective annual emissions. Reporting follows a systematic reporting cycle with predefined templates and provides a complete picture of all relevant parameters (Table 9). Reporting is usually carried out by the operator of the installation.

**Verification:** Key features to be addressed by the verification are the reliability, credibility and accuracy of monitoring systems as well as reported data and information relating to emissions. In many MRV frameworks independent verification (third party) is conducted. This confirms that the monitoring and reporting is in line with the requirements. In the schemes of e.g. New Zealand, Australia and the US, verification is either done by the company itself or by governmental inspections. The verification by the company itself is often used where there are strong national criminal prosecution laws for e.g. CEOs (UNEP 2012a).
Box 4: Verification process under the EU ETS

Under the EU ETS three stages of a verification process can be defined: the strategic analysis, the process analysis and the risk analysis (refer to EU ETS 2005):

The strategic analysis is conducted as a desk review analysis combined with selected interviews in order to assess the following documents and procedures:
- GHG permit (including approved monitoring methodology and frequency),
- Implementation of the approved monitoring methodology (including associated operational records, e.g. forms, procedural and work descriptions),
- Internal QA-/QC-measures (including audit plan, audit findings, quality records)
- Annual emission report.

Based on this the complete system of monitoring and reporting shall be assessed by the verifier, e.g. with regard to the following topics:
- The complexity of the installation (e.g. what kind and how many sources?)
- The operational structure, especially data management system (e.g. what kind of data collection, e.g. online measurement or periodic measurement?)
- The organisational structure, especially responsibilities (e.g. who is the operator?, is the organisational structure documented?)
- QA/CA measures (e.g. how are they documented?)

The process analysis is the main part of the verification process, forms the execution of the verification plan and is in general combined with an on-site inspection of the complete monitoring and reporting system. This analysis can be structured according to the workflow of monitoring and reporting, by e.g. investigation on GHG emission permits including monitoring methodology (e.g. is the monitoring and reporting in line with the monitoring methodology), data management including QA/QC-procedures as well as annual emission report including determination of total CO₂-emissions. Additionally following aspect shall be checked:
- QA-/QC-measures including internal audits;
- Completeness and any changes in sources and streams;
- Inspection of selected measuring devices (e.g. calibration, adjustment of the measuring equipment, failure of measuring equipment and thus changes of tiers);
- Workflow of data management (check e.g. the operator’s data management system, whether it enables transparent reporting and ensures ease of verification);
Handling of any abnormal operation of the installation (repairs, malfunctions, extensions or incidents that affected the reported data);

In case of missing or wrong data, the verifier shall request the operator to provide additional information.

As a third pillar, a risk analysis has to be conducted. Risk could occur due to e.g. the complexity of a technology or the complexity of the workflows from primary data via emissions to reported data.

Uncertainty and Quality assurance and quality control (QA/QC)

The monitoring and reporting under the EU ETS is based on one set of guidelines (monitoring and reporting guidelines EU 2004, EU 2007) applied to all types of installations as well as on a clear recognition of calculation and measurement based methods (see Table 9). Quality assurance (QA) and quality control (QC) is essential in the process of monitoring, reporting and verification under an ETS, in order to fulfil overall compliance and legal requirements. Only if reported emissions data (and in the end traded permits) are reliably corresponding to real emissions, the emissions trading system will fulfil its ultimate goal of environmental integrity. Especially during the process of monitoring and reporting emissions data, quality aspects need to be ensured. In the verification process, the verifying entity assesses whether QA/QC have been adequately implemented during the monitoring and reporting process and provide the operator with information on how to improve its performance in monitoring and reporting emissions (EU 2007).

During the monitoring process, QA/QC mainly refers to the data management. The operator shall ensure that relevant measuring equipment is calibrated, adjusted and checked at regular intervals including prior to use, and checked against measurement standards traceable to international measurement standards. Furthermore, he shall identify in the monitoring plan if components of the measurement instrument cannot be calibrated, and propose alternative control activities, which need approval of the competent authority. In case the equipment does not conform to the requirements, the operator shall promptly take necessary remedial action.

Furthermore, it is necessary for an operator to record the results of calibration and authentication for a period of 10 years. And if the operator uses information technology, including process-control computer technology, it shall be designed, documented, tested, implemented, con-
controlled and maintained as a way to ensure reliable, accurate and timely processing of data. Also the information technologies need to be controlled (e.g. provide back-ups) (EU 2007).

Key elements of an upstream MRV system

The core technical components of MRV also differ along the chosen points of obligations. This can either be downstream as in the European ETS (EU ETS, explained above; e.g. coal consumption for industrial production at the plant level) or upstream, as in the NZ ETS. Under the NZ ETS all energy (electricity, other stationary energy and transport) is covered upstream. Industrial process emissions are covered at the point of emission. The Stationary Energy and Industrial Processes) Regulations 2009 (SEIP 2009) outline the respective monitoring and reporting regulations. Monitoring and reporting in a downstream system slightly differ from the upstream version. The key elements of New Zealand’s approach is summarised in NZ Government (2009) bulletin as following: As under the EU ETS, the process for calculating the emissions associated with an activity reflects the following basic formula: Emissions = Activity data x Emissions factor, whereas the emission calculation methods and default emissions factors have been aligned with New Zealand’s Greenhouse Gas Inventory reporting requirements.

Stationary energy: Regarding coal, plant participants must collect data on the tonnes and calorific value of coal imported, mined or purchased. The coal sector is allowed to use unique emissions factors apart from default emissions factor as outlined in the inventory. Reporting of emissions by gas miners is based on the gas measurement at the sales metering point immediately downstream of gas processing, before gas enters the high-pressure transmission network. This approach requires direct measurement of the carbon content and other properties of all natural gas sold. Where measurement is not continuous, testing can be done periodically.

Industrial processes: Emissions from industrial processes are monitored and reported on the basis of pure chemical compounds in inputs or outputs. Hence, participants need to calculate the amount of pure substance used or produced by their particular industrial process.
Box 5 General issues to consider while developing an MRV system under an ETS (Sources: INFRAS and Wang 2011):

› Monitoring requirements may be different and may evolve from phase to phase under an ETS. For instance, monitoring is different for the case of grandparenting or for the case of auctioning the permits. In the case of grandparenting, data to calculate historical emissions and to determine the amount of permits allocated to each installation are key. In the case of auctioning, historical emissions data of each installation are not required.

› Advanced MRV for ETS may require higher quality instrumentation than measurement for internal use only. Instruments may also need to be calibrated in regular intervals and quality checked.

› Improving the MRV system in line with the development of the ETS as well as with new scientific findings is a precondition for a successful system. In the case of the EU ETS this can be seen along the different MRG guidelines. Comparing MRG2007 (EU 2007) and MRG2004 (EU 2004), reference emission factors and reference net calorific values have been extended and updated using information from the 2006 Guidelines of the Intergovernmental Panel on Climate Change (IPCC 2006).

› It is advisable to provide fall-back approaches for ensuring standard MRV methodologies. Such approaches could be implemented in case, when e.g. unreasonably high costs would arise from implementing standard MRV procedures.

› It is important to provide guidelines, adequate training where necessary and examples to the installations before the implementation of the ETS.

› In terms of MRV capacity of companies to be included in a pilot ETS programmes it is advisable to build on existing capacities. One could consider to first including only companies that have already conducted any kind of energy/clean production audits or participated in voluntary carbon accounting schemes such as the Carbon Disclosure Project (www.cdpproject.net) and only in a second phase to include other companies representing a significant share of CO2 emissions.
3.3.2. REGULATORY AND INSTITUTIONAL SETTING: CORE COMPONENTS AND OPTIONS

Institutional setting, key actors and their roles for an MRV system in an ETS

In order to assure compliance of an ETS (cap and trade system) a set of key actors have to be defined. Often, there exists a separation of institutions between policy and operations. In particular, the process for cap setting should be separate from the process for allocation (PMR 2011). Table 4 provides an overview of relevant key actors for an MRV system under an ETS (please note that different settings are possible and the table has illustrative purposes):

<table>
<thead>
<tr>
<th>ROLES OF KEY ACTORS IN MRV IN ETS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Actor</strong></td>
</tr>
</tbody>
</table>
| Policy setting authority          | - Process of cap setting  
                                 | - Definition of inclusion/exclusion of installations                   |
| Regulator                        | - Defines monitoring, reporting and verification provisions  
                                 | - Introduces penalties for non-compliance  
                                 | - Issuance and enforcement of greenhouse gas emissions trading permits, including monitoring plans  
                                 | - Enforcement of the regulations set by the policy setting authority in accordance with permits;  
                                 | - Aggregate and archive data and implement national level QA/QC |
| Operators                        | - Collect, calculate and report data on emissions and activity levels etc.  
                                 | - Implement company level QA/QC                                        |
| Administrator                     | - Accredits verifiers  
                                 | - Operates registries and accounts  
                                 | - Issuance of sanctions                                                 |
| Third party entities              | - Provide independent verification services                             |
| Service providers                 | - Provide electronic monitoring and reporting systems for companies      |

Table 10

On a national level, policies on GHG emission trading regulations are implemented in e.g. different kind of related ministries. Such ministries are e.g. responsible for new entrant policies and regulations, etc. A regulator defines monitoring, reporting and verification provisions as well as penalties for non-compliance for the entire ETS, which potentially can span over several countries. In the EU ETS, the regulator is the European Commission. On a country level, regulators are normally institutionalised within the ministry level and can include different ministries or
affiliated agencies serving as the competent authorities and having the overall responsibility enforcement competences for emissions trading. In the EU ETS the MRV rules are set out through the guidelines for the monitoring and reporting of GHG emissions, known as “MRG” developed by the European Commission for all source types covered in the EU ETS (EU 2007). As a result of the revision of the ETS Directive in 2009, the MRG in 2013 will be replaced by Monitoring & Reporting Regulations, as well as Accreditation & Verification Regulation (EU 2011)\(^3\). In order to promote increased administrative efficiency and ensure a harmonised approach in the member states, the Commission has also published electronic templates for monitoring plans and reports for tonne-kilometre data (EU 2011). Member states in the European Union are required to transpose the directives of the EU into national legislations. Most countries established more than one authority involved in the national implementation of the EU ETS.

**Operators** (or regulated entities) in an ETS are essentially the installations included under the cap and trade system. Their obligation is to comply with the system by monitoring and reporting emission and surrendering sufficient allowances to account for their emissions. They are obliged to collect, calculate and report data on emissions and activity levels. They are also responsible for plant level QA/QC. A typical annual compliance cycle is outlined in the box below.

**Administrators** are typically found at different positions in an ETS. Their role may be to organize the accreditation of verifiers, the operation of registries and accounts and the issuance of sanctions. Data under the EU ETS are stored in registries to account for the greenhouse gas emissions of the participating installations. Since 2012, the permits in the EU ETS are held in a single European Union registry, operated by the Commission. The single Union registry has replaced all EU ETS registries hosted in the Member States. In addition to the registration of verified emissions, the purpose of the registries is to account for the surrender of permits (at the end of the year) by installations along with additional information on the selling or purchase and banking of permits. Under other cap and trade systems such as e.g. the NZ ETS, units are also held in the national units registry.

**Third party** independent verifiers provide independent verification services of the MRV activities carried out by operators. This verification system based on independent entities is being implemented inter alia in the EU ETS, the Californian ETS (Cal ETS) as well as in the

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3 Improved guidelines incorporating monitoring & reporting experiences from 1st and 2nd trading period, emphasis on increased cost-effectiveness and efficiency, addressing issues of accuracy and uncertainty, improving user-friendliness of Monitoring and Reporting Requirements, increasing use of automated Monitoring and Reporting Systems, incorporating experiences and strengthening requirements of Verification, strengthening Requirements and Procedures of Accreditation (EU 2011).
Tokyo C&T system. Under the NZ ETS third party verification is not required, however participants can be audited (following general practice for tax returns in New Zealand) (PMR 2011). Furthermore, a network of independent accredited verification bodies can be established. The establishment of such networks may ensure that the monitoring and reporting of emissions by the operators of the participating installations are implemented in accordance with the MRV guidelines. A third party verification requires an early phase-in of provisions for preparation and accreditation of verification services providers.

**Service providers** which provide e.g. electronic monitoring and reporting systems for companies are a further link in the system. The expert consultation for companies by service providers in order to install and maintain the monitoring systems adequately are key for a successful MRV system. Apart from the registries, which have a book keeping function, the infrastructure for trading (such as the international trading platform European Climate Exchange ECX) on the primary and secondary markets is usually left to the private sector, but should be subject to commodity and financial market oversight (OMR 2011).

**Figure 5** Source: Adapted from defra (2008).
Box 6: Typical compliance cycle of an MRV cycle under a cap and trade system (EU-ETS)

MRV in a downstream system is being conducted at the level of a company or an installation. Wang (2011) summarises the general process as following:

› Monitoring plans (include monitoring methodologies according to installation types and scale) and quality control is prepared and conducted by each operator of an installation.

› The monitoring plans are then reviewed and approved by the competent authority. Information regarding each installation must be kept up-to date and reported to the competent authority for approval.

› Monitoring plans are then being implemented by the operator, i.e. measurements are taken and data is collected and processed as prescribed.

› Reporting under the EU ETS and the NZ ETS is carried out on an annual basis (by 31st March). Under the RGGI the monitoring and reporting is executed on a quarterly basis.

› The operator’s report is being examined by the verifier. An independent site visit before completing a verification report might be conducted by the verifier. Sanctions (suspension of CO₂ allowances transferred to the operator) are implemented due to an unverified or unsatisfactory verification of an operator’s annual emissions report.

› The operator will send the verification report together with its annual emissions report to the competent authority.

› Final decision on CO₂ emissions for each installation is being made by the competent authority.
The process of MRV of the EU ETS outlined above in a full calendar year is depicted in the overview below:

![Diagram showing the role of MRV in a full calendar year]

3.3.3. REGISTRY SYSTEM FOR ETS: CORE COMPONENTS

Electronic registries are key components of Emissions Trading Systems (such as the EU ETS) as well as wider international emissions trading under the United Nations Framework Convention on Climate Change’s (UNFCCC’s) Kyoto Protocol. Generally, registries in the context of ETS are bookkeeping systems are software based applications with the focus on bookkeeping national ownerships and retirement of allowances (such as e.g. national registries under the EU ETS until 2012, etc.). ETS registries are different kind of systems than trading platforms. ETS registries are the bookkeeping system that tracks the transfer of allowances between different accounts of public or private entities. They do not provide matchmaking between buyer and seller. Trading platforms (such as e.g. ECX, BlueNext, EEX etc.) on the other hand are comparable to stock exchanges, where a market is created by bid and ask quotes from buyers and sellers. Once a transaction is agreed on in the trading system, the actual transfer of allowances then takes place in the registry. Trading systems are usually privately operated, whereas registries are usually controlled and operated by governmental bodies. The key functions of registry systems can be summarised as following:
Managing the accounts of the operators. The registry administration shall be able to create, update and close holding accounts as well as record emissions;
Allow demonstrating compliance with national emissions reduction targets;
Allow account holders (e.g. operators but also private persons) within the same registry (and e.g. also in other national registries) to transfer units and allowances between their accounts;

A schematic overview of a registry including the main account types is outlined in Figure 7:
Holding account: Accounting for valid emission allowances.
Surrendering account: For compliance used emission allowances are transferred from the holding account to the surrendering account.
Cancellation account: In order to cancel or decommission allowances, they are transferred from the holding account to the cancellation account. These allowances are blocked and can’t be returned to the market.
Retirement account: In order to fulfil the compliance, the governmental entity transfers the allowances from the surrendering account to the retirement account. The user is not targeted by this transaction.

**ACCOUNT STRUCTURE OF A REGISTRY**

<table>
<thead>
<tr>
<th>Validation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holding account (including valid allowances)</td>
</tr>
<tr>
<td>Surrendering account (used permits for allowances)</td>
</tr>
<tr>
<td>Retirement account (allowances for compliance – for the fulfillment of the compliance)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cancellation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holding account (valid allowances)</td>
</tr>
<tr>
<td>Cancellation account (cancelled or decommissioned allowances)</td>
</tr>
</tbody>
</table>

**Figure 7** Schematic account structure of a national registry. Source: Adapted from FOEN (2011).
Regulatory requirements

Successful registry systems need a sound national regulatory framework to mandate a public or ministry affiliated body with the operation of the registry and the administration of accounts. Legal issues the registries have to comply with include also the legal status of units in the registry (are the units a “right” or a “security”? How is it treated with regards to ownership, taxation, etc.?).

The key requirements for a successful registry can be summarised as following (they are based on learnings of the design and implementation of former European national registries referring e.g. to Peeva 2001):

› Registries are a critical piece of infrastructure requiring sound database functions;
› Possible institutional links shall be considered in order to ensure all the different data recording and processing functions, the information flow between the registry and possible other institutions;
› In order to make sure that each unit (allowances, credits, etc.) is only held in one account in one registry at a given time and thus double counting is avoided, the units shall have unique serial numbers;
› The choice of technology, as well as the security of the system is a key factor. The technology chosen shall ensure efficient data quality control as well as security of communications and data protection. Still, transparency shall be assured;
› The reliability of the system shall be given: Guarantee an uninterrupted access to the registry account;
› Adherence to strict conflict policies;
› Strong measures in place against fraud and security issues (see Box 7 below).

It has to be assessed according to the national circumstances whether the administrator of a registry system may be a governmental or private entity, taking into account also existing capacities regarding human and financial resources and the robustness of the legal setting.
Box 7: Fraud and security issues – learning from European ETS mistakes

The EU ETS has suffered from different criminal manipulations and security leakages during the last years. Damaging cyber thefts from European Carbon registries took e.g. place in 2011. In February 2010, all registries in the EU ETS were halted due to phishing scam that tricked honest traders into giving away their EUAs (CMI 2012). Furthermore, through 2009-2010, Value Added Tax (VAT) fraud occurred, involving the sale of EUAs within the EU ETS. This deprived EU revenue authorities in excess of EUR 5 billion. Furthermore, as emissions trading is taking place in the information age, many transactions, communications and other operations are performed on the internet and are thus subject to online-based threats (including e.g. viruses) (CMI 2012). As a response, new measures and directives have been implemented, such as regular reviews of registry security plans, risk based review of current registry account holders, tighter policies for opening of registry accounts, better exchange between member states as well as better training for registry users.

3.3.4. CAPACITY REQUIREMENTS WITH PUBLIC AND PRIVATE SECTOR PROJECT PARTICIPANTS

In the European Member States, different regional workshops on the implementation of the EU ETS and its monitoring, reporting and verification requirements have been held during the last years. One key conclusion from these events is that a continuous training for operators, verifiers and authorities is essential for the success of a cap and trade system (e.g. EU 2011).

Capacity building is needed on the different levels of actors as outlined in chapter 3.3.2 as well as between the actors. According to EU (2012) key issues to be addressed between different actors refer to e.g.:

› Defining the responsibilities of the different actors regarding MRV,
› Defining and discussing general monitoring, reporting and verification principles and their relevance MRV,
› The importance of the use of information technology to support the various compliance processes and enhance the efficient communication between the operator, the verifier and the competent authority.
A focus of activities on capacity building should be put on the level of the operators and on the level of regulators, third party entities (verifiers), administrators (registries) and service providers. Key focuses on capacity building needs on different levels are outlined below:

** Operators **

Installation operators often need considerable capacity building activities in order to being in a position to monitor and report, and have verified their emissions data and to assure a high level of data quality and to understand the entire processes of an MRV system. Based on EU (2012) capacity building activities may address e.g.:

- General procedural issues (e.g. what is an ETS and how does it work);
- Technical components in order to monitor and report emissions data;
- The importance on monitoring plans and templates and their relevance for a successful monitoring and reporting of emissions;
- Critical components on monitoring methodologies;
- Data management, quality control activities and procedures to ensure that the risks to mis-statements and non-conformities are mitigates as well as the treatment of data gaps;
- Internal awareness raising on MRV under the ETS;
- Regular capacity building activities in order to provide training on up to date information of new regulations, adjusted guidelines etc.

Ideally, operators are able to integrate MRV systems into their everyday control systems that measure and control relevant energy and mass flows in plants. Capacity building should build on the existing knowledge and data storage systems that the operators use and provide information on how to arrive in a cost efficient way to a robust MRV system.

** Regulators **

National authorities acting as regulators especially need initial capacity building activities in order to get the ETS process started. According to EU (2012) best practice example include working groups with regular meetings, specific guidance notes as well as training courses for authorities. In the European Union, dedicated training of regulators in all relevant aspects of MRV have significantly contributed to the successful implementation of institutional frameworks at national level.
Third party entities (verifiers)
Training and capacity building activities for independent verifiers are crucial in order to ensure high quality results. Special focus should be provided on issues such as ensuring the independency of the verification process, the reporting methodologies, and the procedures for site visits as well as on the exchange on best practices between verifiers.

Administrators
Administrators such as registries face difficulties regarding safety and security and e.g. accounting standards. The implementation of cap and trade schemes thus requires a range of complementary provision with regard to these issues as well as the implementation of early measures for the respective education (PMR 2011).

3.3.5. THE COSTS OF MRV SYSTEMS
Setting-up and operating a MRV system in an ETS is correlated with costs. Two main cost streams may arise: The costs for capacity building and the costs for setting up the actual system and the operation of it. Regarding capacity building, the focus shall be on existing capacities. A lot of capacity already exists, especially in countries like Chile and shall be used as a solid basis for further activities (see also Chapter 4). Especially experiences from the significant achievements from the CDM I public as in private institutions shall be used. Still, the establishment of an ETS including a sound MRV system can cause additional capacity building needs. Case studies show, that costs for capacity building in order to set-up an ETS especially arise at the level of policy and legislation measures as well as for the enforcement. Regarding MRV, the capacity building for a sound verification system as well as for the monitoring will be cost intense. The costs for reporting capacity is comparably lower (Vieweg 2009).

Apart from capacity building costs, one has to consider three categories of costs regarding the set-up and operation of the system: The costs occurring in preparing for the scheme, the annual MRV costs as well as the trading costs. Costs for technical set-up of the scheme may be considerable. The expected costs for the operators during the operation phase highly depend on the complexity of the considered processes. Regarding MRV, existing know-how as well as control and measurement systems in the plant will determine the future costs for maintaining the MRV system. Most importantly, the scale of the operating entity matters, meaning that for large point source emitters, relative MRV costs will be nearly negligible, whereas for smaller emitters relative MRV costs may be considerably high. Furthermore, transaction costs in a trading system are highly relevant. This will mainly be an issue for low volume emitters. Experiences from
current ETS show, that if transaction costs would have been lower, the trading activities with smaller emitters would have increased significantly.
4. EXISTING SYSTEMS AND CAPACITY IN CHILE

This chapter provides an overview of existing systems and capacity for MRV in Chile, which may serve as a basis to build a comprehensive MRV system in the country. This stocktaking of existing systems will serve as an input to the gap analysis and the development of MRV roadmaps in Chapter 5.

4.1. CURRENT LEGAL AND INSTITUTIONAL BASIS OF MRV

From a legal point of view, with the exception of the GHG inventory included in the national communication that is mandated under the UNFCCC which reports emissions at an aggregate national level, there is no obligation for any sector or company to report GHG emissions. On the other hand, there is an established regulatory and institutional framework for the monitoring and reporting of local pollutants such as particulate matter, \(\text{SO}_x\) etc (not necessary greenhouse gases). Thus, this chapter describes also the existing capacity regarding reporting and monitoring of local pollutants, and the availability of data and legal framework to establish an MRV system in Chile.

It is important to underline the last amendment of the environmental law in Chile and the recent institutional change in Chile’s energy sector. Under that amendment new institutions responsible to define policies for the energy and environmental sectors were founded. As an outcome of these changes, there is a legal mandate that allows to incorporate an MRV system for GHG in Chile.

The 20.417 law, passed in January 2010, modified the environmental institutional framework in Chile, creating new governmental agencies, and replacing the role of the Environmental National Agency (CONAMA). These institutions are:

› The Environmental Ministry
› The Environmental Superintendence
› The Environmental Assessment Service
› The Environmental Court

In view of the consideration of a new MRV system for GHG emissions in Chile, it is important to specify the existing role of each institution as well as the role it could play in a future MRV system for GHG:
**Environmental Ministry:** Article 70, Letter h of the environmental law indicates that this Ministry is mandated to develop “Policy proposals, programs and action plans regarding climate change issues. To achieve these goals, the Ministry must collaborate with other governmental agencies at local, regional and national level, keeping in mind the aim of assessing impacts and developing adaptation and mitigation actions”.

**Environmental Superintendence:** This institution has all legal and punitive authority over any sort of infraction made regarding environmental topics, and in particular it refers to MRV system installations. Most relevant duties of this institution include:

› Supervise law implementation; proper enforcement of regulations, conditions and standards in the Resolutions of Environmental Qualification, based on inspections, controls, measurements and analysis executed as established in this law.

› Hire adequately certified third party entities to carry out the tasks of inspection, verification, measurements and performance, of laws, conditions and measurements of the Resolutions of Environmental Qualification, Prevention Plans and/or Environmental Depollution, of Regulations of Environmental Quality and Emission Regulations when appropriate, and of Management Plans.

› Collect, examine and process data, samples, measurements and analysis that the supervised subjects must provide according to law, regulations and conditions defined in the respective Resolutions of Environmental Qualification or in the Prevention Plans and/or in the Depollution applicable to each one of them.

**The Environmental Assessment Service:** The role of this institution is to coordinate all the process of environmental assessment according to the environmental law. In many larger projects there are requirement to report local emissions. There is no enforcement to report GHG.

**The Environmental Court:** This is a new court that is specialized on environmental issues. In the context on the private obligations to report is the final instance for any dispute on environmental issues.

In the energy sector the **Ministry of Energy** was created, with the objective to define the policies and regulation in the sector. The former National Energy Commission assume the exclusive role of the regulatory authority, and the Superintendence of Electricity and Fuels the enforcement activities, both institutions under the dependence and following the guidelines of the Ministry of Energy.
4.2. EXISTING MRV SYSTEMS ON NATIONAL LEVEL

4.2.1. REGISTRY OF EMISSIONS AND POLLUTANTS

The Registry of Emissions and Transfer of Contaminants (RETC) is a database accessible to the public, administered by the Ministry of the Environment, which aims to capture, compile, systematize, conserve and spread to the public the information about emissions, residues and contaminants transfers potentially harmful to human health and the environment, which are generated during industrial or non-industrial activities, or when transferred to their final destination or elimination (www.retc.cl).

The database includes information on fixed sources (industry) and mobile sources (transportation). The registry includes all emissions emitted to the air, water and dangerous residues transported to their treatment or final disposition.

Institutional Aspects of the RETC

All the information in the RETC comes from mandatory dispositions established by different sectorial normative institutions, or are estimated using several methodologies, referring to those not regulated sources with relation to the contaminants information data. Therefore, the RETC only compiles and estimate information, based on the enforcement activities of other legal bodies.

Recently, the RETC gained legal recognition, with the approval of the Council of Sustainability Ministries, by the regulations that created it. However, the RETC is only a platform that gathers and systematizes information that came from other sources, to make it available to the public in general. Still, it is considered an adequate source of registry and estimation of information of the productive sector. The periodicity, the level of aggregation, the information accuracy, does not depend of the RETC, it will depend on the institution that receive the first hand report or information.

Content of the electronic platform of the RETC in the fixed sources air emissions

This database compiles information of the air emissions, basically from two sources:

› Depollution and prevention plans.

› Regulations of emissions and air quality applicable to a regional and national level.
The following Table summarizes all regulations through which information of air emissions is incorporated into the RETC.

<table>
<thead>
<tr>
<th>Location</th>
<th>Pollutant</th>
<th>Facility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paipote</td>
<td>SO2</td>
<td>Smelting Paipote</td>
</tr>
<tr>
<td>María Elena y Pedro de Valdivia</td>
<td>PM10</td>
<td>Plant María Elena de Soquimich</td>
</tr>
<tr>
<td>Fundición Caletones</td>
<td>PM10 and SO2</td>
<td>Smelting Caletones</td>
</tr>
<tr>
<td>Potrerillos</td>
<td>PM10 and SO2</td>
<td>Smelting Potrerillos</td>
</tr>
<tr>
<td>Chuquicamata</td>
<td>PM10 and SO2</td>
<td>Smelting Chuquicamata</td>
</tr>
</tbody>
</table>

Table 11 Examples of point sources covered by RETC

<table>
<thead>
<tr>
<th>Law</th>
<th>Pollutant</th>
<th>Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS 185</td>
<td>SO2</td>
<td>Sources emitting quantities higher or equal to 3 tons of sulfurous anhydride daily in the country.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sources emitting sulfurous anhydride in latent or saturated zones.</td>
</tr>
<tr>
<td>DS 165</td>
<td>Arsenic</td>
<td>All sources emitting arsenic.</td>
</tr>
<tr>
<td>DS 138</td>
<td>All</td>
<td>• vapor and/or hot water generator boilers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• cellulose production</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• primary and secondary smelting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• thermoelectric plants</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• cement, lime or gypsum production</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• glass production</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ceramics production</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• iron and steel industry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• petrochemical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• asphalt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• electricity generator equipment</td>
</tr>
<tr>
<td>DS 45</td>
<td>Particulate matter, SO2, NOx, total carbon, cadmium, mercury, beryllium, lead, zinc, arsenic, cobalt, nickel, selenium, tellurium, antimony, chromium, manganese, vanadium, inorganic chlorine and fluorine compounds, benzene, dioxins and furans.</td>
<td>Incineration and co-incineration installations</td>
</tr>
<tr>
<td>DS 167</td>
<td>Sulfur compounds of Hydrogen and Mercaptans: TRS Gases</td>
<td>Manufacture of sulfurized pulp</td>
</tr>
</tbody>
</table>
### Applicable Law to the Metropolitan Region

<table>
<thead>
<tr>
<th>Document</th>
<th>Category Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D.S. Nº 4/1992</td>
<td>Stationary precise sources in the Metropolitan Region, emitting more than one ton of particulate material per day</td>
</tr>
<tr>
<td>D.S. Nº 1.583/1992</td>
<td>Precise sources located in the Metropolitan Region, emitting more than a ton of particulate material per day</td>
</tr>
<tr>
<td>D.S. Nº 58/2003</td>
<td>Precise sources located in the Metropolitan region</td>
</tr>
<tr>
<td>Resolution Nº 15.027/1994</td>
<td>Which establishes the emission declaration system in the Metropolitan Region</td>
</tr>
</tbody>
</table>

**Table 13** Regulatory framework, pollutants and sources covered by RETC for the Metropolitan Region.

On the other side, for those sources that do not fit within the categories that regulate the previously summarized laws, emissions are estimated based on parameters of industrial activity and fuel consumption, using the information obtained from the National Industry Annual Survey, which is carried out by the Institute of National Statistics.

### Content of the electronic platform of the RETC in the air component mobile sources

RETC also generates an annual estimation of mobile sources in the transportation sector (more than 2 million vehicles) for the largest cities in the country, where more than 80% of the total population lives. The geographical scope of the Registry was initially limited to the 17 cities for which the Department of Transportation Planning (Secretaría de Planificación de Transporte; SECTRA) has a transportation model, and for which detailed transportation emissions are estimated. 10 additional cities were added to this scope, and the related emissions are estimated on the basis of a simplified transportation model.

For the 17 cities included the “emission model for mobile sources on route“ (MODEM) emissions are estimated based on traffic flow vehicles rates, and includes variables describing the activity, such as land use, population size, types of economic activity, number of vehicles, road grid capacity, etc.

The simulated vehicle flow scenarios are subsequently supplemented by vehicle counts performed in cities, and by data from various vehicle technologies and specific vehicle numbers by areas.

The main emissions measured or estimated in the transport sector are: CO, NOₓ, CO₂, CH₄, N₂O, SOₓ , NH₃, PM10. Fuel use and CO₂ emissions could probably be derived from the transport models with small modifications.
Reports of the RETC
Based on the information obtained from the RETC database, annual reports can be elaborated for the pollutants, according to the following criteria: year, pollutant, geographical location, industrial activity and type of source.
Likewise, it is possible to identify the specific sources, by providing the National Identification Number or the name of the emission source. In this case it only corresponds to those sources subject to regulation of direct declaration, and not to the ones included by estimation or associated to a regulation.

Available Information of the GHGs in the RETC
The RETC also includes information of CO₂ emissions, but all of them correspond to estimations, given that no regulation establishes obligation to report CO₂ emissions. It should be noted that the resulting total CO₂ emissions portrayed in the RETC tend to significantly underestimate actual emissions, compared to the total emissions resulting from the national inventory (that is based mainly on upstream fuel consumption data). For example, for the year 2006, the last year for which an official inventory has been published, the underestimation of CO₂ emissions based on RETC data compared to the national inventory is 34%.

Declaration of emissions:
An important part of the database of air emissions included in the RETC comes from the registry managed by the Ministry of Health, which was established to allow the performance of the Decree DS 138 (www.declaracionemisiones.cl). The registry found on this website has the purpose of allowing the industry regulated by this Decree to provide information required by the mentioned regulation.
Additionally, and as a mechanism of quality certification of the emission measurements, there are Regulations of laboratory measurements and atmospheric emissions analysis coming from stationary sources that provide the legal framework for the functioning of all those entities that execute emission measurements in Chile with the currently in force normative frame. According to these Regulations, the exclusive functions developed by these institutions are the following:
› Emission measurements of particulate material.
› Emission measurements of gas contaminants.
› Emission factor determination of particulate material and chimney gases, regarding models or group source types.
› Sampling of particulate emissions.
› Sampling of gas emissions.
Analytical determination of the concentration of particulate material.
Analytical determination of the concentration of gas contaminants.
Calibration of equipment and instruments for emission measurement and analysis.

Compliance scheme
The failure to comply with established regulations in these particular laws are subject to procedures and punishments established in the Tenth Book of the Sanitation Code, which in case of a pecuniary fine could reach up to a maximum of approximately US$ 80.000.

Santiago Emission Trading Scheme for particulate matter
At the same time, there are compensation systems for the emission of particulate matter (PM; not a direct greenhouse gas put local pollutant) to the industrial sector in the Metropolitan Region (Santiago), using transactions or offset. The system is in place since 1995, and all new industries regulated under the decontamination plan.

In this innovative and early emission trading program, existing sources were allocated a specific quantity of daily emission permits based on potential emissions of particulate matter. Each permit is an authorization to emit up to one kilogram of PM10 per day in perpetuity. New sources and expansions to existing sources did not receive permits after the introduction of the scheme.

These new and expanded sources had to purchase permits from existing sources to offset 25% of daily potential emissions by 1994, 50% by 1995, 75% by 1996, and 100% by 1997 (EPA 2008). The system has since undergone numerous changes. It is an example of the early adoption of an emission trading scheme that may facilitate the introduction of greenhouse gas ETS in the years to come.

4.2.2. MRV SYSTEM FOR NATIONAL ELECTRICITY GRID.

Another existing MRV system that is relevant in the context of future greenhouse gas related MRV activities in Chile is the MRV system for the national electricity grid. The information related to the operation of the main electrical systems in Chile is available at the Load Economic Dispatch Center (CDEC), an organization defined in General Law of Electrical Services, Decree Law N°1, of year 1982, and established by Supreme Decree N° 291, of 2007, both of Ministry of Mining.
The CDEC is responsible to coordinate the operation of all electrical infrastructures, and its main responsibilities are:

› Keep the service in electrical system safe;
› Guarantee the most economical operation for the set of electrical system installations;
› Guarantee the right of easement over transmission systems established by concession.

The functions of the CDECs are:

› Plan the short-term electrical system operation, considering actual and expected situation for middle and long term.
› Calculate instantaneous marginal costs of electrical energy.
› Coordinate main preventive maintenance for generating units.
› Verify compliance of operation and main preventive maintenance programs.
› Determine and value electricity transfers among generators.

Elaborate necessary procedures to comply, in each generation and transport level, with quality of service requirements stated in Supreme Decree N°327.

The CDEC is the primary source of information of Power generation, and provides first hand data of the main operation parameters of the generators unit that are operating in the two main electric systems in the country,

› the interconnected central system (www.cdec-sic.cl) and
› the interconnected north system (www.cdec-sing.cl).

These systems together cover over 99% of the country total installed capacity.

The CDEC by legal mandate should have information of each power unit in the country. The data should be revised with a periodicity at least of 6 month, as is indicated in the "Security and quality of service norm", approved and revised by the National Energy Commission:

› Hourly operation of each unit.
› Owner of each unit.
› Type of unit.
› Fuel.
› Turbine.
› Power.
› Consumption for regular operation.
› Net power.
› Technical minimal power.
› Forced unavailability rate.
Unavailability forced during rush hour rate.
Programmed unavailability rate.
Nominal tension.
Factor of nominal power.

With this information and other parameters of the operation available at the CDEC, it is possible to calculate the CO$_2$ emission in the electrical sector at unit level. Article 167 of the “Regulation of the Electric Law” (DS 327 Ministry of Mining) indicates that the electric power plants must give all information required by the CDEC with the purpose to maintain energy security and optimize the operation. On the other hand, those companies coordinated by the CDEC should provide the information required.

**Compliance system**

If electric power plants fail to provide the relevant information, penalties will be applied as described in Article 323 and 324 of the “Regulation of the Electric Law”. The failure to provide the required information in a timely manner, or the provision of false information, will be subject to sanctions. An investigation executed by the Superintendence of Electricity and Fuels will investigate potential breaches. But there are no specific levels of fines or sanctions; their level will depend exclusively on the investigation.

**4.2.3. NATIONAL ENERGY STATISTICS**

The Ministry of Energy in Chile is responsible for the publication of the National Energy Balance (BNE). The first publication of the BNE took place in 1960 and considered the consumption of primary and secondary energy. The BNE does not include information detailed by consumption of individual sources, but it depicts aggregate information of the sectorial level. These statistics are considered official information of the national energy consumption, and are therefore the baseline to develop GHG inventories, estimations and projections.

From the institutional point of view, there is no explicit legal mandate that establishes the obligatory nature to provide information of the different consumption sectors. Thus, for the elaboration of the BNE, it was necessary to develop a methodology system for the consistency checks, which would guarantee the reliability of the data.
**Surveys for energy intensive industries**

The energy balance is depicted based on the surveys sent to the energy intensive industries. These surveys are applied to industries, previously identified in a database that has been kept relatively constant for a long period of time. The information compiled through these surveys is the following: (i) Fuel sales made by distributors; (ii) Electricity sales made by generator companies; and (iii) Purchase of electricity made by Utilities.

**Compliance system**

There is no punitive system that can be applied to companies to oblige them to provide the information needed to elaborate the energy balance. However, the information request is supported by the attributions given to: the Superintendence of Electricity and Fuels (SEC), the Ministry of Energy, the Center of Economic Dispatch of Load (CDEC), and the National Commission of Energy (CNE).

**Comparison to IEA**

The main differences between the Chilean Energy Balance and the IEA Statistics are the following:

- The IEA format provides a single Integrated Energy Balance.
- It uses the concept of Total Primary Energy Supply.
- It shows inputs/outputs data of the transformation centers.
- There is a larger range of Energy consuming sectors, according to the ISIC Standard.
- The aviation bunkers and maritime consumption are deducted from the total transport sector consumption.

The National Balance of Energy is still the main source of information used for the compilation of the National Inventory of GHG reported to the UNFCCC (see next section).

**4.2.4. UNFCCC NATIONAL COMMUNICATION**

Chile presented in year 2011 the second national communication\(^4\) before the UNFCCC secretary, and it includes the national emissions inventory up to year 2006. To elaborate this inventory, indirect sources are used, since there is no obligation of the industry to report their emissions, thus sources are considered secondary information.

As explained in the national communication, GHG emissions for the national inventory are calculated using activity data (e.g. tonnes of cement produced) and emissions factors (e.g. ton of CO₂ emitted for the production of one tonne of cement) associated to the sectors. The emission factors are based on IPCC guidelines, or country specific values can also be used. For the activity data, depending on the analyzed sectors, there are several local and international sources of public access. For the case of the energy sector, the National Balance of Energy which is prepared annually by the Ministry of that portfolio, is the most important source of information for the preparation of the National Inventory.

4.3. CDM RELATED EXPERIENCE IN CHILE

Designated National Authority

Chile created its own Designated National Authority (DNA) in 2003, within the National Environmental Commission (CONAMA), which became the Ministry of Environment in January 2010. The Ministry of Environment delegates the operational tasks to the Executive Committee, composed of representatives from the following institutions:

- Ministry of Environment.
- Ministry of Foreign Affairs.
- Ministry of Agriculture.
- National Commission on Clean Production Council.
- Any other Ministry required by the project’s specificities.

Initially, besides its standard Letter of Approval (LoA) issuance function, the Chilean DNA was also in charge of the CDM promotion. For efficiency and strategic reasons, the promotion function has in the meantime been delegated to Prochile (Export Promotion Bureau, an agency belonging to the Ministry of Foreign Affairs), and CORFO (Economic Development Agency of Chile) for the promotion of innovation and support to small and medium sized businesses.

The Ministry of Environment only keeps a simple registry of CDM projects but does not perform supervision functions over the projects or their development.

Experience with CDM project developers/ participants

Chile is rather active in its CDM participation, considering the country’s size and emissions. Chile has currently 89 CDM projects approved by the DNA of which 55 are registered CDM projects generating an estimated 6 mill. CERs. With this, Chile is globally number 11 in terms of number of CDM projects and number 10 in terms of expected CERs.
The 89 projects approved by the DNA in Chile represent a wide range of sectors and technologies:

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Switch</td>
<td>2</td>
</tr>
<tr>
<td>Methane absorption and recovery</td>
<td>29</td>
</tr>
<tr>
<td>Hydroelectricity</td>
<td>27</td>
</tr>
<tr>
<td>Generation from biomass</td>
<td>9</td>
</tr>
<tr>
<td>Generation from wind</td>
<td>7</td>
</tr>
<tr>
<td>Reforestation</td>
<td>3</td>
</tr>
<tr>
<td>Energetic Efficiency</td>
<td>2</td>
</tr>
<tr>
<td>Others</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total projects approved by DNA</strong></td>
<td><strong>89</strong></td>
</tr>
</tbody>
</table>

*Table 14* Overview on CDM projects in Chile that received DNA approval. (Source: Ministry of the Environment)
This significant number of projects in a range of technologies mirrors also the related MRV capacities and services available in the DNA and in the private sector (project participants, CDM developers, aggregators, consultants, DOEs etc.). There are several companies, currently in Chile, which provide services involving carbon credits and CDM projects. Some of them are listed below:

<table>
<thead>
<tr>
<th>Private sector CDM service companies active in Chile</th>
</tr>
</thead>
<tbody>
<tr>
<td>MGM International.</td>
</tr>
<tr>
<td>Evelop.</td>
</tr>
<tr>
<td>South Pole Carbon Asset Management Ltda.</td>
</tr>
<tr>
<td>Ecoscurities.</td>
</tr>
<tr>
<td>Carbon Management Consulting Ltda.</td>
</tr>
<tr>
<td>Pricewaterhouse Coopers Chile.</td>
</tr>
<tr>
<td>Applus.</td>
</tr>
<tr>
<td>Aple Ltda.</td>
</tr>
<tr>
<td>Poch &amp; Asociados.</td>
</tr>
<tr>
<td>Deuman.</td>
</tr>
<tr>
<td>Rudi &amp; Riesco y Cia.</td>
</tr>
<tr>
<td>CCA Qualitas.</td>
</tr>
<tr>
<td>Eratech Chile Ltda.</td>
</tr>
<tr>
<td>Nordic AmbientalConsultores.</td>
</tr>
<tr>
<td>Carbon Managemento Consulting Ltda.</td>
</tr>
<tr>
<td>Enerconsul.</td>
</tr>
</tbody>
</table>

Table 15 Overview on some CDM service companies in Chile (list non exhaustive).
4.4. VOLUNTARY EMISSIONS REPORTING BY INDUSTRY

Some companies and industries are reporting greenhouse gas emissions on a voluntary basis.

Copper mining annual emissions inventory

The Chilean Copper Commission (COCHILCO, depending to the Ministry of Mines) started to publish in 2008 the yearly GHG Emissions Inventory. The Report covers 99% of the Industry Emissions and the methodology of the Inventory follows the IPCC Guidelines, and is included in the National Communications.

Voluntary Carbon Footprint reporting

Since 2006 most of the largest Chilean Company started to measure their carbon footprint according to the international standard, and 67 companies are currently reporting their Environmental impact, including GHG Footprint, through the publication of their Sustainability Report. The main companies reporting their Carbon Footprint within their Sustainability report are the following:

<table>
<thead>
<tr>
<th>Publication/Company name</th>
<th>Sector</th>
<th>Publication/Company name</th>
<th>Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>Endesa</td>
<td>Energy</td>
<td>2010</td>
</tr>
<tr>
<td>2011</td>
<td>Chilecitra</td>
<td>Energy</td>
<td>2010</td>
</tr>
<tr>
<td>2011</td>
<td>Enersis</td>
<td>Energy</td>
<td>2010</td>
</tr>
<tr>
<td>2011</td>
<td>Mall Plaza</td>
<td>Retail</td>
<td>2010</td>
</tr>
<tr>
<td>2011</td>
<td>Bci</td>
<td>Banking</td>
<td>2010</td>
</tr>
<tr>
<td>2010</td>
<td>Aguas Andinas</td>
<td>Water</td>
<td>2010</td>
</tr>
<tr>
<td>2010</td>
<td>Caja Las Andes</td>
<td>Banking</td>
<td>2010</td>
</tr>
<tr>
<td>2010</td>
<td>Minera Los Pelambres</td>
<td>Mining</td>
<td>2010</td>
</tr>
<tr>
<td>2010</td>
<td>Arauco</td>
<td>Paper/Forestry</td>
<td>2010</td>
</tr>
<tr>
<td>2010</td>
<td>Transelec</td>
<td>Energy</td>
<td>2010</td>
</tr>
<tr>
<td>2010</td>
<td>LAN Airlines</td>
<td>Aviation</td>
<td>2010</td>
</tr>
<tr>
<td>2010</td>
<td>Falabella</td>
<td>Retail</td>
<td>2009</td>
</tr>
<tr>
<td>2010</td>
<td>Barrick Sudamérica</td>
<td>Mining</td>
<td>2009</td>
</tr>
<tr>
<td>2010</td>
<td>Enap</td>
<td>Oil/Energy</td>
<td>2009</td>
</tr>
<tr>
<td>2010</td>
<td>Enjoy</td>
<td>Entertainment/Tourism</td>
<td>2009</td>
</tr>
<tr>
<td>2010</td>
<td>Metro</td>
<td>Transport</td>
<td>2009</td>
</tr>
<tr>
<td>2010</td>
<td>Grupo BBVA</td>
<td>Banking</td>
<td></td>
</tr>
</tbody>
</table>

Table 16 Main companies reporting their Carbon Footprint in Chile within their Sustainability Report
4.5. EXISTING CAPACITY FOR VERIFICATION

The numerous activities in the area of CDM (see section 4.3) have also led to significant presence of UNFCCC accredited validators and verifiers in Chile. The following certifying companies have been active in the CDM in Chile:

<table>
<thead>
<tr>
<th>UNFCCC ACCREDITED DOES IN CHILE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DOE with office in Chile</strong></td>
</tr>
<tr>
<td><strong>Other DOEs active in CDM in Chile</strong></td>
</tr>
</tbody>
</table>

Table 17 Overview on DOEs that have been active in the validation and verification of CDM projects in Chile in the past (Sources: Deuman, UNEP 2012b).

Please note that also many other UNFCCC accredited DOEs can work in Chile.

Outside the CDM, there is expertise at the Superintendence of Electricity for accreditation process which is a legal mandate. Also, the superintendence of environment has a legal mandate for accreditation of verifiers on environmental issues. It exist a specific regulation for accreditation for the verification of local pollutants that could serve as a basis for similar accreditation procedures in the area of greenhouse gas emissions.
5. GAP ANALYSIS AND A ROADMAP FOR MRV

From gap analysis to MRV roadmap

This chapter synthesizes main results from the earlier chapters in a gap analysis of MRV systems in Chile: The requirements for MRV, compliance and registry that are identified in Chapter 3 are put into relationship to the existing systems and capacities in Chile described in Chapter 4. The identified gap for the build-up of MRV systems is then translated into a roadmap for MRV in Chile, both for crediting systems (section 5.1) and for the Emissions Trading System (section 5.2).

Overarching issue: Phasing in

An important aspect of the introduction of any new market or regulatory framework on a national scale is the cautious planning of the phasing in. The question of how much MRV systems should be introduced how fast is not primarily a technical, but a political question. In this context, experience e.g. in the EU-ETS has shown that the early inclusion of key stakeholders such as Ministries, industry associations, service providers, universities, NGOs, etc. are key for a successful implementation of MRV systems.

In addition, the proposed roadmap for MRV is to be closely synchronized with similar roadmaps for the underlying Emissions Trading Scheme and Crediting Mechanisms.

Typical phases of roadmap:

Both the roadmap for ETS and crediting systems follows a simple four stage approach which builds loosely on the similar phasing of the roadmap on ETS in PMR activity 2:

I. Preparatory phase (Capacity building, etc.)
II. Pilot phase – voluntary MRV in pilot sectors, on-going capacity building
III. Introductory phase
IV. Full trading phase
5.1. MRV CAPACITY BUILDING FOR CREDITING MECHANISMS

5.1.1. GAP ANALYSIS

The following table provides a list of main elements that are necessary for MRV in crediting mechanisms (see section 3.2), together with a preliminary assessment of the gap in MRV capacity and a summary of main elements of existing capacity that may provide a basis for the build-up of capacity in the next steps (see Chapter 4).

**GAPS IN MRV CAPACITY FOR CREDITING MECHANISMS**

<table>
<thead>
<tr>
<th>Capacity item</th>
<th>Gap</th>
<th>Main existing elements to build on</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity to establish and operate a <strong>policy setting authority</strong> for MRV of new crediting mechanisms</td>
<td>- not existent yet, - but numerous similar bodies exist in other contexts, e.g.</td>
<td>• Explicit mandate for Ministry of Environment to coordinate climate change policies. • Ministry of energy has the capacity and the mandate to regulate the energy sector. • Superintendency of electricity has the legal mandate to supervise and require information to all energy suppliers company (fuel an electricity).</td>
</tr>
<tr>
<td>Capacity to establish and operate a <strong>regulatory body</strong> for MRV of new crediting mechanisms</td>
<td>- not existent yet, - but numerous similar bodies exist in other contexts, e.g.</td>
<td>• There are expertise in the regulation of the electricity and industrial sector for local pollutants (e.g. PM trading). • Many institutions have regulatory activities and capacities at another level, e.g. the Ministry of Health, National Energy Commission, Regional Health and Environmental Authorities.</td>
</tr>
<tr>
<td>Capacity to establish and operate a <strong>administrator body</strong> for MRV of new crediting mechanisms</td>
<td></td>
<td>The Ministry of Health has expertise to administer MRV for local pollutants, this capacity could be extended for GHG.</td>
</tr>
<tr>
<td>Conventional CDM <strong>MRV</strong></td>
<td></td>
<td>- Fully functioning DNA - 89 CDM projects approved by DNA, 55 registered - legal framework and institutional setting are in place. - compliance is assured as CDM project par-</td>
</tr>
<tr>
<td>Capacity item</td>
<td>Gap</td>
<td>Main existing elements to build on</td>
</tr>
<tr>
<td>---------------</td>
<td>-----</td>
<td>-----------------------------------</td>
</tr>
</tbody>
</table>
| MRV on level of operators/installations in industry | - Data on installation level MRV available for some larger installations through 3 main sources: emission declaration database, grid database, decontamination and prevention plans.  
- Existing industrial associations and research institutes may serve as platform to distribute know-how on MRV.  
- Expertise at the industrial level to declare and report emission of local gases. | |
| Capacity to establish and operate an accreditation system for verifiers | There is expertise at the Superintendence of Electricity for accreditation process that is a legal mandate.  
The superintendence of environment has a legal mandate for accreditation on environmental issues.  
Exist a specific regulation for accreditation for the verification of local pollutants that could be used for GHG. | |
| Capacity to establish and operate a registration and issuance system for emission reductions | There is no capacity to establish and operate a registration and issuance system for emission reductions | |
| MRV on level of operators in agriculture and forestry | There is no capacity. | |
| Capacity to calculate and maintain project by project or standardized baselines | There is a private and public capacity to calculate and maintain standardized baselines based at the significant CDM experience in Chile | |
| Capacity to assemble and operate a Chilean “Executive Board” for new crediting mechanisms project approvals | Under the new environmental law there are by legal mandate a board of ministers that coordinate the environmental policy.  
This board has gained significant expertise under the CDM DNA | |
| Capacity to develop and maintain tools and guidance materials for project proponents to participate in new crediting mechanisms | - Capacity may build-up on existing CDM expertise | |
| Capacity to develop and maintain various methodologies for project proponents to participate in new crediting mechanisms | - Capacity may build-up on existing CDM expertise | |
| Regulatory authority to mandate emission reductions | - Ministry of environment has the capacity and the authorities to define caps at all emissions levels | |
**GAPS IN MRV CAPACITY FOR CREDITING MECHANISMS**

<table>
<thead>
<tr>
<th>Capacity item</th>
<th>Gap</th>
<th>Main existing elements to build on</th>
</tr>
</thead>
<tbody>
<tr>
<td>General awareness in the business community including main industries and financial sector on opportunities of <em>conventional CDM</em></td>
<td>🟢🟢</td>
<td>- High level of knowledge of CDM opportunities at electric sector.</td>
</tr>
<tr>
<td>General awareness in the business community including main industries and financial sector on opportunities of <em>new crediting mechanisms</em></td>
<td>🟢🔴</td>
<td>- Political support to the government for the use of market mechanisms for ghg issues.</td>
</tr>
<tr>
<td>Capacity to <em>cross-compare</em> MRV in different reduction programmes</td>
<td>🟢🔴</td>
<td>- High level of awareness on the implication and restrictions for carbon footprint.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Limited capacity</td>
</tr>
</tbody>
</table>

Table 18 The analysis of the existing gap in MRV capacity is done on the basis of our research and expert judgements. The indicator for the gap is expressed in symbols: 🟢🟢 indicates a very high and well developed level of capacity for MRV. On the other extreme 🟢🔴 indicates a very low level of MRV capacity for the considered capacity item. The latter indicates capacity building needs to be taken care of in the MRV roadmap below.

### 5.1.2. MRV ROADMAP FOR CREDITING MECHANISMS

The following table provides a draft roadmap for the build-up of MRV systems for crediting mechanisms in Chile.
### ROADMAP FOR MRV IN CREDITING MECHANISMS

<table>
<thead>
<tr>
<th>Phase</th>
<th>Operators/private sector/PP</th>
<th>“Agency for standardized baseline approaches”</th>
<th>Policy setting/ regulatory body, Administrator body</th>
<th>Activity tracking system</th>
</tr>
</thead>
</table>
| 1. Preparatory phase | - Awareness raising for the opportunities provided by standardized approaches in all relevant sectors,  
- Start participatory process with relevant stakeholders (industry associations, NGOs, etc.) to discuss options for the implementation of crediting systems and related MRV.  
- Special consideration of large industries and industry associations: building on CDM expertise provide training in key issues of standardized approaches (data collection, standardized baseline determination, additionality testing on aggregate level) and related MRV issues.  
- Key sectors to start may include power, cement, iron and steel, pulp & paper, etc.  
- Training of verification companies | - In contrast to conventional CDM, standardized approaches require the DNA to collect large amounts of data on the performance of technologies used in specific markets (e.g. cement). The Agency for standardized baseline approaches would be a new unit under the governance of the DNA that is responsible for research, data collection and establishment of standardized baselines for key sectors.  
- The Agency works with industry associations and other stakeholders to develop databases for baseline relevant data, taking into account limits of data availability, confidentiality of data and data vintage issues  
- In phase 1 the Agency develops two standardized baselines for submission to the UNFCCC or some other suitable standard  
- Institutional setting (incl. financing) of Agency to be identified | - Identify Chilean public institutions with expertise in MRV, e.g. based on earlier systems of monitoring of local pollutants, national energy balance and inventory etc.  
- Definition of governance body for crediting mechanisms (responsible for setting policies and regulatory framework)  
- Definition of administrator body for crediting mechanisms (responsible for day-to-day management of crediting projects, programs or policies, activity tracking system, compliance enforcement)  
- Definition of incentives for actors to participate in the preparatory and pilot phase for MRV  
- Clarification if crediting mechanisms should follow an international standard (e.g. CDM, NMM) or a national standard  
- Identify the main institutional | - Regulatory process maps are developed  
- Technical requirements of tracking system to be defined. Define minimum requirements and nice-to-have options. Estimate number of account holders and expected volume transacted.  
- Registry software products and developers are proposed and analysed (e.g. from-the-shelf vs. customized software package)  
- Safety and security requirements of tracking system to be defined taking into account lessons learnt in the EU-ETS.  
- Consider phased implementation: Simple tracking system in phase 1 and 2, more elaborate system in phase 3 and 4.  
- Registry design is formulated with roundtable input from the private sector/project proponents |
<table>
<thead>
<tr>
<th>Phase</th>
<th>Operators/private sector/PP</th>
<th>“Agency for standardized baseline approaches”</th>
<th>Policy setting/ regulatory body, Administrator body</th>
<th>Activity tracking system</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>clarified.</td>
<td>private and public to constitute EB</td>
<td></td>
</tr>
</tbody>
</table>
| 2. Pilot phase | Foster implementation of several pilot phase projects in two sectors, road test project cycle processes as well as regulatory and institutional framework | - Collect lessons learnt from first two sector standardized baselines regarding MRV<br>- Based on this, development of standardized baselines for Pilot phase for five different sectors<br>- Develop streamlined processes for sector wide data collection and processing<br>- Build-up database of data and parameters with relevance for baseline determination (including both national as well as international data)<br>- Further development of project cycle and MRV for SBL projects<br>- Development of tools to facilitate project implementation under standardized approaches | - Inter-departmental EB is created<br>- Regulatory and institutional framework for administrator body is put into force<br>- Relevant decrees for MRV are put in place<br>- Evaluation of different approaches for compliance regimes for MRV in next phases (pilot phase is purely voluntary)<br>- Develop guidance documents on MRV in key sector for next phase, invite project proponents to stakeholder participation.<br>- Accreditation process for verifiers are in place<br>- Analysis of potential linking with UNFCCC, bilateral or other carbon systems incl. requirements for MRV<br>- First verification companies accredited | - Regulatory process selected and implemented for *simple tracking system*<br>- Registry software developer selected for simple tracking system<br>- Road-testing of simple tracking system in the framework of pilot phase of crediting mechanisms<br>- Documentation of lessons learnt and inputs from stakeholders<br>- Design of simple registry is finalized<br>- Based on lessons learnt development of technical specification for *full tracking system* for phases 3 and 4.
# ROADMAP FOR MRV IN CREDITING MECHANISMS

<table>
<thead>
<tr>
<th>Phase</th>
<th>Operators/private sector/PP</th>
<th>“Agency for standardized baseline approaches”</th>
<th>Policy setting/ regulatory body, Administrator body</th>
<th>Activity tracking system</th>
</tr>
</thead>
</table>
| **3. Implementation phase I**  
*Result:* First sectors involved, constitution of Chilean EB, ERs monitored and calculated, credits issued to a test account |
- Foster implementation of projects in more sectors.  
- Carry out sector specific MRV training for newly integrated sectors.  
- Streamline project cycle in established key sectors  
- Verification tools and guidelines are implemented |
- Check the methodologies of the CDM baselines and direct application to the Chilean system  
- Standardized baselines for several sectors are calculated and published  
- Systems are in place to regularly update baseline database and to revise, issue or approve methodologies and calculation techniques |
- Systems are in place to revise, issue or approve methodologies and calculation techniques  
- Inclusion of new ministries and governmental bodies in the governance and administration framework with the coverage of new sectors with specific MRV requirements (e.g. transport, agriculture) |
- Full tracking system/ Registry system developed and accessible for trials  
- Registry system is tested internally, between government departments  
- Development of user manual for account holders etc.  
- Start-up of operation of registry with assignment of accounts to users etc. |
| **4. Implementation phase II**  
*Result:* More sectors involved, scaling up of mechanisms, Chilean EB authorizes project documentation, credits issued to accounts, Private Sector finance is increasingly involved, 3rd party verifier used |
- Scaling up of crediting mechanisms with involvement of more projects in more sectors.  
- Appearance of specialized service firms for MRV in specific sectors  
- Private sector capital is increasingly deployed  
- Project proponents have full access to registry system  
- Verification entities and systems are consolidated |
- Standardized baselines are calculated and published for more difficult sectors (forestry, agriculture, transport, etc.)  
- Provision of IT tools for PPs to rationalize and streamline MRV procedures in installations and lower transaction costs |
- Administrator body performs registration and issuance  
- Increased number of projects, covered sectors and transactions requires increased support structures and staffing of the administrator body  
- Elaboration of options to streamline and harmonize crediting systems in different countries in order to lower transaction costs and increase market demand abroad |
- Full tracking system/ Registry system is consolidated and optimized  
- Links to other national or international registries established for automatic tracking of transactions between different crediting schemes and Emission Trading Systems  
- Full administrative body around registry in place |

Table 19 Phasing for the implementation of a MRV system and specific capacity building needs of main actors.
5.2. MRV CAPACITY BUILDING FOR ETS
5.2.1. GAP ANALYSIS

The following table provides a list of main elements that are necessary for MRV in an ETS (see section 3.3), together with a preliminary assessment of the gap in MRV capacity and a summary of main elements of existing capacity that may provide a basis for the build-up of capacity in the next steps (see Chapter 4).

<table>
<thead>
<tr>
<th>Capacity item</th>
<th>Gap</th>
<th>Main existing elements to build on</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity to establish and operate a <strong>policy setting authority</strong> for MRV in ETS</td>
<td>- not existent yet, - but numerous similar bodies exist in other contexts, e.g. • The DS 812 for Ministry of health states that the stationary sources may offset emissions from other stationary sources in Santiago City. • To compensate can buy quotas of particulate matter • There are similar instruments in the context of environmental assessment systems.</td>
<td></td>
</tr>
<tr>
<td>Capacity to establish and operate a <strong>regulatory body</strong> for MRV in ETS</td>
<td>- not existent yet, - but similar bodies exist in other contexts, e.g. • The Regional Environment Authority have the capacity to operate like a regulatory body for MVR to local pollutant. It is possible to extend to GHG.</td>
<td></td>
</tr>
<tr>
<td>Capacity to establish and operate a <strong>administrator body</strong> for MRV in ETS</td>
<td>- not existent yet,</td>
<td></td>
</tr>
<tr>
<td>MRV capacity for ETS on level of operators/installations in energy intensive industry</td>
<td>- Data on installation level MRV available for some larger installations through two main sources: Data from Ministry of Health and PRTR (pollution) database. - Existing industrial associations and research institutes may serve as platform to distribute know-how on MRV</td>
<td></td>
</tr>
<tr>
<td>MRV capacity for ETS on level of operators/installations in power generation</td>
<td>- Data on installation level MRV available for some larger installations through two main sources: Data from Ministry of Health and RETC (pollution) database as well as the grid database. - Existing industrial associations and research institutes may serve as platform to distribute know-how on MRV</td>
<td></td>
</tr>
</tbody>
</table>
### GAPS IN MRV CAPACITY FOR EMISSION TRADING SYSTEM

<table>
<thead>
<tr>
<th>Capacity item</th>
<th>Gap</th>
<th>Main existing elements to build on</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRV capacity for ETS on level of fleets/operators in road transport sector</td>
<td></td>
<td>- not existent yet,</td>
</tr>
<tr>
<td>MRV capacity for ETS on level of operators/installations in mining and</td>
<td></td>
<td>There are MRV systems for GHG reporting in a voluntary base with some companies in the larger</td>
</tr>
<tr>
<td>mineral extraction</td>
<td></td>
<td>installations</td>
</tr>
<tr>
<td>MRV capacity for ETS on level of fleets/operators in shipping</td>
<td></td>
<td>- not existent yet,</td>
</tr>
<tr>
<td>MRV capacity for ETS on level of operators in agriculture and forestry</td>
<td></td>
<td>- not existent yet,</td>
</tr>
<tr>
<td>MRV capacity for ETS on level of operators/installations in industry</td>
<td></td>
<td>There are legal bodies that establish the requirements to MRV for local gases in the Industry and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Power Plants</td>
</tr>
<tr>
<td>Capacity to cross-compare MRV in different reduction programmes</td>
<td></td>
<td>- not existent yet,</td>
</tr>
<tr>
<td>General awareness in the business community including main industries and</td>
<td></td>
<td>Not existent yet</td>
</tr>
<tr>
<td>financial sector on opportunities of ETS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity for Verification services for ETS</td>
<td></td>
<td>There are several international DOE’s in Chile that providing this service for CDM and could also</td>
</tr>
<tr>
<td></td>
<td></td>
<td>provide this for ETS</td>
</tr>
<tr>
<td>Capacity for built up and administration of Registry for ETS</td>
<td></td>
<td>- There is no existing similar registry.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Existing capacity and resources within the governmental entities is limited</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- As an option, the registry might be developing by Private Sector for which capacity and expertise</td>
</tr>
<tr>
<td></td>
<td></td>
<td>is available in Chile</td>
</tr>
</tbody>
</table>

Table 20 The analysis of the existing gap in MRV capacity is done on the basis of our research and expert judgements. The indicator for the gap is expressed in symbols: □ indicates a very high and well-developed level of capacity for MRV. On the other extreme □□ indicates a very low level of MRV capacity for the considered capacity item. The latter indicates capacity building needs to be taken care of in the MRV roadmap below.

### 5.2.2. MRV ROADMAP FOR ETS

The following table provides a draft roadmap for the build-up of MRV systems for an Emissions Trading System in Chile.
### ROADMAP FOR MRV IN AN EMISSIONS TRADING SYSTEM

<table>
<thead>
<tr>
<th>Operators/private sector</th>
<th>Operators/private sector</th>
<th>Policy setting/ regulatory body, ETS Administrator</th>
<th>ETS registry system</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRV at source level</td>
<td>MRV at upstream level (if relevant)</td>
<td>Build-up of MRV institutional system in consultation of all relevant ministries. Definition of role and responsibilities of policy setting authority, Regulatory body and ETS Administrator with regards to MRV.</td>
<td>Build-up of MRV institutional system in consultation of all relevant ministries. Definition of role and responsibilities of policy setting authority, Regulatory body and ETS Administrator with regards to MRV.</td>
</tr>
<tr>
<td>1. Preparatory phase</td>
<td></td>
<td>Build-up of MRV regulation for the considered sectors (this is part of regulation for allocation rules and ETS rules). Definition of incentives for actors to participate in the preparatory and pilot phase for MRV.</td>
<td>Build-up of MRV institutional system in consultation of all relevant ministries. Definition of role and responsibilities of policy setting authority, Regulatory body and ETS Administrator with regards to MRV.</td>
</tr>
<tr>
<td><strong>Result:</strong> level of knowledge raised, overview on available data and feasibility of MRV, first structures in place and first reporting</td>
<td><strong>Result:</strong> level of knowledge raised, overview on available data and feasibility of MRV, first structures in place and first reporting</td>
<td><strong>Result:</strong> level of knowledge raised, overview on available data and feasibility of MRV, first structures in place and first reporting</td>
<td><strong>Result:</strong> level of knowledge raised, overview on available data and feasibility of MRV, first structures in place and first reporting</td>
</tr>
<tr>
<td>- Training in MRV approaches in all relevant sectors. Increasing number of companies/sectors covered by training.</td>
<td>- Training in MRV approaches in all relevant sectors (e.g. electricity, transport). Increasing number of companies/sectors covered by training.</td>
<td>- Build-up of MRV institutional system in consultation of all relevant ministries. Definition of role and responsibilities of policy setting authority, Regulatory body and ETS Administrator with regards to MRV.</td>
<td>- Build-up of MRV institutional system in consultation of all relevant ministries. Definition of role and responsibilities of policy setting authority, Regulatory body and ETS Administrator with regards to MRV.</td>
</tr>
<tr>
<td>- Stakeholder consultation of interested industry associations on approaches to MRV</td>
<td>- Stakeholder consultation of interested stakeholders on approaches to upstream MRV (fuel importers/producers, …)</td>
<td>- Build-up of MRV regulation for the considered sectors (this is part of regulation for allocation rules and ETS rules). Definition of incentives for actors to participate in the preparatory and pilot phase for MRV.</td>
<td>- Build-up of MRV institutional system in consultation of all relevant ministries. Definition of role and responsibilities of policy setting authority, Regulatory body and ETS Administrator with regards to MRV.</td>
</tr>
<tr>
<td>- Capacity building with industry associations related to the opportunities and threats for ETS.</td>
<td>- Evaluation of availability of data, instrumentation, control and information systems for NCV, emission factors and activity data</td>
<td>- Build-up of MRV regulation for the considered sectors (this is part of regulation for allocation rules and ETS rules). Definition of incentives for actors to participate in the preparatory and pilot phase for MRV.</td>
<td>- Build-up of MRV institutional system in consultation of all relevant ministries. Definition of role and responsibilities of policy setting authority, Regulatory body and ETS Administrator with regards to MRV.</td>
</tr>
<tr>
<td>- Evaluation of availability of data, instrumentation, control and information systems for emissions and activity data</td>
<td>- Evaluation of availability of data, instrumentation, control and information systems for NCV, emission factors and activity data</td>
<td>- Build-up of MRV regulation for the considered sectors (this is part of regulation for allocation rules and ETS rules). Definition of incentives for actors to participate in the preparatory and pilot phase for MRV.</td>
<td>- Build-up of MRV institutional system in consultation of all relevant ministries. Definition of role and responsibilities of policy setting authority, Regulatory body and ETS Administrator with regards to MRV.</td>
</tr>
<tr>
<td>- Evaluation of availability of data management processes, IT, QA/QC</td>
<td>- Evaluation of availability of data management processes, IT, QA/QC</td>
<td>- Build-up of MRV regulation for the considered sectors (this is part of regulation for allocation rules and ETS rules). Definition of incentives for actors to participate in the preparatory and pilot phase for MRV.</td>
<td>- Build-up of MRV institutional system in consultation of all relevant ministries. Definition of role and responsibilities of policy setting authority, Regulatory body and ETS Administrator with regards to MRV.</td>
</tr>
<tr>
<td>- Evaluation of data confidentiality issues and their solutions</td>
<td>- Evaluation of data confidentiality issues and their solutions</td>
<td>- Build-up of MRV regulation for the considered sectors (this is part of regulation for allocation rules and ETS rules). Definition of incentives for actors to participate in the preparatory and pilot phase for MRV.</td>
<td>- Build-up of MRV institutional system in consultation of all relevant ministries. Definition of role and responsibilities of policy setting authority, Regulatory body and ETS Administrator with regards to MRV.</td>
</tr>
<tr>
<td>- Evaluation of “verifiability” of data</td>
<td>- Evaluation of “verifiability” of data</td>
<td>- Build-up of MRV regulation for the considered sectors (this is part of regulation for allocation rules and ETS rules). Definition of incentives for actors to participate in the preparatory and pilot phase for MRV.</td>
<td>- Build-up of MRV institutional system in consultation of all relevant ministries. Definition of role and responsibilities of policy setting authority, Regulatory body and ETS Administrator with regards to MRV.</td>
</tr>
<tr>
<td>- Implementation of a tiered approach to voluntary reporting</td>
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<td>- Build-up of MRV institutional system in consultation of all relevant ministries. Definition of role and responsibilities of policy setting authority, Regulatory body and ETS Administrator with regards to MRV.</td>
</tr>
<tr>
<td>- Evaluation of results from voluntary reporting, revision</td>
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<td>- Build-up of MRV institutional system in consultation of all relevant ministries. Definition of role and responsibilities of policy setting authority, Regulatory body and ETS Administrator with regards to MRV.</td>
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</tbody>
</table>

- Regulatory process maps are developed
- Technical requirements of ETS registry system to be defined. Define minimum requirements and nice-to-have options. Estimate number of account holders and expected volume transacted.
- Registry software products and developers are proposed and analysed (e.g. from-the-shelf vs. customized software package)
- Safety and security requirements of tracking system to be defined taking into account lessons learnt in the EU-ETS.
- Consider phased implementation: Simple registry system in phase 1 and 2, more elaborate system in phase 3 and 4.
- Definition of stepwise approach for registry built up. Coordination with international registries may be considered.
<table>
<thead>
<tr>
<th>Operators/private sector MRV at source level</th>
<th>Operators/private sector MRV at upstream level (if relevant)</th>
<th>Policy setting/ regulatory body, ETS Administrator</th>
<th>ETS registry system</th>
</tr>
</thead>
<tbody>
<tr>
<td>of regulatory framework if necessary.</td>
<td>of regulatory framework if necessary.</td>
<td>Draft regulation and institutional setting for MRV is road tested in pilot scheme.</td>
<td>- Registry design is formulated with roundtable input from the private sector/project proponents</td>
</tr>
<tr>
<td>- Training of verification companies, build-up of verification capacity for ETS</td>
<td></td>
<td>- Evaluation of road test and revision of framework if necessary.</td>
<td></td>
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<tr>
<td>2. Pilot phase</td>
<td>- Advanced training in MRV for all participants in pilot scheme.</td>
<td>- Definition of compliance scheme and sanctions in case of insufficient MRV performance of ETS members.</td>
<td></td>
</tr>
<tr>
<td>Result: first “stand alone” trading system(s) in different sectors are up and running. (Traded units have almost no value.)</td>
<td>- pilot verification of monitoring and identification of bottlenecks/problems</td>
<td>- Supervision and further training of verification companies</td>
<td></td>
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<td></td>
<td>- Hot line for participants in pilot scheme</td>
<td></td>
<td>- An electronic registry for the pilot phase is developed to gain experience.</td>
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<tr>
<td></td>
<td>- Capacity building with representatives from financial industry related to the opportunities and threats for ETS.</td>
<td></td>
<td>- Registry for pilot phase can be simper and have somewhat reduced functionality and security</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Training and capacity building on the role and functioning of registry systems for relevant actors.</td>
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<td></td>
<td></td>
<td></td>
<td>- Registry system and processes are road tested in pilot scheme.</td>
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<td></td>
<td></td>
<td></td>
<td>- Evaluation of road test and revision of registry concept if necessary.</td>
</tr>
</tbody>
</table>

Table 21 Phasing for the implementation of a MRV system and specific capacity building needs of main actors.
Please note that the roadmap for the subsequent Implementation Phases I and II will heavily depend on the type and scope of Emissions Trading System chosen (e.g. upstream vs. downstream, covering specific sectors etc.) and needs to be defined once the outline of a potential ETS for Chile are better designed.
## GLOSSARY AND ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AFOLU</td>
<td>Agriculture, Forestry and Other Land Use</td>
</tr>
<tr>
<td>BNE</td>
<td>National Energy Balance</td>
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<tr>
<td>BOCM</td>
<td>Bilateral Offset Crediting Mechanism (Japan)</td>
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<td>CAR</td>
<td>California Action Reserve</td>
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<td>CDEC</td>
<td>Load Economic Dispatch Center</td>
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<td>CDM</td>
<td>Clean Development Mechanism</td>
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<tr>
<td>CDP</td>
<td>Carbon Disclosure Project</td>
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<tr>
<td>CER</td>
<td>Certified Emission Reduction</td>
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<tr>
<td>CFI</td>
<td>Carbon Financial Instruments</td>
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<tr>
<td>CNE</td>
<td>National Commission of Energy</td>
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<tr>
<td>CONAMA</td>
<td>National Environmental Commission</td>
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<tr>
<td>CPA</td>
<td>CDM Programme Activities</td>
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<tr>
<td>CRF</td>
<td>Common Reporting Format</td>
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<tr>
<td>DNA</td>
<td>Designated National Authority</td>
</tr>
<tr>
<td>DOE</td>
<td>Designated Operating Entities</td>
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<tr>
<td>EB</td>
<td>Executive Board</td>
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<tr>
<td>ECX</td>
<td>European Climate Exchange</td>
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<tr>
<td>EEX</td>
<td>European Energy Exchange</td>
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<tr>
<td>ETS</td>
<td>Emissions Trading System</td>
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<tr>
<td>EU ETS</td>
<td>European Union’s Emissions Trading System</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>GHG</td>
<td>Greenhouse Gas</td>
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<tr>
<td>ICA</td>
<td>International Consultations and Analysis</td>
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<td>IEA</td>
<td>International Energy Agency</td>
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<tr>
<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
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<td>ISO</td>
<td>International Standards Organization</td>
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<tr>
<td>JI</td>
<td>Joint Implementation</td>
</tr>
<tr>
<td>JVETS</td>
<td>Japanese Voluntary Emissions Trading Scheme</td>
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<tr>
<td>LCA</td>
<td>Ad Hoc Working Group on Long-term Cooperative Action under the</td>
</tr>
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<td></td>
<td>UNFCCC</td>
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<tr>
<td>NAMA</td>
<td>Nationally Appropriate Mitigation Actions</td>
</tr>
<tr>
<td>NIR</td>
<td>National Inventory Report</td>
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</tbody>
</table>
NMM   New Market Mechanisms
NZ ETS  New Zealand’s Emissions Trading System
MODEM  Emission model for mobile sources on route
MRV    Monitoring, Reporting, Verification
PDD    Project Design Document
PM     Particulate Matter (local pollutant)
PMR    Partnership for Market Readiness
PoA    Programme of Activity
QA/QC  Quality Assurance and Quality Control
RETC   Registry of Emissions and Transfer of Contaminants
RGGI   Regional Greenhouse Gas Initiative
SBI    Subsidiary Body for Implementation
SBSTA  Subsidiary Body for Scientific and Technological Advice
SEC    Superintendence of Electricity and Fuels
SECTRA Department of Transportation Planning
UNFCCC United Nations Framework Convention on Climate Change
VCS    Verified Carbon Standard
VER    Verified Emissions Reductions
WBCSD  World Business Council on Sustainable Development
WRI    World Resource Institute
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