



# MRV 101: UNDERSTANDING MEASUREMENT, REPORTING, AND VERIFICATION OF CLIMATE CHANGE MITIGATION

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## EXECUTIVE SUMMARY

The historic Paris Agreement brokered in December 2015 established universal and harmonized measurement, reporting, and verification (MRV) provisions for climate change mitigation. A common system of transparency now applies to all countries. MRV is central to effectively implementing the Nationally Determined Contributions (NDCs) submitted under the Paris Agreement, which describe countries’ mitigation goals and policies. Measurement is needed to identify emissions trends, determine where to focus greenhouse gas (GHG) reduction efforts, track mitigation-related support, assess whether mitigation actions planned under NDCs or otherwise are proving effective, evaluate the impact of support received, and monitor progress achieved in reducing emissions. Reporting and verification are important for ensuring transparency, good governance, accountability, and credibility of results, and for building confidence that resources are being utilized effectively.

Many countries have engaged in MRV to serve a variety of domestic and international purposes. This term is widely used in the climate change field, but often without a clear reference to the type of MRV being discussed. This often leads to confusion because the underlying nature of MRV-related activities differs according to their context and application. This working paper attempts to clarify the term as it is used in the context of climate mitigation, by describing different types of MRV and how they differ from one another.

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*Working Papers contain preliminary research, analysis, findings, and recommendations. They are circulated to stimulate timely discussion and critical feedback and to influence ongoing debate on emerging issues. Most working papers are eventually published in another form and their content may be revised.*

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Three types of mitigation-related MRV are discussed in the paper (Figure ES-1):

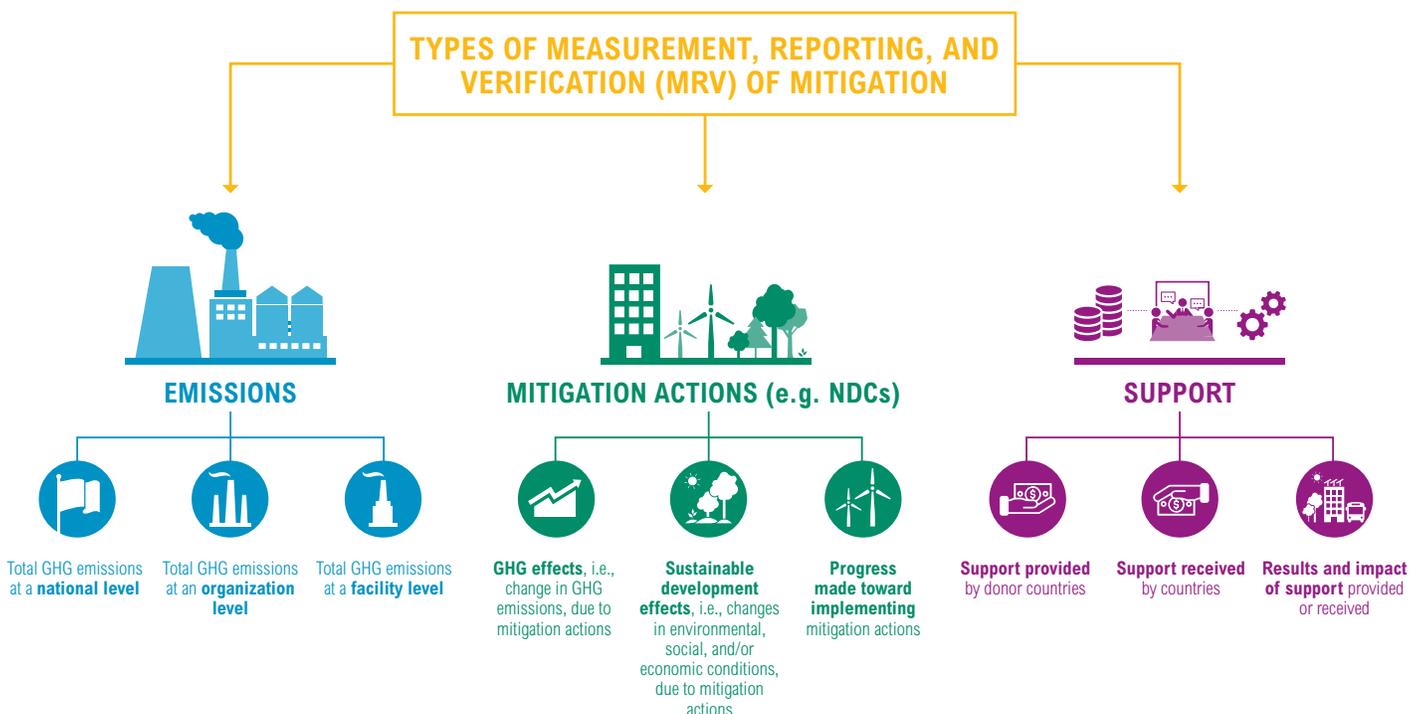
- MRV of **GHG emissions**, conducted at national, organizational, and/or facility level to understand an entity’s emissions profile and report it in the form of an emissions inventory.
- MRV of **mitigation actions** (e.g., policies and projects) to assess their GHG effects and sustainable development (non-GHG) effects as well as to monitor their implementation. This type of MRV focuses on estimating the *change* in GHG emissions or other non-GHG variables.
- MRV of **support** (e.g., climate finance, technology transfer, and capacity building) to track provision and receipt of climate support, monitor results achieved, and assess impact.

The paper aims to disentangle the concept to make it easier for practitioners to understand which types of MRV are most relevant to them, which methodologies can be used for each type, who should perform the related activities, and how often. Accordingly, the paper presents some initial questions to set readers on the path to identifying the appropriate type and level of MRV:

- **Why** undertake measurement, reporting, and verification? This question addresses the objectives and purpose of MRV, which are critical elements in creating ownership of related initiatives at every level.
- **How** will measuring, reporting, and verification be performed? This question focuses on the methodological and technical guidelines and processes involved in performing MRV.
- **When** will measuring, reporting, and verification be performed? This question helps define the appropriate timeframe for undertaking MRV.
- **Who** will carry out measuring, reporting, and verification? It is important to identify clearly the entities and individuals responsible for undertaking MRV.

There are other sub-categories of MRV, for example, MRV of emissions at the sub-national level (e.g., provincial and city level), but the discussion here is limited to those that are understood to be the most relevant for national decision-makers. Further, the paper deals with setting up MRV from the perspective of government and institutions, rather than that of an individual organization or project developer.

Figure ES-1 | **Various Types of Mitigation-related MRV**



This is meant to be an introductory paper to clarify the different types of MRV relevant to climate mitigation. It is aimed at national decision-makers and practitioners from environment and development organizations with no or little prior knowledge. The paper does not provide detailed guidance on implementing each type of MRV, nor does it cover monitoring and evaluation of adaptation efforts.

We hope that this paper will enhance understanding of the landscape of MRV, the ways in which different types of MRV fulfill particular needs and utilize respective methodologies, and the synergies among them.

## 1. INTRODUCTION

Effective mitigation of climate change requires a clear understanding of greenhouse gas (GHG) emissions and their sources, and regular monitoring of mitigation strategies and their impacts. The practice of “MRV,” which integrates three independent, but related, processes of measurement or monitoring (M), reporting (R), and verification (V), is fundamental in this regard (Ninomiya 2012). MRV includes the following steps and procedures (Dagnet et al. 2014):

- **Measure or monitor (M)** data and information on emissions, mitigation actions, and support. This may entail direct physical measurement of GHG emissions, estimating emissions or emissions reductions utilizing activity data and emission factors, calculating changes relevant to sustainable development, and collecting information about support for climate change mitigation.<sup>1</sup>
- **Report (R)** by compiling this information in inventories and other standardized formats to make it accessible to a range of users and facilitate public disclosure of information.
- **Verify (V)** by periodically subjecting the reported information to some form of review or analysis or independent assessment to establish completeness and reliability. Verification helps to ensure accuracy and conformance with any established procedures, and can provide meaningful feedback for future improvement.

The term MRV first appeared in the context of climate change mitigation policy as part of the Bali Action Plan (2007), which called for “measurable, reportable, and verifiable nationally appropriate mitigation commitments or actions” and stated that they should be “supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner” (UNFCCC 2007). Subsequently, efforts have been made to fill in the details and define what should be measured, reported, and verified, how, by whom, and for what purpose.

Most recently, under the Paris Agreement, it was agreed that all countries will provide emissions data and track progress against their contributions. MRV systems will be a significant component in effectively tracking and improving the implementation of mitigation goals and policies articulated under countries’ Nationally Determined Contributions (NDCs) (CDKN Global 2016).

This paper brings together existing knowledge to provide an introductory guide to MRV related to mitigation efforts, with the aim of clearly distinguishing among different types of MRV and enhancing readers’ understanding of the concept of MRV. It seeks to inform a range of groups, including representatives of governmental organizations at national and sub-national levels, donor agencies and development banks, and research organizations, which do not have prior knowledge of the concept and are interested in learning about the basics of MRV.

Detailed guidance on implementing MRV systems and discussion of adaptation-related monitoring and evaluation are outside the scope of this paper. Significant literature exists on the essential building blocks of MRV systems, including establishing institutional arrangements and data management systems, and building capacities.<sup>2</sup> Further, case studies are available identifying good practices based on the experiences of entities setting up different kinds of MRV systems at different levels.<sup>3</sup>

This paper describes three different types of MRV of mitigation in Section 2. Section 3 walks readers through a list of questions designed to assess which type of MRV would be most appropriate for their needs and to help with the first step toward implementing a comprehensive MRV system. The final section presents a number of examples to emphasize the complementary nature of different types of MRV.

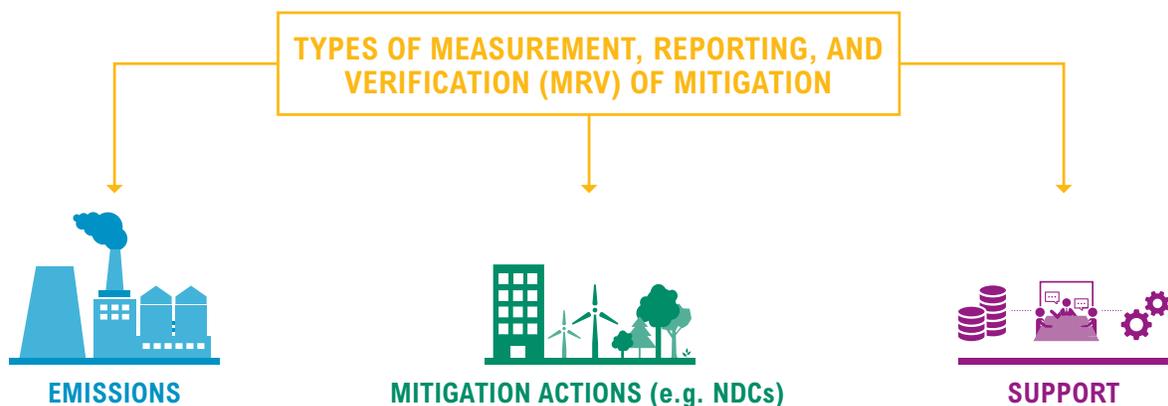
## 2. THREE TYPES OF MRV

Even before the term MRV emerged under the United Nations Framework Convention on Climate Change (UNFCCC), some form of monitoring and evaluation (M&E)<sup>4</sup> had routinely been used by governments and other entities to accurately and transparently assess their actions and goals. Domestically, conducting MRV helps countries understand key sources and sinks of emissions, design effective mitigation strategies as part of their NDCs or other programs, assess impacts of mitigation projects and policies, track progress toward climate goals, meet stakeholder demands for public disclosure of GHG information, and enhance credibility and promote good governance, among other objectives. Internationally, MRV enables countries to meet their international reporting obligations, compare their national mitigation commitments, track emissions trends, build trust in their actions and reported data, unlock new sources of finance to tackle climate change by demonstrating impact and good governance practices, and so on.<sup>5</sup> Entities should employ principles of relevance, completeness, consistency, transparency, and accuracy to establish MRV systems to track and report information for both domestic and international audiences (GHGP 2004, Kolar 2013).<sup>6</sup>

This paper categorizes MRV of mitigation into three types (Pang et al. 2014) (Figure 1):

- MRV of **GHG emissions** refers to estimating, reporting, and verifying actual emissions over a defined period of time. This type of MRV can be performed at national level, or by organizations and facilities. For example, national GHG inventories include an account of emissions from a country for a particular period, are reported to UNFCCC, and undergo some form of review.
- MRV of **mitigation actions** involves assessing (ex-ante or ex-post) GHG emissions reductions and/or sustainable development (non-GHG) effects of policies, projects, and actions, as well as monitoring their implementation progress. It also involves assessing progress toward mitigation goals. An example would be a national government estimating the GHG and job growth-related impacts of its home insulation subsidy program. While MRV of GHG emissions measures actual emissions, MRV of mitigation actions estimates the *change* in emissions and other non-GHG variables that results from those actions.

Figure 1 | **Types of Mitigation-related MRV**



- MRV of **support** focuses on monitoring the provision and receipt of financial flows, technical knowledge, and capacity building, and evaluating the results and impact of support. An example of this kind of MRV would be developing countries tracking climate-specific finance received through bilateral or multi-lateral channels.

There are other sub-categories of MRV that are outside the scope of the paper, for example, MRV of emissions at the sub-national level (e.g., provincial and city level), the sector level (e.g., power generation sector, cement sector), or emissions associated with a product’s lifecycle. The types of MRV considered here are understood to be those most relevant for national decision-makers. It should also be noted that there are synergies across different types of MRV which are discussed further in Section 4.

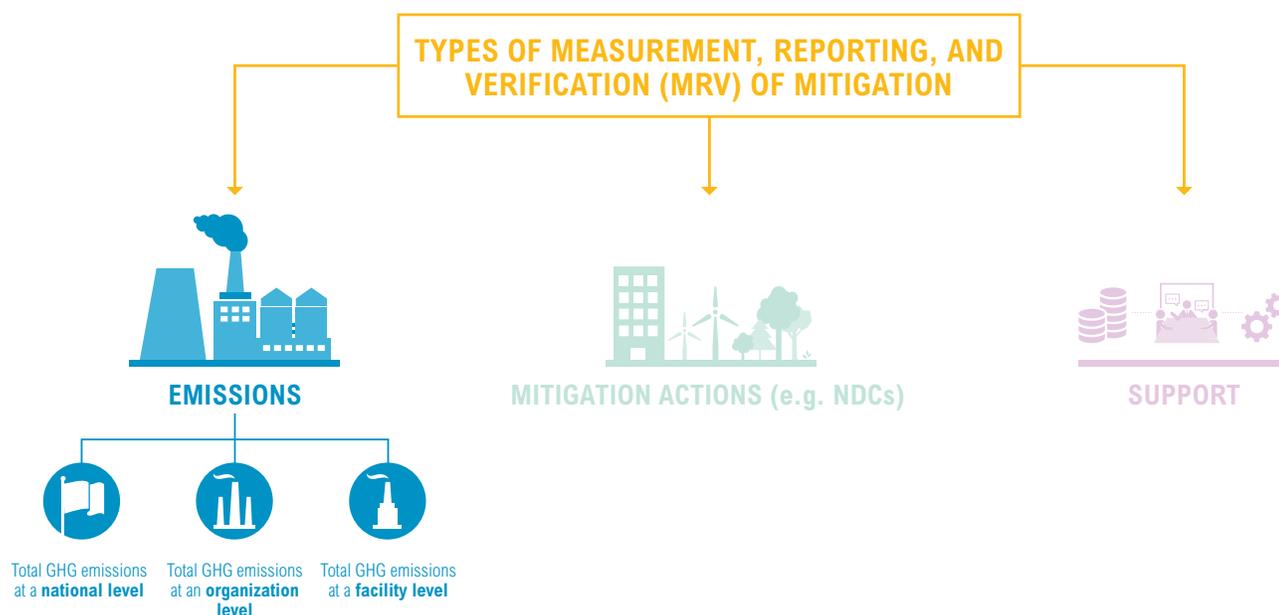
## 2.1 MRV of GHG Emissions

MRV of GHG emissions entails measuring and monitoring the GHG emissions and removals<sup>7</sup> associated with activities of entities such as countries, organizations, or facilities, reporting the collected data in a GHG inventory or other forms, and undertaking review and verification. The paper discusses MRV of emissions undertaken at the following levels<sup>8</sup> (Figure 2):

- **National**, which involves measuring, reporting, and verifying the total amount of GHG emissions and removals resulting from human activities in a country. These are often reported in a national GHG inventory categorized across four major economic sectors: energy; industrial processes and product use (IPPU); agriculture, forestry and other land use (AFOLU); and waste.
- **Organization**, which involves building an organization-wide inventory of total emissions and removals from all sources (including stationary and mobile sources, and process and fugitive emissions) within the organization’s boundary.<sup>9</sup>
- **Facility**, which involves assessing total GHG emissions and removals from all sources within a single facility (e.g., power plant, factory, or waste disposal site), as opposed to an entire organization, to produce a facility-level inventory.

This paper does not consider MRV of emissions performed by individual facilities and organizations. Rather, the emphasis is on the role of government in setting rules and guidance for MRV of emissions by these entities.

Figure 2 | MRV of Emissions



## 2.2 MRV of Mitigation Actions

In this paper, “mitigation actions” refer to interventions and commitments, including goals, policies, and projects, undertaken by a government or another entity to reduce GHG emissions.<sup>10</sup> Examples include national climate plans, nationally determined contributions (NDCs), policies setting emissions standards for vehicles, regional emissions trading systems, sustainable palm oil production policy, and rehabilitation projects to improve degraded land. MRV of mitigation actions includes estimating, reporting, and verifying their GHG and sustainable development effects, as well as monitoring their implementation.<sup>11</sup> The following definitions may be helpful here (GHGP 2014a, GHGP 2014b).

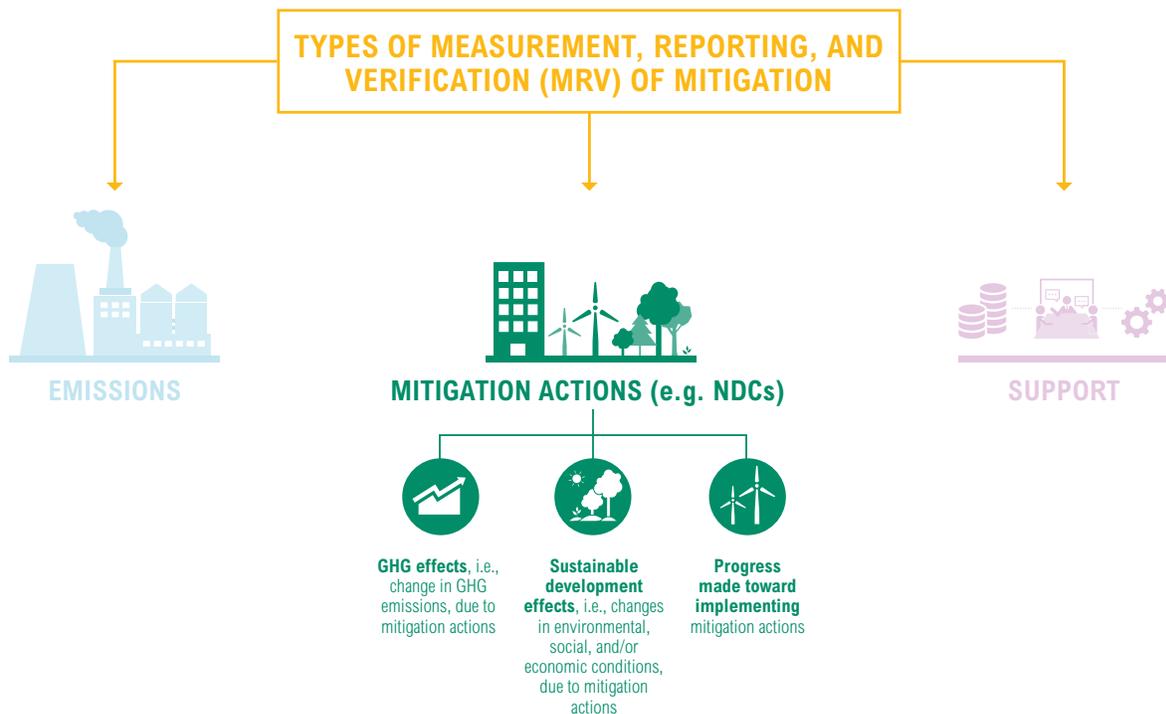
A **mitigation goal** is a commitment by an entity to reduce, limit the increase of, or enhance the removal of GHG emissions, or to reduce GHG emissions intensity by a specified quantity, to be achieved by a future date.<sup>12</sup>

**Mitigation policies** refer to interventions to reduce GHG emissions made or mandated by a government, institution, or other entity, and may include: laws, directives, and decrees; regulations and standards; taxes, charges, subsidies and incentives; information instruments; voluntary agreements; implementation of new technologies, processes, or practices; and public or private sector financing and investment; among others. These are termed mitigation policies and actions.

A **mitigation project** refers to a specific activity or set of activities intended to reduce GHG emissions, increase the storage of carbon, or enhance GHG removals from the atmosphere.

MRV of mitigation actions involves an assessment of the effects and implementation progress associated with mitigation actions (Figure 3):

Figure 3 | MRV of Mitigation Actions



- **GHG effects** refer to actual or projected *changes* in GHG emissions and removals—as opposed to absolute levels of emissions and removals—due to the implementation of mitigation actions. MRV of GHG effects involves estimating changes in emissions resulting from all significant GHG effects of a mitigation action, such as enhanced GHG removals due to tree-planting as part of degraded forestland policy, or a decrease in GHG emissions due to reduced fossil fuel consumption or electricity use resulting from a home-insulation subsidy policy.
- **Sustainable development effects** refer to changes in environmental, social, and/or economic conditions that occur as a result of mitigation actions. Examples include: measuring and reporting changes in average household income resulting from the sale of non-timber forest products (e.g., mushrooms, honey, edible nuts) due to a policy to improve degraded forestland; assessing the changes in household disposable income resulting from a home-insulation subsidy policy; or assessing changes in the incidence of health problems due to air pollution among the population affected by a new bus rapid transit system.
- **Implementation progress** refers to monitoring, reporting, and verifying conformity with agreed modalities and approaches, and assessing progress made toward the implementation of a mitigation action. In the case of a degraded forestland policy, this could entail regularly monitoring the number of forest managers trained, percentage change in annual reforested area, and number of saplings transplanted for reforestation, and verifying whether training-related guidelines, if any, are being followed.

Under the Paris Agreement, countries committed to mitigation actions, which are put forth in their respective Nationally Determined Contributions (NDCs). Box 2 highlights key details relating to MRV or transparency provisions of NDCs in the Agreement.

### Box 1 | Measurement, Reporting, and Verification of Nationally Determined Contributions

Countries put forth their national plans to reduce greenhouse gas emissions in their Nationally Determined Contributions (NDCs) submitted under the Paris Agreement.<sup>a</sup> The Agreement also established a transparency framework with common measurement, reporting, and verification (MRV) provisions for all countries, with built-in flexibility to take account of countries' different capacities.

With respect to MRV of mitigation actions, the Agreement calls for countries to track progress toward implementing and achieving their NDCs, and report on a regular basis (UNFCCC 2015). Accompanying details regarding the kind of information that should be tracked and reported, and the methods to be used, are to be developed by 2018 (Dagnet and Waskow 2015). Although the MRV guidelines have yet to be developed, NDC monitoring could include elements related to tracking of GHG effects, sustainable development impacts, and implementation progress.

<sup>a</sup> The NDCs also included adaptation components, but these are beyond the scope of this paper.

## 2.3 MRV of Support

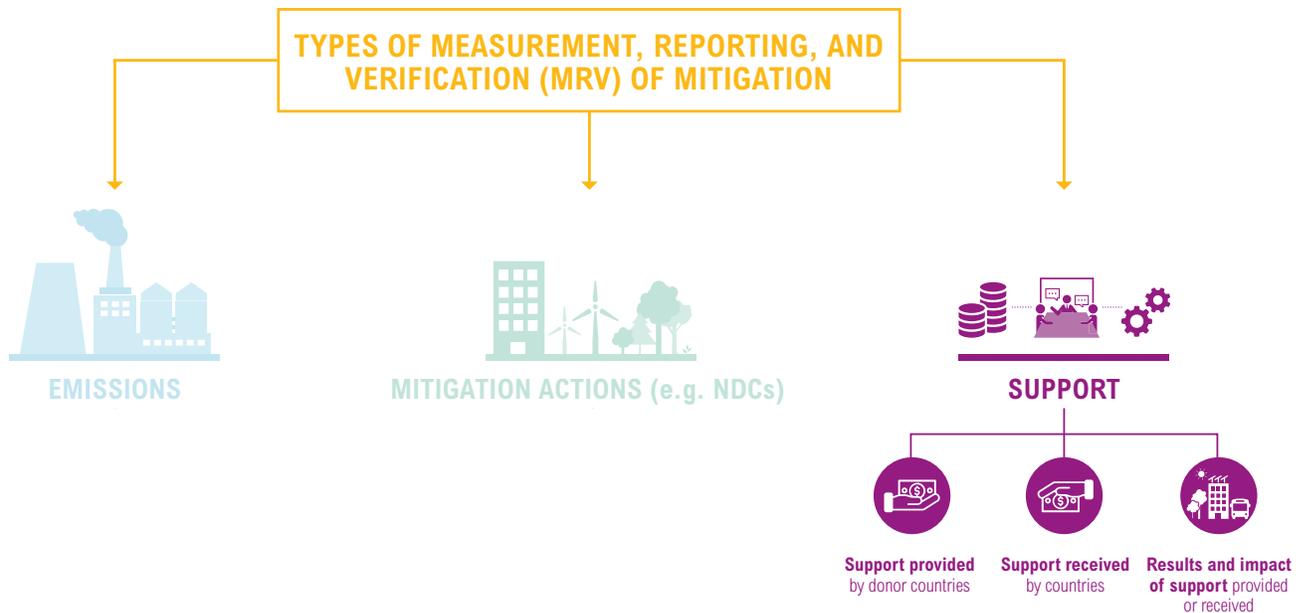
Support refers to climate finance, technology transfer, and/or capacity building. It includes monetary support—such as climate finance for developing a national emissions trading system, investments in low-emissions technologies, and funds toward organizing training workshops for energy auditors. The definition of support also includes non-monetary support—such as technical advice to design national energy efficiency standards or labeling schemes. For simplicity, this paper limits itself to MRV of monetary support; often technology transfer and capacity building are not monetized.

MRV of monetary support encompasses measuring, reporting, and verifying the provision of funds by donor countries, the receipt of funds by recipient countries, and the results and impact achieved that can be attributed to these funds (Figure 4):

- **Provision of support** includes identifying and reporting relevant data on overall support provided by donor countries through various channels, such as multilateral and bilateral institutions, and ensuring that they are reliable. The EU tracks and reports information on mitigation-related financial and technical support provided to developing countries; this is an example of MRV of provision of support (Iro 2014). Relevant information to be collected includes the financial instrument used, recipient country or institution, and information related to the mitigation project.

- **Receipt of support** involves recipient countries tracking and reporting mitigation-related support received from donor countries in the form of various financial instruments such as loans, grants, etc. (Tirpak et al. 2012). For instance, Indonesia reports information on finance needs and finance received in its national communications<sup>33</sup> to the UNFCCC.
- **Results/impact of support** involves monitoring the results achieved and evaluating how effectively climate support is utilized toward achieving mitigation-related objectives. Indicators to measure output and impact of support for various mitigation efforts can include, for example, the number of emissions-reduction projects implemented with the support, GHG emissions avoided, energy savings achieved, and private investment mobilized.

Figure 4 | **MRV of Support**



### 3. IDENTIFYING THE TYPE OF MRV NEEDED

The following questions can assist decision-makers within government and other institutions, who have been tasked with setting up MRV systems, in identifying which type of MRV may be best matched to their needs.<sup>14</sup> These should be considered in the order presented because the answer to a particular question will inform and influence the answers to subsequent questions.

- **Why** carry out MRV? Answering this question describes the objectives of the MRV process and helps to build ownership and consensus around MRV-related initiatives.
- **How** will MRV be carried out? Here the focus is on outlining the methodological and technical guidelines and processes that will be necessary to perform MRV.
- **When** will MRV be performed? This involves deciding on the appropriate timeframe to undertake MRV.
- **Who** will carry out MRV? The next step is to identify entities that can undertake MRV. It also considers the resources and capacity that will be required, and where these could come from, for example, from the national budget or international support.

#### 3.1 Why Carry Out Measurement, Reporting, and Verification?

Different types of MRV fulfill distinct objectives, which eventually determine the design of the MRV system. Therefore, entities should first define the purpose of conducting MRV to ensure that the system is designed to serve their domestic goals and priorities, while also fulfilling international obligations. As discussed in Box 1, under the Paris Agreement, an enhanced transparency framework has been established for both action—for post-2020 climate change commitments, or nationally determined contributions (NDCs)—and support, with flexibility for

countries to take account of their different capacities (UNFCCC 2015). Each country will regularly provide a national inventory report of emissions and removals, as well as information necessary to track progress made in implementing and achieving its NDC. Countries are also expected to provide information on climate impacts and adaptation, as well as information on financial, technology transfer, and capacity-building support provided, needed, and received. Common modalities, procedures, and guidelines will be developed in the future for the transparency of mitigation action and support and will guide the provision of such information, which will then undergo a technical expert review.

Domestically, countries may be interested in conducting MRV to understand their emissions profile and track emissions from major industrial sources, so as to shape mitigation policies. Or they may want to assess and monitor the sustainable development effects of climate change measures. They may also be interested in tracking progress toward climate finance goals (Table 2).

#### 3.2 How will Measurement, Reporting, and Verification be Carried Out?

One of the important issues to address in operationalizing MRV is the provision of methodological and technical guidelines. Methods to measure, report, and verify information differ based on what is assessed and at what level. In some cases, such as MRV of GHG effects from mitigation projects, a variety of methods may be available for use; in other instances, such as building national inventories, there is only one internationally accepted method, that is, the IPCC Guidelines. Methods and tools exist for undertaking MRV (e.g., of emissions or emissions reductions) at different levels (Table 3). Available methods may need to be customized or new methods may have to be developed to suit particular needs and circumstances. Appendix 1 provides links to some of the commonly used methods for different types of MRV.

Table 2 | Objectives of MRV Types

TYPE OF MRV	OBJECTIVES
MRV OF GHG EMISSIONS	
<b>National level</b>	<ul style="list-style-type: none"> <li>■ Understand the country's absolute GHG emissions and removals by source and sink</li> <li>■ Monitor GHG emissions trends over time and track progress toward national mitigation goals, including those under Nationally Determined Contributions (NDCs)</li> <li>■ Prioritize national mitigation strategies based on highest-emitting sectors</li> <li>■ Meet UNFCCC requirements for reporting national GHG emissions</li> <li>■ Example: India started developing its national emissions inventory in the 1990s and, over time, has increased the number of greenhouse gases and sources included in the inventory. Compiling the inventory helps India to meet its commitment under the UNFCCC as well as track emissions trends to support national mitigation policies (Bhattacharya 2013).</li> </ul>
<b>Organizational level</b>	<ul style="list-style-type: none"> <li>■ Facilitate policymaking by analyzing emissions data at different resolutions</li> <li>■ Improve GHG data quality to support policy objectives</li> <li>■ Provide information to stakeholders</li> <li>■ Inform national GHG inventories</li> <li>■ Help reporting entities assess their climate risks and opportunities</li> <li>■ Example: Australia's emissions reporting program collects emissions data from companies and identifies "informing policy formulation" as one of its objectives (Singh et al. 2015).</li> </ul>
<b>Facility level</b>	<ul style="list-style-type: none"> <li>■ Support policies and regulations, such as emissions trading schemes, which require detailed source-level data</li> <li>■ Improve overall GHG data quality and inform national GHG inventories</li> <li>■ Provide information to stakeholders</li> <li>■ Example: The California GHG reporting program, which collects emissions data from facilities, was set up to support the state's emissions trading scheme (Singh et al. 2015).</li> </ul>
MRV OF MITIGATION ACTIONS	
<b>GHG effects</b>	<ul style="list-style-type: none"> <li>■ Assess whether GHG reduction targets or mitigation actions contained in NDCs or other national policies have been achieved</li> <li>■ Generate officially recognized GHG reduction "credits" from mitigation projects, such as those under CDM, that may be sold or used toward meeting a mitigation goal</li> <li>■ Understand GHG impacts of mitigation actions in NDCs or other national policies over time</li> <li>■ Inform the design of future NDCs and mitigation actions by understanding achievable GHG impacts</li> <li>■ Meet national or international requirements related to reporting on the effects of mitigation actions, for example those outlined under NDCs</li> <li>■ Attract financial support for mitigation actions under NDCs or otherwise by demonstrating GHG reductions</li> <li>■ Enhance transparency and accountability</li> <li>■ Example: Costa Rica's National Forest Monitoring System (under development) will provide verifiable information to assess progress toward the country's carbon neutrality goal (among other things) (Vega-Araya n.d.).</li> </ul>
<b>Sustainable development impacts</b>	<ul style="list-style-type: none"> <li>■ Understand sustainable development impacts of a mitigation action, such as job creation, air pollution levels, and health benefits</li> <li>■ Enhance support for mitigation policies among a range of stakeholders by highlighting "co-benefits"</li> <li>■ Meet national or international requirements related to reporting on the effects of mitigation actions</li> <li>■ Inform the design of mitigation actions so that they achieve sustainable development benefits</li> <li>■ Evaluate and report effectiveness of mitigation actions over time</li> <li>■ Attract financial support for mitigation actions from a diverse set of funders</li> <li>■ Example: South Africa is developing an integrated reporting system that will capture information on sustainable development benefits of mitigation measures (Singh and Vieweg 2015).</li> </ul>

Table 2 | Objectives of MRV Types (continued)

TYPE OF MRV	OBJECTIVES
MRV OF MITIGATION ACTIONS	
<b>Implementation progress</b>	<ul style="list-style-type: none"> <li>■ Track/monitor the policies put in place or planned to meet domestic and international climate goals</li> <li>■ Understand the status of the policy implementation process for policies in the NDC as well as those not included in the NDC</li> <li>■ Improve transparency and accountability around policy implementation to help track progress toward NDC goals and other national objectives</li> <li>■ Provide an early view on policy effectiveness</li> <li>■ Inform policy assumptions for modeling future GHG emissions</li> <li>■ Meet UNFCCC requirements related to reporting on progress of implementation</li> <li>■ Example: South Africa's reporting system will also monitor indicators related to progress made on implementation of mitigation measures (Singh and Vieweg 2015).</li> </ul>
MRV OF SUPPORT	
<b>Provision of support</b>	<ul style="list-style-type: none"> <li>■ Track and report support (e.g., funds) provided to recipient countries and mobilized (the Paris Agreement calls for both ex-post and ex-ante data)</li> <li>■ Meet UNFCCC requirements related to reporting the provision of climate finance</li> <li>■ Enhance trust, transparency, and accountability between donor and recipient countries</li> <li>■ Assess progress toward meeting climate finance targets</li> <li>■ Facilitate an understanding of the scale and distribution of climate support, and identify gaps in regional and sectoral support</li> <li>■ Monitor and evaluate trends in climate-related support (Iro 2014)</li> <li>■ Example: The EU tracks and reports information related to financial resources, transfer of technology, and capacity building to UNFCCC in its national communications (EC 2014).</li> </ul>
<b>Receipt of support</b>	<ul style="list-style-type: none"> <li>■ Track and report support (e.g., amount of climate finance) received from donor countries</li> <li>■ Cross-check and assess information on support provided by donor countries</li> <li>■ Meet UNFCCC reporting provisions related to reporting the receipt of and need for climate finance</li> <li>■ Draw lessons from the various experiences of financial instruments used (e.g., grants, loans, export credit, guarantees)</li> <li>■ Facilitate development of policies to expand climate finance by providing more comprehensive data</li> <li>■ Enhance trust, transparency, and accountability between donor and recipient countries</li> <li>■ Example: In the Philippines, public climate finance is channeled through institutions designed to manage public finance flows and markers have been developed to tag climate change projects in order to track funding (Le and Baboyan 2015).</li> </ul>
<b>Results/ impact of support</b>	<ul style="list-style-type: none"> <li>■ Improve understanding of how climate support is being utilized</li> <li>■ Demonstrate whether climate support is being effective (e.g. whether emissions are being reduced, whether climate finance is supporting innovation, the extent to which public funds are leveraging private finance, etc.)</li> <li>■ Potentially lead to scale-up of climate support as impact is demonstrated</li> <li>■ Example: Countries receiving mitigation funding under the Clean Technology Fund are required to report on results and outcomes achieved (Nakhooda et al. 2014).</li> </ul>

Table 3–A | **Methods for MRV of GHG Emissions**

TYPE OF MRV	MEASUREMENT		REPORTING	VERIFICATION <sup>b</sup>
	Method <sup>a</sup>	Data Requirements		
National GHG inventory	<ul style="list-style-type: none"> <li>IPCC Guidelines for National Greenhouse Gas Inventories</li> </ul>	<ul style="list-style-type: none"> <li>Activity data and emission factor</li> <li>Data requirements associated with calculating emissions from some sources, particularly non-energy sources (i.e., AFOLU), can be significantly more complicated</li> <li>Data from continuous emissions monitoring system (CEMS) where feasible</li> </ul>	<ul style="list-style-type: none"> <li>To the UNFCCC as part of:                             <ul style="list-style-type: none"> <li>National Inventory Reports for developed countries</li> <li>National Communications for developed and developing countries</li> <li>Biennial Reports (BR) for developed countries, and Biennial Update Reports (BURs) for developing countries<sup>c</sup></li> </ul> </li> <li>Countries may also develop inventories solely for domestic objectives</li> </ul>	<ul style="list-style-type: none"> <li>Prescribed by UNFCCC—International Consultation and Analysis (ICA) for developing countries, and International Assessment and Review (IAR) for developed countries<sup>d</sup></li> <li>The Paris Agreement sets up a technical expert review process for the information provided by countries</li> </ul>
Corporate GHG inventory	<ul style="list-style-type: none"> <li>GHG Protocol Corporate Accounting and Reporting Standard</li> <li>GHG Protocol Scope 3 Standard</li> <li>ISO 14064-1</li> <li>Source-specific emissions calculation methods</li> </ul>	<ul style="list-style-type: none"> <li>Activity data and emission factor</li> <li>Data from CEMS</li> </ul>	<ul style="list-style-type: none"> <li>To stakeholders and shareholders through a GHG inventory report</li> <li>To a voluntary reporting program (e.g., CDP, India GHG Program) or mandatory reporting program (e.g., Australia’s National Greenhouse and Energy Reporting Program (NGER))</li> </ul>	<ul style="list-style-type: none"> <li>Prescribed by GHG accounting and reporting method and/or relevant reporting program; often aligned with ISO 14064-3</li> </ul>
Facility-level GHG inventory	<ul style="list-style-type: none"> <li>IPCC guidelines can be used for specific sources</li> <li>Guidance on source-specific emissions calculation methods from individual GHG reporting programs</li> <li>May also use guidance from the <i>Design Guide for Mandatory GHG Reporting Programs</i> and relevant standards such as the <i>GHG Protocol Corporate Accounting and Reporting Standard</i></li> </ul>	<ul style="list-style-type: none"> <li>Activity data and emission factor, or</li> <li>Data from CEMS</li> </ul>	<ul style="list-style-type: none"> <li>To facility-level reporting program administered by a government agency</li> <li>To corporate management and stakeholders</li> </ul>	<ul style="list-style-type: none"> <li>Prescribed by relevant reporting program or government agency</li> </ul>

<sup>a</sup> Some of the most commonly used methods are included in this column. See Appendix 1 for further sources of information on each of the methods listed here.

<sup>b</sup> This has been interpreted widely and includes technical analysis as well as the more conventional review and verification.

<sup>c</sup> National Inventory Reports summarize countries’ anthropogenic GHG emissions and removals in a given year. National Communications (NCs) report on a wider range of activities related to climate change, including mitigation policies and measures, vulnerability and adaptation, and research. Biennial Reports (BRs) outline progress made by developed countries in achieving emissions reductions, and also include information on the provision of financial, technological, and capacity building support to developing countries. Biennial Update Reports (BURs) from developing countries contain information on mitigation actions, constraints, and gaps, including support needed and received (UNFCCC 2014a).

<sup>d</sup> International Consultation and Analysis (ICA) of Biennial Update Reports (BURs) of developing countries includes two steps: technical analysis of BURs by a team of technical experts, and a facilitative sharing of views with the country concerned (UNFCCC 2014b). International Assessment and Review (IAR) for developed countries involves a technical review of their Biennial Reports (BRs) and a multilateral assessment of developed countries’ progress toward achieving their mitigation targets (UNFCCC 2014c).

Table 3–B | **Methods for MRV of Mitigation Actions**

TYPE OF MRV	MEASUREMENT		REPORTING	VERIFICATION <sup>b</sup>
	Method <sup>a</sup>	Data Requirements		
GHG effects	<b>For mitigation goals and policies:</b> <ul style="list-style-type: none"> <li>GHG Protocol Mitigation Goal Standard for mitigation goals set by governments</li> <li>GHG Protocol Policy and Action Standard for mitigation policies</li> <li>Guidance to be developed for tracking of nationally determined contributions by countries as per the Paris Agreement</li> </ul>	<b>For mitigation goals:</b> <ul style="list-style-type: none"> <li>National GHG inventory</li> <li>Other data requirements may include data on emissions and removals from the land sector, transferable emissions units (e.g., carbon credits and tradable allowances), depending on the kind of goal</li> </ul>	<ul style="list-style-type: none"> <li>To domestic stakeholders</li> <li>To the UNFCCC as part of National Communications, Biennial Reports, and/or Biennial Update Reports<sup>d</sup></li> <li>To donors supporting the implementation of goals, policies, and projects</li> <li>Any reporting requirements developed in future as per Paris Agreement for post-2020 contributions</li> </ul>	<ul style="list-style-type: none"> <li>May be prescribed by domestic laws</li> <li>Under the UNFCCC, review is carried out as part of International Consultation and Analysis (ICA) and International Assessment and Review (IAR) processes</li> <li>The Paris Agreement sets up a technical expert review process for the information provided by countries</li> </ul>
	<b>For mitigation projects:</b> <ul style="list-style-type: none"> <li>Methodological guidance developed under the Clean Development Mechanism (CDM)</li> <li>GHG Protocol Project Standard</li> <li>Gold Standard</li> <li>Verified Carbon Standard (VCS)</li> </ul>	<b>For mitigation policies and projects:</b> <ul style="list-style-type: none"> <li>Defined by GHG emissions quantification method and the policy/project type</li> <li>Typically include activity data, emission factors, and socio-economic data</li> </ul>	<b>For mitigation projects:</b> <ul style="list-style-type: none"> <li>To the relevant program (e.g., CDM or emissions trading program) under which the project has been undertaken</li> </ul>	<ul style="list-style-type: none"> <li>For credited mitigation projects, verification prescribed by crediting scheme (e.g. CDM, VCS, Climate Action Reserve (CAR))</li> </ul>
Sustainable development impacts	<ul style="list-style-type: none"> <li>Nationally Appropriate Mitigation Action (NAMA) Sustainable Development Evaluation Tool</li> <li>CDM Sustainable Development co-Benefits Tool</li> <li>Methods specific to the sustainable development effect concerned</li> <li>May use guidance from relevant standards such as the <i>GHG Protocol Policy and Action Standard</i><sup>c</sup></li> </ul>	<ul style="list-style-type: none"> <li>Defined by the type of sustainable development effect under consideration</li> <li>Typically include socio-economic data related to employment, health, air quality, etc.</li> </ul>	<ul style="list-style-type: none"> <li>To domestic stakeholders</li> <li>To donors supporting the implementation of policies or projects</li> </ul>	<ul style="list-style-type: none"> <li>May be prescribed by domestic laws</li> </ul>
Implementation progress	<ul style="list-style-type: none"> <li><i>Climate Policy Implementation Tracking Framework</i></li> <li><i>Monitoring Implementation and Effects of GHG Mitigation Policies: Steps to Develop Performance Indicators</i></li> <li>Guidance from donor entities</li> </ul>	<ul style="list-style-type: none"> <li>Data related to performance indicators (such as permitting; licensing; procurement; financing; behavioral, technology, and process changes; changes in GHG emissions)</li> </ul>	<ul style="list-style-type: none"> <li>To domestic stakeholders</li> <li>To the UNFCCC as part of National Communications, Biennial Reports, and/or Biennial Update Reports, and future reporting requirements yet to be determined for post-2020 contributions<sup>d</sup></li> <li>To donors supporting the implementation of mitigation actions</li> </ul>	<ul style="list-style-type: none"> <li>May be prescribed by domestic laws or as per donor or project funder requirements</li> <li>Under the UNFCCC, review is carried out as part of ICA and IAR processes</li> <li>Technical expert review for post-2020 actions, per the Paris Agreement</li> </ul>

<sup>a</sup> Some of the most commonly used methods are included in this column. See Appendix 1 for further sources of information on each of the methods listed here.

<sup>b</sup> This has been interpreted widely and includes technical analysis as well as the more conventional review and verification.

<sup>c</sup> A new guidance document to assess the sustainable development impacts of mitigation policies is under development as part of the Initiative for Climate Action Transparency (ICAT) (<http://www.climateactiontransparency.org/>)

<sup>d</sup> National Communications (NCs) report on a wider range of activities related to climate change, including mitigation policies and measures, vulnerability and adaptation, and research. Biennial Reports (BRs) outline progress made by developed countries in achieving emissions reductions, and also include information on the provision of financial, technological, and capacity building support to developing countries. Biennial Update Reports (BURs) from developing countries contain information on mitigation actions, constraints, and gaps, including support needed and received (UNFCCC 2014a).

Table 3–C | **Methods for MRV of Support**

TYPE OF MRV	MEASUREMENT		REPORTING	VERIFICATION <sup>b</sup>
	Method <sup>a</sup>	Data Requirements		
Provision of Support	<ul style="list-style-type: none"> <li>Common tabular format (CTF) in Biennial Reports under the UNFCCC</li> <li>Future guidance to be developed for post-2020 period per the Paris Agreement</li> <li>May use Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC) climate markers or the joint method developed by the multilateral development banks (MDBs)</li> </ul>	<ul style="list-style-type: none"> <li>Overall amount in US dollars or local currency</li> <li>Source of finance and detailed information on financial contributions to climate specific funds, international financial institutions, and multilateral institutions</li> <li>Detailed information on public bilateral support</li> <li>Indication of new and additional financial resources</li> <li>Information on provision of support for technology development and capacity building</li> <li>Information on status, funding, source, financial instrument (e.g., grant, concessional finance, equity, loan guarantee, insurance), and sector</li> <li>Sector and/or subsector targeted by finance</li> <li>Category (e.g., asset finance, venture capital support, research, demonstrations, capacity building, training, planning, analysis)</li> <li>Recipient ministry or domestic organization in recipient countries (National Implementing Entity)</li> <li>Intended funding to be provided in future as per the Paris Agreement</li> </ul>	<ul style="list-style-type: none"> <li>To the UNFCCC as part of National Communications, Biennial Reports, and/or Biennial Update Reports and any future reporting requirements for post-2020 contributions</li> </ul>	<ul style="list-style-type: none"> <li>May be prescribed by domestic laws</li> <li>Under the UNFCCC, review is carried out as part of International Consultation and Analysis (ICA) and International Assessment and Review (IAR) processes</li> <li>Technical expert review for post-2020 period, per the Paris Agreement</li> </ul>

<sup>a</sup> Some of the most commonly used methods are included in this column. See Appendix 1 for further sources of information on each of the methods listed here.

<sup>b</sup> This has been interpreted widely and includes technical analysis as well as the more conventional review and verification.

Table 3–C | **Methods for MRV of Support (continued)**

TYPE OF MRV	MEASUREMENT		REPORTING	VERIFICATION <sup>b</sup>
	Method <sup>a</sup>	Data Requirements		
Receipt of support	<ul style="list-style-type: none"> <li>Climate Public Expenditure and Institutional Review for domestic budgeting (CPEIR)</li> <li>Different methods in use by different countries and funding agencies to track and report development and climate finance</li> </ul>	<ul style="list-style-type: none"> <li>Climate finance needs and climate finance received as per the Paris Agreement</li> <li>Overall amount in US dollars or local currency</li> <li>Information on status, funding, source, financial instrument (e.g., grant, concessional finance, equity, loan guarantee, insurance), and sector</li> <li>Sector and/or subsector targeted by finance</li> <li>Category (e.g., asset finance, venture capital support, research, demonstrations, capacity building, training, planning, analysis)</li> <li>Recipient ministry or domestic organization in recipient countries (National Implementing Entity)</li> </ul>	<ul style="list-style-type: none"> <li>To the UNFCCC as part of National Communications and Biennial Update Reports</li> <li>To domestic stakeholders and donors</li> </ul>	<ul style="list-style-type: none"> <li>May be prescribed by domestic laws</li> <li>Under the UNFCCC, review is carried out as part of International Consultation and Analysis (ICA) and International Assessment and Review (IAR)</li> <li>Technical expert review for post-2020 period, per the Paris Agreement</li> </ul>
Results/impact of support	<ul style="list-style-type: none"> <li>May use guidance provided by various mitigation funds (e.g., Clean Technology Fund, Global Environment Facility) and donor organizations</li> </ul>	<ul style="list-style-type: none"> <li>Data related to indicators such as emissions reduced, volume of private finance leveraged, annual energy savings, etc.</li> </ul>	<ul style="list-style-type: none"> <li>To domestic stakeholders as well as existing or potential donors</li> </ul>	<ul style="list-style-type: none"> <li>May be prescribed by domestic laws</li> <li>Under the UNFCCC, review is carried out as part of ICA and IAR processes</li> <li>Technical expert review for post-2020 period, per the Paris Agreement</li> </ul>

<sup>a</sup> Some of the most commonly used methods are included in this column. See Appendix 1 for further sources of information on each of the methods listed here.

<sup>b</sup> This has been interpreted widely and includes technical analysis as well as the more conventional review and verification.

### 3.3 When Will Measurement, Reporting, and Verification be Performed?

The key consideration here is when to undertake MRV, whether it should be undertaken before, during, or after the emitting activity has been completed. Undertaking MRV after the activity has happened is called ex-post assessment (e.g., performing MRV after a mitigation project has been completed and emissions reductions have been realized). MRV to assess the future effects of an activity, such as the anticipated effects of a mitigation policy, is called ex-ante assessment. Implementation

progress entails monitoring while the activity is being performed. Some types of MRV can only be carried out ex-post while others may be carried out ex-ante and ex-post (Table 4). Even for ex-post MRV, it is useful to plan early and lay down monitoring systems to ensure that adequate information is available later to undertake MRV.

It should also be noted that performing MRV is an ongoing process and decision-makers should consider how often measuring and monitoring will be undertaken, as well as the frequency of reporting and verification.

Table 4 | **Timeframe for Different Types of MRV**

TYPE OF MRV	TIMEFRAME/FREQUENCY		
	MEASUREMENT	REPORTING <sup>a</sup>	VERIFICATION <sup>a</sup>
<b>MRV OF GHG EMISSIONS</b>			
<b>National GHG inventory</b>	Ex-post However, data may be collected during the year on a regular basis	<ul style="list-style-type: none"> <li>■ Annual inventory for developed countries</li> <li>■ Updated Biennial Reports (BRs) and Biennial Update Reports (BURs) every two years as part of UNFCCC processes</li> <li>■ Every four years as part of National Communication for developed countries</li> <li>■ May report more frequently to domestic stakeholders</li> </ul>	Every two years as part of UNFCCC International Consultation and Analysis (ICA) and International Assessment and Review (IAR) processes
<b>Corporate GHG inventory</b>	Ex-post However, data may be collected during the year on a regular basis	Typically reported annually	Typically annual emissions verified
<b>Facility-level GHG inventory</b>	Ex-post However, data may be collected during the year on a regular basis	Typically reported annually	Typically annual emissions verified
<b>MRV OF MITIGATION ACTIONS</b>			
<b>GHG effects</b>	Ex-ante and/or ex-post Data may be collected regularly while mitigation action is being implemented	<ul style="list-style-type: none"> <li>■ At least every two years as part of UNFCCC BR and BUR processes at a national level</li> <li>■ Can be reported more frequently for domestic purposes</li> </ul>	<ul style="list-style-type: none"> <li>■ At least every two years as part of UNFCCC ICA and IAR processes</li> <li>■ For mitigation projects, such as CDM projects, validation is done ex-ante and verification is ex-post</li> <li>■ Can be done as per domestic or donor-specific provisions</li> </ul>

Table 4 | **Timeframe for Different Types of MRV (continued)**

TYPE OF MRV	TIMEFRAME/FREQUENCY		
	MEASUREMENT	REPORTING <sup>a</sup>	VERIFICATION <sup>a</sup>
<b>Sustainable development impacts</b>	Ex-ante and/or ex-post Data may be collected regularly while mitigation action is being implemented	May be reported at least every two years as part of UNFCCC BR and BUR processes at a national level Can be reported more frequently for domestic purposes	Can be done at least every two years as part of UNFCCC BR and BUR processes, and/or as per domestic provisions
<b>Implementation progress</b>	Ex-post Data to be collected regularly as mitigation action is being implemented	At least every two years as part of UNFCCC BR and BUR processes at a national level Can be reported more frequently for domestic purposes	At least every two years as part of UNFCCC ICA and IAR processes, and/or as per domestic provisions
<b>MRV OF SUPPORT</b>			
<b>Provision of support</b>	Ex-ante or ex-post Data to be regularly collected during the year	At least every two years as part of UNFCCC BR and BUR processes, and/or as per domestic provisions	At least every two years as part of UNFCCC ICA and IAR processes, and/or as per domestic provisions
<b>Receipt of support</b>	Ex-post Data to be regularly monitored and gathered during the year	At least every two years as part of UNFCCC BR and BUR processes, and/or as per domestic provisions	At least every two years as part of UNFCCC ICA process, and/or as per domestic provisions
<b>Results/ impact of support</b>	Ex-post Data to be regularly collected during the year	Can be done at least every two years as part of UNFCCC BR and BUR processes, and/or as per domestic provisions	At least every two years as part of UNFCCC ICA and IAR processes, and/or as per domestic provisions or donor requirements

<sup>a</sup> Frequency of reporting and verification under the UNFCCC at the national level is based on the existing mandate. For the post-2020 period, modalities, procedures, and guidelines will be developed in the future.

### 3.4 Who Will Carry Out Measurement, Reporting, and Verification?

MRV processes may be implemented by a variety of institutions, including governments, civil society, research organizations, and consultants. Some aspects of MRV may need to be carried out domestically, while others may be performed by an international institution, such as the UNFCCC. Institutions and governmental bodies that form part of the MRV system vary from country to country and

with the type and level of MRV (Table 5). Often, a lead institution may work with other contributing institutions and agencies to implement MRV systems. In the case of MRV of emissions at the national level, the lead institution tends to be an environmental ministry or ministry of science and technology, working with other contributing ministries (e.g., ministry for industry, agriculture, waste, energy, transport, etc.). In addition, other entities such as research and academic institutions as well as private sector bodies often collect and provide necessary activity

Table 5 | **Entities Responsible for Implementing the MRV Process**

TYPE OF MRV	ENTITIES RESPONSIBLE FOR IMPLEMENTING MRV	
	MEASUREMENT AND REPORTING	VERIFICATION
<b>MRV OF GHG EMISSIONS</b>		
<b>National level</b>	National level ministry, government department or agency, UNFCCC national focal points	Domestic experts, certification bodies, international experts
	Consultants, research institutions, universities, and statistical agencies may all support the process	
<b>Organizational level</b>	Organizations themselves, consultant(s) may support the process	Internal review by the reporting organization itself (carried out by personnel not involved in developing emissions inventory), or a third-party verifier
		GHG reporting programs may also perform review or random checks and audits
<b>Facility level</b>	Facilities themselves, consultant(s) may support the process	Internal review by the reporting organization, review by the company, or a third-party verifier
		GHG reporting programs may also conduct review or perform random checks and audits
<b>MRV OF MITIGATION ACTIONS</b>		
<b>GHG effects</b>	Governments, national institutions, research organizations, project developers, civil society organizations, regional organizations, consultants	At the discretion of relevant government or non-governmental independent agency and/or as per UNFCCC processes
<b>Sustainable development impacts</b>	Governments, national institutions, research organizations, project developers, civil society organizations, regional organizations, consultants	At the discretion of relevant government agency
<b>Implementation progress</b>	Governments, national institutions, research organizations, project developers, civil society organizations, regional organizations, consultants	At the discretion of relevant government agency and/or as per UNFCCC processes
<b>MRV OF SUPPORT</b>		
<b>Provision of support</b>	Governments, national institutions, research organizations, development banks, project developers, civil society organizations, regional organizations, consultants	At the discretion of relevant government agency and/or as per UNFCCC processes
<b>Receipt of support</b>	Governments, national institutions, research organizations, development banks, donors, project developers, civil society organizations, regional organizations, consultants	At the discretion of relevant government agency and/or as per UNFCCC processes
<b>Results/impact of support</b>	Governments, national institutions, research organizations, development banks, donors, project developers, civil society organizations, regional organizations, consultants	At the discretion of relevant government agency and/or as per UNFCCC processes

data for national inventories. For CDM projects, countries have established Designated Operational Entities (DOEs), often in environment ministries, to validate mitigation project proposals or verify whether planned emission reductions were achieved (CDM n.d.).

Related to the question of who will undertake MRV is the issue of their capacity to carry out MRV-related tasks. Many developing countries need strengthened capacity to fulfill their commitments regarding transparency and MRV. Depending on the type of MRV, different resources and capacities may be required, and it is important to

assess how they may be sourced, for example, from the national budget or international support. Table 6 describes various kinds of capacities that may need to be enhanced. Under the Paris Agreement, the Capacity-building Initiative for Transparency (CBIT) has been established to strengthen institutional and technical capacity, and support developing countries in establishing effective MRV systems (Dagnet and Waskow 2015). Appendix 2 lists some of the existing MRV-related support initiatives that can be utilized to perform MRV and set up MRV systems.

Table 6 | **Capacities Required for MRV**

CAPACITY	DESCRIPTION AND KEY ELEMENTS
<b>Human resources</b>	<p>Human resources are needed to perform a range of tasks and functions related to different types of MRV. Typical functions include: overall planning; coordination; management and technical oversight; conducting research, data collection and management; emission calculations; and quality assurance/quality control coordination.</p> <p><b>Key elements:</b></p> <ul style="list-style-type: none"> <li>■ Capacity and skills of individual staff, including managerial abilities and technical skills</li> <li>■ Recruitment and retention of skilled staff</li> <li>■ Regular training of new and existing staff</li> </ul>
<b>Institutional capacity</b>	<p>Performing MRV requires institutions that have the necessary mandate, and clear and efficient processes.</p> <p><b>Key elements:</b></p> <ul style="list-style-type: none"> <li>■ Ability of institutions to perform their functions</li> <li>■ Effective institutional arrangements, processes and coordination mechanisms, leadership, and institutional mandates</li> <li>■ Capability to identify problems and develop and implement solutions</li> </ul>
<b>Technical capacity</b>	<p>Technical capacity needs can be understood in terms of availability of appropriate methodologies to obtain accurate data and adequate platforms for data collection and management.</p> <p><b>Key elements:</b></p> <ul style="list-style-type: none"> <li>■ Availability and quality of data and information</li> <li>■ Retention of institutional memory, archiving, and documentation procedures</li> <li>■ Collection and dissemination of information</li> <li>■ Technical and technological infrastructure (e.g., data collection platforms and monitoring technology)</li> </ul>
<b>Financial resources</b>	<p>Financial capacity involves ensuring that sufficient resources are available to start and sustain the implementation of MRV. Financial resources are needed to equip governments and other relevant entities for several MRV-related tasks, such as hiring qualified professionals dedicated exclusively to perform MRV, building capacity among stakeholders to support MRV implementation, putting in place effective institutional arrangements and processes, and implementing new data collection systems and methods.</p> <p><b>Key elements:</b></p> <ul style="list-style-type: none"> <li>■ Adequate financial resources to perform functions and achieve objectives</li> <li>■ Ability to manage these resources</li> </ul>

## 4. RELATIONSHIPS AMONG DIFFERENT TYPES OF MRV

Different types and levels of MRV can use common methodologies and data, and the same institutions can perform different MRV-related functions. For example, the methodology used to estimate GHG emissions from natural gas use may also be used to build a national GHG inventory and to assess the effects of energy policy. A single lead institution might coordinate all national MRV processes. Entities should identify areas of overlap between their different MRV processes and explore ways of increasing synergies to improve the efficiency of the overall MRV system. This can help in developing a comprehensive MRV system while utilizing fewer overall resources, and provides an opportunity to customize the MRV system to serve domestic objectives.

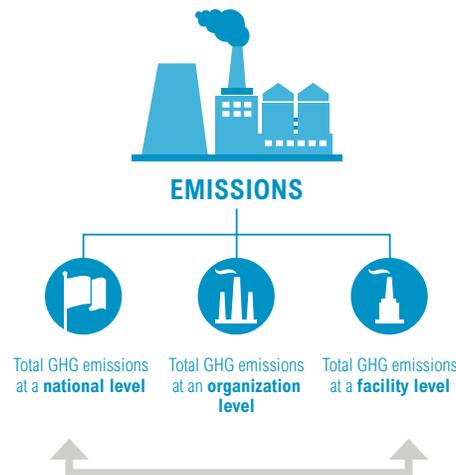
Below we describe four illustrative examples of overlapping relationships between various types and levels of MRV. Other synergies are also possible but a description of all synergies is beyond the scope of this paper.

### 4.1 Relationship between National Inventories and Facility Inventories

National inventories and facility inventories can complement each other in two important ways (Singh et al. 2014) (Figure 5):

- First, source-level data from facilities can be used to improve the accuracy of national emissions estimates and provide a reference for validating national numbers. However, in order to facilitate consistent use of facility-level data in national inventories, certain conditions should be met. There should be consistent definitions of emissions source categories between inventories and completeness of data within each reporting category.
- Second, because national inventory systems are typically in place before corporate/facility inventories, practitioners can build on existing institutional resources, technical expertise, and data systems related to national inventories when developing facility inventory systems. This approach can increase synergies and efficiencies and get the most from limited resources.

Figure 5 | Synergies between National- and Facility-Level Inventories



Leveraging these linkages can enhance consistency and accuracy of national datasets and formalize the use of data from facility inventories in the national inventory system, thereby strengthening overall GHG management and mitigation efforts within limited resources.

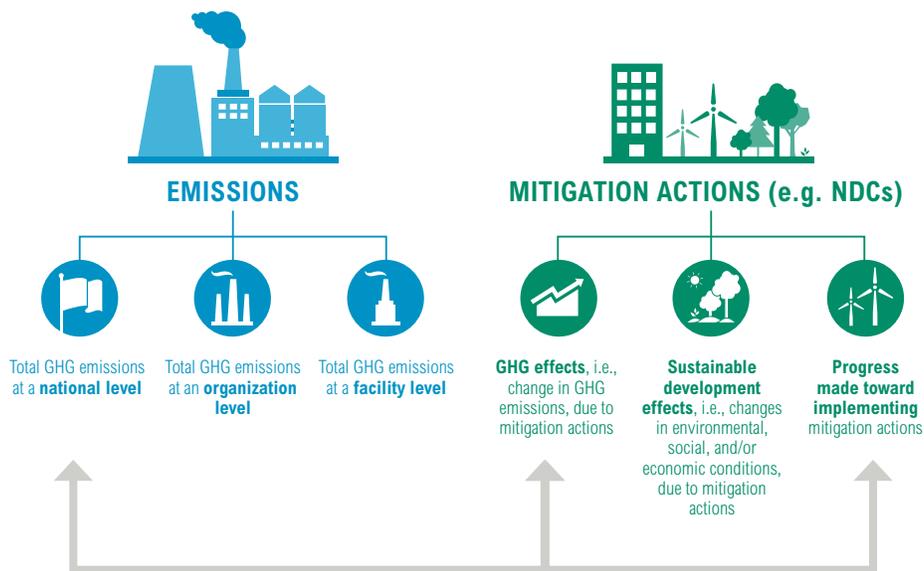
## 4.2 Relationship between National Inventories and MRV of Mitigation Actions

National inventories are a critical element in designing national mitigation goals, tracking goal progress, and assessing goal achievement (Figure 6). When designing a mitigation goal, national inventories are needed to identify high-emitting sectors, understand mitigation opportunities, and target significant emissions sources. To track progress toward the goal, an inventory is needed to calculate base year emissions or as the starting point for estimating baseline scenario emissions, depending on the goal type. National inventories are also needed throughout

the goal period to assess progress toward the goal. At the end of the goal period, governments need to review the national inventory to determine whether their goal has been achieved.

However, at the same time, tracking progress toward goals differs from inventory accounting in a number of important ways. While a GHG inventory covers the full range of a jurisdiction’s emissions and removals across all sectors and gases, accounting for mitigation goals focuses only on those sectors and gases included in the goal boundary, which may be a subset of total emissions. Furthermore, goals accounting can include purchases and sales of transferable emissions units (such as offset credits and tradable allowances) and emissions and removals from the land sector, which may be accounted for under a different inventory system. Therefore, tracking progress toward mitigation goals should be carried out as a complement to developing and updating a GHG inventory.

Figure 6 | Synergies between MRV of Emissions and MRV of Mitigation Actions



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### 4.3 Relationship between MRV of GHG Effects and Tracking Progress toward Mitigation Goals

When designing mitigation goals, entities need to decide the absolute amount or percentage of emissions reductions to be targeted. As an input to this process, governments can utilize information collected through MRV of GHG effects of policies and gain a better understanding of the likely emissions reduction impact of various existing and/or planned mitigation policies. Such information can be used to assess the contribution of these policies toward reducing national emissions and inform the mitigation goal. Conversely, after deciding on a mitigation goal and calculating the emissions reductions needed to achieve it, governments can assess the emissions impacts of their mitigation policies to determine whether they are collectively sufficient to achieve the goal. They can continue to track policy implementation, in order to determine whether the country is on the right path to achieve its mitigation goal.

### 4.4 Relationship between Assessing GHG Effects and Sustainable Development Impacts of a Mitigation Policy

The basic procedures that are required to assess the GHG effects of a policy are applicable when assessing sustainable development impacts; they include developing a baseline (business-as-usual) scenario and a scenario with the policy in place.<sup>15</sup> This is especially true for sustainable development impacts most clearly linked to GHG emissions in terms of data needs, such as energy use, waste generation, or local air pollution. For example, estimating GHG reductions from the promotion of public transit requires information on how many passengers no longer drive by car, from which fuel savings and GHG reductions can be calculated. The same information can be used to estimate money saved through avoided fuel purchases, and reduced emissions of local air pollutants, such as particulate matter, ozone, SO<sub>2</sub>, and NO<sub>x</sub>. However, to assess impacts that are less directly related to GHG emissions, such as public health impacts or broader economic impacts like changes in GDP or jobs, additional methods and data will be necessary.

## APPENDIX 1: SELECT RESOURCES— METHODS FOR CONDUCTING MRV

### MRV of GHG Emissions

#### National

- Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories <http://www.ipcc-nggip.iges.or.jp/public/2006gl/>

#### Organizational

- GHG Protocol Corporate Accounting and Reporting Standard <http://ghgprotocol.org/standards>
- GHG Protocol Scope 3 Standard <http://ghgprotocol.org/standards>
- GHG Protocol Source-specific Emissions Calculation Methods <http://ghgprotocol.org/calculation-tools>
- ISO 14064-1 Greenhouse Gases Part 1: Specification with Guidance at the Organization Level for Quantification and Reporting of Greenhouse Gas Emissions and Removals [http://www.iso.org/iso/catalogue\\_detail?csnumber=38381](http://www.iso.org/iso/catalogue_detail?csnumber=38381)
- ISO 14064-3 Greenhouse Gases Part 3: Specification with Guidance for the Validation and Verification of Greenhouse Gas Assertions [http://www.iso.org/iso/catalogue\\_detail?csnumber=38700](http://www.iso.org/iso/catalogue_detail?csnumber=38700)

#### Facility

- GHG Protocol Corporate Accounting and Reporting Standard <http://ghgprotocol.org/standards>
- GHG Protocol Source-specific Emissions Calculation Methods <http://ghgprotocol.org/calculation-tools>
- Guide for Designing Mandatory Greenhouse Gas Reporting Programs <http://www.wri.org/publication/guide-designing-mandatory-greenhouse-gas-reporting-programs>
- ISO 14064-1 Greenhouse Gases Part 1: Specification with Guidance at the Organization Level for Quantification and Reporting of Greenhouse Gas Emissions and Removals [http://www.iso.org/iso/catalogue\\_detail?csnumber=38381](http://www.iso.org/iso/catalogue_detail?csnumber=38381)
- ISO 14064-3 Greenhouse Gases Part 3: Specification with Guidance for the Validation and Verification of Greenhouse Gas Assertions [http://www.iso.org/iso/catalogue\\_detail?csnumber=38700](http://www.iso.org/iso/catalogue_detail?csnumber=38700)

### MRV of Mitigation Actions

#### GHG effects

- Clean Development Mechanism (CDM) Methodologies <https://cdm.unfccc.int/methodologies/index.html>
- GHG Protocol Mitigation Goal Standard <http://ghgprotocol.org/standards>
- GHG Protocol Policy and Action Standard <http://ghgprotocol.org/standards>
- GHG Protocol Project Standard <http://ghgprotocol.org/standards>
- Global Environment Facility (GEF) Guidance on Greenhouse Gas Accounting Methodologies <https://www.thegef.org/gef/ghg-accounting>
- Gold Standard <http://www.goldstandard.org/>
- Verified Carbon Standard <http://www.v-c-s.org/project/vcs-program/methodologies/>

#### Sustainable Development Impacts

- CDM Sustainable Development co-Benefits Tool <http://cdmcobenefits.unfccc.int/Pages/SD-Tool.aspx>
- GHG Protocol Policy and Action Standard <http://ghgprotocol.org/standards>
- Nationally Appropriate Mitigation Action (NAMA) Sustainable Development Evaluation Tool, United Nations Development Programme (UNDP) <http://www.undp.org/content/undp/en/home/librarypage/environment-energy/mdg-carbon/NAMA-sustainable-development-evaluation-tool.html>

#### Implementation progress

- CDM Methodologies <https://cdm.unfccc.int/methodologies/index.html>
- CDM Sustainable Development co-Benefits Tool <http://cdmcobenefits.unfccc.int/Pages/SD-Tool.aspx>
- Climate Policy Implementation Tracking Framework <http://www.wri.org/publication/climate-policy-implementation-tracking-framework>
- GHG Protocol Mitigation Goal Standard <http://ghgprotocol.org/standards>
- GHG Protocol Policy and Action Standard <http://ghgprotocol.org/standards>

- GHG Protocol Project Standard <http://ghgprotocol.org/standards>
- Monitoring Implementation and Effects of GHG Mitigation Policies: Steps to Develop Performance Indicators [http://www.wri.org/sites/default/files/Monitoring\\_Implementation\\_and\\_Effects\\_of\\_GHG\\_Mitigation\\_Policies.pdf](http://www.wri.org/sites/default/files/Monitoring_Implementation_and_Effects_of_GHG_Mitigation_Policies.pdf)

## MRV of Support

### Provision

- Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC) Climate Markers <https://www.oecd.org/dac/stats/48785310.pdf>
- Common Principles for Climate Mitigation Finance Tracking. Jointly developed by the joint climate finance group of multilateral development banks (MDBs) and the International Development Finance Club (IDFC) <http://www.worldbank.org/content/dam/Worldbank/document/Climate/common-principles-for-climate-mitigation-finance-tracking.pdf>
- UNFCCC Common Tabular Format for “UNFCCC Biennial Reporting Guidelines for Developed Country Parties” <http://unfccc.int/resource/docs/2012/cop18/eng/l12.pdf>

### Receipt

- Climate Public Expenditures and Institutional Review (CPEIR) <http://climatefinance-developmenteffectiveness.org/about/what-cpeir>
- Common Principles for Climate Mitigation Finance Tracking. Jointly developed by the joint climate finance group of multilateral development banks (MDBs) and the International Development Finance Club (IDFC) <http://www.worldbank.org/content/dam/Worldbank/document/Climate/common-principles-for-climate-mitigation-finance-tracking.pdf>
- Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC) Climate Markers <https://www.oecd.org/dac/stats/48785310.pdf>

### Results/impact

- Department for International Development Multilateral Aid Review: Ensuring Maximum Value for Money for UK Aid through Multilateral Organisations. [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/67583/multilateral\\_aid\\_review.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/67583/multilateral_aid_review.pdf)
- Climate Finance: Is it Making a Difference? A Review of the Effectiveness of Multilateral Climate Funds: Table 1. <https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9359.pdf>
- First Steps Toward a Quality of Climate Finance Scorecard (QUODA-CF): Creating a Comparative Index to Assess International Climate Finance Contributions. <http://www.brookings.edu/~media/research/files/reports/2013/07/climate-finance-scorecard-sierra-roberts/07-climate-finance-scorecard-sierra-roberts.pdf>
- United Nations Framework Convention on Climate Change (UNFCCC). Decision 3/CP.4 Review of the Financial Mechanism. [https://unfccc.int/files/cooperation\\_and\\_support/financial\\_mechanism/application/pdf/3\\_cp.4.pdf](https://unfccc.int/files/cooperation_and_support/financial_mechanism/application/pdf/3_cp.4.pdf)
- UNFCCC Decision 6/CP.13 Fourth Review of the Financial Mechanism. [https://unfccc.int/files/cooperation\\_and\\_support/financial\\_mechanism/application/pdf/6\\_cp.13.pdf](https://unfccc.int/files/cooperation_and_support/financial_mechanism/application/pdf/6_cp.13.pdf)

## APPENDIX 2: SELECT MRV-RELATED SUPPORT INITIATIVES

- Capacity-building Initiative for Transparency (CBIT) under the Paris Agreement <https://www.thegef.org/gef/CC/capacity-building-initiative-for-transparency>
- Global Environment Facility <https://www.thegef.org/gef/node/10563>
- Green Climate Fund Readiness Program <http://www.greenclimate.fund/ventures/readiness>
- Information Matters: Capacity Building for Ambitious Reporting and Facilitation of International Mutual Learning through Peer-to-Peer Exchange <https://www.giz.de/en/worldwide/30164.html>
- Initiative for Climate Action Transparency (ICAT) <http://www.climateactiontransparency.org/>
- International Partnership on Mitigation and MRV <http://mitigationpartnership.net/>
- Low Emission Capacity Building (LECB) Program [http://www.undp.org/content/undp/en/home/ourwork/environmentandenergy/focus\\_areas/climate\\_strategies/undp\\_projects\\_thatcontributetogreenlecrds/national\\_sub-nationalstrategies/low\\_emission\\_capacitybuildingprogramme.html](http://www.undp.org/content/undp/en/home/ourwork/environmentandenergy/focus_areas/climate_strategies/undp_projects_thatcontributetogreenlecrds/national_sub-nationalstrategies/low_emission_capacitybuildingprogramme.html)
- Low Emissions Development Strategies (LEDS) Global Partnership [http://ledsgp.org/?loclang=en\\_gb](http://ledsgp.org/?loclang=en_gb)
- Measurement and Performance Tracking (MAPT) <http://www.wri.org/our-work/project/measurement-and-performance-tracking-developing-countries>
- Nationally Appropriate Mitigation Actions (NAMA) Partnership <http://www.namapartnership.org/>
- Partnership for Market Readiness (PMR) <https://www.thepmr.org/>

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## ENDNOTES

1. For the purposes of this paper, greenhouse gases (GHGs) refer to the seven gases covered under the Kyoto Protocol: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), sulfur hexafluoride (SF<sub>6</sub>), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and nitrogen trifluoride (NF<sub>3</sub>). However, many of the concepts in this paper are also applicable to the MRV of other gases, such as those covered under the Montreal Protocol.
2. For example, see Damassa and Elsayed (2013), IPCC (2006), Rosenheim et al. (2016), Singh et al. (2015).
3. For example, see Bannai et al. (2015), International Partnership on Mitigation and MRV (n.d.), MAPT (n.d.).
4. Monitoring and evaluation (M&E) focuses on assessing inputs, implementation processes, as well as results and outcomes (UNDP 2002). It has been an integral part of managing projects and programs in organizations and governments at different levels (Sharma 2014). M&E is also used in the context of adaptation to understand whether adaptation measures have achieved their desired results and whether resources have been used efficiently and effectively (GIZ 2013). Further, some countries such as South Africa are developing national M&E processes to analyze impact of mitigation measures, which also fulfill international MRV obligations (Letete 2014).
5. For more information, see Levin and Finnegan (2013).
6. The exact definition of principles will differ based on type of MRV. For instance, for MRV of emissions, the principle of relevance implies that the information contained in reports and inventories is what is needed by both internal and external users for their decision making. Completeness means that the MRV process covers all significant emissions sources within the boundary of the entity. Consistency refers to consistent application of accounting and calculation methods so that the reported emissions can be compared and tracked over time. Transparency relates to the degree to which information on the processes, assumptions, and limitations of the GHG inventory are disclosed in a clear, factual, neutral, and understandable manner. Accuracy implies that the GHG measurements, estimates, or calculations are systematically neither more nor less than the actual emissions value, as far as can be judged, and that uncertainties are reduced as far as practicable.
7. For simplicity, this paper often uses the term “emissions” as shorthand for “emissions and removals.”
8. MRV of emissions at sub-national, sector, or product level is outside the scope of the paper.
9. The term “corporate” has been used broadly to include entities such as public sector organizations and non-profit organizations.
10. “Mitigation actions” do not usually include goals but, for simplicity, this paper uses the term to include all interventions that emphasize change in emissions as opposed to emissions themselves.
11. These definitions are based on GHGP (2014a) and GHGP (2014b).
12. See the GHG Protocol Mitigation Goal Standard for further information on various types of goals (GHGP 2014, 4.3: 35).
13. National communications from developing countries provide information on GHG emissions and a wide range of activities related to climate change, such as mitigation and adaptation measures, that are relevant to achieving the objective of the UNFCCC (UNFCCC 2014a).
14. These questions have been informed by Ninomiya (2012).
15. Baseline scenario—A reference case that represents the events or conditions most likely to occur in the absence of the policy or action (or package of policies or actions) being assessed.  
Policy scenario—A scenario that represents the events or conditions most likely to occur in the presence of the policy or action (or package of policies or actions) being assessed (GHGP 2014b).

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## ABOUT WRI

World Resources Institute is a global research organization that turns big ideas into action at the nexus of environment, economic opportunity and human well-being.

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Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

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### Our Approach

#### COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

#### CHANGE IT

We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

#### SCALE IT

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