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GHG Mitigation Actions: MRV Issues and Options

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ABSTRACT

The Bali Action Plan (BAP) language on “measurable, reportable and verifiable” (MRV) greenhouse gas mitigation actions and commitments for a post-2012 climate framework was introduced to apply both to developed countries’ greenhouse gas (GHG) commitments and actions (paragraph 1(b)(i) of the BAP), as well as to “nationally appropriate mitigation actions by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity-building” (paragraph 1(b)(ii)). This paper provides an overview of current efforts to assess if GHG mitigation actions underway in different countries and regions are “measurable, reportable and verifiable”. The paper also assesses how such efforts could be improved, explores MRV options for different types of GHG mitigation actions, and highlights decision points needed to establish a post-2012 framework.

Several different types of GHG mitigation actions and commitments have been proposed for the post-2012 period. Some of these - such as national-level GHG emission limits - are already being used, with countries therefore already gaining experience with implementing, monitoring, reporting (and potentially reviewing or verifying the effects of) such actions/commitments. The extent of this experience varies both by type of action/commitment, as well as by country and sector. In general, Annex I countries have significant experience with monitoring and reporting national emission levels (reflecting their reporting commitments under the UNFCCC and Kyoto Protocol). However, official reporting on other GHG-mitigation actions occurs every few years in Annex I countries and only irregularly in non-Annex I countries. Thus, significant new guidance would be needed if post-2012 MRV provisions were to focus on GHG mitigation actions rather than GHG emission levels.

In deciding a MRV framework, it will be important to consider measurement, reporting and verification issues separately (as for example some non-supported actions may be reported but not verified). A transition process may also be needed for some countries, in terms of what is to be subject to MRV provisions, and how M, R and V are to be carried out.

JEL Classification: F53, G15, Q54, Q56, Q58

Keywords: Climate change; greenhouse gas; MRV; measurement, reporting, verification; mitigation actions

RÉSUMÉ

Les termes « mesurables, notifiables et vérifiables » (MNV) utilisés dans le Plan d'action de Bali pour qualifier les initiatives et les engagements en matière d'atténuation des émissions de gaz à effet de serre (GES) envisagés dans le cadre climatique pour l'après 2012 s'appliquent à la fois aux engagements et initiatives d'atténuation des émissions de GES des pays développés (paragraphe 1(b)(i) du Plan de Bali), et aux « mesures d'atténuation appropriées au niveau national de la part des pays en développement parties dans le cadre d'un développement durable, soutenues et rendues possibles par des technologies, des moyens de financement et un renforcement des capacités » (paragraphe 1(b)(ii)). Le présent document passe en revue les efforts déployés actuellement pour évaluer si les initiatives d'atténuation des émissions de GES lancées dans les différents pays et régions sont « mesurables, notifiables et vérifiables ». Il étudie en outre comment ces efforts pourraient être améliorés, considère les options MNV pour différents types d'initiatives d'atténuation et fait ressortir les questions qu'il faudra trancher pour établir un cadre pour l'après-2012.

Différents types d'engagements et d'initiatives d'atténuation des émissions de GES ont été proposés pour l'après-2012. Certains, comme les plafonds nationaux d'émissions de GES, sont déjà utilisés, ce qui permet à des pays d'acquiescer d'ores et déjà une expérience de la mise en œuvre, du suivi et de la notification de ces initiatives/engagements (et éventuellement de l'examen ou de la vérification de leurs effets). L'ampleur de ces expériences varie selon le type d'initiative/d'engagement et selon les pays ou secteurs considérés. En général, les pays visés à l'Annexe I ont une grande expérience du suivi et de la notification de leurs émissions nationales (en vertu des engagements de notification souscrits au titre de la CCNUCC et du Protocole de Kyoto). Cependant, les communications officielles sur les autres mesures prises pour atténuer les émissions de GES ne sont présentées qu'à plusieurs années d'intervalle dans le cas des pays visés à l'Annexe I, et de façon sporadique dans celui des autres pays. En conséquence, de nouvelles directives seront nécessaires s'il est décidé qu'après 2012 les dispositions relatives à la MNV s'appliqueront non plus aux niveaux d'émission mais aux initiatives d'atténuation des émissions de GES.

Pour établir un cadre MNV, il importera de considérer séparément les questions de mesure, de notification et de vérification (sachant que par exemple, certaines initiatives mises en œuvre en l'absence de soutien peuvent être notifiées mais pas vérifiées). Un processus de transition pourrait également être nécessaire pour certains pays, portant sur le champ d'application des dispositions relatives à la MNV et les modalités de M, N et V.

Classification JEL: F53, G15, Q54, Q56, Q58

Mots-clés: Changement climatique; gaz à effet de serre; MNV; mesure, notification, vérification; actions d'atténuation

FOREWORD

This document was prepared by the OECD and IEA Secretariats in Spring 2009 in response to the Annex I Expert Group on the United Nations Framework Convention on Climate Change (UNFCCC). The Annex I Expert Group oversees development of analytical papers for the purpose of providing useful and timely input to the climate change negotiations. These papers may also be useful to national policy-makers and other decision-makers. In a collaborative effort, authors work with the Annex I Expert Group to develop these papers. However, the papers do not necessarily represent the views of the OECD or the IEA, nor are they intended to prejudge the views of countries participating in the Annex I Expert Group. Rather, they are Secretariat information papers intended to inform Member countries, as well as the UNFCCC audience.

The Annex I Parties or countries referred to in this document are those listed in Annex I of the UNFCCC (as amended at the 3rd Conference of the Parties in December 1997): Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, the European Community, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom of Great Britain and Northern Ireland, and United States of America. Korea and Mexico, as OECD member countries, also participate in the Annex I Expert Group. Where this document refers to “countries” or “governments”, it is also intended to include “regional economic organisations”, if appropriate.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY	8
1. INTRODUCTION	11
1.1 Possible aims and options of post-2012 MRV provisions	11
2. NATIONAL EMISSIONS TARGETS	13
2.1 MRV-related experience with national emissions targets	13
2.2 Options for future MRV-related provisions	15
2.3 Experience with other forms of national commitments or actions	15
3. SECTORAL EMISSIONS TARGETS	16
3.1 MRV experience with sectoral targets and other actions	16
3.1.1 Measurability	17
3.1.2 Reporting	17
3.1.3 Verification	18
3.2 Options for future MRV-related provisions for sectoral targets	18
3.2.1 Measurability	18
3.2.2 Reporting	20
3.2.3 Verification	20
4. CDM AND/OR OTHER CREDITING MECHANISMS	21
4.1 MRV-related experience with the CDM	21
4.2 Options for future MRV-related provisions	21
5. DOMESTIC POLICIES AND MEASURES OR OTHER NON-CREDITING APPROACHES	22
5.1 Current MRV-related experience	23
5.1.1 Measurability	24
5.1.2 Reporting	26
5.1.3 Verification	27
5.2 Options for post-2012 MRV of PAMs	28
5.2.1 Measurability	28
5.2.2 Reporting	29
5.2.3 Verification	30
6. HOW COULD MRV REQUIREMENTS EVOLVE BY TYPE OF GHG MITIGATION ACTION?	30
7. CONCLUSIONS	34
REFERENCES	37
GLOSSARY	41

LIST OF TABLES

Table 1: Summary of possible post-2012 M, R, V provisions for different types of action/ commitment...	9
Table 2: Summary of current provisions of reporting on national GHG emissions.....	14
Table 3: Examples of different types of PAMs and associated non-GHG metrics	23
Table 4: Possible evolution of MRV provisions and associated results of an MRV system for different types of action/commitment	33

LIST OF FIGURES

Figure 1: Measurement needs relating to sectoral emission targets.....	19
Figure 2: Evolving MRV requirements for GHG mitigation actions and commitments	31

Executive Summary

The Bali Action Plan (BAP) highlighted the importance of “measurable, reportable and verifiable” (MRV) greenhouse gas mitigation actions and commitments for a post-2012 climate framework. This MRV language was introduced to apply both to developed countries’ greenhouse gas (GHG) commitments and actions (paragraph 1(b)(i) of the BAP), as well as to “nationally appropriate mitigation actions by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity-building” (paragraph 1(b)(ii)). This paper provides an overview of current efforts to assess if GHG mitigation actions underway in different countries and regions are “measurable, reportable and verifiable”. The paper also assesses how such efforts could be improved, explores MRV options for different types of GHG mitigation actions, and highlights decision points needed to establish a post-2012 framework.

Several different types of GHG mitigation actions and commitments have been proposed for the post-2012 period. Some of these - such as national-level GHG emission limits - are already being used, with countries therefore already gaining experience with implementing, monitoring, reporting (and potentially reviewing or verifying the effects of) such actions/commitments. The extent of this experience varies both by type of action/commitment, as well as by country and sector. In general, Annex I countries have significant experience with monitoring and reporting national emission levels (reflecting their reporting commitments under the UNFCCC and Kyoto Protocol). However, official reporting on other GHG-mitigation actions occurs every few years in Annex I countries and only irregularly in non-Annex I countries. Thus, as outlined in a previous analysis (Ellis and Larsen 2008), significant new guidance would be needed if post-2012 MRV provisions were to focus on GHG mitigation actions rather than GHG emission levels.

The scope of post-2012 GHG mitigation actions/commitments could also differ, e.g. with more focus on sectoral actions/commitments. There is increasing experience with reporting sector-based emissions. However, there is no consistent, internationally-agreed guidance on how this should be done. Such guidance will be needed in order to implement some GHG mitigation actions under discussion, such as a sectoral no-lose target.

As well as variations in the possible type and scope of post-2012 GHG mitigation actions/commitments, there are three other areas of uncertainty surrounding possible post-2012 MRV provisions.

1. There could be **several aims** of any MRV provisions on GHG emissions and actions in a post-2012 climate agreement. These aims could include collecting a more timely and comprehensive picture of emission trends; collecting qualitative or quantitative information on countries’ GHG mitigation actions or quantifying the GHG impact of such actions.

2. There are also **different ways of assessing GHG mitigation actions**, i.e. qualitatively or quantitatively. Assessment could be in terms of the qualitative or quantitative input to such actions (e.g. funding, establishment of energy efficiency regulations), intermediate output (e.g. numbers of energy efficient appliances installed) and/or the GHG outcome of such actions/commitments. Some actions that can mitigate GHG emissions are straightforward to quantify in GHG (or non-GHG) terms, but others are not.

3. The **process** for carrying out MRV of mitigation actions would vary with the type of action undertaken (e.g. measuring the effectiveness of energy efficiency standards and incentives to address REDD will require methods that have little in common). Thus, countries could agree to measurement and reporting guidelines, rules and/or best practices, while understanding that requirements could differ for different types of action, different groups of countries and/or whether

actions are binding or non-binding and/or whether actions are supported. Agreement will also be needed on verification, including what the verification process should be and who should undertake it.

Policy guidance on what MRV provisions are trying to achieve will be needed in order to establish the details of a MRV framework, such as the type(s) of MRV metric(s) appropriate for different type of actions/commitments. Possible MRV provisions for different types of action/commitment are outlined in Table 1, below. In deciding a MRV framework, it will be important to consider measurement, reporting and verification issues separately (as for example some non-supported actions may be reported but not verified). A transition process may also be needed for some countries, in terms of what is to be subject to MRV provisions, and how M, R and V are to be carried out.

Table 1: Summary of possible post-2012 M, R, V provisions for different types of action/commitment

Action/ commitment type	Quantitative		3 rd party verifi- cation	MRV metrics	Would MRV outcome be comparable between countries?
	Measurement	Reporting			
National emission levels	Yes	Yes	Yes*	GHG outcomes	Yes (emission levels, not emission reductions)
Other national emission-related targets	Yes	Yes	Yes*	GHG outcomes or inputs	No, if metrics differ between countries
Sectoral emissions targets	Yes	Yes	Yes*	GHG outcome/ intermediate output	Yes/No, depending on how targets are established, and whether they differ between countries
CDM/other crediting mechanisms	Yes	Yes	Yes	GHG outcome (and often intermediate output), project/ sectoral output	Yes, as MRV focuses on emission reduction
Policies and measures (PAM) (no crediting)	Maybe, depending on type of PAM	Maybe, depending on type of PAM	Maybe	Inputs, intermediate output or GHG outcome	No, as metrics are likely to differ within and between countries (depending on sector and PAM).

* 3rd party verification may be needed in order to access the international carbon market.

Different potential MRV provisions have advantages and disadvantages. For example, focusing on qualitative description of GHG mitigation actions would not give any indication of the global GHG impact of actions undertaken, nor would it be able to highlight the relative efforts undertaken by different countries. In contrast, creating a MRV system that generates a comprehensive picture of global emissions would help identify emission trends and progress towards any global emissions goal – but could take significant resources to set up.

The MRV system will be an important part of the post-2012 climate regime. Its development will follow, rather than lead, decisions on other aspects of the post-2012 framework (such as type of action/commitment). Care will be needed in order to balance environmental accuracy with economic and institutional constraints. Further, if MRV is done in non-GHG terms, the choice of possible metric(s) will be wide – so it will be important that these metric(s) are now, and remain, appropriate indicators to assess GHG mitigation efforts and actions.

When a measure becomes a target, it ceases to be a good measure.

Professor Marilyn Strathern FBA, restating Goodhart's Law.

1. Introduction

The Bali Action Plan (BAP) highlighted the importance of “measurable, reportable and verifiable” greenhouse gas mitigation actions and commitments for a post-2012 climate framework. This language on “measurable, reportable and verifiable” (MRV) was introduced to apply both to developed countries’ commitments and actions (paragraph 1(b)(i) of the BAP), as well as to “nationally appropriate mitigation actions by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity-building” (paragraph 1(b)(ii)).

Several different types of greenhouse gas (GHG) mitigation actions and commitments have been proposed for the post-2012 period. These vary in terms of their scope and legal nature, and may also vary in terms of whether they apply to developed and/or developing countries. Some of these GHG mitigation actions (e.g. national emission limits) have been implemented by some countries in the current climate regime, hence there is already considerable guidance on and experience relating to MRV for these types of actions. However, other types of GHG mitigation actions – such as sector no-lose targets or nationally appropriate mitigation actions (NAMAs) – are not yet implemented, and would thus require the establishment of new MRV provisions.

This paper provides an overview of current efforts to assess if GHG mitigation actions underway in different countries and regions are “measurable, reportable and verifiable”. The paper also assesses how such efforts could be improved, and explores MRV options for different types of GHG mitigation actions. This paper does not cover the issue of MRV in the context of support for mitigation actions – this is covered in an accompanying paper (Kim *et al.*, 2009).

After outlining what the overall aims and options of post-2012 MRV provisions could be, sections 2 to 5 explore MRV in the context of four broad categories of GHG mitigation actions: national emission targets or other forms of national commitments; sectoral emissions targets; CDM or other crediting mechanisms; and domestic policies and measures or other non-crediting approaches. Each section highlights experience with measurability, reporting and verification, and presents options for post-2012 MRV-related provisions. Where relevant, these sections also discuss capacity issues with measuring, reporting and verifying mitigation actions. Section 6 explores how MRV requirements could evolve by type of GHG mitigation action, providing a synthesis of issues and options raised in the previous sections. Conclusions are presented in section 7.

1.1 Possible aims and options of post-2012 MRV provisions

There could be several different aims of any MRV provisions on GHG emissions and actions in a post-2012 climate agreement. These aims could include:

- Generating a more timely and comprehensive picture of global/national or sectoral GHG emissions trends¹, e.g. in order to assess if global action on GHG mitigation needs to be enhanced;

¹ Annex I countries report annually on GHG emission levels, but GHG inventory information from non-Annex I countries are very patchy and/or out of date.

- Collecting qualitative or quantitative information on what GHG mitigation actions different countries are taking, e.g. in order to provide international recognition for these actions;
- Quantifying the GHG impact of such actions (i.e. calculating the difference between performance and baseline);
- Identifying promising areas for future GHG mitigation action;
- Building trust, by providing for an MRV system that will confirm that what is actually happening in terms of GHG mitigation actions (and/or support) reflects the actions/commitments that different countries have agreed to.

While these options are not all mutually exclusive, they do differ from each other, sometimes substantially. The design of any post-2012 MRV provisions may therefore vary, depending on which of the above aims they are trying to fulfill. These aims are all potentially valid, and which one(s) will be fulfilled by any MRV provisions will need to be agreed (implicitly or explicitly) in the post-2012 negotiation process.

The process for carrying out MRV of mitigation actions can also vary. Thus, countries may need to agree on specific issues:

- On **measurement**: countries could agree to guidelines, rules and/or best practices to be followed when estimating the impacts of measures that mitigate GHG emissions. Agreement will also be needed on whether measurement/monitoring requirements should vary, for example according to type of action. Alternatively, country and action-specific estimation methodologies and processes could be used.
- On **reporting**: countries could agree to a common reporting format, and/or common reporting guidelines outlining how actions are reported, such as which language, what units, what timing, where reports are collated/collected, what should be reported, and/or when reporting should take place.
- On **verification**: agreement will be needed on who the verification body or bodies (national or international) is/are; what the verification process should be, how results should be reported, and how to make any needed adjustments in reports of GHG mitigation. Agreement will also be needed on the consequences of problems raised at the verification stage.

Countries may also need to agree on some more general issues, such as whether/how measurement, reporting and verification issues should be considered separately.

The types of actions/commitments proposed for the post-2012 period can also differ (UNFCCC, 2009). These vary from “soft” actions (such as ones that are non-binding) to “hard”² actions (such as binding national targets), with each presenting different MRV-related challenges. These actions can be grouped into five major categories:

- National emission targets (binding or non-binding);
- Other forms of national commitments or actions (e.g. GHG-intensity or energy-intensity targets);
- Sectoral emissions targets (binding or non-binding);

² The terminology “hard” and “soft” here refer to the type of action and compliance provision. It does not refer to the cost of undertaking such actions, which will be determined by the stringency/ambition of the action itself.

- CDM and/or other crediting mechanisms;
- Domestic policies and measures (PAMs) or other non-crediting approaches.

In order to assess progress with these different types of actions/commitments, different provisions for MRV will be needed both between and potentially also within categories. These issues are outlined in sections 2 to 5 below.

2. National emissions targets

Under the Kyoto Protocol, Annex B countries (representing almost 43 % of global GHG emissions in 2005, IEA 2008a) adopted national emissions targets, and are required to report GHG emissions annually. In contrast, non-Annex I countries do not regularly report their GHG emissions, but rather submit inventory information with their national communications³. This means that there is no recent, official data⁴ on aggregate GHG emissions in non-Annex I countries, which are projected to account for an increasing share of global GHG emissions.

The context for the Bali Action Plan language on “measurable, reportable and verifiable” GHG mitigation actions is “enhanced national/international action on mitigation of climate change”. In order to express such enhanced action in terms of global GHG emissions (or emission trends), a clearer picture of these emissions and trends would be needed. This could be achieved if a greater number of countries were to regularly monitor and report national GHG emissions.

2.1 MRV-related experience with national emissions targets

MRV-related experience with monitoring, reporting and reviewing national GHG emissions has been gained by Annex I countries, as part of their implementation of commitments under the UN Framework Convention on Climate Change (UNFCCC) and Kyoto Protocol. Legally-binding national emission limits are the only type of quantified GHG emissions commitments currently allocated under the Kyoto Protocol. These limits relate to national GHG levels in Annex B Parties⁵ only.

The UNFCCC, Kyoto Protocol and Marrakech Accords include several provisions relating to monitoring, reporting and reviewing (MRR) national GHG emissions, such as guidance on calculating national inventories; on establishing national inventory systems; on reporting and review of national inventories; and on reporting transactions of different GHG units between countries (see South Centre 2008 for an outline and Table 2 for a summary). Because one group of countries faces legally-binding emission commitments and the other not, MRR provisions under the Kyoto Protocol differ between Annex I and non-Annex I countries, as described in Ellis and Larsen (2008).

A country’s emissions inventory forms the basis of any MRV provisions relating to a national emissions target. Estimating a country’s emissions will need some country-specific activity data (e.g. energy use). Obtaining these activity data, and potentially also country-specific emission factors, requires both time and

³ Most non-Annex I countries have as yet only produced one National Communication.

⁴ Thus, the data that do exist for global GHG emissions are developed by third parties; not governments.

⁵ Annex B Parties are the following: Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, the European Community, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom of Great Britain and Northern Ireland The USA is listed in Annex B, but has not ratified the Kyoto Protocol.

resources. The resource cost of establishing a country’s emissions inventory can vary widely depending on the country and its economy.⁶ For example, developing Brazil’s GHG inventory for its initial national communication involved 150 entities (research centres, NGOs, industry organisations and government institutions) and approximately 700 experts (Paciornik, 2008). Malawi has pointed out that a “huge increase in human capacity” is needed for it to address all its requirements under the UNFCCC; developing national communications, national adaptation plan of actions, and attending a large number of meetings present a big challenge (UNFCCC, 2007a).

Table 2: Summary of current provisions of reporting on national GHG emissions

	Annex I countries			Non-Annex I countries		
	Reporting Frequency	Reviewed?	Impact	Reporting Frequency	Reviewed?	Impact
GHG emissions inventory (Required under the UNFCCC)	Annual	Yes (“technical review”)	Required to participate in Kyoto mechanisms	Irregular (included in National Communications)	No	--
GHG inventory system (Required under the Kyoto Protocol for AI countries, “encouraged” for NAI countries)	Included in National Inventory Reports (annually)	Yes (as part of the inventory review)	Required to participate in Kyoto mechanisms	Irregular (included in National Communications)	No	--
Transfers/acquisitions of GHG units (Required under the Kyoto Protocol)	Annual	Yes; also verified by International Transaction Log	Required to participate in Kyoto mechanisms	Not reported*	No	--
Registries (Required under the Kyoto Protocol)	Included in National Communications (every 3-5 years)	Yes (National Communications)	Required to participate in Kyoto mechanisms	Not reported*	No	--

Source: UNFCCC (2002, 2005)

* While this information is not reported on a national level, information on the project level is reported and verified through the CDM registry and Executive Board.

⁶ The GEF provides indicative figures of approximately USD 190k in order to prepare national GHG emission inventories as part of non-Annex I countries’ National Communications. This figure also includes general project management, monitoring and reporting (GEF, 2007a). Country-specific information indicates the wide variation in such costs, with for e.g. developing China’s GHG emissions inventory and database for its second National Communication costing more than USD 3.6m (GEF, 2007b) and Costa Rica’s USD 35k (GoCR *et al.*, 2004).

2.2 Options for future MRV-related provisions

If the post-2012 climate regime establishes national emission targets for specific countries, these could be either binding targets (as under the Kyoto Protocol), or non-binding. In any case, requiring reporting of national emissions from a larger group of countries than at present would help to gain a better picture of trends in global emissions⁷.

Current monitoring, reporting and review (MRR) provisions of national emission limits could form the basis of post-2012 provisions to assess measurable, reportable and verifiable GHG mitigation efforts in developed and developing countries. For Annex I countries, only limited changes would be needed to current international guidance if future emission mitigation commitments were quantified emission limits, and if the definitions of MRV under the Bali Action Plan were similar to those used for MRR under the Kyoto Protocol and Marrakech Accords (Ellis and Larsen 2008). In contrast, significant changes (in terms of resources, institutions, implementation) at the national level would be needed if any countries not currently included in Annex I were required to provide regular GHG emissions inventories post-2012.

There is little precedent in the current climate regime for the MRV-related requirements of any national non-binding targets that could be agreed for the post-2012 period. Thus, an appropriate MRV system would need to be established if this type of GHG mitigation action were recognised under a post-2012 agreement. Decisions would be needed as to whether MRV provisions for a non-binding target should be different to those for binding targets. If countries were to be allowed to sell credits for emissions below their non-binding target, they would probably need to measure, report and verify their inventory with the same guidelines as countries with binding targets, so as to maintain the integrity of the carbon market.

2.3 Experience with other forms of national commitments or actions

National targets relevant to GHG mitigation can also be expressed in terms other than absolute GHG emission levels, and have been by several countries. For example, national energy efficiency objectives have also been established under the EU Energy End-use Efficiency and Services Directive (COM2006/32 EC) EU Member States should achieve energy savings of 1% per year from 2008 to 2017, and are to draw up action plans to achieve it⁸. The action plans are reviewed and must be approved by the European Commission, which can undertake legal proceedings against States if they do not meet the requirements set out in the Directive⁹. National energy savings in relation to the national energy savings target are to be measured from 1 January 2008 onwards, and States are to report to the Commission every three years. The Directive contains annexes that provide guidance on data used to measure savings and calculation methods. It also specifies that energy savings resulting from implemented measures shall be verified by third parties or appropriate national authorities “if deemed cost-effective and necessary”.

⁷ Obtaining a comprehensive estimate of global GHG emissions would be both time and resource-intensive if the provisions contained in the UNFCCC carry forward post-2012 (Article 4.3 of the UNFCCC indicates that Annex I countries will pay the “agreed full costs” for national inventories in non-Annex I countries). However, 95% of global emissions are accounted for by Annex I countries and the 30 non-Annex I countries who emit more than 100 Mt CO₂-eq/year (IEA, 2008b). Limiting requirements to produce annual emissions inventories to these 30 non-Annex I countries (while maintaining support for periodic national communications from non-Annex I countries) would allow the global community to obtain a clearer picture about GHG emission levels and trends, while limiting costs for doing so.

⁸ The energy savings are to occur across all sectors, i.e. retail, supply and distribution of electricity, natural gas, urban heating, and other energy products including transport fuels. The relative importance of different sectors and the measures undertaken to achieve the target are determined by the States.

⁹ The Directive indicates (i.a.) how targets should be calculated.

Other forms of national targets can include energy-intensity or GHG-intensity goals. For example, the US adopted an objective of improving its GHG-intensity by 18% between 2002-2012. China has also established energy intensity goals. The Chinese 11th Five Year Plan (2006-10), established a goal of reducing energy intensity, by 20% between 2005 and 2010. Given certain GDP and energy use growth rate assumptions, achievement of this target requires a reduction in energy use of 1812 Mtoe below baseline.¹⁰ The overall energy intensity target is distributed by region, with individual provinces given targets to 2010 which are then verified by the NDRC.

The goal has led to various initiatives across sectors and levels of government, such as the strengthening of building codes, the reform of excise tax on vehicles to promote the purchase of smaller cars, and measures to make local governments and enterprises responsible for implementing energy-saving measures by including attainment of these objectives in performance evaluations (Zhang, 2008). As of 2007, China was not yet on track to meet its energy intensity target, though the national average target of 4% improvement was reached for the first time in 2008 (Reuters, 22 January 2009). The energy savings or reduced energy intensity resulting from the above targets could also be “translated” in GHG mitigation terms, such as avoided emissions or reductions in emission intensity. For example the UK intends to routinely estimate the carbon savings resulting from the measures outlined in its energy efficiency action plan, and has developed guidance to do so (Defra, 2007). While there are presently no MRV-related provisions under the UNFCCC for national targets in terms other than absolute GHG emissions in the climate regime, decisions could be made regarding such requirements for the post-2012 period.

3 Sectoral emissions targets

Similarly to national emissions targets, any post-2012 sectoral emissions targets could be binding or non-binding. There are many different designs that such sectoral GHG emissions targets could take (see e.g. Baron, Barnsley and Ellis, 2008, CEPS 2008). Recent ideas and proposals from countries (summarised in UNFCCC 2009) include intensity targets; sectoral trading and “no-lose” crediting baselines. Ensuring that GHG mitigation from such sectoral approaches are measurable, reportable and verifiable would require different mechanisms, depending on the design of a sectoral emissions target. A MRV system may also need to vary depending on whether over-achieving the target would generate tradable credits.

3.1 MRV experience with sectoral targets and other actions¹¹

Several sector-wide initiatives to mitigate GHG emissions are currently underway. These can range from mandatory and binding activities undertaken in Annex I countries as part of their efforts to meet their Kyoto Protocol targets (e.g. activities under the EU emissions trading scheme – EU ETS – which has established absolute emissions limits for selected sectors in EU countries as part of its response to achieving its emissions reduction target under the Kyoto Protocol) to voluntary and non-binding activities that extend across Annex I and non-Annex I countries (such as the aluminium industry’s objective to reduce its emissions of perfluorocarbons). Sectoral targets can also be established as part of a national climate change strategy. For example, Brazil’s National Climate Change Plan (PNMC) (GoB, 2008) sets non-binding quantitative targets for Amazon deforestation reduction rates, reduction in annual electricity consumption and use of sugarcane ethanol. The emissions avoided by achieving these targets are calculated and reported in the PNMC. Experience with such actions could be useful in any attempt to establish post-2012 sectoral targets (e.g. sectoral no-lose targets) or sectoral crediting mechanisms.

¹⁰ This is greater than the United States’ total final energy consumption (TFC) in 2006 (1572.16 Mtoe); the average yearly reduction would be equivalent to the United States’ total consumption of energy in transport in 2006 (648.83 Mtoe) (IEA, 2008c). Note: 1Mtce (tonne of coal equivalent) = 0.7 Mtoe (tonne of oil equivalent).

¹¹ This section draws on Baron, Barnsley and Ellis (2008) and Baron *et al.* (2007).

3.1.1 Measurability

Accurate emission measurement or monitoring forms the backbone of sectoral targets, as it is needed to assess performance/progress towards a particular target. Depending on how a sectoral target is established, historical estimates of GHG emissions (or GHG emission intensity) may also be needed.

Several of the quantified sector-based approaches currently underway include robust measurement protocols.¹² For example, the EU ETS has established legally-binding monitoring and reporting guidelines (MRG), which provide a tiered system of monitoring methodologies for measuring and reporting emissions.¹³ The Cement Sustainability Initiative (CSI) has also established¹⁴ a sector-specific CO₂ accounting and reporting protocol, based on the WRI-WBCSD Greenhouse Protocol on cement. A majority of CSI members have also set themselves quantitative intensity targets (CO₂ emissions per tonne of cement produced). The International Aluminium Institute has also developed a protocol (and associated worksheet) for calculating emissions from aluminium production – also based on the WRI-WBCSD GHG Protocol (IAI, 2006). The Worldsteel association is also collecting and reviewing data at the site and company level, as well as reporting on CO₂ emissions from steel production at the national/regional level (Jitsuvara, 2009).

Experience to date shows that emission measurement protocols can be developed for fairly large industrial activities. What any protocol sets out to measure/monitor, however, depends on how the sectoral target is established. Thus, the CSI protocol and MRG for the cement sector under the EU ETS are not consistent.¹⁵ The system boundaries of the steel sector in the EU ETS and in Worldsteel's calculations also differ.

3.1.2 Reporting

Reporting requirements under different sector-based approaches differ. For example, under the EU ETS operators must have their monitoring plan approved, which at the national level is part of or connected to the permit of an installation. Emissions are reported annually according to a specific reporting template. According to the MRG, data systems, control systems, quality control and assurance, as well as review and validation systems must be in place to ensure reporting is as accurate as possible. In contrast, the CSI protocol provides reporting recommendations, rather than requirements. This is because the protocol is designed to comply with a variety of reporting purposes. Eleven of the 19 CSI members report specific CO₂ emissions (per tonne of cement produced), to measure progress with meeting their quantitative reduction targets.

CSI, Worldsteel and IAI data is aggregated to ensure that individual plants cannot be identified. This means that in some cases, data is only made publicly available at the regional (not country) level.

¹² These are not necessarily consistent - particularly in terms of boundary definition - with the IPCC guidelines for national inventories, which sometimes aggregate several sectors together (e.g. non-ferrous metals) and/or report emissions from one sector in more than one category.

¹³ Commission Decision of 18 July 2007, 2007/589/EC. An installation operator can use a calculation-based methodology, a measurement-based methodology, or a combination thereof. This must be approved by the designated national authority as part of the installation's monitoring plan. Activity-specific methodologies are provided to determine a variety of variables, which range on a scale from one to four, corresponding to an increased level of accuracy and specificity and a lower level of uncertainty.

¹⁴ The CSI comprises 19 member companies that account for 25% of the world's cement production.

¹⁵ For example the CSI protocol includes indirect emissions from purchased clinker and electricity. The CSI protocol also accounts for avoided emissions in the incineration sector, which are counted as full emissions under the ETS.

3.1.3 Verification

Both the EU ETS and the CSI incorporate external third-party verifications of CO₂ emissions. Verification of data for individual plants is optional under the IAI protocol, but collated industry-wide data is verified by a third party. Data submitted to Worldsteel is also verified by a third party.

Eighteen CSI members measure and report their CO₂ emissions according to the CSI protocol, and since 2006 data is also verified by a third party. For the eleven members reporting specific CO₂ emissions, there appears to be no third party verification of cement production; this may be sensitive for confidentiality and anti-trust reasons. Installations under the EU ETS must undergo verification by designated verifiers, which must meet minimum requirements under the MRG¹⁶.

3.2 Options for future MRV-related provisions for sectoral targets

The different designs of possible post-2012 sectoral approaches under discussion will influence the MRV-related provisions needed. For example, MRV-related provisions of a sectoral target that aims to achieve a given emissions performance (in terms of emissions levels or emissions intensity) will need to focus on monitoring actual emissions (and output) of a sector. In contrast, a sectoral target that aims to achieve a given level of emission reductions would need to include MRV provisions both for the sector's performance and baseline¹⁷. Similarly, a sectoral target that aims to produce tradable GHG credits would need to allow for MRV in terms of greenhouse gases – whereas other types of sectoral targets (e.g. technology-based targets) would not necessarily need to be quantified in terms of GHG.

3.2.1 Measurability

There is already a large body of material relating to how to monitor or measure emissions from different sources and sectors – at the project, organisation or national level (e.g. IPCC 2006, WRI/WBCSD 2001, ISO standard 14064). Any future sectoral approach could build on such material, which has already gone through an extensive international review process.

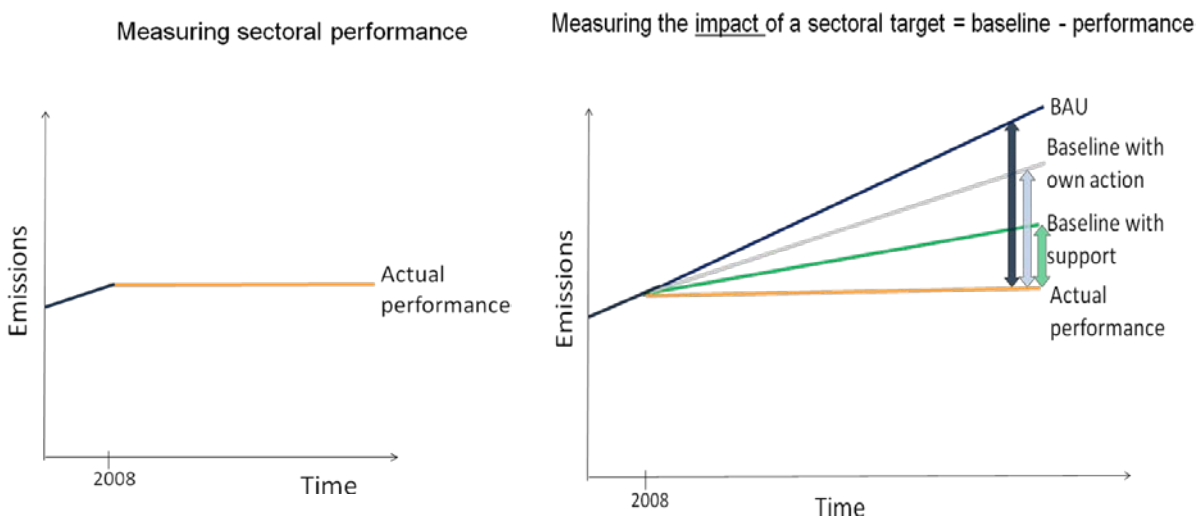
There is much less guidance, however, on how to measure emission reductions in a particular sector. In order to calculate such a figure, the difference between actual sectoral emissions and projected sectoral emissions would need to be quantified¹⁸. This in turn requires a quantified baseline projection, as well as an estimate of actual emissions – and so increases requirements related to measuring and monitoring. Emission reductions are the difference between the baseline and actual performance. Depending on the type of sectoral emissions target, the baseline may reflect business-as-usual (BAU) development, or may reflect other scenarios, such as domestic action taken and/or planned with and/or without support from other countries. Depending on which baseline is used, the volume of credits (represented by the different length arrows in Figure 1) will vary. If a sectoral target were expressed in terms of emissions intensity, non-emissions data (e.g. electricity production, GDP) would also be needed.

¹⁶ These cover a strategic analysis, a risk analysis, a verification plan, an on-site audit as required, and the issuance of two reports.

¹⁷ MRV of a baseline could include assessment of appropriate baseline calculation methodologies, monitoring methodologies, metrics to express performance and/or values of individual parameters.

¹⁸ Of course, changes could also be measured compared to a base year. However, for many developing countries, such a measure would show an increase, but would not indicate whether such an increase ^{had been lower compared to BAU.}

Figure 1: Measurement needs relating to sectoral emission targets



Source: Authors

There will be some level of uncertainty in quantifying both the baseline projection (whichever baseline is used, which will vary depending on which form of sectoral target is applied), and actual emissions from a sector. This level of uncertainty will vary by country and sector, depending on many factors such as trends in technology/process/fuel, plant age/replacement life, demand growth etc.

For many sectors however, the magnitude of uncertainty in estimating baseline emission projections are likely to be higher than those involved in estimating actual emissions. This is because while estimates of actual emissions may involve uncertainties around emission factors, activity data and sector boundary, projected sectoral emissions (or emission intensity) would – as well as these factors – also need to make explicit or implicit assumptions about the strength and/or implementation efficiency of relevant current or planned policies, technology development/penetration, and also activity data. Uncertainties in projections are likely to be greater for sectors that are growing rapidly, and where the GHG-intensity of production can vary significantly over the period of the baseline projection (either through technology choice, or technology developments)¹⁹. Thus, simple projection methods (such as extrapolating total electricity production or kgCO₂/kWh) can lead to widely different results depending on the reference time-period used (Schneider, 2008). More complex projection methods can also highlight the range in plausible development pathways. For example, different policy and technology assumptions about the Chinese electricity sector could lead to a range of baselines for a “no-lose” target that could vary by approximately 2 billion t CO₂-eq in 2030 (GWEC and Greenpeace 2008).

While it is not possible to eliminate uncertainties from projections, establishing some sort of “best practice” (or agreed methodology) to estimate emission projections would help increase the comparability of such projections. Such an approach would not lead to a single baseline level or intensity for sectors

¹⁹ For example, the Chinese electricity sector has grown very rapidly since 2000, which means that projections made even a few years out have had significant errors. For example, the EIA (2000) projection for 2005 Chinese electricity consumption was 1.5 trillion kWh, whereas actual Chinese electricity generation in 2005 was more than 2.5 trillion kWh (IEA, 2008c). Similarly, technology change is also occurring rapidly in the Chinese electricity sector, with supercritical coal plants starting to be ordered in 2002, and accounting for more than 40% of new orders for plants >200MW in 2004 (Baumgartner 2006). What impact this has had on the CO₂ intensity of electricity production is unclear, however (IEA 2008b) – which also highlights uncertainties in the underlying energy statistics.

across countries as national circumstances still play a large role in choices of technology, fuel, and other factors that affect emissions. Comparability in quantifying a sector's actual emissions could also be achieved if internationally-agreed GHG-calculation methods (e.g. IPCC emission inventory) or standards (e.g. ISO 14064) were used.

3.2.2 Reporting

There are several reporting-related issues that would be raised by implementing sectoral emission targets. These relate to how a sector is defined for the purposes of setting a sectoral target, and whether/how any such sub-sectoral emissions are reported. These issues would apply both to binding and non-binding sectoral targets, as well as to the different potential forms of sectoral targets.

Careful thought will also need to be given to how any reporting of sectoral emissions fits within a wider GHG reporting framework. Thus, given scarce resources, should efforts focus on monitoring and reporting emissions of sectors – even if such sectoral emissions inventories are not compatible with IPCC national inventories? This is illustrated by different estimates of EU27 iron and steel emissions, which vary widely depending on where the boundary of the sector is drawn (Lindroos, 2009).

For example, a sectoral emissions target may be established for only part of a sector (e.g. emissions from installations over a certain size and/or newer installations and/or installations using a particular production process or technology). Defining a sector in such a way (e.g. new iron and steel manufacturing plants with a production capacity over X tons/day, electricity generation facilities with a capacity greater than Y MW) could facilitate developing an emission baseline, as it would mean that data would need to be collected from a smaller number of facilities, and potentially also from a more homogeneous set of facilities (in terms of age, size, efficiency, process type etc). However, defining sectoral baselines for sub-sectors could complicate both reporting and verification if the sectoral target uses a sectoral disaggregation not used in official statistics.

Reporting sub-sectoral emissions may also present challenges. At present, most reporting of emissions is done at either a national level (e.g. using the IPCC inventory guidelines), or at a project level (e.g. using agreed CDM methodologies). Using IPCC guidelines and associated good practice guidance help countries develop a comprehensive national picture of GHG emissions. However, IPCC guidelines are not necessarily well-suited for sectoral emissions inventories. The 2006 guidelines (IPCC 2006) recommend reporting aggregate emissions of some sectors (e.g. energy-related emissions from aluminium production are included with energy-related emissions of “other non-ferrous metals”). Alternatively, emissions from other sectors can be included in several different IPCC sub-categories (e.g. for cement production, which includes process-related emissions, emissions from fossil fuel combustion and emissions from electricity use). Similarly, IPCC methodologies cannot be used to estimate emissions associated with carbon capture and storage, as emissions from pre-combustion processes are included in one category, (along with other unrelated emission sources such as fuel used for coal mining) and emissions from pipeline transport are included in another. If the sectors where any emissions targets are agreed do not correspond exactly with IPCC sectoral categories, some new reporting formats may need to be established.

3.2.3 Verification

Parties' views differ on the role of verification for mitigation actions in non-Annex I countries, in terms of what should be verified (e.g. mitigation actions and/or the results of such actions), how they should be verified, and whether any verification should be undertaken at national or international level (see e.g. UNFCCC 2009).

However, if GHG mitigation actions undertaken at the sectoral level generate carbon credits, independent (e.g. third-party and/or international) verification of their impact is likely to be needed – whether these

targets are binding or non-binding. Such verification may need to include an examination of the boundaries used to monitor and report sectoral actions, in order to ensure consistency within countries, and to avoid double-counting.

4. CDM and/or other crediting mechanisms

The CDM was established by the Kyoto Protocol as a project-based activity, and has since been extended to include “bundles” and “programmes” of activities²⁰. This extension of the CDM to allow multiple activities within the same sector, means that the CDM and possible future sectoral mechanisms may overlap to some extent.

4.1 MRV-related experience with the CDM

Framework provisions for monitoring, reporting and verification of CDM activities were agreed at COP7 (in 2001), and detailed methodologies outlining how to estimate baselines, monitor and report different types of activities have been (and continue to be) developed. More than 120 baseline/monitoring methodologies in many different sectors (including electricity generation, heavy industry, agriculture, waste, forestry) have been approved by the Executive Board of the CDM. There is now a large body of relevant guidance at the project level, and a growing contribution on that front for CDM programmes. Accredited third parties carry out verification of CDM projects.

More than 4500 CDM projects are in the pipeline to date, with more than 1300 of these registered (URC 2009). There is thus already considerable experience with developing baselines as well as monitoring, reporting and verification of some types of GHG mitigation activities in many countries and sectors.

Experience with monitoring, reporting and verification through the CDM can have wider applicability for other types of actions. For example, the Central Electricity Authority (CEA) of India has developed a CO₂ baseline database for the Indian power sector as a tool for CDM project developers to calculate baselines. Plants directly report data to the CEA for the database, which allows calculation of absolute emissions in tonnes of CO₂ and GHG-intensity emissions in tonnes of CO₂ per MWh (CEA, 2008). The information measured and reported for this CDM tool could potentially be expanded and used to monitor power sector emissions trends or as inputs to monitor other power or industrial sector policies and measures. An important insight regarding verification under the CDM is the need for sufficient capacity. A lack of trained auditors has resulted in a significant bottleneck of projects at the verification stage. In this regard, suggestions for reform have been made aimed at steering the CDM verification procedure towards properly managing the risk of overestimating emission reductions, rather than checking the occurrence of every emission reduction (UNEP Risø, 2008).

4.2 Options for future MRV-related provisions

In addition to the CDM, other crediting and/or trading schemes may also be implemented in the post-2012 climate regime. These schemes are currently being designed, so there is no agreed guidance on their MRV provisions to date. Such schemes could focus on a particular sector, such as reducing emissions from deforestation in developing countries (REDD) or designed to be applied to many sectors, e.g. as for the

²⁰ “Programme of activities” (PoA) under the CDM is defined (UNFCCC 2007) as a voluntary coordinated action by a private or public entity which coordinates and implements any policy/measure or stated goal (i.e. incentive schemes and voluntary programmes), which leads to anthropogenic GHG emission reductions or net anthropogenic greenhouse gas removals by sinks that are additional to any that would occur in the absence of the PoA. A list of approved methodologies can be found at <http://cdm.unfccc.int/methodologies/PAMethodologies/index.html>. This page also lists relevant methodological tools that can be applied more widely, such as how to calculate the emissions factor from an electricity system.

different types of sectoral crediting mechanisms (described in section 3.2). The scope of a crediting mechanism can affect how general (or specific) framework guidance will be.

For post-2012 crediting schemes that build on the CDM, the need for international monitoring and reporting of issues related to emission reductions, and for third party verification, is likely to remain. However, significant changes could occur in terms of what is subject to MRV (e.g. whether baseline calculation methodologies need to be reported and approved).

Other types of crediting mechanisms could also be envisaged post-2012. As well as the sectoral targets described above, these could also potentially include technology-based crediting mechanisms. The issue of crediting based on technology objectives is discussed in more detail in a forthcoming paper (Baron, Buchner and Ellis, 2009, forthcoming). MRV-related issues associated with technology-based crediting mechanisms focus on how to establish the link between technology deployment and mitigation without a pre-agreed methodology to do so²¹.

5. Domestic policies and measures or other non-crediting approaches

Domestic policies and measures or other non-crediting approaches to mitigate GHG emissions are widely used in both Annex I and non-Annex I countries. Domestic policies and measures (PAMs) – which (depending on how they are defined) could also include NAMAs - can be established for various purposes, implemented in different sectors and can also take a variety of forms. Many different methods/approaches of measuring, reporting and verifying the effects of domestic GHG mitigation actions are also possible (see Table 1). Such performance metrics could focus on the input (e.g. level of a CO₂ tax or renewable energy incentives), intermediate output (e.g. MW renewable capacity, hectares of forest planted) or GHG outcomes (either in terms of GHG emission levels, or GHG emission reductions) of such PAMs.

²¹ If there was a pre-agreed methodology, this mechanism would be very similar to the CDM or to sectoral crediting mechanisms currently under discussion.

Table 3: Examples of different types of PAMs and associated non-GHG metrics

Type of PAM	Example	Monitoring/reporting metric	Type of metric
General economic/fiscal measures	Phasing out subsidies	Date and/or subsidy amount; change in consumption of subsidised energy	Input, Intermediate output
	CO ₂ tax	\$/t CO ₂ ; evolution of tax revenues for the taxed products	Input, Intermediate output
Targeted economic/fiscal measures	Landfill tax	\$/t landfill, m ³ CH ₄ collected	Input, GHG Outcome
	Feed-in tariffs for renewables	\$/MWh; MW installed capacity; MWh generated	Input, Intermediate output
Regulations/standards	Appliance standards	Energy consumption standards; X% of appliances on market meeting new standards	Input, Intermediate output
	Electricity market regulations	MW installed capacity; %RES in production	
	Biofuel standards	X% biofuel/litre	
Market-based measures	Green certificates (renewables)	\$/certificate; GWh produced	Input, Intermediate output
	Emissions trading	t CO ₂ -eq (emitted, not reduced)	GHG Outcome
Industry/sector agreements	Performance standards	GJ/t cement, PFC emissions per tonne of aluminium - X% emissions of Y/t production	Intermediate output
Goals/targets	Increased forested area	Hectares forest land	Intermediate output
Information, education, capacity development	Public awareness campaigns	Number of requests for funding/tools/information; hits on sites; actual expenditures	Input, Intermediate output
	Capacity for implementing agents	Number of researchers (etc); funding	
R,D&D	R&D for low-C technologies Demonstration/pilot projects	\$/; number of patents Number of projects; Funding leveraged; Project-specific metric (MW; emissions)	Input, Intermediate output

Source: Authors

5.1 Current MRV-related experience

There is significant experience with monitoring and reporting GHG-mitigation PAMs in both developed and developing countries. However, reports of GHG mitigation actions are generally illustrative, rather than comprehensive²². Moreover, some reports of GHG mitigation actions are not quantified, or are quantified in non-GHG terms.

²² Current reporting guidelines do not require either Annex I or non-Annex I countries to report a comprehensive list of GHG mitigation policies and measures.

5.1.1 Measurability

The UNFCCC review of Annex I countries' 4th National Communication refers to more than 1,000 GHG mitigation policies and measures (UNFCCC, 2007d). Some of these actions are easier to quantify than others. Indeed, many individual policies and measures are not quantified (e.g. Japan and Belgium do not quantify the expected GHG effects of their PAMs²³). This is consistent with current reporting requirements on GHG mitigation actions in Annex I countries which requests ("should include, as appropriate"), but does not require ("shall"), quantitative estimates of individual or collections of policies and measures in countries' National Communications. This non-requirement to quantify the effects of individual policies and measures highlights the difficulty in doing so.

Fransen *et al.* (2008) outline some of the many ways that current GHG mitigation actions in selected non-Annex I countries are monitored. The most frequently used method/approach for monitoring PAMs in these NAI countries is the sector-specific impact of the policy in non-GHG terms, e.g. level of improved energy efficiency in China (see discussion in box 2), deforestation rates in Brazil, capacity of renewable electricity generation in India.

The same variety in the measurement and monitoring of PAMs is seen in Annex I countries. For example, the Keidanren voluntary industry agreements in Japan monitor progress in terms of reductions in CO₂ emissions, or energy savings. Other actions such as building regulations or building energy performance certificates are measured in terms of the percentage of new build complying with the regulations or number of certificates issued (IEA, 2008d). In Germany, a preferential loan programme for energy efficiency housing renovations reports the amount of funding disbursed and the number of applications received and approved. However, evaluations are undertaken to measure the programme's impact in terms of amount of living space improved in m², as well as avoided CO₂ emissions (IEA, 2008e; 2008f). Other programmes are directly measured in terms of CO₂ impacts, such as the UK's Carbon Emissions Reduction Target (CERT), an obligation scheme imposed on energy utilities (IEA, 2008e). Thus, routine estimation of the GHG impact of policies that help to mitigate GHG emissions do not always occur. This is because "translating" a policy, programme or sector-specific impact to quantities of GHG mitigation is not always straightforward, and is one of the reasons why quantifying the GHG impact of individual PAMs is not required (either for Annex I or non-Annex I countries) under the monitoring and reporting provisions of the Kyoto Protocol. Nevertheless, there is growing guidance on how to quantify the GHG impact of different actions at the programme and project level (e.g. CDM methodologies, national programme evaluations). There is also guidance on estimating actual emissions at the company level (see e.g. WBCSD/WRI 2001, and ISO standard 14064s). Although not strictly applicable from one scale (project, company) to the next, this body of work could be of use in establishing appropriate methods to measure emissions for the perimeter of various PAMs.

In terms of monitoring provisions, the Dutch LTA (see Box 1) provided monitoring guidelines at the outset of the programme. These vary according to industry, and require detailed data on energy consumption for different types of final and intermediate products. In the Chinese Top-1000 Entreprises programme (see Box 2), a generic reporting spreadsheet is used for all plants. Energy savings are calculated using unit energy consumption for 36 products covering nine sectors, as opposed to the LTA programme, where twelve products are covered in the steel sector alone (op cit. Price, Wang and Yun, 2008). In the Indian power sector (see Box 3), producers are required to submit a large number of reporting formats to the Central Electricity Authority. While the system is currently not optimised – since some reports are sent in by fax – an online reporting system is under development (Sachdev, 2009).

²³ Countries' 4th National Communications can be downloaded from http://unfccc.int/national_reports/annex_i_natcom/submitted_natcom/items/3625.php.

Box 1 - Netherlands: Voluntary long-term agreements (LTA) with industry

These agreements, undertaken by the Ministry of Economic Affairs, establish energy efficiency targets by sector and by company within each sector, through agreements with industry association bodies. These are based on sector-specific energy-efficiency potential studies, following which an inventory of economically-viable measures that could be implemented by the companies was established. These studies set a target for energy-efficiency improvement for each sector (Nuijen and Booij, 2002). Both quantitative and qualitative energy-efficiency measures to be undertaken are outlined in the agreement by the sector industry association body. The Dutch government supports this exercise by providing expertise to help draft the energy efficiency investment plans, as well as a knowledge infrastructure through information and research on energy efficiency measures in the various sectors.

The Dutch LTA system is based on energy management systems guided by environmental management standards such as ISO 14001 and the upcoming European standard prEN 16001. This requires each company to establish an energy efficiency target and develop and implement an energy efficiency plan. These are verified by a government energy agency, SenterNovem. A monitoring and energy management protocol is also developed to guide and facilitate this process. Energy use is monitored on an individual company basis. Following this, the company must submit yearly reports meeting specific reporting protocol requirements that are also verified. (SenterNovem, 2001).

Box 2 - China: Top-1000 Energy-Consuming Enterprises Programme

One of the key initiatives established to meet China's energy efficiency target is the Top-1000 Energy-Consuming Enterprises Programme, which has set energy-saving targets for China's 1000 highest energy-consuming enterprises. The programme was launched in April 2006 by a variety of government bodies through the issuance of a notice and implementation plan. The programme's target is to save 100 Mtce (70 Mtoe) during the 2006-10 period.

The industries selected for the Top-1000 programme cover a variety of sectors. Enterprises must: establish an energy conservation organisation, formulate energy efficiency goals, establish an energy-use reporting system, undertake energy audits, conduct training, develop an energy conservation plan, adopt energy conservation incentives and invest in energy efficiency improvements. The programme has established monitoring and reporting requirements and some guidance in the form of training workshops and manuals. Some of the reporting is undertaken by local governments, such as the energy audits and action plans.

The National Bureau of Statistics (NBS) is responsible for gathering data from the enterprises; companies must report their energy consumption by fuel source quarterly, using a generic spreadsheet online via a website. Based on statistics submitted to the NBS, the Programme achieved savings of 20 Mtce (14 Mtoe) in 2006, with total savings up to the first quarter of 2007 of 28 Mtce (19.6 Mtoe). If savings continue at the 2007 rate, the Programme will exceed the target.

Box 3 - India: Reporting requirements for the electricity sector

There are several national and State-wide bodies, as well as state and private companies, involved in electricity generation in India. However, data is collected centrally, by the Central Electricity Authority (CEA). The CEA is empowered to collect and record data on the generation, transmission, trading, distribution and utilisation of electricity. Power plants, captive units and industries consuming electricity at high and extra high voltages regularly report data to the CEA. 65 different types of data are reported for plants over 1MW, 28 of which relate to GHG emissions, including generation, generation capacity, fuel consumption, losses and fuel supply. Thermal, nuclear and hydro plant data are also regularly reported. Some of these reports are annual, others are monthly or even daily. Many reports are publicly available on the CEA website (www.cea.nic.in). The Ministry of New and Renewable Energy (MNRE) is responsible for compiling data on electricity generated from renewable energy sources.

Various measures are currently underway to improve the reporting and monitoring system, including better coverage of renewable sources of energy and the establishment of an on-line reporting system. While reporting requirements are relatively robust, verification does not always take place.

As part of an Indo-German energy co-operation programme, data on the thermal efficiencies of power plants is being developed. This information is included in a CO₂ emission database, which is publicly available on the CEA website, and which includes plant-specific information on absolute (t CO₂) and relative (CO₂/MWh) emissions in the Indian electricity sector.

Overall there is much data regularly reported and collected on the power sector, which is important given the sector's contribution to India's overall GHG emissions. Based on the data collected, the Indian government has been able to track a reduction in average GHG intensity in electricity production, from 0.85 t CO₂/MWh in 2002-03 to 0.79 t CO₂/MWh in 2007-08.

Source: Sachdev, 2009

5.1.2 Reporting

The Kyoto Protocol established reporting requirements for GHG mitigation actions. However, because commitments under the Kyoto Protocol are expressed in terms of national emissions limits, the focus of monitoring, reporting and review under the Protocol are on these, rather than on policies and measures. Thus, countries are not currently required to provide a comprehensive, quantified estimate of the effects of individual GHG policies and measures (Ellis and Larsen, 2008). Rather, Annex I countries' reporting of GHG mitigation policies in their National Communications "should give priority to policies and measures, or combinations of policies and measures, which have the most significant impact in affecting GHG emissions and removals and may also indicate those which are innovative and/or effectively replicable by other Parties of Annex I countries" (UNFCCC, 2000). The substance and frequency of reports of GHG mitigation actions required in non-Annex I countries are different from Annex I countries, with reports being more irregular (most non-Annex I countries have only submitted one National Communication to date, although many countries are preparing their 2nd National Communication).

Under the Montreal Protocol, developing country parties are subject to the same provisions as developed country parties, though with longer phase-out schedules for ozone depleting substances (ODS), and thus to the same reporting requirements. This involves annual reporting of data on production, destruction, imports and exports of controlled substances as well as trade with non-parties. In addition various MOP decisions

result in the reporting of additional information, such as measures taken to regulate import and export of certain products and equipment or the essential use of controlled substances. Instructions are provided for filling in the questionnaires and data reporting forms, specifying units to be used and elements to be included or excluded (UNEP, 2008).

In addition to official reports to the UNFCCC, which are prepared according to agreed guidelines, several non-Annex I countries have recently published national climate plans. Some of these plans include quantified estimates of the effects of some policies and measures undertaken. For example, the Chinese National Climate Change Programme (NDRC 2007) includes the estimated GHG impact of policies and activities in forest management, avoided deforestation, afforestation and the use of renewable energy sources.

While the companies under the Dutch LTA do not measure GHG emissions reductions, they are required to report estimates of such reductions – based on measured energy use and calculated energy savings. Specifically, they report the CO₂ emissions reductions resulting from the implementation of their energy efficiency plans and energy management systems (SenterNovem, 2008). In terms of GHG impacts, the enterprises participating in the Chinese Top-1000 Programme do not submit data on GHG emissions, nor were these calculated in the official Chinese 2007 programme report which only provides analysis of energy consumption (NDRC and NBS, 2007).

However, governments have sometimes identified lack of capacity as a barrier to monitoring, reporting and verifying the effects of policies and measures. For example, provisions in Chile's National Climate Change Action Plan (GoC, 2008) announced in December 2008 seek to develop robust measurement and monitoring capacities. Under the plan, there would be improved quantification of the GHG mitigation outcomes of GHG mitigation policies, including energy efficiency measures. In order to achieve this, the Plan outlines initiatives to update Chile's GHG inventory (both energy and non-energy), and to monitor actual emissions as well as estimate the projected baseline. Much of the Plan outlines capacity development activities; if achieved, these could allow Chile to provide information on GHG emissions and/or quantify the GHG impacts of mitigation actions at the sectoral and national levels.

Capacity building for monitoring and reporting, as well as verifying the effects of policies and measures, can also involve developing technical capacity and human resources. For example, one of the major challenges faced by Chile's energy efficiency plan (PPEE) and associated measures is the lack of consultants to undertake studies to determine energy efficiency potential and the impact of policies. In addition, public tenders launched as part of the PPEE do not always have proponents due to the lack of technical capacity and trained energy managers – those often responsible for any measuring and reporting provisions established by policies (Jacques, 2008).

5.1.3 Verification

At present, there is little international verification of GHG mitigation policies and measures. Some verification-type activity takes place for Annex I countries, i.e. as part of the review of their National Communications. However, this review does not require a quantification of the effects of individual policies (either in terms of GHG, or in other terms). An estimation of the total effect of policies and measures in terms of GHG emissions avoided or sequestered is required, and must be included in Annex I countries' emissions projections. Reviewers also encourage provision of a quantitative estimate of the impacts of policies and measures in Annex I National Communications.

Non-Annex I National Communications are not subject to review or verification. However, if policies and measures in non-Annex I countries are submitted as CDM programmes of activities (PoA), they will be

subject to verification in the same manner as other CDM project activities²⁴. In terms of the type of GHG mitigation actions undertaken, there is therefore a potentially large overlap between policies and measures that a country could undertake without requesting credits, (e.g. nationally appropriate mitigation actions) and measures that a country could submit as a CDM PoA.

Some countries do undertake national-level verifications of GHG mitigation actions. For example, annual reports submitted by companies under the Dutch LTA programme are submitted to an independent third party for verification (UNIDO, 2007). However, data reported quarterly by companies in the Chinese Top-1000 Programme are not externally verified.

Under the Montreal Protocol, there is no formal procedure for verifying the accuracy of submitted data. In practice, developing country parties that consume below a certain threshold level of CFCs and halons (known as Article 5 parties) receive financial assistance with phase-out of ozone depleting substances (ODS), and thus work together with implementing agencies in collecting and reporting data. Any inconsistencies or unexplained deviations with obligations in the data are reported to the Implementation Committee, which can instigate non-compliance procedures. Atmospheric concentrations of ODS are also measured, and while these are not country-specific, their consistency with reported production and estimated emissions is checked (Brack, 2003).

5.2 Options for post-2012 MRV of PAMs

The Bali Action Plan indicates that GHG mitigation actions need to be “measurable, reportable and verifiable”. It does not stipulate that GHG mitigation actions actually all need to be measured, reported and verified or that this needs to be done in terms of GHG emissions (i.e. outcomes). How post-2012 MRV of PAMs (and/or NAMAs) should occur, and whether MRV provisions should allow for different types of reporting for different actions/by different countries as a transition while building capacity, is therefore an open question. Decisions will also be needed on whether MRV provisions of such PAMs or NAMAs should vary depending on whether they have been undertaken unilaterally, or with the support of finance, technology or capacity building.

5.2.1 Measurability

For countries who do not take on quantified emissions targets, post-2012 MRV provisions could potentially focus on collecting qualitative information about what is being undertaken (e.g. information on inputs and/or intermediate outputs) - rather than focusing on the (emissions) outcomes of such actions. As outlined in section 1, collecting qualitative information on GHG mitigation actions could be an aim of post-2012 MRV provisions. The interim report on performance indicators developed by the Expert Group on Technology Transfer (EGTT) for the Subsidiary Body on Implementation (SBI) refers to such indicators as “descriptive” indicators (UNFCCC, 2008d).

The advantage of establishing a qualitative MRV provision is that it would be relatively simple to put in place: each country could indicate all or some the GHG mitigation actions that it is implementing. This information could be collated in a database or registry²⁵ that outlined the country; description/type of action and implementation status. As GHG mitigation policies are typically implemented for several years, annual updating of such a qualitative database would not be needed. MRV in such a system would focus on reporting and verifying what PAMs have been implemented, rather than on the impact of these PAMs. Such a system could increase the comprehensiveness of information on mitigation actions undertaken across different countries, and could also help in building trust that countries are implementing any PAMs agreed to.

²⁴ However, at the time of writing this report, no PoA had yet been verified.

²⁵ Some non-Annex I countries have already suggested the idea of a registry of GHG mitigation actions.

The International Energy Agency's (IEA) qualitative database of climate change mitigation PAMs undertaken in its member countries can provide an example of how such information could be collated. The database classifies information by country, type of action, sector, year and implementation status. The information is reviewed and supplemented by IEA member countries up to twice a year, and updated for changes in implementation status or policy design. Countries use a standardised reporting template specifying the information to be provided. Long-running policies are ideally updated to account for changes in funding levels and to include information on impacts of policies where available, though these are not always measured and reported in GHG terms. The information provided is not verified by a third party, though it can be cross-checked with information from other sources. Reporting on outputs or outcomes is not required at present.

The disadvantages of focusing on qualitative description of GHG mitigation actions would be that such a description would not give any indication of the global GHG impact of actions undertaken. Nor would a qualitative database be able to highlight the relative efforts undertaken by different countries. Any focus on a qualitative description may need to ensure that it can distinguish between actions enforced, and those not enforced.

Section 5 above highlights that many individual GHG-mitigation measures in non-Annex I, and also in Annex I countries, may not be routinely measured in terms of their GHG impact. Post-2012 MRV of GHG mitigation actions could therefore also be based on non-GHG metrics. The advantages of quantifying actions (even if done in non-GHG terms) is that the necessary monitoring and reporting provisions could be included in the implementation of measures themselves and so may not necessarily add to monitoring costs. Further, some of this information on non-GHG impacts could be "translated" to GHG mitigation in a fairly straightforward manner (e.g. for renewable energy use, energy savings). Such information could therefore help to identify the magnitude of different countries' GHG mitigation actions. The process of reporting an action's impacts in non-GHG terms, or even just qualitative terms, could thus still hold some value for capacity-building, and potentially also international recognition of actions, particularly in non-Annex I countries. The disadvantage of measuring, reporting and verifying GHG mitigation actions in non-GHG terms is that the magnitude of such actions' impact on emissions would not always be clear, if reported in terms which cannot be easily mapped to GHG emission reductions (e.g. expenditure on R&D; reduction in subsidy levels etc). Further, it would not necessarily be easy to compare the relative effort of different countries' actions if the effect of similar actions were reported on using different metrics²⁶.

While quantifying the GHG impact of individual actions could be complex, it can be useful and may be undertaken for national-level policy evaluation. For example the Dutch LTA programme exceeded its 20% energy efficiency improvement target between 1989 and 2000, achieving a 22.3% improvement, although CO₂ emissions for the sectors covered by the LTA actually increased (Nuijen and Booij, 2002). Being able to quantify the GHG impacts of actions thus also allows for an assessment of an individual policy's effectiveness in terms of GHG mitigation, and can help identify what are driving GHG emissions trends.

5.2.2 Reporting

Significant changes will be needed in countries' reporting of GHG mitigation policies post-2012 if enhanced GHG mitigation actions focus on PAMs (rather than e.g. national emissions limits). Some proposals for a centralised "registry" of GHG actions have already been made (e.g. UNFCCC 2008, Republic of Korea, 2009). Key questions surrounding such a registry are whether reporting should be mandatory or voluntary; whether any registry should include a list of actions, or also estimate the effect of

²⁶ For example the interim report to SBI of the EGTT indicates that there are more than 160 possible indicators to assess technology transfer (UNFCCC 2008c). This is interesting! Suggest put up in main text.

such actions; whether similar types of actions should be reported in a similar way (e.g. using the same metrics); whether reporting of non-Annex I actions should include all actions, or only those supported through technology, finance and capacity building.

5.2.3 Verification

Verification of non-Annex I countries' GHG mitigation actions in the post-2012 climate regime is a contentious issue in terms of what is verified and by whom. Recent submissions show that current positions are wide apart, with India indicating that it does not view the verification process foreseen in paragraph 1 (b) (ii) of the BAP applying to mitigation actions of developing countries other than those implemented under a contractual agreement between a developing country and a developed country (or a UNFCCC financial entity), whereas countries such as AOSIS and South Africa indicate that nationally appropriate mitigation actions (NAMAs) could be subject to verification in some countries, potentially according to international guidelines (UNFCCC, 2008a). Korea echoes this latter position in its February 2009 submission on a NAMAs registry (Republic of Korea, 2009), which indicates that NAMAs that have been supported should be subject to MRV provisions that have been agreed between developed and developing countries.

6. How could MRV requirements evolve by type of GHG mitigation action?

As highlighted above, different types of GHG mitigation actions and commitments will vary in the ease and accuracy with which their GHG outcome and/or other impacts can be estimated. This is illustrated in Figure 2 below.

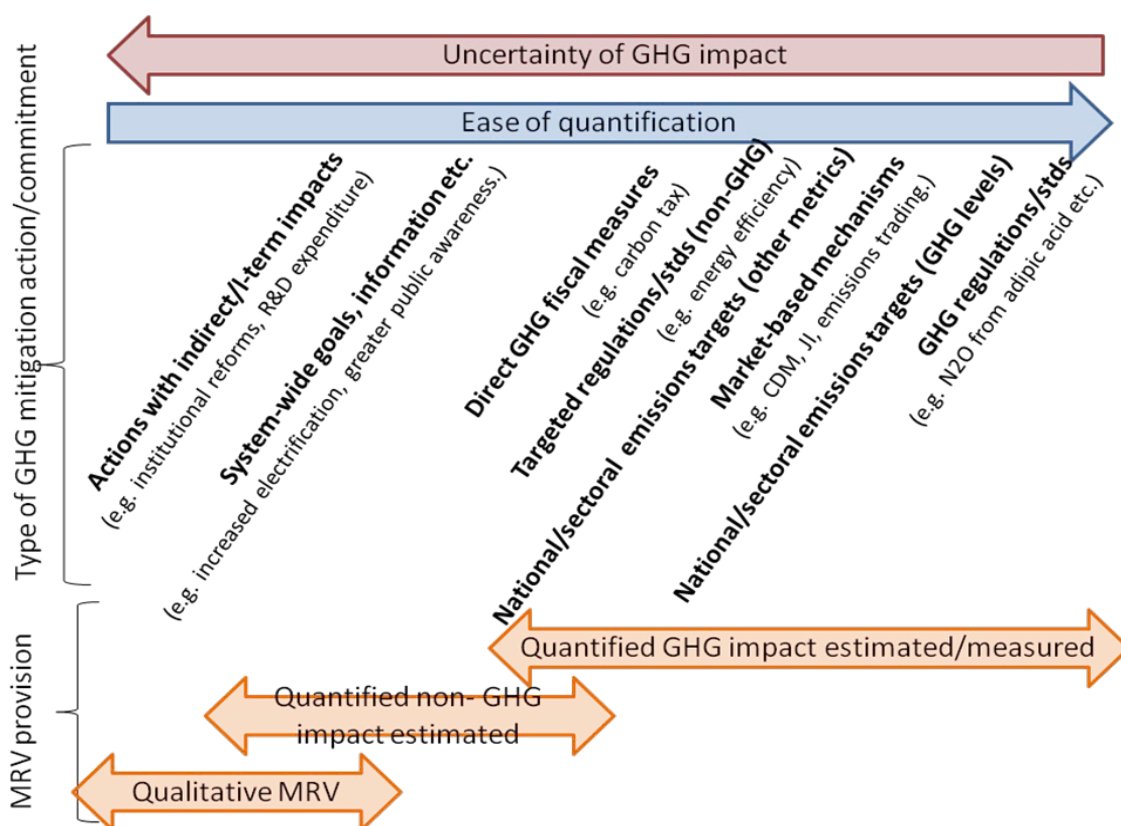
For example, the GHG outcome of some types of policy or measure could be measured relatively easily. This would include measures involving the capture and destruction of a waste gas (such as methane from landfills). The cost of such measurement would not necessarily be significant, if measurement could be automated and/or was to be carried out anyway for other purposes. The outcome of other GHG-specific regulations or standards (such as requirements to fit coal-fired power stations with carbon capture and storage, CCS) could also be quantified in GHG terms – both in terms of absolute emission levels, and emission reductions. The GHG impact of several other types of GHG mitigation action (e.g. actions increasing the deployment of renewable energies) can also be quantified in energy terms, and then “translated” to GHG.

GHG emission levels, and progress towards national emission targets can also be estimated – as is being done under the Kyoto Protocol for Annex I countries. Such targets can allow for measurement, reporting and verification of emission levels (but not the emission reductions generated by such targets). Relative GHG targets (e.g. GHG/GDP) could also be quantified. As noted above, developing and applying the national inventory system needed to estimate national emission levels can be a considerable undertaking in terms of time and resources. Emission reductions and emission levels can also be estimated for the project-based mechanisms, such as CDM – although there are uncertainties associated both with calculating the baseline and assessing a project's additionality. Emission levels (but not emission reductions) are also estimated as an integral part of emission trading systems.

Other types of GHG mitigation measures may be more difficult to quantify in terms of GHG emission levels (or GHG emission reductions). This is particularly true for PAMs that affect a large number of actors (e.g. measures that affect the demand for road transport), where impacts may be indirect and/or occur after a considerable time-lag (e.g. for R&D), and/or where feedback or effects from other sources can be important (e.g. energy efficiency measures). Thus, while the GHG impact of some mitigation actions such as a carbon tax could be estimated/monitored, they could not be measured. Estimating the

GHG outcome of actions where the intermediate output could be monitored relatively accurately could also be subject to significant uncertainty. Thus, while protocols have been established to estimate the energy savings results of certain energy efficiency measures, “translating” these into GHG mitigation is not necessarily straightforward (although this can be done, as is illustrated by the development of CDM methodologies to estimate the impact of energy efficiency actions). The impact of such GHG mitigation actions would not need to be quantified if they were undertaken in some circumstances, for example as part of efforts to meet a national emissions cap, since only overall emissions would need to be measured and monitored. However, if GHG mitigation measures were focused on a collection of such bottom-up actions in the absence of a top-down cap, some sort of measurement, reporting and verification would be needed – and careful consideration would be needed as to how best this should be done (such as in GHG or other terms).

Figure 2: Evolving MRV requirements for GHG mitigation actions and commitments



Source: Authors

Since the ease by which different types of GHG mitigation actions can be measured/monitored and reported differs, one option for a future MRV framework would be to have different MRV requirements for different types of GHG mitigation actions and commitments. Thus, MRV of different GHG mitigation actions could vary in terms of:

- What is measured, reported and verified (e.g. whether MRV focuses on estimating emission reductions, emission levels, technology deployment, energy savings etc...) and at what scale (national, sector, policy, project);
- How MRV occurs;

- Who undertakes verification.

Different MRV provisions would also have different implications regarding the capacity needed to implement them (Table 4). This means that there could be a time lag between deciding to implement a particular type of GHG mitigation action and associated MRV provisions, and actually being able to implement such a provision. Such resource constraints could be important at the country level (e.g. in establishing national emissions inventories), but also at other levels. For example, the limited number of accredited, independent auditors for CDM projects means that there can be significant delays in verifying the emission reduction achievements of particular projects. What needs to be verified will therefore also influence capacity needs for verification: the more disaggregated the level of GHG mitigation that needs verifying (e.g. at the level of a particular project or action), the greater the numbers of verification that will need to occur, and therefore the higher the overall capacity requirements.

The achievements and transparency/comparability of a MRV system can also vary significantly (Tables 1 and 4). For example, a MRV system set up to focus on national emissions targets would – if extended to major emitters as well as Annex I countries - allow for a more comprehensive picture of global GHG emission trends. It would also provide results that could easily be compared, as all reports would be in the same unit (t CO₂-eq)²⁷. In addition, it could remove the need for MRV at an individual policy level, and its associated difficulties. In contrast, establishing a MRV system that focused on countries' implementation of GHG mitigation policies and measures would generate an qualitative or quantitative overview on GHG mitigation actions, but this would not necessarily be in a comparable or transparent format if countries reported the impact of different actions in different ways. The type of action/commitment may also influence verification provisions. For example, if over-achievement of a national or sectoral target generates carbon credits, the environmental integrity of these credits would require 3rd-party verification – rather than national-level verification (A system that allowed crediting without 3rd-party verification of emission baselines and emission reductions - or alternatively, discounting of credits - would not rate high in terms of environmental integrity).

²⁷ While such a system would allow for easy comparison of absolute emission levels across countries, it would not necessarily provide a good estimate of the comparability of different countries' efforts in GHG mitigation.

Table 4: Possible evolution of MRV provisions and associated results of an MRV system for different types of action/commitment

Action/ commit- ment type	Need for baseline?	Monitoring/ measurement and reporting	Verification	Additional capacity requirements		Achievements of MRV system
				Annex I	Non-Annex I	
National emissions targets (GHG levels)	No	Yes. Outcome, i.e. emission <u>levels</u> . Much guidance already available.	Yes.	L	H	Would allow for a more comprehensive picture of GHG emission trends (particularly if larger NAI countries included)
National emissions targets (other forms)	Yes/No (depending on how target is expressed)	Yes. Outcome, e.g. emission <u>reduction</u> , emission intensity; or Input, e.g. funding for GHG mitigation	Yes	L-M	M-H	Quantitative (but not always comparable) indication of countries' actions.
Sectoral emissions targets	Yes/No (depending how target is expressed)	Yes. Outcome (or intermediate output). Some guidance available. Decisions needed on whether M&R should use IPCC or other formats designed specially for sectors.	Yes.	M	M-H	Developing a baseline helps highlight mitigation potential (of sector). Would allow for a more comprehensive picture of sectoral emissions trends.
CDM or other crediting mechanis ms.	Yes	Yes. Often all 3 of input, intermediate output and outcome	Yes. Independent verification of both baseline and emissions	L	L-H (depends on country and sector, what aspect of PAM is subject to MRV)	Difference between baseline and performance highlights mitigation potential (at project/programme level)
PAMs/ NAMAs (non- credited) (criteria may vary for PAMs that are supported or not)	Yes/No (depending how PAM is expressed)	Yes. Input <u>and/or</u> intermediate output <u>and/or</u> outcome (I, IO, O)	Yes/No. Could be done of I, IO and/or O.	L-M (depending how comprehen- sive reporting is to be)	M-H	Qualitative or quantitative information on GHG mitigation actions. Would not indicate relative efforts nor total contribution of countries.

Source: Authors

7. Conclusions

The Bali Action Plan indicates that GHG mitigation actions need to be measurable, reportable and verifiable. However, it is not yet clear to what actions any MRV provisions will apply or what the broader aim of MRV provisions are.²⁸ The details of such provisions will logically follow answers to these broader framework questions. As a first step, political guidance on what MRV provisions are trying to achieve is necessary to establish such a framework. Details of these provisions will then need to balance what MRV is to achieve with the cost necessary to achieve it.

There are many different types of possible GHG mitigation actions and commitments. These can be top-down commitments, such as the national emission limits under the Kyoto Protocol. Alternatively, they could be bottom-up commitments or actions, at the sector, policy or project level. The impact of different types of GHG mitigation measures can be estimated in terms of input (e.g. level of a CO₂ tax or renewable energy incentives); intermediate output (e.g. MWh of renewable electricity supply, hectares of forest planted) or GHG outcomes (either in terms of GHG emission levels, or GHG emission reductions). As noted in Ellis and Larsen (2008), the effects of some actions that mitigate GHG emissions are particularly difficult to quantify in GHG terms. In addition, some new types of actions may be undertaken post-2012, such as sector no-lose targets. Guidance on MRV provisions for these new types of actions would need to be developed.

Measurement/monitoring and reporting

There is much relevant experience and guidance on which post-2012 MRV provisions could build. This is particularly true regarding measurement/monitoring and reporting of **national GHG emission levels** in Annex I countries. However, more significant reporting of emissions in non-Annex I would be needed in order to generate regular, national emissions inventories. This would also entail significant capacity needs.

There is also increasing experience with monitoring and reporting **sector-based emissions**, both within Annex I countries, and across Annex I and non-Annex I countries. However, unlike national-level emissions, there is no internationally-agreed guidance on how this should be done²⁹. This reduces the consistency and comparability between different estimates of emissions from the same sector. Work on harmonising existing guidance would therefore be useful. Increased guidance on how to measure, report and verify emissions from sectors will be needed post-2012 in order to enable measurement, reporting and verification of some GHG mitigation actions under discussion, such as a sectoral no-lose target. More rigorous MRV procedures are likely to be needed for sectoral approaches that generate tradable carbon credits.

The framework establishing monitoring and reporting for **CDM activities** was established in 2001, and there is increasing experience with applying these requirements. There is therefore significant guidance for project-level (and programme-level) MRV. Whether these activities are of direct use as MRV instruments for possible post-2012 crediting mechanisms is not clear, however.

²⁸ Such a framework could vary from identifying mitigation potential or the GHG mitigation actions that different countries are undertaking, to quantifying the effects of such actions.

²⁹ The National Inventory Guidelines of the IPCC were set up to facilitate calculation of a complete and consistent national emissions inventory. Reporting according to IPCC guidelines, however, renders the separate reporting of sectoral emissions impossible in some cases (e.g. aluminium) and difficult in others (e.g. where a sector's emissions is reported in several sub-categories).

Countries have also gained some experience with monitoring and reporting on the implementation and effects of **GHG mitigation policies and measures**. This monitoring and reporting occurs both at the national and international level. There are detailed guidelines indicating what Annex I countries should report (in terms of GHG emissions and GHG mitigation activities), when they should report it, and how they should make such reports. There are lower international-level monitoring and reporting requirements for non-Annex I countries, but many non-Annex I countries have indicated that they have difficulties to meet these requirements, even with support. There is consequently less standardised information available on national emission levels and GHG mitigation actions in non-Annex I countries. On a national level, best policy practice in Annex I countries aims to integrate monitoring and reporting guidelines directly into the design of a policy or measure. This allows for data collection and measurement of the policy's impact to be conducted more regularly and accurately. Having MRV provisions "built into" GHG mitigation policies and measures (including Nationally Appropriate Mitigation Actions) could be an important capacity-building focus activity in non-Annex I countries, particularly where such actions receive support.

At present, routine estimation of the GHG outcomes of policies that help to mitigate GHG emissions does not always occur, either in Annex I or non-Annex I countries. This is consistent with current guidelines for Annex I National Communications, which request, but do not require, quantified estimates of the impacts of individual GHG mitigation measures in Annex I countries. If more widespread and/or more regular monitoring and reporting of such actions (or indeed, national emission levels) were to be required under a post-2012 climate regime, it could have considerable resource implications, especially for non-Annex I countries – particularly if monitoring and reporting was to be done in terms of the GHG outcome of actions. However, national-level monitoring and reporting of information relevant to GHG-mitigation actions is already occurring in some non-Annex I countries as part of the policy-making process. This information is, however, not reported in a standardised manner, nor necessarily in terms of GHG emissions (or emission reductions), nor in a common language³⁰. For example, the Chinese top-1000 Energy-Consuming Enterprises Programme reports information in terms of energy savings. Using a single unit or metric to report on the impact of GHG mitigation actions would enhance transparency between reports from different countries/sectors, and enable different countries' actions to be more easily compared with one another. This could enhance recognition of GHG mitigation actions that are already being undertaken in non-Annex I countries. However, quantifying - and verifying - the GHG impacts of some types of actions (such as institutional reform or expenditure on R&D) could be extremely challenging.

Verification

Experience relating to verification or review of GHG emissions or mitigation actions is less widespread. There are therefore fewer precedents and/or experience on which to build a post-2012 verification framework for climate actions.

For Annex I countries, an independent, international expert review team reviews countries' National Communications, which includes descriptions of GHG mitigation actions and an overall estimation of their impacts. The emissions inventories of Annex I countries are also reviewed by a similar type of review team. National-level evaluations, reviews or verification are also undertaken of particular policies in some countries.

Under the current climate regime, however, there is no international review or verification of national GHG emissions or GHG mitigation actions in non-Annex I countries. In contrast, CDM activities (i.e. activities undertaken at the project or programme level) are subject to international verification by

³⁰ Annex I National Communications need to be submitted in an official UN language and should be translated in English, and information on CDM projects is also submitted in English (project design document, validation/verification reports etc.).

accredited companies. Capacity limitations of accredited verifiers under the CDM has led to a bottleneck in verifying CDM activities.

Looking forward

For a post-2012 climate regime, a MRV system could be established to measure, report and verify different types of actions in different ways. Countries may need to agree on the following issues:

- **General:** Should MRV-related provisions differ depending on whether a particular type of action is binding or non-binding, and/or whether the action has been supported by technology, finance and capacity building? When emission reductions (not emission levels) from a mitigation action are quantified, should any M, R and/or V provisions also relate to the establishment of a baseline, or just to the estimate of performance? Should MRV provisions focus on GHG outcomes, or also include inputs and/or intermediate outputs of actions (i.e. in non-GHG terms)?
- **On measurement:** countries could agree to guidelines, rules and/or best practices to be followed when estimating the impacts of measures that mitigate GHG emissions. Agreement will also be needed on whether measurement/monitoring requirements should vary, e.g. according to type of action. Alternatively, country and action-specific estimation methodologies and processes could be used.
- **On reporting:** countries could agree to a common reporting format, and/or common reporting guidelines outlining how actions are reported, e.g. which language, what units, what timing, where reports are collated/collected, what should be reported, and/or when reporting should take place.
- **On verification:** agreement will be needed on who the verification body or bodies (national or international) is/are; what the verification process should be (e.g. national or international guidance), how results should be reported, and how to make any needed adjustments in reports of GHG mitigation. Agreement will also be needed on whether any verification issues should lead to consequences for the reporting country.

Different potential MRV provisions have advantages and disadvantages. For example, focusing on qualitative description of GHG mitigation actions would not give any indication of the global GHG impact of actions undertaken, nor would it be able to highlight the relative efforts undertaken by different countries. In contrast, creating a quantitative MRV system that generates a comprehensive picture of global emissions would help identify emission trends and progress towards any global emissions goal – but could take significant resources to set up.

The MRV system will be an important part of the post-2012 climate regime. Its development will follow, rather than lead, decisions on other aspects of the post-2012 framework (such as type of action/commitment). In deciding a MRV framework, it will be important to consider measurement, reporting and verification issues separately (as e.g. some non-supported actions may be reported but not verified). Care will be needed in order to balance environmental accuracy with economic and institutional constraints. This may require more up-front consideration of the type of MRV provisions required for different types of GHG mitigation actions, as well as integrating such provisions into the implementation plans for such actions. Further, if MRV is done in non-GHG terms, the choice of possible metric(s) will be wide – so it will be important that these metric(s) are now, and remain, appropriate indicators to assess GHG mitigation efforts and actions.

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Glossary

BAP	Bali Action Plan
CDM	Clean Development Mechanism
CFC	Chlorofluorocarbon
CH ₄	Methane
CO ₂	Carbon dioxide
EN	European Standard
GHG	Greenhouse Gas
ISO	International Organisation for Standardisation
KP	Kyoto Protocol
MRR	Monitoring, reporting and review (as laid out in the Kyoto Protocol)
MRV	Measurement, reporting and verification (as laid out in the Bali Action Plan)
MW	Megawatt
ODS	Ozone depleting substances
PAMs	Policies and measures
PFC	Perfluorocarbon
REDD	Reducing emissions from deforestation and degradation
UNFCCC	United Nations Framework Convention on Climate Change

www.oecd.org/env/cc/ccxg.htm

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