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Enhancing Today's MRV Framework to Meet Tomorrow's Needs: The Role of National Communications and Inventories

TARYN FRANSEN

The United Nations Framework Convention on Climate Change employs a system of national communications and greenhouse gas inventories to monitor implementation of the Convention. This analysis examines the strengths and weaknesses of that system in the context of a post-2012 international climate change agreement, considering the Bali Action Plan provisions on measurement, reporting, and verification. It concludes that while the existing system contains elements that can support some parts of a post-2012 framework, a significant retrofit, accompanied by new processes, will be needed to measure, report, and verify the obligations envisioned in the Bali Action Plan.

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I. INTRODUCTION

Parties to the United Nations Framework Convention on Climate Change (UNFCCC) agreed in the Bali Action Plan to consider a set of "measurable, reportable, and verifiable" (MRV) responsibilities: nationally appropriate mitigation commitments or actions by all developed country parties; nationally appropriate mitigation actions (NAMAs) by developing country parties; and technology, finance, and capacity-building support for those actions (see Box 1). These commitments, actions, and support would form the core of parties' mitigation responsibilities under a post-2012 international climate change agreement, and the requirement that they be undertaken in a measurable, reportable, and verifiable manner suggests a level of specificity and significance beyond previous obligations under the UNFCCC. Taken together, measurability, reportability, and verifiability have implications for how obligations are defined, how they are financed and implemented, and how parties evaluate each other's delivery on those obligations, making the concept of MRV a critical source of credibility and effectiveness in a post-2012 agreement.

Neither the nature of the obligations (commitments, actions, and support) nor the nature of MRV is defined explicitly in the Bali Action Plan. As a result, the obligations themselves, and the way in which they will be measured, reported, and verified, are being negotiated in parallel, and have become central and linked themes in parties' submissions to and interventions in the negotiation process. Parties and observers have suggested various approaches to MRV, including creation of a registry to facilitate MRV of actions and support and development of national low-carbon development strategies or plans. The role of international verification and the need toensure MRV of support have also been highlighted, as has the logic in building the post-2012 MRV structure on the foundation of existing national

Box 1 | MRV in the Bali Action Plan

The Bali Action Plan contains the following text related to MRV:

The Conference of the Parties…(1) decides to launch a comprehensive process to enable the full, effective and sustained implementation of the Convention through long-term cooperative action, now, up to and beyond 2012, in order to reach an agreed outcome and adopt a decision at its fifteenth session, by addressing, inter alia:…(b) enhanced national/international action on mitigation of climate change, including, inter alia, consideration of: (i) measurable, reportable and verifiable nationally appropriate mitigation commitments or actions, including quantified emission limitation and reduction objectives, by all developed country Parties, while ensuring the comparability of efforts among them, taking into account differences in their national circumstances; (ii) nationally appropriate mitigation actions by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner.

communication and inventory systems.[1]

As the international community moves toward defining commitments, actions, and support, as well as how they will be measured, reported, and verified, it is worth considering the existing processes related to measurement, reporting, and verification under the UNFCCC and the Kyoto Protocol.[2] This analysis discusses experiences to date with national communications and inventories, evaluates their strengths and weaknesses, and assesses their potential to contribute to implementation of the Convention as envisioned in the Bali Action Plan. First, it defines MRV and describes its role in a post-2012 agreement. Next, it examines the current requirements of Annex I and non-Annex I national communications and inventories – as well as how these requirements are implemented in practice – with a focus on those areas that overlap with the measurable, reportable, and verifiable obligations listed in the Bali Action Plan. It then analyzes the extent to which existing requirements and processes are adequate to achieve post-2012 objectives, and finally, suggests ways in which the existing framework of national communications and inventories might be re-structured to create a system consistent with the vision laid out in the Bali Action Plan.

II. DEFINITIONS AND FUNCTIONS OF MRV

The Bali Action Plan does not define measurable, reportable, or verifiable, but the concepts are used both in the context of climate change and in international law more generally. In general, measurement is understood to refer not only to direct physical measurement, but also to estimation based on indicators. For example, greenhouse gas (GHG) inventories are based on estimates of GHG emissions derived from activity data (such as quantity of fuel burned) multiplied by a GHG emission factor (quantity of GHG per unit activity). While measurement is generally associated with quantification, it can also be based on qualitative metrics, provided that they can be evaluated in an objective manner. Anything that is measurable is, by definition, reportable. However, effectiveness in reporting is generally characterized not only by the existence of reliable measurement data, but also by whether it is reported in a transparent and standardized manner. Finally, verification refers to the independent assessment of the accuracy and reliability of reported information. It does not necessarily imply a political judgment regarding compliance, although it may provide information on which compliance decisions can be based.[3]

In the context of international environmental agreements, verification systems typically serve two sets of objectives: one related to accountability and trust-building, and another related to facilitating implementation.[4] Reaching agreement on a post-2012 climate change policy will hinge on the trust parties have in one another to carry out their obligations, and on their ability to hold one another accountable for doing so. More specifically, parties need confidence that other parties, particularly countries with high levels of greenhouse gas (GHG) emissions, will contribute appropriately to the global mitigation effort. Developing countries need assurance that adequate support will be provided for mitigation efforts they undertake in the context of sustainable

[1] McMahon and Moncel (2009), South Centre (2008), Wyns (2009)
[2] While MRV has become a term of art in the negotiations surrounding a post-2012 agreement, this paper uses MRV to refer to measurement, reporting, and verification more generally.
[3] Breidenrich and Bodansky (2009)
[4] MacFaul (2006)

development, and likewise, countries providing that support must be convinced that it will result in effective mitigation on the ground. Providing this assurance is the accountability function of MRV in a post-2012 agreement.

MRV also has a facilitative role that should not be overlooked. Ideally, the process of measuring and reporting on climate change mitigation and support would catalyze coordination and planning both within and between countries. An MRV framework could also improve the availability of information about the range of actions that countries are taking to mitigate climate change, as well as their impacts and cost-effectiveness, increasing awareness of options and best practices for effective mitigation in the context of sustainable development.[5] Additionally, information provided through the MRV process could facilitate evaluation of the agreement's effectiveness, its strengths, and weaknesses, both by the Conference of the Parties (COP) and by external stakeholders. Finally, MRV could catalyze the matching of mitigation actions proposed by developing countries with finance, technology, and capacity-building support. MRV's facilitative role is perhaps less critical than its accountability role when it comes to reaching an agreement, but it could be instrumental to implementation once an agreement is adopted. These accountability and facilitative roles are summarized in Box 2.

Box 2 | **Functions of the MRV Process**

Accountability Functions

- Enable assessment of developed country progress toward mitigation commitments
- Enable assessment of developed country implementation of mitigation actions
- Enable assessment of developing country implementation of mitigation actions
- Enable assessment of the provision of technology, finance, and capacity-building support (particularly, although not necessarily exclusively, by developed country parties)

Facilitative Functions

- Catalyze coordination and planning on mitigation and support within and between countries
- Facilitate information-sharing on effective mitigation options and their cost within and between countries
- Enhance the ability of the COP to assess the agreement's effectiveness
- Link mitigation actions proposed by developing countries with technology, finance, and capacity-building support

III. THE EXISTING MRV FRAMEWORK: NATIONAL INVENTORIES AND NATIONAL COMMUNICATIONS

The UNFCCC (Articles 4.1 and 12) requires all parties to report on their activities to implement the Convention through national inventories and national communications. National inventories report quantitative information on countries' anthropogenic emissions and removals of greenhouse gases, whereas national communications report on a wider range of activities related to climate change, including policies and measures, vulnerability and adaptation, and research. Under the principle of common but differentiated responsibilities, Annex I and non-Annex I countries have different obligations under the Convention and under the Kyoto Protocol. As such, they are also subject to different reporting requirements. This section characterizes the current national inventory and communication requirements and practices for Annex I and non-Annex I countries, and discusses their relevance to the obligations outlined in the Bali Action Plan.

National Inventories

National inventories summarize countries' anthropogenic GHG emissions and removals in a given year. The UNFCCC requires the submission of inventories by all parties, with different rules for Annex I and non-Annex I parties. The Kyoto Protocol introduces additional requirements for Annex I parties in order to evaluate their compliance with emission reduction targets (see Box 3).

The Intergovernmental Panel on Climate Change (IPCC) has developed an extensive body of guidance for national inventory preparation, including guidelines for quantifying emissions from energy, industrial processes and product use, waste, agriculture, forestry, and other land use. It also provides additional "good practice guidance." IPCC methodologies for each sector are subdivided into tiers, representing different levels of methodological complexity. Tier 1 methodologies rely on national or

[5] Fransen et. al (2008)

international statistics (activity data) in combination with default emission factors to convert activity data into GHG quantities. Tiers 2 and 3 use more complex methodologies and more site- or source-specific emission factors, and are generally assumed to be more accurate than Tier 1. IPCC methodologies are updated from time to time to reflect improvements in scientific knowledge and to address shortcomings of previous versions.

Annex I parties are required to prepare annual inventories in accordance with the IPCC guidelines and good practice guidance described above. They are also required to report inventory information according to a standardized format, including a National Inventory Report (NIR) and a Common Reporting Format (CRF). The NIR provides qualitative information regarding institutional arrangements, processes, methodologies, and other topics that serve to place inventory data in context and enhance transparency and comparability of reported information. The CRF provides a standardized structure for reporting quantitative inventory data.

Annex I inventories are subject to an expert review process. The process consists of three parts: an *initial check* conducted by the secretariat to ensure that complete information is reported in the correct format; a *synthesis and assessment* conducted by the secretariat to facilitate comparison across parties and to flag issues for further review; and finally, an *individual inventory review*. The synthesis and assessment identifies key emission sources, and for each key source compiles methodologies, implied emission factors (and IPCC defaults), and activity data as reported in the inventory and by other authoritative sources (where available), in order to facilitate the individual review. The individual inventory reviews are conducted by international expert review teams selected from a roster of experts who have been nominated by Annex I and non-Annex I parties and who have passed a qualifying exam. By way of a combination of desktop reviews, centralized reviews, and in-country reviews, the expert review team then conducts a more detailed assessment of the CRF and NIR as well as supplementary information submitted by the party.

Box 3 | Methodological Issues, Reporting, and Review under the Kyoto Protocol

Monitoring, reporting, and review under the Kyoto Protocol are based on the national inventory process established under the Convention, but also contain additional provisions necessary to determine compliance. Articles 5, 7, and 8 of the Kyoto Protocol establish a basic framework for monitoring, reporting and review. Article 5 commits Annex I countries to develop national systems for estimating anthropogenic emissions and removals, and provides specifications related to quantification methodologies and global warming potentials. Article 7 requires Annex I parties to submit national inventories and communications on a regular basis, and to include supplementary information demonstrating compliance with the Protocol. Article 8 addresses the expert review process for Annex I communications and inventories.

The Marrakech Accords, adopted in 2005, contain further provisions on accounting, reporting, and review under the Kyoto Protocol. They require Annex I parties to establish a national system (per Article 5 of the Protocol) and a registry to track transactions of Protocol units: Assigned Amount Units (AAUs), Certified Emission Reductions (CERs), Emission Reduction Units (ERUs), and Removal Units (RMUs). They specify accounting decisions that each Annex I party must make prior to each commitment period, and establish a Secretariat accounting database to record parties' emissions and transactions, as well as an independent transaction log, also maintained by the Secretariat.

Furthermore, the Marrakech Accords contain provisions on expert review of Annex I inventories, and charge expert review teams with recommending adjustments to inventories and raising apparent problems with the Compliance Committee.

The scope of the review includes, *inter alia*:

- Assessment of the application of IPCC guidelines and good practice guidance and identification of inconsistencies in key source categories;
- Selection and use of methodologies and assumptions, development and selection of emission factors;
- Collection and selection of activity data;
- Missing sources; and
- Areas for improvement.[6]

Expert review teams can recommend adjustments to the reported information – that is, replacing the country's estimate with a conservative estimate derived by the expert review team – if it is found to

[6] FCCC/CP/2002/8

be inconsistent with agreed methodologies, per Article 5.2 of the Kyoto Protocol. The secretariat has developed e-learning modules and a review manual to train new reviewers and guide the review process; however, reviewer capacity remains problemmatic. Lead reviewers have expressed concern that an insufficient number of experts has been nominated and trained.[7]

In general, the combination of the IPCC methodologies, a comprehensive and standardized reporting format, and regular expert review is widely considered to provide a robust verification process, especially in comparison to those of other international environmental agreements.[8] This does not mean that inventories produced, reported, and reviewed through this process are completely accurate reflections of anthropogenic emissions and removals of greenhouse gases. First, actual emissions are not usually measured directly, but rather are estimated based on activity data and emission factors. Second, the default emission factors used in "lower tier" IPCC methodologies are based on average conditions and may not be representative of conditions in particular facilities or countries. Third, there are additional scientific uncertainties for emissions from some CH_4 and N_2O sources. Finally, inventories are only as accurate as the activity data on which they are based; if accurate activity data is unavailable for certain sources, emissions cannot be accurately quantified. Top-down methods to estimate GHG emissions and removals, such as inverse modeling, would circumvent some of these obstacles, but are not yet accurate or streamlined enough to replace the bottom-up national inventories.[9]

While more can and should be done to improve the accuracy and certainty of Annex I inventories, to bridge the gaps between bottom-up and top-down emission quantification methods, and to strengthen reviewer capacity, the Annex I national inventory system strikes a reasonable balance between the need to prepare credible information, to determine compliance, and to avoid excessive costs associated with monitoring, reporting, and review. Observers note that because Kyoto Protocol targets are framed in percentage terms relative to a base year, and because expert review teams check for consistency between the base year and the reporting period, in general it would be difficult to game the inventory system by selectively reporting favorable data.[10,11]

Non-Annex I parties are also required to prepare national GHG inventories. In contrast to Annex I inventories, which are submitted as stand-alone documents, non-Annex I parties' inventories are submitted as part of their national communications. These are not required on a frequent or uniform basis. Non-Annex I countries are expected to prepare an initial inventory (and national communication) using 1990 or 1994 data and a second national communication using 2000 data. The deadlines for completing these communications depend on when each country receives funding to support its communication. Least Developed Countries (LDCs) may complete inventories and communications at their discretion. For non-Annex I parties, the use of IPCC methodologies is optional – although in practice countries usually use them[12] – and only three of the six gases covered by the Kyoto Protocol are required. No specific reporting format is prescribed, although one is recommended, and inventories are not subject to an expert review process.

To date, 134 out of 150 non-Annex I countries have submitted an initial inventory (and communication); nine[13] have submitted a second, and one (Mexico) has submitted a third. Non-Annex I parties have identified a number of obstacles to preparing their inventories, including lack of activity data (especially for energy, land use change, and forestry, but also for agriculture, waste, and industrial processes); inappropriateness of default emission factors for national circumstances (although more

[7] Conclusions and Recommendations: Sixth Meeting of Lead Reviewers, May 2009, available at www.unfccc.int.
[8] MacFaul (2006)
[9] Rypdal et al. (2005)
[10] Swart et al. (2007)
[11] Accounting modalities for land use, land-use change, and forestry (LULUCF) under the Kyoto Protocol and Marrakech Accords suffer from widely recognized limitations that resulted from a combination of scientific uncertainty and the fact that they were negotiated following the establishment of Annex B targets. See Schlamadinger et al. (2007) for a more complete discussion of this issue.
[12] FCCC/SBI/2005/18/Add.2
[13] Argentina, Kyrgyzstan, Mauritania, Mexico, Korea, Tajikistan, the former Yugoslav Republic of Macedonia, Uruguay, and Uzbekistan.

countries are now developing their own emission factors); and the need for financial and technological support to ensure the continuous collection and archiving of data.[14] (The UNFCCC does not publish a similar summary for obstacles to preparing Annex I inventories.)

Despite these obstacles, and the uncertainty that they imply for information reported in non-Annex I inventories, initial inventories serve as a catalyst for countries to compile emissions information and begin considering their emissions profiles. Ideally, countries would build off of the foundation established by the initial inventory and work toward producing more robust and more frequent inventories. Indeed, there is evidence that the few countries that have submitted multiple inventories often do enhance their subsequent inventories by, for example, including more data and more gases.

However, two major characteristics of the national communication process prevent capacity from being built as effectively and continuously as it might. First, countries receive financing for national communications on a project basis – that is, the Global Environment Facility finances preparation of a single national communication rather than development of an ongoing national communication or inventory program. (See Box 4 for information on financing Mexico's third national communication.) Therefore, countries tend to use the financing to contract experts to prepare inventories (and other sections of the communications) on their behalf; they do not necessarily invest in establishing the data collection and management processes necessary to support future inventories. Because inventories are not prepared on a regular basis, there is not a continuous inventory team to carry knowledge and capacity from inventory to inventory. Second, non-Annex I inventories are not subject to regular expert review. Expert review serves an important capacity-building function by providing feedback on ways to improve the inventory. Non-Annex I countries, for which capacity building has been identified as a key need,[15] do not have access to a regular review process through the Convention.[16]

National inventory requirements for Annex I and non-Annex I countries are summarized in Table 1.

Box 4 | Financing Mexico's Third National Communication

Mexico is the only non-Annex I country to have submitted three national communications. Its national inventory, which includes data on all six Kyoto Protocol gases and a time series from 1990 to 2002, is among the most complete of non-Annex I inventories. Mexico estimates that it cost $1,655,000 to produce its third national communication.[17] This amount was financed as follows:

- $460,000 from United Nations Development Program
- $540,000 from the U.S. Environmental Protection Agency, which supported (1) updates to the national inventory, (2) GIS equipment, and (3) studies on adaptation, co-benefits, and energy efficiency
- $650,000 from the Mexican government, which supported research efforts

These data illustrate several points. First, the cost of preparing a relatively advanced non-Annex I national communication is insignificant compared to the estimated $200B annual investment needed to stabilize and begin to reduce global GHG emissions, and is even relatively modest compared to the $50M biennial budget of the UNFCCC. Second, despite Article 12 of the UNFCCC, which stipulates that developed countries should finance the agreed full cost of developing countries' reporting obligations under the Convention, the Mexican government funded a significant share of the cost of its third communication. Third, some of the bilateral and unilateral support was channeled to inventory infrastructure (i.e., GIS, research efforts), suggesting that multilateral support may not have been adequate to establish this infrastructure.

National Communications

The UNFCCC requires that all parties prepare national communications to report on the activities they are undertaking to implement the Convention. As is the case with national inventories, requirements

[14] FCCC/SBI/2005/18/Add.2

[15] FCCC/SBI/2007/20

[16] The COP has established a Consultative Group of Experts (CGE), the mandate of which includes provision of technical advice on non-Annex I national communications. The CGE executes this mandate through workshops, synthesis of non-Annex I communications, and recommendations to the COP; it does not provide individualized reports on non-Annex I inventories. The CGE is described further in the following section.

[17] INE-SEMARNAT (2006)

for Annex I and non-Annex I communications are different, although the categories of information to be reported are largely the same. These include inventory information (for Annex I, a summary of the inventory, and for non-Annex I, the entire inventory), national circumstances, measures to facilitate mitigation and adaptation, research and systematic observation, education, training, and public awareness. Annex I countries are also required to report on measures undertaken to meet their commitments under UNFCCC Articles 4.3, 4.4, and 4.5 related to financing and technology transfer.

Mitigation: Both Annex I and non-Annex I countries are to report on mitigation activities. Annex I countries must report a standardized set of information on each policy or measure, including its objective, the sector(s) and gas(es) it affects, its type (economic, fiscal, etc.), the status of its implementation, and the implementing entity. They are asked, but not required, to quantify the expected impact of each policy or measure, although there are no standardized methodologies for doing so. They are also asked to project future emissions scenarios both with and without the policies and measures. Countries implement these guidelines in different ways. For example, Japan reports policies and measures contained in its Kyoto Target Achievement Plan, adopted in 2005. It projects emissions with and without policies and measures, but does not estimate the mitigation impact of each policy or measure. It describes the models and assumptions used to project emissions. The United States reports federal policies and measures and lists their estimated GHG impacts where available from the responsible agency, but does not describe the methodology used to quantify impacts. It projects emissions in "business as usual" and "full implementation of climate programs and measures" scenarios, and describes the models and assumptions used to develop the projections.

Non-Annex I countries are asked to report in a general manner on programs containing mitigation measures, and countries have responded to this request very differently. India, for example, in its initial national communication, does not discuss mitigation activities explicitly, but rather describes a set of programs related to sustainable development more generally. On the other hand, Mexico, in its third national communication, presents mitigation activities in five sectors, and estimates emissions avoided as a result of many of them. China, in its first national communication, also describes mitigation activities by sector, but does not quantify their GHG impact.[18]

Support: Annex I countries are required to report information related to their activities undertaken in accordance with Articles 4.3, 4.4, and 4.5 of the Convention, which obligate them to help developing countries prepare national communications and inventories, adapt to adverse effects of climate change, and mitigate emissions, among other things. Major Annex I countries typically report extensive data under this section, including, for example, quantity of financing by country and by sector, along with narratives on programs and projects supported. However, the utility and comparability of this information is limited. Articles 4.3, 4.4, and 4.5 do not frame Annex I obligations in specific, quantitative terms, so there is no agreement on which financing qualifies to meet these obligations and should therefore be reported. National communication reporting guidelines do not effectively clarify this matter. While they require that countries indicate what "new and additional" financial resources they have provided pursuant to Article 4.3, and clarify how they have determined such resources to be "new and additional," national communication review teams have concluded that major Annex I parties, including the European Union, Japan, and the United States, routinely fail to report on how this determination has been made. During the review process, the United States indicated that it considered all funding in any year to be "new and additional." [19]

Review process: Annex I national communications are subject to an "in-depth review," coordinated by the UNFCCC secretariat and conducted by a team of experts from Annex I and non-Annex I countries. The review process serves to summarize and clarify the information reported by parties; it generally

[18] Ministry of Environment and Forests (2004), INE-SEMARNAT (2006), The People's Republic of China (2004)
[19] FCCC/IDR.3/EC (2006), FCCC/IDR.4/JPN (2006), FCCC/IDR.4/USA (2007)

refrains from judging the adequacy of each party's efforts to achieve the objectives of the Convention. Each review results in a review report, which summarizes the information presented in the national communication, comments on the adherence of the information to the UNFCCC guidelines, and suggests ways to improve reporting. Individuals involved in the review process have commented in not-for-attribution interviews that the process is subject to weaknesses: parties at times pressure the review teams to alter the language used in the reports, the Subsidiary Body for Implementation does not consider individual reports, and parties are reluctant to challenge each others' communications for fear of their own communications being challenged.

Consultative Group of Experts: In 1999, the COP established a Consultative Group of Experts (CGE) to facilitate preparation of non-Annex I national communications. The CGE consists of 24 members from Annex I and non-Annex I parties and is organized around four themes: national inventories, vulnerability and adaptation assessments, mitigation, and cross-cutting issues (including research and systematic observation; technology transfer; capacity building; education, training, and public awareness; information and networking; and financial and technical support). The CGE provides technical support to non-Annex I parties in the form of training materials and workshops, and advises the Subsidiary Body for Implementation on ways to improve non-Annex I national communications; it does not publish reviews of individual national communications. The CGE's mandate is renewed and revised periodically by the COP.

Guidelines for Annex I and non-Annex I national communications are outlined in Table 2.

Table 1 | **Summary of Guidelines for Annex I and non-Annex I Inventories**

	Annex I	Non-Annex I
Frequency	[Annual.]	[In conjunction with national communications, as agreed by the COP; least developed countries may complete at their discretion.]
Gases	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6. *CO, NOx, NMVOCs, SOx.*	As appropriate and to the extent possible, provide estimates of CO_2, CH_4, and N_2O on by-gas basis and in units of mass. *As appropriate, provide information on HFCs, PFCs, SF_6, CO, NOx, NMVOCs, SOx.*
Base year and time series	*Include information for all years from the base year to the year of the current annual inventory submission.*[20]	Estimate national GHG inventories for the year 1994 for the initial national communication or alternatively provide data for the year 1990. For the second national communication, estimate national GHG inventories for the year 2000. *LDCs could estimate their national GHG inventories for years at their discretion.*
Methodologies	Use IPCC guidelines and good practice guidance. *Use national methodologies, provided that they are compatible with IPCC guidelines and good practice guidance and are well documented and scientifically based.*	*Use IPCC guidelines.* *Apply good practice guidance.*
Uncertainty	Quantitatively estimate uncertainties for all source and sink categories.	*Provide information on the level of uncertainty associated with inventory data and their underlying assumptions.*
Quality assurance and quality control	Elaborate an inventory QA/QC plan and implement general inventory QC procedures following IPCC good practice guidance.	N/A
Reporting format	[National Inventory Report (NIR) and Common Reporting Format (CRF).]	*Use table specified by guidelines.*
Review process	[Initial check (annual): Conducted by Secretariat to determine whether complete information is presented in the correct format. Synthesis and assessment (annual): Conducted by Secretariat to facilitate comparison and flag issues for further review. Individual review (annual): Conducted by an expert review team selected from a roster of experts who have been nominated by parties and who have passed qualifying exams, to assess conformity of methodologies and data sources with IPCC guidelines/guidance.]	[Secretariat produces a compilation and synthesis, identifying gaps in national communications and inventories as well as problems and capacity-building needs. Consultative Group of Experts has provided feedback and capacity-building for national communications, including inventories.]

Key: Font indicates the strength of the language used to articulate each provision. Regular black font indicates a "shall" item; *italicized black font* indicates "should;" and *italicized grey font* indicates "may," "can," "encouraged to," etc. Brackets indicate that the language has been summarized by the author.

[20] Most countries have a base year of 1990. Exceptions are: Bulgaria, 1988; Hungary, average of 1985 to 1987; Poland, 1988; Romania, 1989; and Slovenia, 1986.

Table 2 | **Summary of Guidelines for Annex I and non-Annex I National Communications**

	Annex I[21]	Non-Annex I[22]
Frequency	[Periodically; dates set by COP: 1994/1995; 1997/1998; after 30 Nov 2001; 1 Jan 2006; 1 Jan 2010.]	[In conjunction with national communications, as agreed by the COP; least developed countries may complete at their discretion.]
Scope	[Inventory, national circumstances, policies and measures, projections and total effect of PAMs, vulnerability and adaptation, financial resources and transfer of technology, research and systematic observation; education, training and public awareness.]	[National inventory of all anthropogenic sources and sinks not controlled by the Montreal Protocol, to the extent capacities permit; general description of steps taken or envisaged to implement UNFCCC; any other information party considers relevant.]
National circumstances	Provide a description of national circumstances and how they affect GHG emissions and removals over time. *Provide information about how national circumstances are relevant to factors affecting GHG emissions and removals, including disaggregated indicators.* *The following headings are recommended: Government structure, population profile, geographic profile, climate profile, economic profile, energy, transportation, industry, waste, building stock/urban structure, agriculture, forest, other.*	*Provide a description of national and regional development priorities, objectives, and circumstances, on the basis of which they will address climate change and its adverse impacts.* *Provide a summary of relevant information in a tabular form.* *Provide a description of existing institutional arrangements relevant to the preparation of national communications on a continuous basis*
Inventory data	[Provide summary of national inventory information.]	[See Table 1.]
Mitigation policies and measures	Communicate information on policies and measures adopted to implement commitments under 4.2a and b. *Prioritize measures with the most significant effect on GHG emissions and removals; clearly distinguish between planning and implementation phases.* Report by sector, subdivided by gas. *Describe overall policy context, including any national targets for GHG mitigation.* Include: name and short description, objectives, gas(es) affected, type(s) of policy or measure (economic, fiscal, voluntary/negotiated agreements, regulatory, information, education, research, other), status of implementation, implementing entity(ies). *Include quantitative estimate of impact including changes in activity levels and/or emissions/removals.* [Present summary in table provided.]	Provide to the COP information on regional programmes containing measures to mitigate climate change. *Use whatever methods are available and appropriate to formulate and prioritize programs within the framework of sustainable development objectives.* *Provide relevant information as appropriate by key sectors on methodologies, scenarios, results, measures and institutional arrangements.*
Projected emissions	At minimum, report "with measures" projection encompassing currently implemented and adopted policies and measures. *Report "without measures" and "with additional measures" projections.* *Include projections for 2005, 2010, 2015, 2020.* *Project using any models and/or approaches*; *explain for which gases and/or sectors the model or approach was used, describe type of model or approach, its characteristics, its original purpose; summarize strengths/ weaknesses; provide references.*	N/A.

[21] FCCC/CP/1999/7
[22] FCCC/CP/2002/7/Add.2

Table 2 (continued)

	Annex I	Non-Annex I
Vulnerability and adaptation	Include information on expected impacts and an outline of action taken to implement 4.1(b) and (e) with regard to adaptation.	Provide information on regional programs containing measures to facilitate adequate adaptation to climate change. *Provide information on vulnerability.* *Use appropriate methodologies.*
Financial resources and transfer of technology	Provide details of measures taken to give effect to their commitments under 4.3, 4.4., and 4.5. Indicate what "new and additional" financial resources they have provided pursuant to 4.3; clarify how they have determined such resources as being "new and additional". Provide detailed information on the assistance provided for assisting developing country Parties in meeting the costs of adaptation. Clearly distinguish between public sector and private sector activities. Provide information on financial resources related to UNFCCC provided through bilateral/regional/other multilateral channels [using tables provided]. Where feasible, report activities related to technology transfer, including success and failure stories [using table provided]; report activities for financing access by developing countries to environmentally sound technologies. Report information on steps taken by governments to promote, facilitate, and finance technology transfer.	*In light of social and economic conditions, provide information on activities relating to the transfer of, and access to, environmentally sound technologies and know-how, the development and enhancement of endogenous capacities, technologies, and know-how, and measures relating to enhancing the enabling environment for development and transfer of technologies.*
Other information	Communicate information on their actions relating to research and systematic observation. Communicate information on their actions relating to education, training and public awareness.	*Provide information on research and systematic observation.* *Provide information on education, training and public awareness.* *Provide information on how capacity-building activities are being implemented.* *Provide information on efforts to promote information sharing among and within countries and regions.* *Describe constraints and gaps, and related financial, technical and capacity needs.*

Key: Font indicates the strength of the language used to articulate each provision. Regular black font indicates a "shall" item; *italicized black font* indicates "should;" and *italicized grey font* indicates "may," "can," "encouraged to," etc. Brackets indicate that the language has been summarized by the author.

IV. NATIONAL COMMUNICATIONS AND INVENTORIES IN THE CONTEXT OF THE BALI ACTION PLAN

The provisions of the national inventory and communication system begin to address the MRV requirements implied by the Bali Action Plan, but leave important gaps. Table 3 maps measurement, reporting, and verification as conducted through national communications and inventories against the accountability functions of MRV identified in Section II. The first accountability function is to enable the assessment of developed country progress towards mitigation commitments. This analysis assumes that all developed countries will take on binding commitments in the form of economy-wide, quantified emission limitation and reduction objectives (QELROs). The existing national inventory process for Annex I countries – which is based on standardized measurement methods and reporting formats and incorporates regular, independent expert reviews – could be expanded to assume the role of an MRV process for developed country commitments under a post-2012 agreement. Such an expansion would consist of applying the Annex I inventory requirements, as well as applicable Kyoto Protocol accounting rules, to all developed country parties. In the interest of continuous improvement of the MRV system, the IPCC should continue to refine methodologies for sources with high levels of uncertainty, and comparable, objective uncertainty assessments should be encouraged.[23]

The second and third accountability functions relate to the assessment of implementation of developed country and developing country NAMAs, respectively. Because economy-wide QELROs would encompass all of a developed country's domestic mitigation efforts, the MRV of developed country NAMAs is not an urgent priority from an accountability perspective; therefore, this discussion focuses on MRV of developing country NAMAs.[24] It is possible that some developing countries might undertake NAMAs that resemble QELROs, at either a national or a sectoral level. In this case, the existing Annex I inventory process could be modified to enable the measurement, reporting and verification of QELRO-style NAMAs by developing countries. In practice, however, developing countries are likely to adopt NAMAs that differ significantly from Kyoto-style targets. Current negotiating text suggests that NAMAs could include, for example, technology standards, sectoral targets, cap and trade schemes, energy taxes, and "REDD-plus" activities.[25] While national inventories have a fundamental role in assessing the aggregated impact of a country's actions over time, they have two major limitations with regard to measurement, reporting and verification of individual NAMAs. First, many of the proposed types of NAMAs are framed at a sub-national level, whereas inventories address national-level emissions. Second, absolute GHG emissions may not be the most appropriate metric by which to assess the implementation of NAMAs, which might be framed in terms of GHG intensity, renewable energy capacity, or area reforested, for example.[26] Therefore, to measure, report, and verify NAMAs, a supplement to the national inventory process is required.

The existing national communication system offers a non-inventory alternative for reporting on NAMAs. Annex I communications include a section on policies and measures adopted to implement commitments, and non-Annex I communications include a section on programs containing measures to mitigate climate change. Neither section, however, can be considered measurable, reportable and verifiable. While Annex I communication guidelines provide standardized metrics and reporting structures for NAMAs - quantified changes in activity levels and/or emissions or removals - they lack quantification methodologies. Moreover, the expert review process for national communications falls short of verification, in that it assesses the document's adherence to reporting guidelines, rather than the reliability of reported information. Non-Annex I communications lack standardized measurement and reporting guidelines, and are not subject to verification or review.

[23] Gillenwater et al. (2007)
[24] MRV of developed country NAMAs could facilitate implementation of a post-2012 agreement, and is addressed in the following section.

[25] FCCC/AWGLCA/2009/8: REDD stands for reducing emissions from deforestation and degradation; REDD-plus refers loosely to policy approaches and positive incentives for REDD.
[26] Fransen et al. (2008); Fei Teng et al. (2009)

Therefore, the existing national communication process would need to be revised or replaced with an alternative supplement to national inventories to enable the measurement, reporting and verification of developing country NAMAs.

The final accountability function of MRV is to enable assessment of the provision of technology, finance and capacity-building support. Annex I national communication guidelines contain provisions on reporting on financing and technology transfer, including a requirement to report "new and additional" financial resources and, where feasible, technology transfer. As discussed in the previous section, however, these reporting provisions are quite general, and are not applied consistently in practice. Again, the review process for Annex I communications falls short of verification.

The facilitative function of national communications and inventories is also limited by shortcomings in both measurement and reporting guidelines and in the process by which non-Annex I communications are funded and, therefore, developed. While national communications contain extensive information on mitigation measures undertaken by parties, reporting typically excludes details – particularly quantitative aspects of their mitigation potential, cost-effectiveness, and co-benefits – that might assist other parties and the COP to identify especially interesting mitigation options. The lack of up-to-date inventory information from most developing country parties limits our understanding of national and regional emission trends. Additionally, the fact that non-Annex I communications are funded on a project-by-project basis undermines their ability to facilitate continuous national planning. Finally, national communications and inventories do not link mitigation actions with support in a measurable, reportable, and verifiable manner.

The existing system of national communications and inventories would, therefore, require significant enhancements, new complementary processes, or both in order to serve the accountability and facilitative functions identified in Section II.

Table 3 | **Existing Provisions Relevant to MRV Accountability Functions**

	Measurement	Reporting	Verification
Enable assessment of developed country progress toward mitigation commitments	A1 national inventories provide standardized indicators and methodologies	A1 national inventories require National Inventory Report and Common Reporting Format	Three-phase process consists of initial check, synthesis and assessment, and individual inventory review
Enable assessment of developed country implementation of mitigation actions	A1 national communications provide standardized indicators (quantified changes in activity levels and/or emissions or removals) but no standardized methodologies; additional indicators may be needed	A1 national communications provide a standardized table for reporting information on mitigation policies and measures	A1 national communications are subject to an in-depth review process, but the review focuses on reporting (rather than implementation)
Enable assessment of developing country implementation of mitigation actions	NA1 national communications do not provide standardized indicators or methodologies for measuring mitigation actions	NA1 national communications do not provide a standardized reporting format for reporting on mitigation measures	NA1 communications are not subject to regular expert review or verification
Enable assessment of the provision of technology, finance, and capacity-building support	Neither A1 nor NA1 national communications provide a standardized methodology for measuring technology, finance, or capacity-building support	A1 national communications provide standardized reporting structures for reporting on financial resources and technology transfer	A1 national communications are subject to an in-depth review process, but the review focuses on reporting (rather than implementation)

Key: Darker squares equal stronger MRV provisions; lighter squares indicate weaker MRV provisions.

V. MEASUREMENT, REPORTING, AND VERIFICATION IN A POST-2012 AGREEMENT

This section discusses possible revisions to the existing national communication and inventory system in order to enhance its role in promoting accountability among parties and facilitating implementation of the agreement. It also attempts to reflect the following guiding principles:

- *Urgency:* MRV requirements should not create an undue obstacle to near-term action on mitigation
- *Flexibility:* The MRV structure should catalyze creative models of mitigation and technology, finance, and capacity-building support, and avoid being overly prescriptive
- *Continuous improvement:* The MRV structure should incentivize and support enhanced MRV capacity over time

Figure 1 illustrates one way in which old and new MRV components might fit together.

Developed Countries

According to the Bali Action Plan, developed countries are responsible for measurable, reportable and verifiable commitments (assumed here to be QELROs), NAMAs, and technology, finance, and capacity-building support.[27] Under the structure illustrated in Figure 1, developed country commitments would be measured and reported through annual inventories prepared according to existing national inventory provisions, which could be improved over time as scientific knowledge is enhanced. These inventories would be subject to international verification through expert review.

Because developed countries would be accountable for meeting economy-wide targets, to which each NAMA would be merely a contributing factor, MRV of developed country NAMAs would serve a largely facilitative, as opposed to accountability, function. MRV provisions for developed country NAMAs should be designed with this facilitative role in mind. Improved guidance and standardized measurement and reporting procedures could clarify the magnitude of the impact of NAMAs, as well as their relative costs and, potentially, co-benefits. International verification of NAMAs would not be necessary, since emission targets would be internationally verified through national inventories.

MRV of developed country support is discussed below in the context of a registry system.

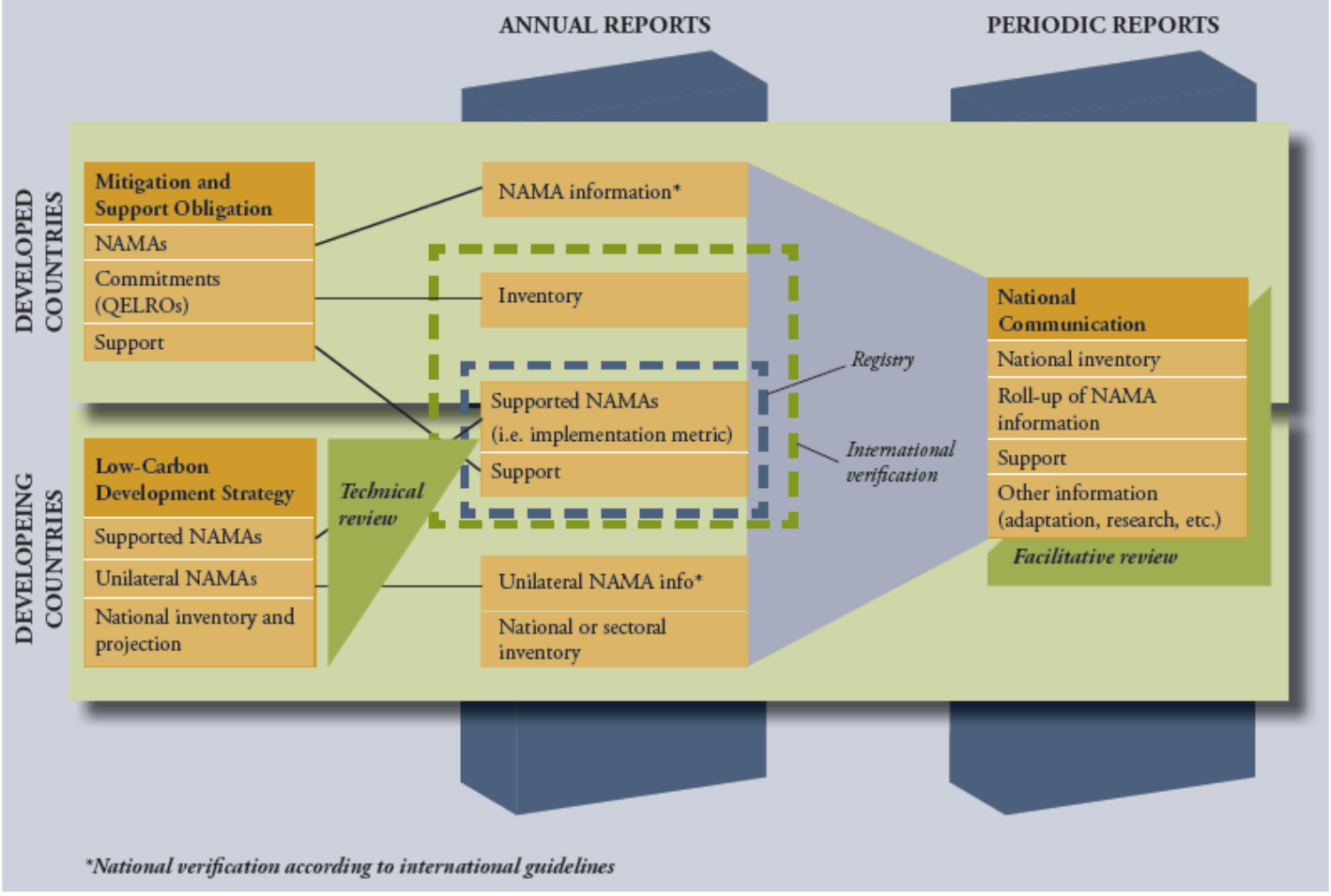
Developing Countries

Developing country NAMAs are likely to include diverse policies and measures, and are not encompassed by economy-wide emission targets as are developed country NAMAs. This complicates attempts to define an appropriate MRV framework for them. In the interest of maintaining flexibility and promoting creativity, the structure discussed here does not pre-suppose which actions would qualify as NAMAs, but instead suggests a process by which NAMAs could be reviewed and approved, in advance of their implementation, and then measured, reported and verified throughout their implementation.

Under the proposed process, developing counties would prepare low-carbon development plans, which would consist of a national inventory, a national emission projection over a defined time frame, and a NAMA proposal. The purposes of the inventory and projection would be (1) to provide context to the proposed NAMAs and (2) to enhance the COP's understanding of developing country emission trends. Countries that lacked the capacity to prepare economy-wide inventories and projections might at first prepare inventories and projections only for those sectors for which they intended to propose supported NAMAs, moving to more comprehensive reporting over time. The NAMA proposal would contain a defined set of information about each proposed NAMA, including its objective, sector(s) and gas(es) affected, type of policy or measure (e.g., economic, fiscal, or regulatory), status of implementation, implementing entity, timeline for implementation, estimated mitigation potential (in

[27] The Bali Action Plan does not specify that technology, finance, and capacity-building support be provided exclusively by developed countries, and some parties have supported the idea of a fund to which developing countries would also contribute, according to their capabilities. Under the Convention, however, developed countries have a clear and unique obligation to provide financing and technology transfer.

Figure 1. Schematic of a Prospective MRV Process



tons of CO_2-equivalent) and timeline for mitigation potential to be achieved, estimated cost, support required, and a proposed metric of implementation against which it would be verified. The metric of implementation need not be a GHG metric. While countries would prepare ex ante estimates of NAMA impact in GHG terms, NAMA implementation could be monitored according to any metric that would accurately indicate implementation and could be verified effectively. NAMA proposals could include both NAMAs that require international support and NAMAs that the country intends to implement unilaterally, for which it wishes to receive international recognition. Guidelines for emission projections and for ex ante estimation of the NAMAs' mitigation potential would need to be developed.

The low-carbon development plan would undergo review by a technical panel, which would assess the national inventory, emission projection, estimated NAMA mitigation potential, and adequacy of the proposed implementation metric from a technical perspective. The panel would consider the following questions: Were the inventory, emission projection, and estimate of NAMA impact prepared in accordance with agreed technical guidelines? Are the proposed implementation metrics an appropriate basis for measuring, reporting and verifying the implementation of their associated NAMAs? Following review and approval by the technical panel, the low-carbon development plan could be submitted to a registry where its NAMAs would become eligible to receive international support. Depending on the governance structure of the registry, donor countries and/or a centralized body under the COP would determine which NAMAs would receive support, drawing on supplementary information such as the emission projection and estimated NAMA impact. Countries would report annually on implementation of supported NAMAs according to their agreed implementation metrics;

they would also report on support received per NAMA. These reports would be subject to international verification. Countries would also provide annual inventories covering, at a minimum, the sector(s) and gas(es) affected by supported NAMAs, and all sectors and gases as capacities permitted. These inventories would not be subject to international verification, but might undergo periodic facilitative reviews in the interest of enhancing developing country inventory capacity. Countries with very low emissions and limited capacity, such as the Least Developed Countries, might be exempt from the inventory requirement.

With regard to the role of mitigation actions undertaken unilaterally, major developing countries are already planning and implementing a range of mitigation policies and measures that are not necessarily linked to international support.[28] The position of these "unilateral NAMAs" in the post-2012 MRV framework is unclear. On one hand, the Bali Action Plan does not explicitly bind developing countries to undertake NAMAs on their own. On the other hand, the international community seems to expect emerging economies to step up their mitigation efforts, and developing country submissions have called for recognition of their endeavors. This implies some sort of MRV process for unilateral NAMAs Figure 1 suggests that unilateral NAMAs be reported either in annual reports or in periodic national communications; this reporting should be done according to strengthened standardized guidelines. They could be verified at the national level, according to international guidelines.

Reporting on other information, including any technology, financing, and capacity-building support provided to other countries, could be undertaken through periodic national communications.

The Role of a Registry in MRV

The idea of a NAMA registry as a way to recognize developing country mitigation actions has gained traction in international negotiations. Increasingly, the registry is also being viewed as a mechanism for matching NAMAs with support.[29] Among those parties that view the registry as a financing mechanism, two divergent models are under discussion. One, supported primarily by developed countries, is a decentralized model that leverages existing bilateral and multilateral institutions. The other, supported primarily by developing countries, is a centralized model under the authority of the COP. A hybrid model has also been proposed.[30] The nature and function of a registry is a topic that would benefit from greater clarification in the negotiations. Figure 1 assumes a registry that serves as a financing mechanism for supported NAMAs, and recognizes unilateral NAMAs outside of the registry. It does not take a view as to the centralized or decentralized nature of the registry, although this variable would have important implications for the feasibility of using the registry to measure, report and verify support. Under a centralized model, all funding would flow through a body governed by the COP, which suggests that it could be measured, reported and verified as a matter of course, although this model would not necessarily address MRV of support in the form of technology or capacity-building. Under a decentralized model, funding would flow through diverse entities, the functions of which would not necessarily be limited to climate funding. Measurement, reporting, and verification under a decentralized model would require defined criteria as to which support is subject to MRV, as well as uniform standards for reporting on support.

National Communications

In a future agreement with more frequent and detailed reporting and verification processes, the role of periodic national communications comes into question. One possibility would be to maintain these communications as a comprehensive reporting vehicle for all of a country's climate-related efforts. These communications could contain summaries of national inventories and NAMA reports – as well as full inventories for countries that do not conduct them annually – along with information on adaptation, research, and other national efforts and

[28] Fransen et al. (2008)

[29] McMahon and Moncel (2009)

[30] Technical Working Group on the Institutional Architecture for Climate Finance (2009)

needs related to climate change. Depending on the extent to which countries undertake reporting on unilateral NAMAs, as well as the success of the international community in building national inventory capacity in developing countries, this structure may introduce some reporting redundancies. Additionally, conducting meaningful verification of this information would strain reviewer capacity.

An alternative would be to re-invent national communications as more streamlined, annual reports containing measurable, reportable, and verifiable information on emissions, NAMAs, and support – essentially, all of the information listed under the Annual Reports column in Figure 1. All countries' reports would undergo some form of verification: Developed country inventories would undergo international verification on an annual basis, as would supported developing country NAMAs. Unilateral NAMAs could be periodically verified at the national level according to international criteria. Developing country inventories could undergo a periodic technical review intended to improve inventory capacity. This model might provide an efficient reporting structure for information specified as measurable, reportable, and verifiable under the Bali Action Plan. However, national communications also cover a range of topics not related to MRV in the Bali Action Plan, such as national circumstances, adaptation, research, and education. Any revisions to the national communication system should be considered in the context of these other topics.

Interestingly, although the Bali Action Plan does not mention MRV in the context of adaptation, current negotiating text suggests that progress in the implementation of adaptation, including delivery of the means of implementation by developed countries, "should be monitored and reviewed to ensure the full implementation of adaptation actions and commitments in a measurable, reportable and verifiable manner."[31] This suggests significantly enhanced reporting on adaptation compared to current national communications practice.

VI. CONCLUSIONS AND RECOMMENDATIONS

National communications and inventories can contribute to MRV under a post-2012 agreement, but are not adequate – as they currently stand – to serve the accountability and facilitative functions critical to the success of such an agreement. These functions could be facilitated by revisions to the existing MRV structure, complemented by new frameworks and processes.

A retrofit of the existing MRV structure for a post-2012 environment might include the following modifications:

- Application of the current Annex I inventory process, as well as relevant Kyoto Protocol accounting provisions, to all developed country parties
- Standardized reporting structure for NAMAs
- More frequent and complete GHG inventories for developing-country parties with significant emissions
- Improved definition of support requirements, along with standardized reporting and verification procedures for them
- Low-carbon development plans or strategies as a means to identify and prioritize NAMAs
- A registry as a means to recognize supported and, perhaps, unilateral NAMAs, and to verify both NAMAs and support
- More frequent, streamlined, and standardized reports, as a complement to or replacement for national communications

In addition, a number of outstanding questions need to be addressed in order to inform the development of an effective MRV framework and to clarify the role of national communications and inventories in it. These include:

- What is the nature of parties' obligations to provide technology, financing, and capacity-building support? What institutional arrangements would facilitate this support, and what MRV structure would complement such arrangements?
- What role do unilateral NAMAs by developing countries have in a post-2012 agreement? Should these NAMAs be recognized through a

[31] FCCC/AWGLCA/2009/8

registry? What level of verification is appropriate for them?

- Should national communications be replaced by, reinvented as, or complemented by more streamlined and standardized reports? What capacity would parties need in order to report in this manner? What role would the Secretariat have, and what capacity would it need in order to process the increased volume?
- What role do national communications have in reporting on adaptation, research, and other areas not addressed in detail by this analysis, and what would changing the national communications process imply for reporting on these issues?
- What information should low-carbon development plans comprise in order to facilitate the identification and prioritization of NAMAs? To what extent are developing countries prepared to put forward low-carbon development plans, and on what timeline?
- Should developed countries also prepare low-carbon development plans? Would consideration of such plans by the international community detract from or create redundancies with MRV of QELROs, or would it provide important additional information?
- What frequency of reporting and verification makes sense for which Bali Action Plan obligations, including supported NAMAs, unilateral NAMAs, and support?
- How can developing countries be supported to enhance their GHG MRV capacity over time, without imposing an unrealistic reporting burden up front? What role might the CGE play in this effort?

Careful consideration of these questions should contribute to the construction of an MRV framework that provides meaningful information to parties about one another's efforts without tangling the system in unproductive processes. To be effective, the post-2012 agreement will need to be accompanied by a significant capacity-building effort to strengthen parties' ability to measure and report on their efforts, as well as to ensure that the Secretariat will be able to manage enhanced review and verification processes. Given the central role of measurement, reporting and verification in reaching and implementing a global agreement, investment in appropriate MRV frameworks and capacity can be expected to pay off in the form of more effective and sustained international cooperation on climate change.

LIST OF ACRONYMS

A1	Annex I
CGE	Consultative Group of Experts
COP	Conference of the Parties
CRF	Common Reporting Format
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
LULUCF	Land use, land-use change, and forestry
MRV	Measurement, reporting and verification
NA1	Non-Annex I
NAMA	Nationally appropriate mitigation action
NIR	National Inventory Report
QELRO	Quantified emissions limitation and reduction obligation
UNFCCC	United Nations Framework Convention on Climate Change

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ABOUT THE AUTHOR

Taryn Fransen is a Senior Associate with the GHG Protocol Initiative in WRI's Climate and Energy Program. Please direct any feedback or inquiries about this paper to tfransen@wri.org.

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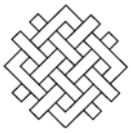

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