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A comparative analysis of emerging institutional arrangements for domestic MRV in developing countries

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Key points

- This paper considers how developing countries are approaching the development of their domestic MRV systems.

- Case studies of MRV-related activities are presented from Brazil, Chile, China, Ethiopia, Ghana, India, Kenya, Thailand and South Africa.

- The analysis considers how the political context and domestic interests can inform the institutional arrangements around MRV systems.

- Developing countries surveyed for this paper approach the development of their domestic MRV systems based on their political systems and existing institutional arrangements, as well as their intention of building an effective and efficient system that meets domestic interests.

Contents

1.   Introduction

Domestic monitoring, reporting and verification (MRV) is an emerging field in international and domestic climate policy and, therefore, practitioners and researchers are beginning to explore how domestic MRV systems are being implemented across different jurisdictional scales and sectors. Sharing international experiences can contribute to strengthening learning in this field.

This paper builds on previous research which predominantly focused on institutional arrangements for domestic MRV in the South African context. A series of research papers emerged, relating firstly to the national context for MRV-related activities (Boyd et al, 2013) and then extended into individual case studies considering MRV of co-benefits (Dane, 2012) MRV of solar water heating (Rennkamp, 2012) and multi-level governance of MRV (Boyd, 2012) – all with a South African focus. However, an underlying issue emerged, namely: what are other developing countries doing with regards to designing and implementing domestic MRV systems? Other pertinent questions also surfaced, such as how other countries are interpreting domestic MRV needs and what we can learn from each other.

To this end a workshop was hosted[1] focusing on international sharing on domestic MRV. The discussions, participants and case studies were chosen to reflect the broad nature of MRV – going beyond only GHG emissions, and not being constrained by political positions in international negotiations. This paper draws significantly on discussions and inputs from this workshop, as well as incorporating new literature relating to domestic MRV, and also the latest discussions on domestic MRV under the Subsidiary Body for Implementation (SBI) at the United Nations Framework Convention on Climate Change (UNFCCC).The premise of this research was to also consider the multi-level interaction across national, provincial and local-level MRV systems.

The main purpose of this particular paper is to consider how developing countries are approaching the development of their domestic MRV systems.[2] *The findings presented in this paper are based on inputs presented at a workshop in September 2013, and are illustrative rather than representative of a country position. Further research was undertaken to provide more insight into the national level context.*

Methodology

We first consider new available literature on domestic MRV in developing countries, and then present and analyse findings from our own research, which is predominantly based on reflections from nine developing country inputs – Brazil, Chile, China, Ethiopia, Ghana, Kenya, India, South Africa and Thailand. These countries were selected partly based on their existing engagement with World Resource Institutes' (WRI) Measurement and Performance Tracking (MAPT) initiative,[3] but the list also extended to other countries where interesting research has been undertaken and valuable experiences can be shared on developing MRV systems. The focus on developing countries was intentional. Firstly, developing countries are in the process of developing their institutional arrangements for MRV and secondly, as much of the literature and insights relating to domestic MRV have emerged from developed country institutions, this paper contributes to the literature from a developing country perspective The table below summarises the presentations that have informed this research paper.

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[1]   At the Energy Research Centre, University of Cape Town from 5–6 September 2013.

[2]   MRV is considered in a broad sense, not being strictly related to the concept under the Convention, originally conceived for NAMAs.

[3]   Brazil, South Africa, India, Ethiopia and Thailand are all part of the MAPT initiative.

Table 1: Workshop presentations informing this paper
Source: Presentations at international workshop, September 2013[4]

Country	Case study of MRV-related activity
Brazil	National: Seeking harmonisation of multilevel MRV systems
	Rio de Janeiro low carbon city development programme
Chile	Reflections on MRV of NAMAs
China	Development and Application of MRV tools at municipal level
Ethiopia	MRV of climate resilient green economy plan
Ghana	National MRV system
India	Perform Achieve and Trade (PAT) mechanism for energy efficiency
Kenya	National MRV+ system
South Africa	National level: Developing South Africa's climate change monitoring and evaluation system
	Industry level: Private sector MRV
	Sectoral level: Strengthening the South African MRV through national institutions and international standards
Thailand	Market-based programs for GHG emissions reduction

The comparative analysis of these international experiences has been framed in order to understand whether it is possible to identify key determinants that influence the development of domestic MRV systems in developing countries. Consideration is given to the role of the political systems and institutional arrangements, what the different domestic interests are to undertake MRV and how they affect the design of the systems, and subsequently what makes these systems or approaches efficient and effective. We also consider what is driving the development of different types of domestic MRV systems and how this may inform the institutional arrangements.

In brief, this paper presents key findings from the literature on MRV, specifically on the design and implementation of domestic MRV systems. It discusses the various domestic MRV schemes that were presented in our workshop, in terms of the context provided by the host country's political form and climate policy, and any prevalent institutional arrangements for MRV. It seeks commonalities between the presented case studies and possible reasons for the location of authority for domestic MRV. The paper then identifies drivers for domestic MRV development and assesses whether, and if so how, these drivers might influence the system design. Finally, it presents reflections from our workshop discussions as to what might be learnt from developing country experiences to inform what constitutes an effective and efficient system for domestic MRV.

2. What do we know about domestic MRV in developing countries?

MRV has been carried out for many years but the concept was introduced into international climate change discussions more comprehensively in the Bali Action Plan (BAP) (decision1/CP.13) in 2007. Since then, MRV has become essential in the climate negotiations as the primary performance tracking tool, of GHG emissions, of support, and of climate action. The emerging body of literature on MRV focuses on the international context and follows the development of MRV under the UNFCCC. The vague definition of MRV in the BAP has elicited literature describing the function of MRV and what activities should be covered by

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[4] These presentations were given by workshop participants representing government, private consultants, NGOs and academia. They are not government positions on national MRV systems.

MRV (Bakker, De Vita, & Olivier, 2010; Breidenich & Bodansky, 2009; Fransen, McMahon, & Nakhooda, 2008; McMahon & Moncel, 2009; Winkler, 2008).

Guidelines for domestic MRV were adopted at COP19 in Warsaw (decision -/CP.19) clarifying principles for the design of domestic MRV. They state that domestic MRV is to be 'voluntary, pragmatic, non-prescriptive and non-intrusive, tak[ing] into account national circumstances and national priorities' and highlighting a 'cost-effective approach'. They strongly encourage developed countries to provide financial, technical and capacity-building support for (developing country) domestic MRV. The characterisation of MRV remains rather vague, perhaps to facilitate multilateral agreement, to be inclusive and to encourage an innovative approach. Also worth noting are the latest transparency rules under the UNFCCC, which will require developing countries to report more frequently, with National Communications every four years (decision 1/CP.16) and biennial update reports (decision 2/CP.17).

Noteworthy features of UNFCCC provisions for domestic MRV[5]

- Domestic MRV guidelines are voluntary and offer an opportunity to build on existing domestic processes.

- International consultation and analysis has two major components: technical analysis and multi-lateral consultation.

- Technical teams of experts will be mainly from developing countries, and can help identify capacity needs.

- The multi-lateral consultation is a 'facilitative sharing of views'.

- First reports are due end of 2014, with a first round of ICA expected in mid-2015.

- The processes provide significant opportunity for learning and improvement.

A general search of the literature on domestic MRV reveals a focus on MRV of GHG emissions rather than on climate policy, support, or other mitigation action. Areas with a growing literature include various approaches to MRV in REDD+ (Palmer Fry, 2011; Puliti, 2012), MRV of support, specifically of financial support (Ellis *et al.*, 2010; Buchner *et al.*, 2010) and challenges to building credible MRV schemes (Okubo, Hayashi, & Michaelowa, 2011). Within the past couple of years, guidelines for design (Falconer *et al.*, 2012; Lütken, Aalders, Pretlove, Peters, & Olsen, 2012) and for assesment of domestic MRV have been published (Falconer *et al.*, 2012; Koakutsu, Usui, Watarai, & Takagi, 2013), highlighting the essential elements for effective MRV systems. Notably, these guidelines and assessments have been authored within research and climate think-tank institutions located in developed countries (De Vit, Röser, & Fekete, 2013; Falconer *et al.*, 2012; Koakutsu *et al.*, 2013). Notwithstanding the loose definition of Nationally Appropriate Mitigation Actions (NAMAs) *et al.*, 2013) and of domestic MRV, attempts have been made to define important criteria for the assessment of MRV implementation (Falconer *et al.*, 2012; Lütken *et al.*, 2013), to provide guidelines and metrics for domestic MRV (Hinostroza *et al.*, 2012; Lütken *et al.*, 2013), and to discuss issues in implementing domestic MRV (De Vit *et al.*, 2013). The criteria offered to assess domestic MRV are listed as completeness, comparability, reliability (accuracy and consistency), and transparency (Falconer *et al.*, 2012; Levin & Finnegan, 2013; Lütken *et al.*, 2012) Timeliness and usefulness for policymaking is also highlighted (Falconer *et al.*, 2012), as is conservativeness where there is uncertainty in data when quantifung emissions and emissions

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[5] These features emerge in the 'Cancun package' relating to transparency of mitigation actions undertaken in and funded by developing countries. The details for the composition, modalitoes and procedures for the Technical Teams of Experts were agreed at COP in Warsaw (UNFCCC, 2013b), as were the general guidelines for domestic MRV (UNFCCC, 2013c)

reductions (Lütken *et al.*, 2013). The elements robustness, feasibility and cost-effectiveness are also considered important for the design of MRV systems (De Vit *et al.*, 2013). Another approach to understanding the important elements for an effective MRV system typifies MRV as being at one of four different scales: organisational, projects, national or policy (Koakutsu *et al.*, 2013).

Domestic MRV systems linked to international or to large-scale, mandatory domestic policies or to significant spending of public funds were found to have the strongest tracking of mitigation action (Falconer *et al.*, 2012). However, regardless of the level of implementation, there is agreement in the literature that the most common problem for domestic MRV is the collection of data and the lack of comparability of data between MRV schemes – both within and between countries (Falconer *et al.*, 2012; Koakutsu *et al.*, 2013). The importance of an identified individual institution with overall authority on MRV and completeness of the system is stressed as necessary for effective domestic MRV (Lütken *et al.*, 2012).

Case studies in the literature show that domestic MRV is implemented across various sectors and at different scales of authority (Elsayed, 2013; Koakutsu *et al.*, 2013), and that in practice domestic MRV is developing often in the absence of an overarching authority.

This observation prompts questions of how, regardless of the presence of an overarching authority for MRV, systems of domestic MRV are emerging in developing countries; what drives the design and implementation of domestic MRV in developing countries; and to what level domestic MRV systems are shaped by the designation of authority for MRV. We seek to learn from developing countries experiences of, and reflection on, domestic MRV.

3.   Political systems and institutional arrangements for domestic MRV systems[6]

Domestic MRV systems rely heavily on the political systems and existing institutional arrangements in a country. This holds for the general way polity and institutions are organised in a country, as well as for the specific climate-related policies. The relationship is not always perfect and we find some exceptions. Some federal states, like India, have rather centralised approaches to MRV, whereas the centralised government of China currently emphasises the approaches to MRV at the municipal levels. This section provides examples from the nine developing countries, which presented at the workshop.

We can also observe different ways of organising the MRV systems. There are many ways of categorising these systems. For example, we find i) centrally managed cross-sectoral systems, as in South Africa and Kenya; ii) sectoral approaches, as in Ethiopia and Ghana, which feed into a national strategy; or iii) MRV systems designed to track specific mitigation actions as in Chile, Thailand and to some extent India. (The findings are summarised in Table 2 below). Of course, some systems would cut across these categorisations, such as Ethiopia, which has a centrally managed CRGE strategy that relies on sectoral level implementation. Or Chile, which tracks actions, but in the context of achieving a national goal.

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[6]   Where no citation is included, the views reflect inputs and discussions from the September 2013 workshop.

Table 2: Overview: Summary of institutional arrangements for MRV
Source: Presentations at international workshop, September 2013

Political system	Examples of MRV from case studies	Country
Centralised	Cross-sectoral and economy-wide national approaches dominate	South Africa, Kenya
	Tracking specific mitigation actions administered through coordination at the national level	Chile, Thailand, India
	Sectoral approaches dominate, coordinated at the national level	Ethiopia, Ghana
Decentralised	Provincial and municipal systems dominate over national coordination	None from workshop presentations
Mixed	Interplay of provincial, municipal and national systems in a coordinated or uncoordinated way	Brazil (implicit coordination at the federal level)
		China (central government which prioritises MRV at the provincial levels)

The Brazilian and South African cases exemplify the importance of the political systems for the emergence of MRV systems. Whereas Brazil is a federal republic with distinct divisions between the responsibilities of the federal government, the 27 states and the municipalities, the national government in South Africa makes most policy decisions centrally. In these different countries, now two MRV systems emerge which reflect these inherently different structures. In South Africa, the Department of Environmental Affairs (DEA) drives the process of developing a domestic MRV system in the national government. The system, currently under design, makes provision for central reporting to the national government. The nine South African provinces were consulted in the process, but do not have their own systems or defined mandates for measuring, reporting and verifying emission reductions. There is also no separate agency mandated to execute the function of MRV. The national government is the main actor in executing MRV in South Africa.

In Brazil, the main MRV systems at installation level to date have emerged at the state level. The federal government only picked up MRV as an issue later through the international negotiations. The main systems in place are in São Paulo and Rio de Janeiro. Both provinces host the main industrial hubs and megacities in the country. The state of São Paulo counts 43 million inhabitants, Rio de Janeiro about 16 million.[7] MRV in the two states was mostly driven by the need of both states to comply with their own legislation on climate change without coordination at the federal level. As a result, both systems now look quite different. Whereas São Paulo requires a mandatory reporting mechanism for GHG emissions, the government in Rio de Janeiro introduced a market-oriented reporting mechanism,[8] and in Minas Gerais firms report on a voluntary basis. The reporting mechanisms in the three states are quite evolved.

Climate policy at the state level is important, as most states already have their own climate legislation and policies. MRV has become an important issue for those states which advanced their climate legislation. Lacking coordination led to different structures of the inventories, many of which apply different base years (see Figure 1) . The Ministry of Science, Technology and Innovation (MCTI) established a working group in order to build capacity within the states and design a solution capable of corresponding their needs and achieving comparable results. The federal government has its own programme and structure and has picked up it as an issue before the states in response to its commitments under the Convention. MCTI is responsible for

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[7]   According to the official statistics institute IBGE, the state of São Paulo counts 43 million inhabitants and Rio de Janeiro about 16 million inhabitants: http://www.ibge.gov.br/estadosat

[8]   For more detail access: http://www.bvrio.org/site/index.php/mercados/carbono/mercado-de-reducoes-de-emissoes-do-estado-do-rio-de-janeiro

coordinanting the elaboration of the National Inventory and Communication as well as the bi-ennual reports. All in all, as for inventories, it is possible to affirm that state efforts are complementary to the national exercise, despite the inefficiencies created by the lack of coordination at the subnational levels, which impairs comparability between the results obtained by states (Silva 2013).

Lacking coordination of the systems between the states made the comparability between the inventories in different states of Brazil difficult. Subnational initiatives have requested leadership at the federal government in the process of coordinating those efforts. Despite the drawbacks of such a decentralised process, it has fostered capacity-building within the local governments, the universities and the private sector, which has been paving the way for the establishment of a more robust system (Silva, 2013).
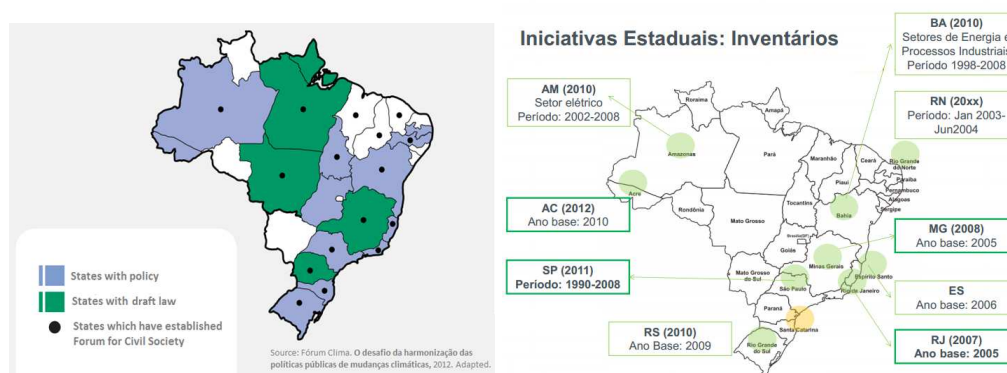

Figure 1: Maps of Brazil, showing states with climate policy or draft law (left), and the base year or period of greenhouse gas emission inventories for nine states (right)
Source: Silva (2013)

At the national level in Brazil, numerous departments have been involved in developing NAMAs, but have not submitted any to the NAMA registry. The involvement of multiple institutions leads to a somewhat fragmented climate governance structure at the national level. The Ministry of Foreign Affairs (Itamaraty) leads on the UNFCCC issues. The Interministerial Committee on Climate Change has been mainly mandated with climate policy and the implementation of NAMAs. The committee is coordinated in the planning unit (Civil Cabinet) within the presidency. The Climate Forum, Climate Science Network and Climatology Association consult regularly with the Committee. The Committee is well set up in order to deal with the cross-governmental challenges of climate change, but does not have the full authority for implementation. The Departments of Environment, Science and Technology, Finance and Industry share different aspects of the mandate for reporting of GHG emissions.

The representative from Brazilian Federal Government at the workshop focused exclusively on the work under NAFC which is seeking harmonisation of multilevel MRV systems.

The Brazilian government is currently developing and implementing a modular system for GHG emissions reductions called SMMARE[9] to monitor actions and, to the extent possible, their GHG emissions reduction achieved through the several actions of the Mitigation Plans. This system also has the purpose of helping the analysis and management of the mitigation actions. The general coordination is in charge of the Ministry of Environment. The SMMARE is implemented based on two scenarios: 1) Possible scenario, in which, based on the existing data and/or data that can be easily obtained, the monitoring of GHG emissions reduction could be done in the short-term at the national level; 2) Ideal scenario: in which it would be necessary to improve the data collection in order to make the GHG emissions reduction monitoring in a more

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[9]   Sistema Modular de Monitoramento e Acompanhamento das Reduções das Emissões de Gases de Efeito Estufa 9Modular Monitoring System for GHG Emissions Reductions).

disaggregated level (e.g. emissions reduction at the territorial-unit level, due to decrease in deforestation; emissions reduction at the plant level due to implementation of a specific technology; etc).

The SMMARE is designed as a tool able to provide information, in particular in relation to the mitigation actions implemented in each Mitigation Plan and its associated methodologies and assumptions, the progress made in their implementation and information on domestic measurement, reporting and verification.

In South Africa, in turn, the DEA carries the main mandate for climate policy implementation. MRV is one key issue. The mandate for a domestic monitoring and evaluation system emerges from the National Climate Response White Paper, which the Cabinet approved in 2011 (DEA, 2010). The DEA serves as the main focal point for the international climate negotiations in the UNFCCC. The implementation of the M&E system works through consultations with other government departments and stakeholders through technical working groups and task teams. The National Treasury has developed a strong interest in the monitoring and evaluation (M&E) framework to monitor the reporting of the emissions reductions of a carbon tax, which the Department seeks to implement in 2015.

Subnational government at provincial and municipal levels were involved through the working groups and bilateral consultations. South Africa's largest cities (Johannesburg, Cape Town and Durban) have done initial work towards GHG reporting, but there are no competing systems in place as in Brazil. The GHG inventories have also been coordinated through the DEA, following IPCC guidelines. The 2011 National Climate Change Response Policy stipulates mandatory reporting for the entities (companies and installations) that emit more than 0.1 Mt of GHG or consume an equivalent of electricity (RSA, 2011).

The South African government initiated a nationwide M&E system, based on the idea that cross-governmental monitoring will facilitate national planning. The system focuses on monitoring emissions produced by companies and installations, rather than monitoring specific mitigation actions. This might change with the carbon tax, which has been announced for implementation in 2015 and triggered a vivid debate about the reporting requirements between the industry with the technical teams in the national treasury and the department of environmental affairs. The system is still in the process of implementation, but will supposedly link up with the M&E efforts in the area of actions for GHG reductions (Cloete, 2009).

South Africa is not the only country with a centralised approach to MRV; in Ghana and Kenya, we find similar approaches. The Kenyan government suggests a structure with a chair from the National Climate Change Council for a cross-governmental steering committee that represents the key ministries to ensure sectorial coverage. A MRV system management team sits in the Climate Change Directorate, which oversees technical working groups who collect and manage the relevant data. However, these suggestions have not been approved by the Kenyan government yet (Harries, 2013).

Ghanaian approaches to MRV are similarly centralised but not yet as elaborated, as the system is still in the earlier phases of conception. The entry points into the government for MRV are the GHG inventories and the national communications required by the UNFCCC. The country makes efforts to improve sectorial data collection and management (Baffoe, 2013). Neither Kenya nor Ghana have made voluntary pledges under the Copenhagen Accord and both are low-emitting developing countries.

In China, which is also a centrally organised republic, climate policy decisions occur at the national level. The National People's Congress approves Chinese climate policy in the five-year-plans. The general plan splits into sectoral plans, which outline concrete climate action in renewable energy and conservation. China made voluntary pledges under the Copenhagen Accord in 2009 for carbon intensity reductions of 40–45% below 2005 levels by 2020. The Chinese government has not put forth any NAMAs to the UNFCCC registry, although a lot of local actions might qualify (Teng *et al.* 2009). The main priorities in the development of the domestic MRV system are to support the achievement of China's target for the 12th Five Year Plan and the 2020 goal, by planning guidance and performance tracking at city level. The

priorities include the establishment of a basic statistical system of GHG emissions based on the improvement of the energy statistical system and increasing emissions accounting at the national, provincial, municipal and enterprise level. However, most of the pilot and case study work happens at the municipal level, because the implementation in the municipalities is a key challenge for MRV in China. There is evidence from Beijing, Qingdao, Guiyang, Kunming, Dezhou and Baoding, which can inform a handbook and calculation tool based on Excel to support development of GHG inventory at municipal level in China based on existing data availability and statistical conditions (Ke *et al.*, 2013).

Chile is a relatively small country with a national government that takes specific action in MRV. Chile has a voluntary climate mitigation target projected from 2007 to 2020 of a 20% deviation below business as usual, which is different from the Chinese. The main focus is on the MRV of NAMAs, because Chile is one of the few countries which has put forth NAMAs in the UNFCCC registry and the bilateral NAMA facility (Hänsel *et al.*, 2013). MRV focuses on specific sectors, energy (renewable energy and energy efficiency), forestry, agriculture and transportation. The Ministry of Environment and Foreign Affairs is the national government's main entry point for NAMA development. Chile has coordination and data management problems similar to South Africa's, especially in the energy sector. Mining is not represented in the current MRV system, although the sector is a significant contributor to the country's emissions. So far, there is no carbon tax or related carbon pricing mechanism on the agenda, which the mining sector could engage with (Pirazzoli, 2013).

Thailand has a centralised monarchic system, which mandated several governmental departments and agencies to deal with MRV. These are the Department of Alternative Energy Development and Efficiency (DEDE), which deals mainly with the energy sector and the Ministry of Natural Resources and Environment. The Thailand Green House Gas Management Organisation (TGO) is the implementing agency for GHG emission reduction in Thailand, and is an autonomous governmental organisation. The Second National Communication in 2000 identified the energy sector as a key priority for GHG emissions reductions. The main actions for emissions reductions in this sector focus on designing carbon pricing mechanisms, renewable energy and energy efficiency. DEDE is conducting a programme to certify energy auditors to verify energy reports. The reporting structure is twofold (see Figure 2). Firstly, designated factories and buildings are responsible for measuring and reporting directly to the DEDE. Secondly, the municipal authorities engage through the TGO.
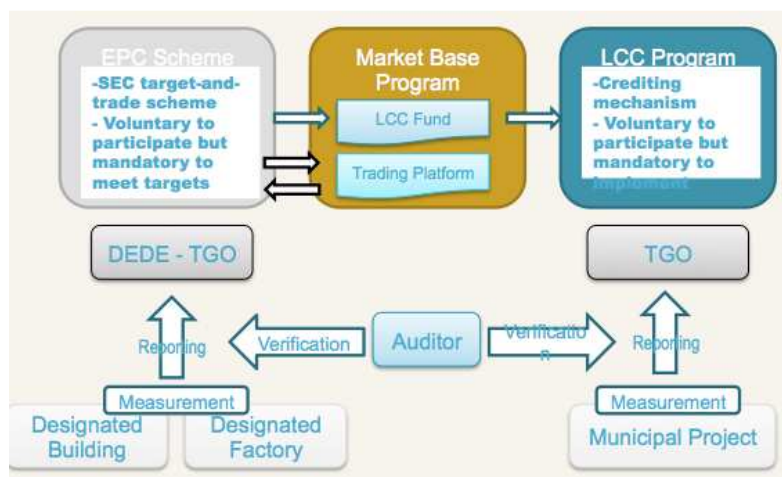

Figure 2: Proposed MRV in Thailand's energy trading system

The national government is currently seeking to design a market mechanism (energy trading programme through tradable energy performance certificates (EPCs)) to reduce energy consumption. This may eventually transform into an emissions trading scheme (ETS), for which an MRV system becomes necessary. The targeted sectors are cement, iron and steel, food and

beverage, and energy. The start for energy trading is scheduled for 2015. The government proposes to make the reporting mandatory. The ETS is the main mitigation action for which a MRV scheme has become urgent, but the country is also implementing sophisticated renewable energy plans and energy efficiency plans, which potentially could become NAMAs (Sakulku, 2013).

India is a large federal state. The federal government frames India's climate policy in the National Action Plan on Climate Change (NAPCC) that outlines eight National Missions. The Missions on solar energy, enhanced energy efficiency, sustainable habitats, water, Himalayan ecosystem, ecosystem services, sustainable agriculture, and strategic knowledge on climate change, require specific MRV systems. Each Mission has a monitoring and evaluation system, which comprises specific data from a range of knowledge institutions. India pledged to reduce emissions intensity by 20–25% from 2005 levels by 2020 (Koakutsu *et al.*, 2013). A crucial mitigation action to achieve reductions in the energy sector is the Perform Achieve and Trade (PAT) mechanism, which targets the energy-intensive industries (Adhia, 2013). The framework has recommended mandatory reporting of energy intensity, absolute energy consumption data and energy efficiency measures for eight sectors targeted in the first phase. These sectors include aluminum, chlor alkali, textile, pulp and paper, iron and steel, fertiliser, cement and thermal power plants covering almost 478 facilities. This scheme, however, does not recommend or request any information on GHGs. The federal government is largely coordinating the Missions and MRV thereof, so there are no major issues anticipated around competing systems at the state and municipal levels as in Brazil.

Ethiopia is committed to becoming a middle-income country by 2025. The developmental approach to achieving this target is to become a Climate Resilient Green Economy (CRGE). Ethiopia's economic growth plans are set out in its Growth and Transformation Plan (GTP), which spans three five-year planning periods (2010–2015; 2015–2020 and 2020–2025). These plans require average annual economic growth of around 10% predicated on improved agricultural productivity, strengthening the industrial base, and fostering export growth. Ethiopia's Sectoral Reduction Mechanism (SRM) is the sector-wide approach to implementing the CRGE plan. It involves multiple stakeholders for preparing and implementing reduction actions targeted at GHGs and the adverse effects of climate change in the context of poverty eradication and sustainable development. The institutional setup for the MRV of the CRGE posits sectoral lead ministries and a lead agency in each ministry engaging with the private sector for monitoring and reporting. Verification occurs through private companies and the Ministry of Environment and Forests. Ethiopia plans for a centrally managed MRV system with strong sectorial components (Wondimagegn, 2013).

In sum, we find a range of different approaches to MRV depending on the existing governance structures, political systems and size. All countries coordinate their domestic approaches at the national level when it comes to the international reporting requirements. The extent to which this national coordination happens varies. In South Africa and Kenya, centralised approaches propose to monitor and evaluate emissions from industrial installations and companies over a certain threshold. Thailand, Chile and India coordinate their efforts on tracking specific actions. Ethiopian and Ghanaian administrations put more emphasis on sectoral approaches. In smaller countries, and central governance systems like South Africa, Kenya, Thailand and Ghana, centralised systems are more favourable to implement, on the basis of existing structures. In Brazil, India and China the coordination of single centralised MRV systems becomes more challenging for the national governments. Both Brazil and China therefore pursue a mixed strategy with the attempt to coordinate emerging municipal and state level systems at the national level. India rather focuses on MRV of specific actions under the general coordination of the main missions, which are defined in the national plans.

4. Domestic interest of MRV and impact on systems design

Internationally the request for domestic MRV systems stems from the need for transparency in reporting and to show aggregate progress towards reducing global emissions under the UNFCCC. It is also in order to satisfy MRV requirements around individual NAMAs,

particularly if finance, technology and capacity-building support are being sought. Therefore the domestic interests underpinning the establishment of a national MRV system could be international reporting requirements – Biennial Update Reports, National GHG Inventories and National Communications (UNFCCC, 2013). This would by default nurture MRV systems that build heavily on existing GHG reporting processes. However, in the context of NAMAs, developing countries are required to undertake MRV of *actions* rather than of *GHG emission*s (Boyd *et al.*, 2013), which would go beyond GHG reporting processes and is more likely to build on broader sustainable development information. Therefore MRV systems may emerge around domestic priorities and interests – such as employment, energy access or economic growth.

Although the international UNFCCC requirements do act as a driver for some countries to develop an MRV system, for example in Ghana and Kenya, it is certainly not the only motivation for establishing MRV-type processes. The system may be designed in order to track progress towards a particular national goal or target, such as in the case of Ethiopia which has an M&E framework linked to its CRGE strategy, or to establish a market mechanism as in the case of the Thai energy trading system. In the Brazilian example presented at the workshop, the incentive to establish an MRV system is associated with the state- and municipal-level GHG reporting requirements, whereas designing Chile's MRV system is closely linked to the development of NAMAs. The driver is sometimes also linked to donor requirements, rather than to domestic priorities.

The domestic interest can influence the design of the MRV system and also the institutional arrangements coordinating the data collection and analysis. The table below summarises broadly some of the domestic interests behind the MRV-related systems from the nine country case studies - although in many cases the examples given, span across different elements.

Table 3: Summary – Domestic interests behind country presentations
Source: Presentations at international workshop, September 2013

Domestic interest	Motivation behind MRV system	Country case study
National developmental goals (non-GHG specific)	Responding to recent national strategies; the National Climate Change Action Plan and Climate Resilient Green Economy Strategy	Kenya, Ethiopia
National objectives (with GHG goal)	National-level MRV which support local processes, but also potentially feed into the BUR and National Communications and GHG Inventories	Chile, South Africa, Ghana
Sectoral goals	For example in energy; energy efficiency, energy trading, energy security	Thailand, India
Sub-national objectives	State-level climate objectives, or improving sub-national emissions accounting.	Brazil, China

The systems are also influenced by the scale at which the tracking occurs. Elsayed (2013) proposes the groupings indicated in Figure 3 for domestic drivers of MRV.

Within the context of the nine country case studies informing this particular research, domestic interests relate to broader national developmental goals (non-GHG specific) or specifically national GHG goals. Furthermore there are examples of MRV systems focused on domestic interest within a sector (e.g. energy), and those that are driven by sub-national objectives.

Target	e.g. a national goal such as reduction of GHG emissions by 30% compared to BAU
Policy	e.g. a cap-and-trade program
Project	e.g. project to deploy 500MW of wind capacity in a country
Sub-national inventory	e.g. municipal inventory, state inventory
Corporate Level	All emissions within boundary of a company
Facility Level	Similar to corporate level but just at one, usually high-emitting, operating unit
Product Level	Carbon footprint of one product, cradle to grave

Figure 3: Scales at which countries may want to track domestically
Source: Elsayed (2013)

National developmental goals (non-GHG specific)

For MRV systems born out of national strategies that are aiming at goals beyond climate change objectives, the MRV framework will not necessarily be linked to international UNFCCC reporting requirements. Returning to an earlier question on why to do MRV, one could argue that tracking broader development objectives through a domestic MRV system is more relevant for developing countries. It provides an approach for tracking progress towards achieving broader socio-economic objectives. Ethiopia's CRGE programme, already mentioned, is an example. The objectives of the CRGE are twofold: to achieve middle-income status by 2025 and to establish a climate-resilient and low-carbon green economy. Ethiopia has also proposed a national carbon neutrality goal. In order to implement the CRGE, a sector-wide approach known as the Sectoral Reduction Mechanism (SRM) is being proposed. The main purpose of the MRV framework is to outline the approach and methodology for measuring, reporting and verifying results from investment initiatives under the SRM (Wondimagegn, 2013). The main SRM objectives of the MRV framework are as follows:

- to measure and quantify the reduced cost of vulnerability due to the implementation of reduction actions;

- to measure and quantify the achieved emissions reduction due to the implementation of reduction actions; and

- to track progress to achieve a middle-income status with zero net carbon emissions by 2025.

The MRV framework will be used to estimate a national emissions baseline and account for any emission reductions associated with the full CRGE strategy. A CRGE financial facility will be established in order to support implementation of the CRGE objectives – any proposals submitted to the CRGE facility will be required to demonstrate MRV accordingly. This system has been established to capture emissions resulting from actions under the CRGE, rather than tracking progress towards an emission reduction target, although the third objective listed above is about tracking progress towards a GHG goal.

Similarly the MRV+ system conceptualised in Kenya is also more closely aligned with tracking climate actions (mitigation and adaptation) than with tracking an emissions target *per se*. 'Development actions' and their resulting emissions will also be captured. The system aims to draw on synergies between mitigation, adaptation and development (Harries, 2013). However, here international reporting obligations under the UNFCCC are a key component of the MRV+ system and therefore data and information flows will be responding to top-down guidelines. The MRV+ system emerges out of the National Climate Change Action Plan, and links into principles set out in Kenya's Vision 2030 (Jura, 2013). It is also seen as an opportunity to demonstrate financial readiness to attract finance (Republic of Kenya, 2013). The importance to have a strong link to the M&E Directorate (MED) of the Ministry of Planning, National Development and Vision 2030, and Threshold 21 (integrated development model) has been

acknowledged, so that experiences and knowledge of setting indicators and estimating baselines are brought into the MRV+ system indicators and baselines working group (Republic of Kenya, 2013). This approach ensures a more embedded system that addresses broader governmental objectives, not just climate-related ones (GGBP case study). Ultimately, the purpose of the MRV+ system is to help inform the Kenyan government on implementation of response actions, meet international reporting obligations and demonstrate climate finance readiness (Harries, 2013).

National level with GHG goal
Chile has to date been a pioneer in setting ambitious national climate change targets (20% below business-as-usual projected emissions in 2020, projected from 2007 levels, requiring international support) and in submitting NAMAs to the UNFCCC. It is therefore natural progression that their approach towards MRV will be shaped around the MRV of individual NAMAs and eventually culminate in an MRV system of the national goal (expected in 2017). Although the national goal is the driver of climate action, it is the international MRV requirements that are likely to provide the necessary justification to stakeholders to provide the required data and information. Therefore, the MRV system will be informed by the domestic requirements, but justified by the international reporting guidelines. Due to the starting focus being NAMAs, it is the Climate Change Office (which engages in UNFCCC negotiations) which is currently driving MRV activities, although the ambition is to streamline this expertise across departments.

Ghana, on the other hand, is conceptualising an MRV system very much geared towards international MRV requirements. This is essentially a pre-emptive approach for future reporting requirements, which is understandable in the context of capacity constraints. However, the flesh of this system is less driven by domestic priorities and likely to be shaped about the data and reporting formats stipulated by the latest UNFCCC requirements (from the Warsaw COP). Similarly to Chile, the institutions involved are therefore those most engaged in the UNFCCC process. The role of international reporting requirements also resonates quite strongly in the early design stages of the MRV system proposed for Ghana. Although Ghana does not to date have a national goal, the proposed MRV system is primarily designed around international reporting requirements, such as submitting GHG inventory reporting as part of the national communications, reporting and disclosure including the biennial update reports, and demonstrating MRV with regards to the NAMA registry (Baffoe, 2013).

Sectoral objectives
Sector-specific or industry-level objectives can also determine the shape of the MRV system. As an illustrative example take the energy sector – whether it is an energy trading scheme or an emissions standard, it will naturally lead to the development of MRV-type systems that are more focused on more quantitative goals. There may be financial incentives involved (e.g. the demand-side management programme in South Africa) or reputational voluntary reporting within the private sector (e.g. the Carbon Disclosure Project). In some cases the systems may even aim to feed into a market-based mechanism. Therefore the methodologies around emissions accounting or verifying energy savings may be more technical and stringent to ensure a fair playing field. The systems would have to demonstrate compliance and accurate verification. Similarly the level of accuracy, and therefore the extent of verification, may play a strong role in the design of the MRV system. The institutional arrangements will span across sector-specific government departments (such as the Department of Energy in South Africa), private sector stakeholders, and potentially an independent verification body. This differs from a national MRV system designed around a national climate objective, where the institutional arrangement would, for example in South Africa, be located in the DEA.

In Thailand, market mechanisms are being designed to reduce energy consumption and to drive down GHG emissions with the view of moving towards the future establishment of a mandatory emission trading scheme (Sakulku, 2013). The proposed market mechanism is being driven by the Thailand Greenhouse Gas Organisation (TGO) and the Ministry of Energy, Alternative Energy Development and Efficiency (DEDE). The role of standard reporting formats and a well developed IT infrastructure to support such a numerical system, are key. The mechanism entails

a Low Carbon City (LCC) Fund and a trading platform. The trading platform will be implemented through an Energy Performance Certificate (EPC) programme for industry whereas the LCC programme will engage with local municipalities. The aim is also to design new methodologies and standards to assist local municipalities and communities to implement GHG mitigation actions while achieving sustainable development and low-carbon society goals (Sakulka, 2013). The MRV system is being designed to address both these objectives (see Figure 2). The system will be based on mandatory commitments which provide assess to the LCC Fund, and it will provide for voluntary engagement in carbon credits generated in a linked Voluntary Emission Reduction Programme. For industry, the incentive for participating in voluntary reporting programmes is to demonstrate best practice, commercial competitiveness and potentially improving profitability.

The PAT initiative in India is designed to establish a market mechanism and mandatory targets for industry. Sectoral targets have been set for designated high volume energy consumers in certain sectors (e.g. cement, paper and pulp, and iron and steel production) and energy savings will be rewarded with energy savings certificates (ESCerts) which can then be traded. The scheme thus requires standardised MRV protocols. The Bureau of Energy Efficiency is the federal government agency implementing the scheme and the reporting system for the PAT will be achieved through an online tool (Sakulku, 2013).

Driven by sub-national objectives

Local, provincial and national government all play an important role in the delivery of climate projects (Boyd, 2012). Sub-national institutions are also already involved in the collection of data and information on environmental, social and economic activities. Building on this experience, and integrating existing systems into national MRV frameworks is therefore key to developing cost-effective MRV. In many cases, whilst national and international discussions continue on how to design domestic MRV systems, many sub-national governments have set targets – for example as mentioned earlier for some state-level targets in Brazil. Therefore sub-national governments are already active in MRV activities and may actually drive the expansion of MRV systems – be that in scale, geography or sector. In Brazil, interestingly, the MRV system is not just focusing on climate projects or mitigation targets, but there is also a process in place for undertaking MRV on the implementation of national policy objectives outlined in the Plano Nacional sobre Mudança do Clima (or National Plan on Climate Change). Sub-national actors are involved in pursuing this.

The variety of incentives to develop MRV systems also stems from different ministry objectives: MRV of the implementation of the National Development Plan and any associated emissions is in the remit of the Brazilian Ministry of the Environment (MMA); capturing GHG inventory data is the responsibility of the Department of Science and Technology; and MRV at installation level is of interest to the Ministry of Finance. There is acknowledgement that there are different expectations across the States and therefore different priorities concerning MRV systems (Silva, 2013).

In China, efforts are being made to establish a basic statistical system to capture GHG emissions based on the improvement of the energy statistical system (Wang *et al.*, 2013) and also to strengthen GHG emissions accounting across national, provincial, municipal and enterprise level.

Evidently, the drivers behind the development of MRV systems can range from domestic interests to responding to international requirements. Even within these, there are a variety of reasons. Domestic drivers could be linked to green growth objectives, or to national climate targets. International requirements could relate to the UNFCCC or to attracting international finance. All of these factors can carve the shape that MRV systems take.

5. What is an effective and efficient system?

A commonly shared view across the countries is the acknowledgement that establishing MRV systems has implications on resources and capacity – both existing and new. These concerns are generic for many developmental or climate change-related activities and therefore not unique to

the MRV discourse. There is, however, recognition that effective MRV systems are useful to track the implementation of actions against developmental objectives and other climate goals, and hence a willingness to engage on this issue prevails. A system that is both efficient in terms of resources and capacity and effective in terms of tracking progress on implementing actions relies heavily on understanding the existing data and institutional frameworks nationally and sub-nationally, and how best to integrate and establish an MRV infrastructure that builds on this. Building on existing capacity will generally be more cost-effective than creating entirely new capacities.

As introduced in the previous section, domestic interests for developing MRV systems can vary. Creating a new MRV system that purely responds to international UNFCCC reporting requirements will potentially entail different components (to a greater extent new institutions, regulations, etc) than a system that has emerged in response to tracking progress on the implementation of actions aimed at a national developmental goal. An effective balance – whether between national, international, sectoral or subnational – should be ascertained; but clarity on the purpose of the system is key, as is whether its design actually generates the data the country wishes to monitor.

Essentially a system needs to be adequate to its purpose. As a workshop participant remarked, the system 'does not have to be perfect from the word go but must be good enough – avoiding a situation where we have to invest in a polished system before it is useful. The system should be iterative'. This logic resonated for most stakeholders, where a discussion emerged on 'what would the minimal effort look like' in the context of an efficient and effective system – in terms of what would be the key elements if a phased approach to MRV were to be implemented that maximised existing processes rather than starting from scratch.

The required level of accuracy in all stages of MRV also affects the efficiency and viability of a system. A market mechanism-based MRV system requires a commonly agreed methodology and level of accuracy to ensure a fair playing field. Double counting is also an issue that needs to be taken into account, to ensure actions are accurately and fairly reflected. Closely linked to this is harmonisation across reporting channels. Approaches in terms of harmonising data sets, methodologies and reporting templates across different national, regional and local institutions in both the public and private sector could support this (ERC, 2013). However, there was mixed opinion amongst the nine countries on whether focusing resources and efforts towards harmonisation adds or removes inefficiencies from the development of an MRV system (ERC, 2013). If it avoids duplication of reporting or aligns better with, for example, UNFCCC requirements, this is favourable. If many resources are allocated to harmonising two systems that may not align well, this could become an unrealistic and unconstructive endeavour.

Countries are looking for simplified, clear, and implementable first steps for designing their MRV systems and acknowledge that this may be an iterative process.

6.   Synthesis and conclusion

This paper has drawn from case studies of existing MRV-related systems presented at a workshop, as well as further literature on the national contexts to better understand what could be underpinning these MRV systems. Table 4 summarises, based on our findings, some of the key determinants that would inform the institutional arrangements around a domestic MRV system. The table presents findings from two perspectives: firstly, considering national level components relating to a country's political system, climate change policy and existing pledges or NAMA submissions under the UNFCCC; and, secondly, taking the examples of the case studies of existing MRV-related systems presented at the workshop and considering both the domestic interest behind these and whether there are voluntary or mandatory reporting requirements.

		NATIONAL CONTEXT		CASE STUDIES FROM WORKSHOP		
	Political system	Climate change policy	Existing pledges/ NAMA	Example of existing MRV-related system	Voluntary/mandatory reporting requirements	Domestic Interest behind these
Brazil	Presidential republic, Federal	National Climate Plan 2008, Sectoral policy plans 2012, Climate policy plans in 19 provinces	36.1% to 38.9% in 2020 compared to BAU emissions	Existing MRV systems at state level in 3 of 27 state.	At provincial level São Paulo mandatory, Rio de Janeiro and Minas Gerais voluntary, at national level to be defined	State level objectives
Ethiopia	Parliamentary republic Federal	Growth and Transformation plan 2010-2025, includes Climate Resilient Green Economy Plan (CRGE)	Project level voluntary NAMAs, which it is planning to implement by 202010 & Submitted project-level NAMA seeking support for preparation	MRV to implement CRGE	Proposed to be Voluntary for now	Achieving middle income status & climate resilient growth
Chile	Presidential republic, centralized	National climate change action plan (2008-2012), National climate change strategy (2006)	20% below BAU in 2020 (as projected from 2007)	MRV of NAMA in renewable energy and energy efficiency	Mandatory MRV of NAMA according to requirements of the facility/registry	MRV of national target and NAMAs
China	Republic of people, centralised	12th Five year plan under way, sectoral plans, Work Plan for Controlling Greenhouse Gas Emissions during the 12th FYP	Reduce CO2 emissions per unit of GDP by 40-45% compared to the 2005 level by 2020	Statistical data for MRV at GHG emissions and energy consumption in major cities, statistical data collection in provinces	Voluntary in general, 28 mandatory national standards on energy consumption quotas	Strengthening of GHG emissions accounting: national, provincial, municipal and enterprise level
Ghana	Presidential republic, centralised	National Climate Change Policy (NCCP) (2013)	None, specific sectoral targets in NCCP	Data collection on sectoral GHG emissions.	Voluntary, depending on reporting requirements for NAMA support	Being prepared for international reporting, and national GHG goal
India	Parliamentary republic, federal	National Climate Action Plan (2008), Sectoral five year plans	reduce the emission intensity of its GDP by 20 to 25% by 2020 compared to the 2005 level	MRV in energy efficiency, energy consumption data	Mandatory reporting of emissions performance for aviation and telecom. Other sectors are voluntary e.g. CDP, GRI, etc.	Emissions intensity target & energy intensity

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[10]   2011 FCCC/AWGLCA/2011/INF.1 (http://unfccc.int/resource/docs/2011/awglca14/eng/inf01.pdf).

	NATIONAL CONTEXT			CASE STUDIES FROM WORKSHOP		
	Political system	*Climate change policy*	*Existing pledges/ NAMA*	*Example of existing MRV-related system*	*Voluntary/mandatory reporting requirements*	*Domestic Interest behind these*
Kenya	Presidential republic, centralised	National Climate Change Action Plan (2013), linked to Vision 2030 objectives	None, maximum reduction potential of about 15% below the 2010 reference level by 2015	MRV+ system for implementation of action plan in development	Voluntary for now	Reporting on National Climate Change Action Plan
South Africa	Parliamentary republic, centralised	National Climate Change Response White Paper (2011)	Reduce emissions by 34% by 2020 and by 42% by 2025	National M&E system,	Mandatory for entities emitting more than 0,1 Mt per annum	M&E system stipulated in national climate policy
Thailand	Constitutional monarchy, centralised	National Climate Change Master Plan 2012-2050, National Strategy for Climate Change 2013-2017	No pledge under UNFCCC	Data on energy consump-tion (type, amount) in EPC scheme, emissions data for specific actions	Proposal for mandatory reporting, not approved yet	Sector-level energy trading scheme

Conclusion

Essentially, any MRV system will be iterative and there is certainly no silver bullet, no 'one fits all' approach for developing MRV systems. Each will depend on a country's unique circumstances, needs, governing structure, and existing systems. There is already activity happening, however, and there are opportunities for building up from existing approaches and learning from others internationally (ERC, 2013). Building on existing institutions, data, experts, and processes is likely to be most effective in developing countries. Additional information from market-based systems and systems developed by sub-national authorities are likely to benefit the building of national, domestic MRV systems.

Political systems can influence the shape of the MRV system – whether a more centrally managed system such as in South Africa or a more state-driven arrangement such as in the case of Brazil. We distinguish between centralised, mixed and decentralised approaches to MRV. The political systems and existing institutional arrangements affect the domestic approaches in MRV. We find more decentralised approaches to MRV in federal systems and large countries, where local and provincial approaches emerge. We find centralised approaches at the national government level in centrally organised political systems and smaller countries. There may be pros and cons to both approaches – a decentralised approach may be easier to implement however inconsistencies and comparability becomes problematic, whereas a centralised approach may follow a more standardised approach, though remaining more challenging to operationalise.

Domestic interests and drivers motivating the development of the national MRV systems can be broadly grouped into those that pursue outcomes relating to national development goals, and those that are driven by a national climate change objective (e.g. a GHG reductions target). Sectoral objectives can also influence the design of the system and the institutional arrangements surrounding this. Furthermore, there are examples where sub-national governments have set targets, which have therefore driven the development of state-level MRV systems. Institutionally these systems may function in parallel to nationally developed centralised MRV systems.

In terms of implementing an effective MRV system, it is clear that there is no single approach with a comprehensive solution. Therefore, adopting a phased and iterative approach which grows and consolidates over time would provide an opportunity to identify the key elements of the system based on realistic data sets and existing institutional arrangements. The sequencing of these phased systems may be driven by a need or the availability of particular data sets, or initially start with collecting aggregated information at a national level and eventually extend to sub-national level data. Meanwhile it must be recognised that both capacity and data quality issues, as well as supportive institutional arrangements, will also have to be developed over time.

References

Baffoe, J. A. (2013). Ghana's national MRV system. In Poster presented at international workshop 'Sharing international experiences of domestic MRV' 5-6th of September, Energy Research Centre. Cape Town.

Bakker, S. J. A., De Vita, A., & Olivier, J. G. J. (2010). Monitoring emissions and actions in the post-2012 climate regime. Bilthoven: Netherlands Environmental Assessment Agency.

Boyd, A. (2012). MRV across multi-level governance: National, provincial and municipal institutions in South Africa. Cape Town. Retrieved from www.erc.uct.ac.za/Research/publications/13-Boyd-MRV_Multilevel_Governance.pdf

Boyd, A., Rennkamp, B., Dane, A., & Winkler, H. (2013). Current approaches to MRV in South Africa: A scoping study. Climate Policy, (forthcomi. doi:10.1080/14693062.2014.845477.

Breidenich, C., & Bodansky, D. (2009). Measurement, reporting and verification in a post-2012 climate agreement (p. 40). Arlington, VA. Retrieved from http://www.pewclimate.org/docUploads/mrv-report.pdf

Buchner, B., Brown, J., & Corfee-Morlot, J. (2011). Monitoring and tracking long-term finance to support cliamte action (p. 59). Paris.

Cloete, F. (2009). Evidence-based policy analysis in South Africa: critical assessment of the emerging government-wide monitoring and evaluation system. South African Journal of Public Administration, 44(2), 293–311.

Dane, A. MRV of Non GHG aspects of mitigation actions: Developing and approach in the South African context (2012). Cape Town. Retrieved from www.erc.uct.ac.za/Research/publications/13-Dane-MRVnonGHG_Aspects_Mitigation_Actions.pdf

De Vit, C., Röser, F., & Fekete, H. (2013). Measuring, reporting and verifying Nationally Appropriate Mitigation Actions. Retrieved from http://www.ecofys.com/files/files/ecofys-ecn-2013-mitigation-momentum-mrv-paper_02.pdf

DEA. (2010). National Climate Response White Paper. Pretoria: Department of Environmental Affairs. Retrieved from www.info.gov.za/view/DownloadFileAction?id=152834

Ellis, J., Moarif, G., Briner, G., Buchner, B., & Massey, E. (2010). Options to revise reporting guidelines for Annex I and non-Annex I National Communications (p. 61). Paris.

Elsayed, S. (2013). Institutional arrangements for MRV. Retrieved from http://mitigationpartnership.net/sites/default/files/institutional_arrangements_mrv_final.pdf

ERC. (2013). Workshop report. Sharing international experiences of domestic MRV, prepared 23rd September 2013. Cape Town.

Falconer, A., Hogan, P., Micale, V., Vasa, A., Yu, Y., Zhang, X., … Zuckerman, J. (2012). Tracking emissions and mitigation actions: Evaluation of MRV Systems in China, Germany, Italy, and the United States. San Francisco.

Fransen, T., McMahon, H., & Nakhooda, S. (2008). Measuring the way to a new global climate agreement. Washington, DC.

Hänsel, G., Halstead, M., Hinostroza, M., Kato, M., Levin, K., Mitra, A., … Wienges, D. S. (2013). Annual status report on nationally appropriate mitigation actions (NAMAs). (G. Hänsel, F. Roeser, N. Höhne, X. van Tilburg, & L. Cameron, Eds.). Mitigation Momentum Project.

Harries, J. (2013). Kenya's MRV+ system. In Poster presented at international workshop 'Sharing international experiences of domestic MRV' 5-6th of September, Energy Research Centre. Cape Town.

Jura, M. (2013), MRV System for Kenya, Ministry of Environment & Mineral Resources, UNFCCC Regional Workshop on on promoting international collaboration to facilitate preperation, submission and implementation of Nationally Appropriate Mitigation Actions in Africa, Maseru 18th April, 2013

Ke, W., Ji, Z., Xueqin, C., Baolu, Y., (2013). Development and Application of MRV tools at municipal level in China - Poster presented at international workshop 'Sharing international experiences of domestic MRV'm 5-6th of September, 2013, Cape Town

Koakutsu, K., Usui, K., Watarai, A., & Takagi, Y. (2013). Measurement, reporting and verification (MRV) for low carbon development: Learning from experience in Asia (p. 149). Kamiyamaguchi.

Levin, K., & Finnegan, J. (2013). Designing National Commitments to drive measurable emissions reductions after 2020. Washington, DC. Retrieved from wri.org/publcation/measurable-emissions-reductions-after-2020

Lütken, S., Aalders, E., Pretlove, B., Peters, N., & Olsen, K. H. (2012). Measuring, reporting, verifying. A primer on MRV for Nationally Appropriate Mitigation Actions. (M. L. Hinostroza, Ed.) (pp. 1–32). Roskilde: UNEP Risø Centre. Retrieved from http://orbit.dtu.dk/fedora/objects/orbit:112215/datastreams/file_8167750/content

McMahon, H., & Moncel, R. (2009). Keeping track: National positions and design elements. Washington, DC.

Okubo, Y., Hayashi, D., & Michaelowa, A. (2011). NAMA crediting: How to assess offsets from and additionality of policy-based mitigation actions in developing countries. Greenhouse Gas Measurement and Management, 1 2011: 37–46., (1), 37–46.

Palmer Fry, B. (2011). Community forest monitoring in REDD+: The 'M' in MRV? Environmental Science & Policy, 14(2), 181*187. doi:10.1016/j.envsci.2010.12.004.

Pirazzoli, A. (2013). ?? In Poster presented at international workshop 'Sharing international experiences of domestic MRV' 5-6th of September, Energy Research Centre. Cape Town.

Puliti, S. (2012). Analyses of the feasibility of participatory REDD+ MRV approaches to Lidar assisted carbon inventories in Nepal. Second cycle, A2E. Umeå: SLU.

Rennkamp, B. (2012). MRV of mitigation actions: The case of installing solar water heaters in South Africa. Cape Town. Retrieved from www.erc.uct.ac.za/Research/ publications/13-Rennkamp-SA_Approaches_MRV_Mitigation_Actions.pdf.

Sakulku, J. (2013). MRV in Market-based Programs for GHG Emissions Reduction in Thailand. In Poster presented at international workshop 'Sharing international experiences of domestic MRV' 5-6th of September, Energy Research Centre. Cape Town.

Silva, C. (2013). Seeking harmonisation of multi-level MRV systems. In Poster presented at international workshop 'Sharing international experiences of domestic MRV' 5-6th of September, Energy Research Centre. Cape Town.

Teng, F., Wang, Y., Alun, G., & Xu, R. (2009). Mitigation actions in China: Measurement, reporting and verification. Washington DC.

Tyler, E., Boyd, A., Coetzee, K., Torres Gunfaus, M., & Winkler, H. (2013). Developing country perspectives on 'mitigation actions', 'NAMAs', and 'LCDS.' Climate Policy, 13(6), 770–776. doi:10.1080/14693062.2013.823334

UNFCCC (2010). Decision 1/CP.16: The Cancun Agreements: Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention. Document FCCC/CP/2010/7/Add.1. New York, United Nations. Available at http://unfccc.int/files/meetings/cop_16/application/pdf/cop16_lca.pdf.

UNFCCC (2011). Decision 2/CP.17: Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention. Durban, South Africa. Available at http://unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf .

UNFCCC. (2013a). Reporting on national implementation and MRV. Warsaw, Poland. Available at http://unfccc.int/focus/mitigation/items/7173.php.

UNFCCC (2013b). Decision -/CP.19: Composition, modalities and procedures of the team of technical experts under international consultation and analysis (advance unedited version). Warsaw, Poland. Available at http://unfccc.int/files/meetings/warsaw_nov_2013/decisions/application/pdf/cop19_tte_ica.pdf.

UNFCCC (2013c) Decision -/CP.19: General guidelines for domestic measurement, reporting and verification of domestically supported nationally appropriate mitigation actions by developing country Parties (advance unedited version). Warsaw, Poland. Available at http://unfccc.int/files/meetings/warsaw_nov_2013/decisions/application/pdf/cop19_domestic _mrv.pdf.

Wang, K., Zou, J., Cui, X., & Yang, B. (2013). Development and Application of MRV tools at municipal level in China. In Poster presented at international workshop 'Sharing international experiences of domestic MRV' 5-6th of September, Energy Research Centre. Cape Town.

Winkler, H. (2008). Measureable, reportable, verifiable. The keys to mitigation in the Copenhagen deal. Climate Policy, (8), 534–537.

Wondimagegn, M. (2013). MRV framework for the Sectoral Reduction Mechanism. In Poster presented at international workshop 'Sharing international experiences of domestic MRV' 5-6th of September, Energy Research Centre. Cape Town, presenting work undertaken by the Ministry of Environment and Forests, Compliance Monitoring and Control Directorate.