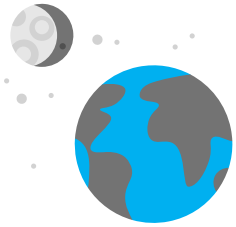

Establishing relevant and high quality domestic MRV systems to support effective climate action

by

Thapelo Clifford Mohale Letete

BSc Chemistry & Mathematics, BSc (Eng.) Chemical Engineering, MSc (Eng.) Chemical Engineering

Thesis presented for the degree of

DOCTOR OF PHILOSOPHY

in

Energy and Development Studies

in the Department of Mechanical Engineering

UNIVERSITY OF CAPE TOWN

12 OCTOBER 2022

Supervisors: Prof. Harald Winkler
Dr Brian Mantlana

Declaration

This thesis is my own unaided work, both in concept and execution, save for that which is properly acknowledged. Apart from the normal guidance from my two supervisors, I have received no other assistance.

ABSTRACT

The adoption of the United Nations Framework Convention on Climate Change (UNFCCC or Convention) at the 1992 Rio Earth Summit marked a decisive global turning point in the fight against anthropogenic climate change. The ultimate objective of the Convention is to stabilize greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference with the climate system within a time frame that allows ecosystems to adapt naturally to climate change.

Transparency, through 'Measurement, Reporting and Verification' (MRV), is one of the key elements of the Convention, required to build mutual trust and confidence and to promote effective implementation. The wording of the Framework Convention itself contains various provisions for MRV, with the information requirements and the frequency for MRV differentiated substantially between developed and developing country Parties. Termed 'the UNFCCC MRV Framework', these MRV requirements together with the related MRV activities within the Convention have been evolving, almost continuously over the years, with the adoption of every major decision by the COP and as calls for more transparency by Parties increase. The Paris Agreement, which is the latest agreement under the Convention, contains the most demanding MRV requirements to date.

To enable themselves to adequately respond to these MRV requirements, Parties to the UNFCCC have been establishing domestic MRV systems. However, the constant evolution of the UNFCCC MRV framework as well as the countries' domestic policies, strategies and laws which keep coming with their own MRV requirements have made ensuring full relevance of these systems to all their reporting requirements as well as maintaining high quality of their outputs a challenge, thereby jeopardizing the ability of those MRV systems to effectively support climate action.

This thesis set out to investigate the factors that affect the success and failure of establishing domestic MRV systems that are fully relevant to the countries' information requirements and of high quality, and to determine a framework which countries can use to establish such systems. The thesis investigated the hypothesis that 'results-based planning through logical modelling ensures maximum relevance of domestic MRV systems and improves their quality.'

In terms of relevance of domestic MRV systems, it was found that relevance can be fully achieved at the planning phase by ensuring that the system's objectives and envisaged outcomes are fully aligned with the country's MRV needs. Furthermore, it was concluded that results-based planning through logical modelling, if undertaken properly, comprehensively, and by an adequately skilled and experienced team, and ideally coupled with monitoring and evaluation, can lead to maximum relevance of the domestic MRV systems.

In terms of quality, it was found that transparency, accuracy, completeness, comparability, consistency and timeliness (TACCCT) adequately capture the quality of domestic MRV systems, and that availability of resources, frequent reporting, third party expert reviews assist in the improvement of the quality for domestic MRV systems. Furthermore, it was determined that only following the steps of results-based planning on their own does not improve the quality of domestic MRV systems, rather it is inclusion of the second part of the planning phase, focusing on monitoring and evaluation, that leads to improved quality of domestic MRV systems. This combination of results-based planning with monitoring and evaluation is also known as results-based management.

The main contribution of this thesis is then the development of a framework that countries can use to establish relevant and high quality domestic MRV systems to support effective climate action.

Dedication

This thesis is dedicated to my beloved 92-year-old dad and my beloved mom who has rested in the Lord, awaiting His second coming!

Psalm 23 – My mom's favourite quotation.

"[1] The LORD is my shepherd; I shall not want.
[2] He maketh me to lie down in green pastures: he leadeth me beside the still waters.
[3] He restoreth my soul: he leadeth me in the paths of righteousness for his name's sake.
[4] Yea, though I walk through the valley of the shadow of death, I will fear no evil: for thou art with me; thy rod and thy staff they comfort me.
[5] Thou preparest a table before me in the presence of mine enemies: thou anointest my head with oil; my cup runneth over.
[6] Surely goodness and mercy shall follow me all the days of my life: and I will dwell in the house of the LORD for ever."

Acknowledgements

Firstly, I'd like to thank God who made completion of this thesis possible. I dreamt about it day and night, and He turned my dream into reality! This thesis stands as an Ebenezer, a book of remembrance, that hitherto hath the Lord helped me!

I'd also like to thank my wife, 'Mampepuoa, and my children, Mpepuoa, Lerotholi and Ntoetse, for their understanding when daddy would take his laptop with him on every family vacation for five years and sometimes pass on or postpone family activities because he's studying! My daughter – Mpepuoa – would even help daddy with proof-reading some parts of the thesis; thank you very much daddy's big girl. Well, that's all history now!! I've got a full list of all the fun things we'll be doing as a family from hence-forth!

My heartfelt appreciation goes to Prof. Harald Winkler and Dr Brian Mantlana, who helped me steer this ship to its destination. Especially Harald, who, before I even decided to pursue a PhD, would always tell me that I should rest assured that he's ready to supervise me the day I make that decision, and he never gave up on me during the PhD journey when I sometimes felt like it's better to just give up!! @Harald, the speed with which you've also been reviewing my work and sending me comments is just phenomenal and highly appreciated!

Special thanks also go to my friends and colleagues who directly contributed to this thesis by accepting my invitation to interview them. From this group I'd like to explicitly mention Mookho Monnapula, 'Malehloa Jockey, Helen Plume, Jongikhaya Witi, Ts'epang Makholela, Anke Herold, Fredrick Ouma, Paula Arbelaez, Camila Vargas, Rizaldi Boer, Sina Wartmann, Randy Caruso, Chris Dragisic and the entire Lesotho case study respondents – thank you very much guys; I'm done troubling you 😊. The same goes for those who gave me advice and information without directly contributing to the thesis, including you, Ticha Nithitsuttibuta! My good friend, Motsomi Maletjane, your assistance with proofreading some of the chapters is also much appreciated.

The enabling environment of the Partnership for Transparency in the Paris Agreement (PATPA) is also hereby acknowledged because it is through those annual PATPA retreats where I met many of the friends and colleagues whom I interviewed, with some interviews even happening in the margins of those retreats.

How can I forget the rest of my family – my brothers and sisters – as well as my friends and colleagues at the Environmental Resources Management (ERM) and at Zutari who always motivated me and checked up on me fearing that perhaps PhD had finally caused "Permanent head Damage" to me! Your support is much appreciated. To my sister – Prof. Puseletso Letete – who availed her house when I needed a quiet place to study or when Eishkom's loadshedding was upon me – thank you very much! You too Minkis, thanx for checking up on me every now and then!

This thesis was made possible through in-kind funding of ERM South Africa, which sponsored me for two years, and Zutari PTY (Ltd), which sponsored me for a year.

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Abbreviations and Acronyms

12th FYP	=	China's 12th Five-year Plan
13th FYP	=	China's 13th Five-year Plan
A1	=	Annex 1
AFOLU	=	Agriculture, Forestry and other Land Use
Art	=	Article
BEIS	=	Department of Business, Energy and Industrial Strategy
BMU	=	German Ministry for the Environment, Nature Conservation, and Nuclear Safety
BMUB	=	German Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
BMUV	=	German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
BR	=	Biennial Report
BTR	=	Biennial Transparency Report
BUR	=	Biennial Update Report
CAP	=	Climate Action Plan
CBIT	=	Capacity Building Initiative for Transparency
CC	=	Climate Change
CCC	=	Climate Change Committee
CDM	=	Clean Development Mechanism
CF	=	Climate Finance
CGE	=	Consultative Group of Experts
CONPES	=	CONSEJO NACIONAL DE POLÍTICA ECONÓMICA Y SOCIAL
CP / COP	=	Conference of Parties
CRIV	=	climate risks, impacts and vulnerability
CSE	=	Central System for Emissions
CTU	=	Clarity, transparency and understanding
DAC	=	Development Assistance Committee
DFFE	=	Department of Forestry, Fisheries and the Environment
DFID	=	Department for International Development
EEA	=	European Environment Agency
EEP	=	Energy and Emissions Projections
EKF	=	Special Energy and Climate Fund (German acronym)
EO	=	Executive Order
ETC/CME	=	European Topic Centre on Climate Change Mitigation and Energy
ETF	=	Enhanced Transparency Framework
ETS	=	Emission Trading Scheme
EU	=	European Union

GAO	=	Government Accountability Office
GCR Act	=	Global Change Research Act
GHG	=	Greenhouse gas
GIZ	=	Gesellschaft fur Internationale Zusammenarbeit GmbH
GWMES	=	Government-wide Monitoring and Evaluation System
IAR	=	International Assessment and Review
ICA	=	International Consultation and Analysis
ICAI	=	Independent Commission for Aid Impact
IFC	=	International Finance Corporation
INDC	=	Intended Nationally Determined Contribution
IPCC	=	Intergovernmental Panel on Climate Change
IPPU	=	Industrial Processes and other Product Use
LMS	=	Lesotho Meteorological Services
M&E	=	Monitoring and Evaluation
M&V	=	monitoring/measuring and verification
MfE	=	Ministry for the Environment
MMR	=	Mechanism for Monitoring and Reporting
MoEF	=	Ministry of Environment and Fisheries
MoI	=	Means of Implementation
MPGs	=	Modalities, procedures and guidelines
MRV	=	Measurement, Reporting and Verification
N/A	=	Not Applicable
NA1	=	Non-Annex 1
NAP	=	National Adaptation Plan
NAPA	=	National Adaptation Programme of Action
NAS	=	National Adaptation Strategy
NaSE	=	National System of Emissions
NC	=	National Communication
NCA	=	National Climate Assessment
NCCA	=	National Climate Change Assessment
NCCAP	=	National Climate Change Action Plan
NCCIS	=	National Climate Change Information System
NCCP	=	National Climate Change Policy
NCCPIS	=	National Climate Change Policy Implementation Strategy
NCCRWP	=	National Climate Change Response White Paper
NDC	=	Nationally Determined Contribution
NDP	=	National Development Plan
NDRC	=	National Development and Reform Commission
NIR	=	National Inventory Report

NPBMF	=	National Performance and Benefit Measurement Framework
NRS-CC	=	National Registry System for Climate Change
NZ	=	New Zealand
ODA	=	Official Development Assistance
OECD	=	Organization for Economic Co-operation and Development
OMB	=	Office of Management and Budget
PAMS	=	Policies and Measures (including strategies, actions and laws)
PNACC	=	National Climate Change Adaptation Plan (Spanish acronym)
PNCC	=	National Policy on Climate Change (Spanish Acronym)
QA/QC	=	Quality Assurance / Quality Control
RAN-API	=	National Action Plan for Climate Change Adaptation (Bahasa Indonesia acronym)
RCP	=	Representative Concentration Pathway
REDD+	=	Reducing Emissions from Deforestation and Land Degradation
SIDIK	=	Vulnerability Index Data and Information System (in Indonesian)
SIGN-SMART	=	National GHG Inventory System / Sistem Inventarisasi GRK Nasional
SINGEI	=	Colombian GHG Inventory System (Spanish acronym)
SMMARE	=	Modular System for Monitoring Actions and GHG Emission Reductions
SIRENE	=	Brazil's National GHG inventory System (Spanish acronym)
TACCC	=	Transparency, Accuracy, Completeness, Comparability & Consistency
TACCCT	=	Transparency, Accuracy, Completeness, Comparability, Consistency & Timeliness
TER	=	Technical Expert Review
TNA	=	Technology Needs Assessment
TTG	=	Thematic Technical Group
UK	=	United Kingdom
UNDP	=	United Nations Development Program
UNFCCC	=	United Nations Framework Convention on Climate Change
UNODC	=	United Nations office on Drugs and Crime
USA	=	United States of America
USAID	=	United States Agency for International Development
USGCRP	=	United States Global Change Research Program
WAM	=	With Additional Measures
WEM	=	With Existing Measures

1 Introduction

1.1 Background

The adoption of the United Nations Framework Convention on Climate Change (UNFCCC or Convention) at the 1992 Rio Earth Summit marked a decisive global turning point in the fight against anthropogenic climate change. Since then, a total of 195 countries have ratified the Convention and become party to it. The ultimate objective of the Convention is to stabilize greenhouse gas (GHG) concentrations "*at a level that would prevent dangerous anthropogenic interference with the climate system*" within a time frame that allows ecosystems to adapt naturally to climate change (United Nations, 1992). The six key elements of the Convention are mitigation, adaptation, transparency, technology development and transfer, climate finance and capacity-building (UNFCCC, 2011). The latter three are commonly referred to as means of implementation (MoI).

The original text of the Convention presents the first attempt at a comprehensive approach to achieving the objectives of the Convention, but by 1995 it was clear that the emission reduction provisions in the Convention were "*inadequate*" (UNFCCC, 2014; United Nations, 2014). The Kyoto Protocol, adopted in 1997, was the second attempt. While the Kyoto Protocol had many strengths and achievements, it too, fell short of achieving the objectives of the Convention fully (Claussen, 2000). From 2005 Parties under the UNFCCC started discussions of an adequate global climate deal, which turned into formal negotiations from 2007, leading to the third and much anticipated attempt at the 15th Conference of Parties (COP) to the UNFCCC in Copenhagen in 2009 which failed to agree to a treaty (Environmental and Energy Study Institute, 2014; European Commission, 2007). In December 2015 the 21st Conference of Parties finally adopted the Paris Agreement which seeks to address the inadequacies of the original Convention and the Kyoto Protocol and is envisaged to guide long-term global climate action (UNFCCC, 2015).

Transparency, through "Measurement, Reporting and Verification" (MRV[1]), is one of the key elements of the Convention, required to "*build mutual trust and confidence and to promote effective implementation*" (UNFCCC, 2015). The wording of the Framework Convention itself contains various provisions for MRV, with the information requirements and the frequency for MRV differentiated substantially between developed and developing country Parties (United Nations, 1992; Morgan, 2011). Termed "the UNFCCC MRV Framework", these MRV requirements together with the related MRV activities within the Convention have been evolving, almost continuously over the years, with the adoption of every major decision by the COP and as calls for more transparency by Parties increase. The latest major enhancements to this MRV framework were adopted as part of the Cancun agreements in 2010, and more recently, as part of the Paris Agreement. Under the Paris Agreement, this MRV framework is called the Enhanced Transparency Framework (ETF) and is presented in Article 13 of the Paris Agreement as well as in paragraphs 84 to 93 of the Decisions to give effect to the Paris Agreement, termed Decision 1/CP.21 (UNFCCC, 2015). The modalities, procedures and guidelines (MPGs) of the ETF were adopted at the COP serving as the meeting of the Parties to the Paris Agreement in its first session, held in Katowice in December 2018 (UNFCCC, 2018).

[1] The term MRV is discussed in detail in Chapter 2. At this stage it suffices to define it as "Measurement, Reporting and Verification"

Strong institutional, procedural and legal arrangements (collectively termed "systems") at domestic level are "vital to enabling countries to provide reliable, comprehensive and regularly updated information that meets the UNFCCC MRV Framework requirements and serves national decision makers and action-implementing stakeholders" (Consultative Group of Experts, 2020). As such, Parties to the Convention have been establishing domestic MRV systems[2] to varying degrees, at different times and pace to enable themselves to properly respond to their MRV requirements and obligations.

However, over the years countries have had challenges with ensuring relevance and quality of their domestic MRV systems. This thesis investigates the relevance and quality of domestic MRV systems for supporting effective climate action and presents guidance on how countries can establish domestic MRV systems that are relevant and of high quality.

1.2 Problem Statement

MRV is essential in climate change response to build mutual trust and confidence among stakeholders and to promote effective implementation. As such the UNFCCC has established an MRV framework requiring its Parties to compile and report certain information at specified frequencies. To enable themselves to adequately respond to these MRV requirements, Parties to the UNFCCC have been establishing domestic MRV systems. However, ensuring full relevance of these systems to all their reporting requirements as well as maintaining high quality of their outputs has been a challenge for most countries, and this, in turn, has jeopardized the ability of those MRV systems to effectively support the building of mutual trust and confidence among stakeholders as well as effective implementation of the Convention.

Specifically, the following challenges have affected the relevance and quality[3] of domestic MRV systems:

1. Firstly, the evolution of the UNFCCC MRV framework over time has meant that new reporting requirements for Parties have continuously been introduced and/or existing ones enhanced in terms of content and/or reporting frequency, while the domestic MRV systems that already existed when the changes were introduced may not be setup to respond to those new requirements either in part or in totality, thereby reducing the relevance and quality of the systems in relation to that newly updated MRV framework.

   For instance, when the Cancun MRV framework came into effect, developed countries generally had domestic MRV systems established for GHG inventory compilation which had been set up to respond to their annual reporting obligations under the Convention. This meant that unless those countries updated those domestic MRV systems accordingly, in their existing state they will have very poor relevance to the new framework and the outputs will not meet the quality required.

   Similarly, the ETF of the Paris Agreement has introduced additional reporting requirements that were not in the Cancun MRV Framework, but many countries have either initiated or already completed establishing their domestic MRV systems based on the Cancun MRV Framework requirements. This means that those domestic MRV systems may not be relevant to the new reporting requirements of the ETF and any attempt to use those systems in their

[2] The term "domestic MRV system" has been defined in more detail in the next chapter.
[3] Relevance and quality have been defined in Chapter 3 of this thesis.

current form to respond to the new reporting requirements of the ETF is likely to compromise the quality of their outputs.

2. Secondly, parallel to setting up domestic MRV systems, Parties to the UNFCCC have also been establishing domestic, regional and bilateral policies, strategies, decrees, laws, frameworks and plans for climate change response (hereinafter referred to as "policies and measures", or PAMs), and these PAMs often have their own measurement, reporting and verification requirements and implications which may be different from those under the UNFCCC MRV Framework. This means that those domestic MRV systems that have been established before the PAMs and were based on the UNFCCC MRV Framework will neither have adequate relevance, if any, to these new PAMs MRV requirements nor meet their quality requirements.

   For instance, a domestic climate change policy may require tracking and reporting of domestic climate finance which is not required under the UNFCCC MRV Framework, or a developing country may have a domestic law requiring annual tracking of national GHG emissions instead of the biennial requirement under the UNFCCC MRV Framework. As such a domestic MRV system established to respond to the UNFCCC MRV Framework will not be able to adequately respond to these new requirements.

3. Finally, there exists no comprehensive guidance, covering all elements of the Convention, that countries can use to ensure relevance and quality of their domestic MRV systems, whether for countries designing such systems from scratch or those that need to amend existing systems.

   For instance, there are countries that were in the middle of developing their domestic MRV systems when the Paris Agreement was adopted, and those countries had to stop those activities and go back to the drawing board to redesign systems that will assist them to respond to the new ETF requirements, but some of them have spent as much as six years trying to figure out how to do this properly.

   The closest existing tool to such guidance is the "2020 Handbook on institutional arrangements to support MRV/transparency of climate action and support"[4] compiled by the Consultative Group of Experts (CGE) under the UNFCCC. However, that handbook too falls short in many respects. It does not give guidance on how countries can determine and address MRV requirements that are outside the UNFCCC MRV Framework. Furthermore, it is silent on how countries can ensure that their MRV systems are relevant to all the country's reporting and information requirements, as much as it is silent on what quality means for domestic MRV systems and how it can be enhanced at the design and implementation phases.

There is therefore a need to understand how countries can design and implement domestic MRV systems that are fully relevant and of high quality to support effective climate action.

1.3 Research objective

The objective of this thesis is to investigate the factors that affect the success and failure of establishing domestic MRV systems that are fully relevant to the countries' information requirements and of high quality, and to develop a framework which countries can use to establish such systems.

[4] This handbook has been discussed in more detail in Chapter 2

1.4 Key research questions

Based on the research objective, the key research question can thus be framed as follows: "**What are the key determinants of relevant and high quality domestic MRV systems, and how can such systems be established?**"

This overarching key question can be broken down into the following questions which the thesis will answer individually:

1. What are the drivers for the development of domestic MRV systems by the different countries, and which ones have been prioritized?
2. How have the different countries designed and established their domestic MRV systems? What lessons can be drawn from the observed trends?
3. What does relevance mean for domestic MRV systems? How can it be defined, measured and maximized? How relevant are the established domestic MRV systems?
4. What does quality mean for domestic MRV systems? How can it be defined, measured and improved? What can be learnt from the quality of existing domestic MRV systems?
5. How can countries establish relevant and high quality domestic MRV systems that support effective climate action?

1.5 Outline and structure of the thesis

This thesis is presented over ten chapters that can be grouped into three stages: 1) preparatory stage, 2) results stage and 3) concluding stage.

The preparatory stage starts with the current introductory chapter and moves on to the review of relevant literature (Chapter Two), followed by the theoretical framework (Chapter Three). It is in the theoretical framework chapter that a hypothesis is formulated and presented. Furthermore, the theoretical framework does not only inform the methodology chapter that follows it (Chapter Four), but it also forms the framework upon which the rest of the thesis is based, including the presentation and interpretation of the results.

Guided by the theoretical framework, the second stage of the thesis develops and presents results. This stage starts with an assessment of "MRV needs" in Chapter Five, followed by the results of reviewing and studying how different countries have established their domestic MRV systems in the sixth chapter. From there the thesis focuses on the results of assessing the relevance of established domestic MRV systems (Chapter seven), as well as one system that is in design phase, as a case study (Chapter Eight), thereby identifying key factors that determine the success and failure of establishing relevant MRV systems. In Chapter Nine, the thesis shifts from relevance to quality, where quality results of the domestic MRV systems and the factors affecting the success and failure of establishing systems of high quality are presented and discussed.

Finally, the thesis concludes in Chapter 10 with a consolidation of the key findings, including findings in relation to the hypothesis, and a summary of how the thesis answered the key research questions. It is also in this chapter that the limitations of the thesis, further areas of research and the contribution of this thesis to the body of knowledge are outlined.

This thesis outline and roadmap is presented schematically in Figure 1 below.

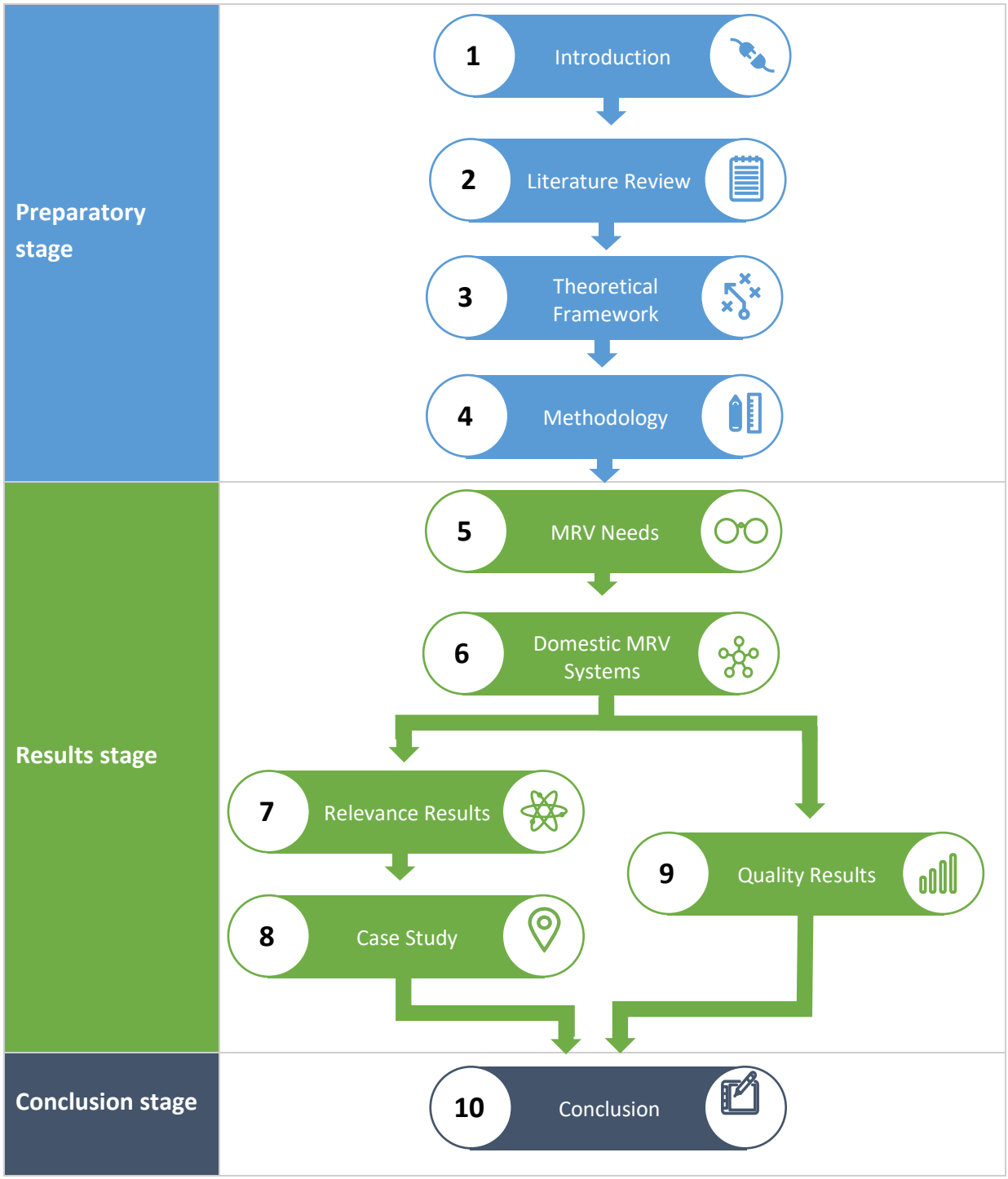


Figure 1: Schematic representation of the thesis outline and structure.

2 Literature Review

This chapter presents a review of the key literature relevant to this thesis. Three bodies of literature are reviewed in turn: Firstly literature on the UNFCCC and its processes (section 2.1), secondly literature on transparency, measurement, reporting and verification (sections 2.2 to 2.4), and finally literature on domestic MRV systems (section 2.5).

2.1 The UNFCCC: Structure, processes, and progress

The UNFCCC entered into force on 21 March 1994 after it was ratified by 50 countries, and as of 2022 it had 197 members, that are referred to as Parties to the Convention (UNFCCC, 2022a). It is organized on a "framework to protocol" basis, which means that the general principles are proposed in the framework to be later specified in protocols (Friman, 2013; Bodansky, 2015). A Party to the Convention may also choose to ratify and become Party to any of its protocols.

The supreme decision-making body of the Convention is called the Conference of Parties (COP), and it normally meets once a year. All Parties to the Convention are represented at the COP, at which the implementation of the Convention and any other legal instruments that the COP adopts are reviewed and the necessary decisions to promote effective implementation of the Convention are negotiated and adopted through consensus (UNFCCC, 2017). The COP presidency rotates among the five recognized regions of the United Nations (UN) – Africa; Asia; Latin America and the Caribbean; Central and Eastern Europe; Western Europe and Others (ibid).

The original text of the Convention contains several obligations to which all Parties to the Convention commit to, in line with the Convention's principle of common but differentiated responsibilities and respective capabilities (United Nations, 1992). These include the commitments to develop, periodically update and publish "*national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol*", termed National GHG inventories, and to submit national communications of information related to implementation of the Convention to the COP (ibid). Furthermore, Parties to the Convention commit to undertaking several other activities to contribute to the achievement of the convention, including implementing measures to mitigate climate change and measures to adapt to the impacts of climate change (ibid).

The Kyoto Protocol was the first protocol to be adopted under the Convention. It was adopted at the 3rd meeting of the COP, and it entered into force in 2005. In December 2015 the 21st COP adopted the Paris Agreement as the second and latest protocol under the Convention (Figure 2 below).

Figure 2: The timelines of the UNFCCC and its two protocols

***Source**: Adapted from (ATSE, 2020)*

The Paris Agreement sets an ambitious target of holding the increase in the global average temperature to well below 2°C above pre-industrial levels while pursuing efforts to limit the temperature increase to 1.5°C (UNFCCC, 2015). In contrast to the Kyoto Protocol, the Paris Agreement approach to mitigation is primarily "bottom up" in nature, requiring countries to submit their Nationally Determined Contributions (NDCs) every five years, with a requirement for Parties' successive NDCs to represent a progression on the last, and reflect the Parties' highest possible ambition (ibid). On adaptation, the Paris Agreement established a global goal of "*enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change*, *with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the global temperature goal*", requiring all Parties, "as appropriate," to plan and implement adaptation efforts, encouraging all Parties to report on their adaptation efforts and/or needs and committing enhanced adaptation support for developing countries (ibid). The Agreement emphasised that support, including financial support, capacity-building support and technology transfer will continue to be provided to developing countries to support them in achieving their obligations under the agreement. It also reaffirmed "the binding obligations of developed countries under the UNFCCC to support the efforts of developing countries, while for the first time encouraging voluntary contributions by developing countries too" (ibid).

To track progress of its implementation, the Paris Agreement established an enhanced transparency framework, with built-in flexibility for those developing countries that need it light of their capacities (UNFCCC, 2015). The ETF and its MPGs are meant to build upon and eventually supersede the MRV Framework established under the Convention (ibid).

The ETF and the UNFCCC MRV framework are discussed in more detail in section 2.3 of this thesis. But first it is important to understand the key concepts of MRV and MRV system.

2.2 Defining "Measurement, Reporting and Verification" (MRV) and MRV systems

This section presents a review of literature on the two key terms of 'MRV' and 'domestic MRV system', which are at the heart of this thesis. It finally concludes by establishing working definitions of these terms.

2.2.1 Origins and evolution of MRV

The term MRV was first used in the UNFCCC as part of the Bali Action Plan in 2007 in relation to:

- "Measurable, reportable and verifiable nationally appropriate mitigation commitments or actions" by developed country Parties, and
- "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" (UNFCCC, 2007).

In 2009 MRV featured as an important element of the Copenhagen Accord, which was agreed upon by 114 Parties to the Convention, where developed country Parties to the Accord committed to have their emission reductions and financial support to developing countries "measured, reported and verified" (UNFCCC, 2009). Developing country Parties, on the other hand, committed to having all their mitigation actions subjected to their respective "domestic measurement, reporting and verification" and to report them to the COP every two years, while their supported nationally mitigation actions would also undergo "international measurement, reporting and verification" (ibid).

A year later in 2010, most of this MRV thinking from the Copenhagen Accord made it to the Cancun Agreements that were adopted at the 16th Conference of Parties and termed the *Cancun MRV System or Framework* (UNFCCC, 2015). The Cancun MRV Framework, whose guidelines were adopted at the 17th and 18th COPs in Durban and Qatar respectively, included:

- enhanced reporting in National Communications for all Parties, including biennial update reporting (BUR) by developing countries and biennial reporting (BR) by developed countries,
- domestic and international MRV of internationally-supported mitigation actions of developing countries and the corresponding support,
- domestic MRV of Nationally-Appropriate Mitigation Actions (NAMAs) undertaken with domestic resources, and
- MRV of anthropogenic forest-related emissions by sources and removals by sinks, forest carbon stocks and REDD+[5] (UNFCCC, 2010).

Since then the use of the term MRV has been expanding, in UNFCCC negotiations, in academia and in practice, to incorporate climate change information more broadly, including greenhouse gas information (Niederberger & Kimble, 2011; Dagnet, et al., 2014; UNFCCC, 2015; Singh, et al., 2016), information contained in National Communications to the UNFCCC (Niederberger & Kimble, 2011; Dagnet, et al., 2014; UNFCCC, 2015), impacts of climate change (Dagnet, et al., 2014), carbon off-set information (Niederberger & Kimble, 2011), information related to climate change adaptation (UNFCCC, 2015; Wiener, 2015; Dagnet, et al., 2014; Morgan, 2011), mitigation policies and actions (UNFCCC, 2015; Wiener, 2015; Dagnet, et al., 2014; Morgan, 2011; Winkler, 2008), co-benefits of mitigation policies and actions (Wiener, 2015; Winkler, 2008) as well as information on means of implementation (UNFCCC, 2015; Wiener, 2015; Dagnet, et al., 2014; Morgan, 2011; Winkler, 2008).

The UNFCCC itself does not have a formal definition of MRV (Breidenich, 2009). Many authors have defined MRV based on their understanding, and sometimes context, with most defining the terms "measurement", "reporting" and "verification" individually. Table 1 summarizes various definitions of individual components (M, R and V) of MRV from literature.

[5] REDD+ refers to reducing emissions from deforestation and land degradation (REDD), as well as conservation of forest stocks, sustainable management of forests and enhancement of forest carbon stocks (REDD+).

Table 1: Definitions of "Measurement", "Reporting" and "Verification" in literature

***Source**: Author's own analysis, drawing on sources cited in first column*

Source	Measurement	Reporting	Verification
Wemaere (2009)	"Applies to a given object (action / commitment / support to action) to be realized in response to a specific obligation, which requires Parties to collect and compile national information / data / statistics in relation to this object, that are complete, accurate and consistent overtime, for reporting purposes."	"Implies the compilation and availability of national data and statistics for information and/or scrutiny. Reporting requirements may cover issues other than those subject to measurement."	"Implies the establishment of a process whereby reported information is subject to a technical review, including a comprehensive and objective assessment of completeness, accuracy and quality."
Dagnet et al. (2014)	"Describes all the steps and procedures taken by countries to collect data and information on emissions, mitigation actions, adaptation programs, capacity building, and financial and technical support provided or received."	"All the steps and procedures taken by countries to compile the collected information in reports and inventories, according to a predetermined format and standards"	"Steps and procedures taken to subject the reports to some form of review or analysis"
Morgan (2011)	"Measurement involves describing a phenomenon in precise terms and in an objective manner, by means of units of measurement. Thus, whatever is measured must be quantifiable."	"Reporting of the measured information to permit others to assess what countries are doing and how successful they are in meeting their commitments."	"Verification typically refers to the process of independent checking of the factual accuracy and reliability of reported information…. In principle, verification is a technical and non-judgemental task. In reality, however, verification may involve elements of review, as the uncertainty and technical difficulties in measuring the impact of certain climate actions inevitably call for expert judgement of the appropriateness of the methodologies used to estimate outcomes and the ultimate veracity of the reported information"
Sharma & Desgain (2013)[6]	***In relation to NAMAs***: "Collection of relevant information on the progress and results of the NAMA"	"Communicating the measured information in a transparent and standardized manner"	"Assessing the completeness, consistency and reliability of the information by an independent process"

[6] Defined in the context of MRV of NAMAs only

Source	Measurement	Reporting	Verification
Falconer et al. (2012b)	"It refers to direct measurement of emissions, abatement, or some other outcome and to estimate based on proxy indicators or data."	"It refers to the presentation and transmission of data, measurements, and associated analysis"	"It refers to the evaluation of the emissions, abatement, and other information that is measured and reported"
Lovbrand & Stripple (2009)	"The actual accounting techniques and methods that state and non-state actors may employ when estimating GHG emissions and removals."	"Specifies the format, units and timing such estimates should be communicated in."	"Refers to an independent double-checking of these estimates."
Fransen (2009)	"Is understood to refer not only to direct physical measurement, but also to estimation based on indicators. 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."	"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."
Breidenich (2009)	"The function of measurement is to describe a phenomenon in reasonably precise, objective terms—that is, in terms of an established standard or 'unit of measurement'. Often, it is not practical or even possible to measure an attribute directly, so measurement may even use indirect indicators or inferences."	"Successful reporting is a function of two factors: (1) the precision and reliability of the reported information, which links with measurement, and (2) the degree to which information is presented in a transparent and standardized way that allows comparisons between reports and verification by others. Reporting can be self-reporting or reporting by business or non-government actors, independent experts or international institutions."	"Verification generally refers to the process of independently checking the accuracy and reliability of reported information or the procedures used to generate information, although the term is occasionally used differently in international law…" "While verification is often associated with 'review' (and in some cases the two overlap), they are not synonymous. Generally speaking, verification is a technical, non-judgmental function, in contrast to review, which may contain more political elements."

Table 1 shows that most scholars agree on what measurement and reporting entail: the former covers collection of data and information by means of actual measurement or use of indirect proxy indicators, while the latter involves communication or submission of the measured information and other related information in a transparent manner. In relation to verification, however, while there seems to be general consensus in the literature presented in Table 1 that it is an independent process concerned with assessing the transparency, accuracy, consistency, completeness and comparability of the information, or parts thereof, there is no consensus on whether it goes further to include evaluation or value judgement of the merits of the reported information, including assessment of compliance. A working definition of MRV adopted and used in this thesis is presented in section 2.2.4 below.

A review of literature also shows that, while the term "measurable, reportable and verifiable" was only first used in the UNFCCC in the Bali Action Plan, the activities of measuring, reporting and verification have existed in the UNFCCC from its inception, being enshrined in the wording of the Convention itself, in the form of national GHG inventories and National Communications (Fransen, 2009; Niederberger & Kimble, 2011; UNFCCC, 2015; McMahon & Moncel, 2009).

According to Sharma and Desgain (2013), who are researchers at the UNEP Copenhagen Climate Centre, *"MRV* is *not a new concept, instead it has been widely used in many contexts at the national and international levels to ensure transparency and help in effective implementation*" and a common term for it is Monitoring and Evaluation (M&E) (Sharma, 2014). A further review of literature shows that the terms MRV and M&E are often used interchangeably by many institutions and practitioners, and many of them even refer to MRV as "*Monitoring, Reporting and Verification*" instead of Measurement, Reporting and Verification (Niederberger & Kimble, 2011; UNEP Riso, 2011; Gupta & Mason, 2014; Wiener, 2015; Nortje, 2013). For instance, Garibaldi et al. (2014) assessed various ways in which action and finance can be catalysed through mitigation and adaptation synergies, and concluded that one way would be through commitments by countries to develop national systems for "*MRV/M&E of mitigation*", while Perera et al. (2015) identified the development of "*MRV/M&E systems* that deal with international climate change reporting such as Intended Nationally Determined Contributions as one of the opportunities where donors, researchers, and development practitioners can immediately strengthen the connection between energy access and adaptation". Similarly, in her Masters thesis that explored the capturing of co-benefits from climate change mitigation actions at municipal level, Nortje (2013) states that "*the words or phrases monitoring and evaluation (M&E), monitoring/measuring and verification (M&V), monitoring, reporting and verifying (MRV) are used interchangeably*", although she acknowledges that the use of the different words can indicate significantly different practices or processes. Using the same principle, Wilkes et al. (2011) argue that existing national agricultural extension systems in developing countries already have some means of MRV, commonly referred to as agricultural M&E systems. Finally, in their review of the assessment of domestic MRV systems of four large GHG emitters, Rahat and Holvoet (2016) also concluded that the assessment shows that "*monitoring is stronger than evaluation*" in those four MRV systems.

Likewise, many countries also link the two terms or use them interchangeably in their official documents. For instance South Africa has named its domestic MRV System the National Climate Change Response M&E System (Department of Environmental Affairs, 2014; Republic of South Africa, 2015), while Namibia and Ghana both state, in the MRV chapters of their Biennial Update Reports, that both countries already have operational M&E systems, but because the MRV systems required under the climate change framework are more demanding that these M&E systems, their approaches

to developing and operationalizing their domestic MRV systems will involve integration of MRV requirements under the climate change framework into their existing M&E systems. (Republic of Namibia, 2014; Republic of Ghana, 2015). In the same manner, Ethiopia, Kenya, Liberia, Nepal, Uganda and Vietnam have all identified MRV systems for estimating and reporting emission reductions from forests as principal tools for monitoring and evaluation within their M&E frameworks for REDD+ (Ethiopia REDD+ Secretariat and Baastel, 2014; Kenya Forest Service, 2010; Nepal Ministry of Forests and soil conservation, 2013; Uganda REDD+ Secretariat and Baastel, 2015; Liberia REDD Implementation Unit & Le Groupe-conseil baastel Itee, 2013; Socialist Republic of Vietnam, 2010).

On the other hand, there are those climate change practitioners who make a distinction between the terms MRV and M&E, arguing that while the processes may be the same or similar, MRV is more suited for use in reference to processes under the UNFCCC while M&E is more commonly used to refer to domestic processes (Spearman & McGray, 2011).

The reviewed literature further shows that there is consensus among climate change practitioners that the concept of transparency is also intimately related to MRV and M&E. For instance:

- Paragraph 4 of Article 13 of the Paris Agreement talks about the **transparency** arrangements of the Cancun **MRV** system, including national communications (UNFCCC, 2015);
- In reviewing MRV literature for a Masters thesis, Kamil (2013) found that "**MRV** is crucial since it entails provisions of **transparency** and accountability which are needed to assess countries' performance and compliance to the decisions made in the international climate change negotiations".
- Dagnet et al. (2014) explored options for enhancing the MRV framework in the post-2020 climate regime and found that **MRV** provides **transparency**, and therefore varying **MRV** requirements between developed and developing countries create different levels of **transparency**.
- Gao and Wang (2018) use the terms MRV and transparency interchangeably in their "review of the operationalization of the common but differentiated responsibilities and respective capabilities principle in the transparency framework under the international climate change regime", and they further assert that "some developing countries employ a certain extent of legislation to regulate the **MRV** practice under the **transparency** system".
- As part of their conclusions from a critical assessment of transparency in global environmental governance, Gupta and Mason (2014) assert that **transparency** is implicated in the design of robust international **MRV** systems for global climate mitigation; and
- In its second Biennial Update Report to the UNFCCC, Lebanon has stated that "the requirements of the Paris Agreement's article 13 on **transparency** call for a considerable improvement of Parties' **MRV systems** to reach a mechanism that ensures the periodic flow of needed information while ensuring the transparency, accuracy, completeness, consistency and comparability in all of its components" (Ministy of Environment Lebanon, 2017).

Evidently, while the term MRV is relatively new, its related, overlapping and often interchangeable sister terms of M&E and transparency have been studied and used for much longer. The next section, therefore, looks at these latter terms in more detail in the quest to further understand MRV.

2.2.2 Transparency, monitoring, and evaluation

A review of literature on M&E revealed that there is no single, uncontested definition of M&E. There is, however, a commonly used definition which comes from the Organization for Economic Co-operation and Development (OECD) (The World Bank, 2009; Naidoo, 2011), which expresses the terms "monitoring" and "evaluation" separately as follows (OECD, 2002):

> *Monitoring is a continuous function that uses the systematic collection of data on specified indicators, to provide management and the main stakeholders of an on-going development intervention with indicators of the extent of progress and achievement of objectives and progress....*
>
> *Evaluation is the systematic and objective assessment of an on-going or completed project, program, or policy, including its design, implementation, and results, with the aim of determining the relevance and fulfilment of objectives, development efficiency, effectiveness, impact and sustainability. It should provide information that is credible and useful, enabling the incorporation of lessons learnt into decision-making process."*

Whilst "monitoring" and "evaluation" are defined independently of each other, with the former defined as a continuous function while the latter is episodic, Naidoo (2011) cautions that this is too simplistic a distinction. He argues that in practice "the two are inter-related and the sequencing is not as linear as one following the other, but rather dynamic, depending on the situation" (ibid). He further asserts that in doing monitoring, one is also evaluating, hence it is more useful to refer to and to discuss the holistic process of M&E as opposed to just evaluation or monitoring. Woodhill (2007) shares the same view, noting that "monitoring" and "evaluation" are overlapping spheres of activity and information, and that "where monitoring stops and evaluation begins is rather less clear than M&E theory often claims".

Woodhill therefore defines M&E holistically as:

> *"an integrated process of continual gathering and assessing information to make judgements about progress towards particular goals and objectives, as well as to identify unintended positive or negative consequences of action, and providing insight into why success or failure has occurred"* (Woodhill, 2007).

This definition is consistent with the view of many evaluation practitioners that view evaluation as the overall discipline, with monitoring regarded as a subset of evaluation, guided by its theoretical, and practice conventions (Markiewicz & Patrick, 2016; Patton, 2008; McDavid, et al., 2013)(.

In his assessment of the purposes and types of M&E, Naidoo (2011) determined that there is a spectrum of views on what M&E should achieve, but identified three distinguishable objectives as:

- Supporting an accountability function,
- Promoting transparency, and
- Promoting learning.

In addition to these three objectives, Woodhill (2007) further identified the following key functions of M&E:

- "Supporting operational management: *providing basic management information needed to direct, coordinate and control resources required to achieve any given objective*;
- Supporting strategic management: *providing the information for and facilitating the process required to set and adjust goals, objectives and strategies and to improve quality and performance;* and
- Empowerment."

The term "transparency", on the other hand, in its primary usage relates to physical properties of materials or objects, and is defined as having the property of transmitting light, so that objects behind can be distinctly seen (Oxford Dictionary, 2016). When used metaphorically, as in governance and policy, information or a process is categorized as transparent if it is open and available for examination and scrutiny (Schauer, 2010; Oxford Dictionary, 2016).

A review of relevant literature shows that the term "transparency" has been used for much longer than MRV within the UNFCCC. According to Wang and Gao (2018), the Convention has required the information provided by the Parties to be "transparent, consistent, comparable, complete, and accurate," since its first reporting guidelines.

According to Touchard (2019), the objective of promoting transparency and sharing information within the UNFCCC is to increase trust, confidence and accountability amongst Parties, and to reduce free-riding. These objectives of transparency can also be extracted from Article 13 of the Paris Agreement where the Enhanced Transparency Framework is presented. What is also clear from that Article is that the objectives of ETF are consistent with those of M&E as discussed above (UNFCCC, 2015). Specifically:

a. The overall objective of the Enhanced Transparency Framework is to "build mutual trust and confidence and promote effective implementation" (UNFCCC, 2015). This is consistent with the M&E objectives of *accountability, transparency* and *supporting operational and strategic management*.
b. The "framework for transparency of action aims to provide clear understanding of climate action in light of the Convention's adaptation and mitigation objectives" (UNFCCC, 2015). This is consistent with M&E objectives of *supporting operational and strategic management* as well as *promoting learning*.
c. The "framework for transparency of support strives to provide clarity on support provided and received by relevant individuals and to inform the global stocktake" (UNFCCC, 2015). This is consistent with M&E objectives of *transparency* and *supporting operational and strategic management*.

As such, it can be concluded that transparency seeks to achieve the same objectives as monitoring and evaluation.

A review of literature shows that the question about the usefulness and role of transparency in improving global environmental governance, accountability and empowerment is one that has occupied the minds of many social science researchers in recent times. There seems to be consensus among researchers that transparency matters, especially in this information era where knowledge is understood to be power (Mol, 2014; Gupta & Mason, 2014; Florini, 2010). However, there are different schools of thought in terms of what constitutes valid knowledge, whose information counts,

how much information is required for transparency as well as the extent to which transparency improves global environmental governance, accountability and empowerment (Mol, 2014; Gupta & Mason, 2014). There are scholars who view transparency as a crucial part of good governance (Florini, 2004) while others argue that the relationship between transparency on the one side and environmental improvement and empowerment on the other side, is poor at best (Mol, 2014; Dingwerth & Eichinger, 2010). According to Gupta and Mason (2014), "the relationship between transparency, better accountability and effective governance is far from straightforward".

Mol (2014) identifies six properties of transparency, which he terms 'drawbacks', as follows:

1. Transparency does not yield similar benefits in all circumstances. It fully achieves its objectives only under specific conditions which are not always met.
2. transparency can also be used as a tool for surveillance and control in the name of empowerment.
3. Related to the preceding point, transparency can end up empowering the powerful instead of empowering the powerless, thereby exacerbating societal inequality.
4. Increased transparency comes with unintended consequences of drowning people in too much information, in dis-information or in misinformation.
5. Transparency can only be as useful as the quality and reliability of information that has been disclosed, and lastly.
6. There is no clear causal relation between transparency and environmental improvement.

In addition, Florini (2008; 2010) identifies the following properties:

- Transparency in and of itself is a limited tool, but can be a small step in inducing positive change.
- The impact of transparency is dependent on the environment within which it is implemented, particularly domestic and global politics, as well as state or government systems.
- Transparency can be costly and complex, requiring archiving of materials, training of staff, changes to bureaucratic procedures, and availability of on-going financial and human resources.

The next section then looks at what MRV seeks to achieve.

2.2.3 Objectives of MRV

In a UNEP commissioned guidance report meant to assist policymakers in developing countries to understand how they need to consider and integrate MRV in climate policy planning, Morgan (2011) shows that MRV seeks to achieve the same objectives as M&E. Specifically he lists the following key objectives of MRV (ibid):

a) "Enhancing mutual accountability between developed and developing countries" (mitigation actions and support) – *same as supporting accountability objective of M&E.*
b) "Facilitating national mitigation actions by establishing baselines and helping identify policy options and potentials" (including enhancing effectiveness of actions through expert advice) – *same as supporting operational and strategic management objective of M&E.*

c) "Strengthening mutual confidence in each country's actions and in the overall climate regime, paving a way for stronger collective efforts" – *same as promoting transparency and supporting strategic management objectives of M&E.*

The same conclusion can be drawn from the German Development Corporation (GIZ) (2014) report that took these objectives of MRV and further classified them into "*National drivers*" and "*International drivers*" as shown in Table 2 below.

Table 2: GIZ Classification of MRV objectives compared with M&E objectives[7]
***Source**: Adapted from GIZ (2014)*

National Drivers	International Drivers
1. Assists with identifying priorities, challenges and opportunities for the country – *supporting operational and strategic management, and empowerment* 2. Informing policy planning and prioritization and improving policy coherence – *supporting strategic management* 3. For national tracking of progress – *supporting operational management, accountability and empowerment* 4. For data quality assurance – *supporting operational and strategic management* 5. To demonstrate impact of funds to donors and assist countries to access international climate finance – *supporting strategic management, accountability and transparency* 6. For identifying gaps and international support needs – *supporting operational management*	1. Improve trust amongst Parties: Ensuring greater transparency – *supporting transparency* 2. For international recognition of national performance to help raise ambitions of other countries – *supporting transparency and supporting strategic management* 3. To foster a learning process – *promoting learning* 4. For data quality assurance – *supporting operational and strategic management* 5. Allow international benchmarking – *supporting strategic management* 6. For accounting international progress – *supporting strategic management*

It can thus be concluded that not only are the three terms of transparency, M&E and MRV used inter-changeably in climate change negotiations, in climate policy and in practice, but they also seek to achieve the same objectives. As such, it can be expected that the properties of transparency outlined in the preceding section also apply to MRV. The next section then presents the operational definition of MRV used in this thesis.

2.2.4 Working definitions of MRV and MRV system

Drawing on from the conclusions of the preceding sections, this thesis uses the term **MRV** to mean**:**

"a monitoring and evaluation process involving information and data related to climate change and the response to it".

The term "domestic MRV system" was first introduced under the UNFCCC as part of the Cancun Agreements in 2010, in the context of domestically-supported mitigation actions by developing countries (UNFCCC, 2010). However, as the use of the term MRV expanded, the use of this term also expanded, extending to all countries' institutional arrangements that support the MRV needs of

[7] Italics shows aligned M&E objectives as discussed in the previous section

countries, including UNFCCC MRV needs and MRV needs of domestic policy processes (Falconer, et al., 2012a; GIZ, 2014a; Wiener, 2015).

In this thesis, **domestic MRV system** is used to mean**:**

"a set of domestic arrangements, including institutional, legal and procedural arrangements, established for the purposes of or to support MRV".

Having defined the key terms used in this thesis, the next section looks at the MRV framework under the Convention.

2.3 MRV framework under the Convention

This part of the literature review examines the MRV framework as it developed under the Convention and associated decisions, as well as academic literature on MRV frameworks.

The original wording of the Framework Convention only included the following reporting obligations for Parties (United Nations, 1992):

1 **The Greenhouse gas (GHG) Inventories**: Inventories of greenhouse gases not covered by the Montreal Protocol. They are submitted annually and subjected to technical review for developed countries, while for developing country Parties they are submitted as part of the National Communications with no set frequency or the need for technical assessment.

2 **National Communications**: These are mandated by Article 12 of the Convention. In accordance with the different Parties' respective capabilities, each Party submits the National Communication to the COP through the Secretariat. Table 3 below gives a summary of the content of National Communications as outlined in the original framework convention:

Table 3: Original content of National Communications
Source: (United Nations, 1992)

CONTENT	
a)	National GHG inventory
b)	"General description of steps taken or envisaged to implement the Convention"
c)	Any other relevant information
d)	"Detailed description of policies and measures that the Party has adopted to implement its commitments under the Convention" (Developed countries only)
e)	Estimate of effects of the policies and measures adopted (Developed countries only)
f)	Financial and technology support to developing countries and assistance to vulnerable countries to adapt (Annex II Parties only)
g)	Proposed projects for financing and estimated benefits from those projects (developing countries, on voluntary basis)

The original framework convention specified the dates for the submission of the initial communications but did not specify the frequency of reporting for both national GHG inventories and subsequent National Communications (United Nations, 1992). It was only at the first COP in Berlin that annual reporting of national GHG inventories of developed countries was adopted, together with in-depth review of national communications (UNFCCC, 1995).

Since then, the UNFCCC MRV framework has been evolving over the years, with "many of the MRV provisions having been updated several times, and provisions for developed countries being updated more frequently than those developing countries" (Wang & Gao, 2018).

While the UNFCCC MRV Framework evolved almost continuously, major enhancements were adopted in Cancun and in Paris.

For developing countries, the key enhancements of the Cancun MRV framework, adopted in 2010 at the 16th COP held in Cancun, comprised the following (UNFCCC, 2010):

a. Submitting national communications every four years.
b. Submitting biennial update reports (BURs) every two years: This includes information on progress of mitigation actions as well as information on support received.
c. Undergoing International Consultation and Analysis (ICA), which comprises a technical assessment by a technical team of experts and facilitative sharing of views.
d. Setting up domestic MRV systems of domestically supported NAMAs and reporting on them; and
e. Undertaking MRV of REDD+ activities for the purpose of obtaining and receiving results-based incentives.

For developed country Parties the enhancements included:

a. Submitting national communications every four years.
b. Submitting biennial reports (BRs) every two years: This includes reporting on quantified emission reduction outcomes and their progress, as well as information of financial support rendered to developing countries.
c. Undergoing International Assessment and Review (IAR), comprising of a technical assessment and multilateral assessment of the quantified emission reduction outcomes.
d. Establishing national arrangement for GHG inventory compilation.

Five years later in Paris, the enhanced transparency framework for action and support, further enhanced this Cancun MRV framework, bringing more convergence between the MRV obligations of developed and developing countries. The main components of the ETF can be classified into three parts as follows:

i. Submission, at no less frequently than biennially, of information related to:
    a. GHG emissions: Each Party must submit their national GHG inventories.
    b. Mitigation: Each Party must submit information necessary to track progress of the mitigation component of their NDC.
    c. Adaptation and climate change impacts: Each Party should submit information related to climate change impacts and adaptation.
    d. Support: Developed countries must, while developing countries which provide financial, capacity building and technology transfer support (herein after referred to as support) are encouraged to report this information. On the other hand, all developing countries that are recipients of that support should report the support they receive as well as further support needs.

ii. Technical Expert Review (TER): The EFT provides for a TER for GHG inventories, information necessary to track NDC progress as well as support provided.
iii. Participation in a facilitative, multilateral consideration of progress by all countries.

Figure 3 below presents a comparison of the MRV framework under the Convention and the Enhanced Transparency framework of the Paris Agreement.

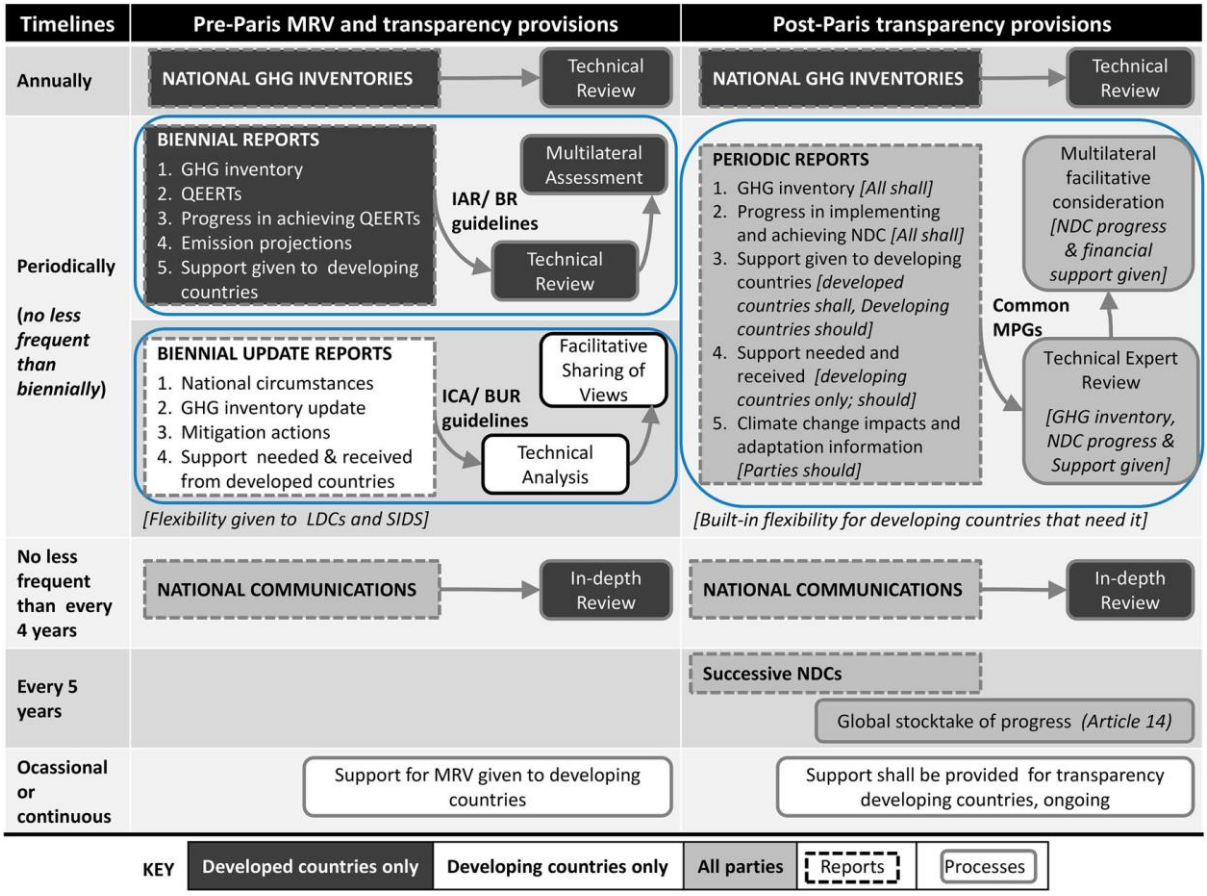


Figure 3: Comparison of the MRV framework under the Convention with the enhanced transparency framework
Source: *Winkler, Mantlana and Letete (2017)*

Then in 2018, at the third session of the first meeting of the Parties to the Paris Agreement in Katowice, Parties adopted the MPGs of the ETF, that expand on the reporting requirements of the EFT as well as the operationalization of the TER and the facilitative multilateral consideration of progress. The key clarifications in the MPGs can be summarized as follows (UNFCCC, 2018):

I. General:
    a. The ETF should facilitate improved reporting and transparency over time.
    b. Transparency, accuracy, completeness, consistency and comparability should be promoted.
    c. Ensuring that Parties maintain at least the same frequency and quality of reporting as in the Cancun MRV Framework under the Convention.
II. National GHG Inventories:
    a. Parties to implement and maintain a national GHG inventory system and report on it.

b. Parties to use the 2006 IPCC guidelines or any later or subsequent version.

III. Mitigation:
   a. Parties to provide information on its arrangements for implementing its NDC as well as the related domestic MRV systems.
   b. Parties to provide information on its mitigation policies, actions and measures, including mitigation co-benefits of adaptation actions.
   c. Parties to provide, to the extent possible, estimates of expected and achieved GHG emission reduction of its mitigation policies, actions and measures, as well as methodologies and assumptions used.
   d. Summary of GHG emissions and removals to be included as part of info required to track mitigation progress.
   e. Projections of GHG emissions and removals from most recent year in the Party's GHG inventory for the following 15 years to be carried out and reported, as well as the methodologies and assumptions used.

IV. Climate Change Impacts and Adaptation:
   a. Parties to report on institutional arrangements and governance for planning and implementation, and their domestic MRV systems for climate change impacts and adaptation actions.
   b. Parties to report on climate risks, projected trends, impacts and vulnerabilities; adaptation priorities and barriers; adaptation policies and measures.
   c. Parties to report on progress on implementing adaptation policies and measures as well as their impact, effectiveness and sustainability.
   d. Parties should also report information related to loss and damage associated with climate change impacts.

V. Support provided and mobilized:
   a. Parties to report on the domestic MRV systems for tracking and reporting on support provided and mobilized through public interventions.
   b. Parties to report on the information on financial support, technology transfer and development support and capacity building support provided and mobilized, as well as the methodologies used.

VI. Support needed and received:
   a. Developing country Parties to report on their domestic MRV systems for identifying, tracking and reporting on support needed and received.
   b. Developing country Parties to report on the information on financial support, technology transfer and development support and capacity building support needed and received, as well as the methodologies used.

VII. TER:
   a. The TER will focus on reviewing the consistency of the information with the MPGs, consideration of the Party's implementation and achievement of its mitigation NDC, consideration of support provided as well as identification of areas of improvement and capacity-building needs.
   b. It may be in the form of a centralized, in-country, desk or simplified review.

VIII. Facilitative, multilateral consideration of progress will be undertaken in a manner similar to the facilitative sharing of views of the ICA in the Cancun MRV Framework, with only a few minor differences between the two.

The Paris Agreement recognizes that in order for this ETF to work there is need for MRV-related capacity building at domestic levels; consequently, it calls for support to be provided to developing countries for this support on a continuous basis (UNFCCC, 2015). The decision that gives effect to the Paris Agreement, 1/CP.21, even established an MRV-specific Capacity Building Initiative for Transparency (CBIT) for this purpose (ibid).

According to Touchard (2019), capacity building, especially for developing countries, is critical to the success of the ETF. In her assessment of potential compliance challenges with the EFT, she determined that the envisaged MRV-specific capacity building initiatives should, at minimum, address technical challenges, institutional challenges, human challenges, technology constraints and financial challenges that the developing countries are already facing in relation to compliance with the existing Cancun MRV Framework (ibid). On Institutional arrangements, she goes on to point out that most of the developing countries "*do not currently have the necessary institutional arrangements to produce good reports*" (ibid). This relates directly to relevance and quality of domestic MRV systems or lack thereof!

While, like Touchard, many researchers have been concerned with the dire need for transparency-related capacity building because of the many enhancements they see in the ETF (Hanle, et al., 2019), some researchers have been asking whether the ETF is truly enhanced. For instance, Mayer (2019) argues that, while the ETF seeks to move away from the bifurcation of the Cancun MRV framework by applying the same rules to all countries, there remains some bifurcation in many important areas of the ETF. Furthermore, he argues that the transparency under the ETF is still intended for a narrow circle of experts, as it was in the Cancun MRV Framework, because there has not been any improvement in the simplification of the reports such that they can be understood by non-expert stakeholders in the field of climate change, including decision-makers and judges (ibid). Similarly, Rouxel (2020) points out that the technical expert review under the ETF remains limited in at least two ways: 1) it will still focus on assessing compliance with reporting requirements instead of making judgements on the countries' achievements of their NDCs, and 2) the involvement of non-state actors remains limited and hindered in the process. What is evident from the review of literature on this topic is that the ETF has been enhanced, compared to the Cancun MRV Framework, but there remains an opportunity for further enhancements in some of its areas.

Having summarized the MRV Framework under the Convention, and reviewed literature related to it and its operation, the next section focuses on the different thematic areas of MRV (e.g., mitigation, GHG emissions, etc.), with a view to understand what MRV entails for each theme as well as the associated challenges.

2.4 Thematic areas of MRV

Using the thematic categorization in the UNFCCC MRV Framework as the basis, but also considering applicability outside the UNFCCC process, this section presents a review of literature related to each of the four themes to which MRV is applied: emissions, mitigation, adaptation and means of implementation.

2.4.1 MRV of emissions

National GHG inventory, also known as MRV of emissions, is by far the most established and common theme of MRV (GIZ, 2014). It is one of the few MRV requirements that were explicitly specified in the

original wording of the Convention. It comprises an inventory of anthropogenic GHG emissions and sinks. It is a standardized process, following guidelines published by the Intergovernmental Panel on Climate Change (IPCC). There have been various versions and refinements of the IPCC guidelines, but all of them are meant to give guidance on, *inter alia*, methods to estimate GHG emissions by source and reductions by sink, data collection, uncertainty analyses, key category analysis, consistent time series, reporting, quality control and quality assurance (IPCC, 2006). The guidelines define quality of GHG inventories in terms of five indicators: transparency, accuracy, completeness, consistency and comparability (TACCC), and they provide guidance in ensuring quality at all steps of the GHG inventory compilation (ibid). The latest version of the guidelines, termed the 2019 refinements, also include guidance on the establishment of institutional arrangements for GHG inventory compilation, also referred to as National GHG inventory systems, to support sustained updating and maintenance of "high quality" and timely GHG inventories (IPCC, 2019).

2.4.2 MRV of Mitigation

The second MRV theme relates to mitigation. While MRV of emissions establishes inventories, MRV of mitigation focuses on reduction of emissions and enhancing of sinks. According to the Paris Agreement, MRV of emissions and mitigation are both part of the information necessary to track progress made in implementing and achieving mitigation NDCs (UNFCCC, 2018). Generally, MRV of mitigation entails *ex-post* tracking of mitigation policies and actions, including NAMAs by developing countries and REDD+ activities, as well as *ex-ante* assessment of mitigation actions (World Resources Institute, 2014). The latter is usually undertaken as part of projecting national emissions and removals, which is also seen as a third component of MRV of mitigation (UNFCCC, 2018). According to GIZ researchers (2014), the MRV of mitigation must ideally analyse the reduced or avoided GHG emissions, the improvement in sequestration capacity of sinks as well as non-GHG reduction outcomes.

There is no single set of standardized or prescribed methods for MRV of mitigation, however the UNFCCC has compiled a number of guiding documents for ex-ante assessment and emission projections, particularly the Consultative Group of Experts' (CGE) Training Handbook on Mitigation Assessment for Non-Annex I Parties (CGE, 2006), as well as the Compendium on GHG Baselines and Monitoring (UNFCCC, 2016). For ex-post mitigation MRV there are various established methods, including those of the Kyoto Protocol's Clean Development Mechanism (CDM), voluntary carbon standards and methods published by various think tank organizations like the World Resources Institute, the GIZ, the Partnership for Transparency under the Paris Agreement (PATPA) and the Initiative for Climate Action Transparency (ICAT) (DNV GL Energy, 2016; World Resources Institute, 2014; Wartmann, et al., 2021; ICAT, 2022).

This absence of a set of standardized methods for MRV of mitigation has often created challenges where analysis or comparison of mitigation actions, whether within one country or across several countries, is required (Schoenefeld, et al., 2019; Hilden, et al., 2014). For instance, while assessing mitigation policies submitted by EU member states under the EU's Monitoring Mechanism, Schoenefeld. et al. (2021) found that the "the absence of a coherent set of procedures.. means that implementation varies in the member states, driven by changing governments and personnel in the national ministries/institutions, creating challenges in dealing with data (in)consistency and interpretation".

2.4.3 MRV of Adaptation

In the context of adaptation, MRV is often referred to as adaptation monitoring & evaluation (Morgan, 2011; Bours, et al., 2014; Spearman & McGray, 2011). Compared to MRV of emissions, MRV of mitigation and, to some extent, MRV of climate finance, the concept of M&E of climate change adaptation or adaptation M&E is much less understood and mature.

Bours et al (2014) synthesized tools, frameworks and approaches for M&E of climate change adaptation, and found that there is general consensus that M&E of adaptation should seek to achieve the following at minimum, 1) documentation of adaptation interventions; 2) assessment and demonstration of effectiveness of the adaptation interventions in enhancing resilience and/or reducing vulnerability and/or disaster-risk reduction; and 3) generation of knowledge, learning and evidence to inform future policy and action.

The nature of climate change adaptation itself, however, makes this easier said than done! Adaptation M&E researchers and practitioners give the following reasons why adaptation M&E is methodologically challenging to undertake (Bours, et al., 2014a; Lamhauge, et al., 2012; Dinshaw, et al., 2014):

1. Adaptation is not an objective or endpoint, but rather a process on continual adjustment which should ultimately enable the achievement of specific socio-economic and environmental goals in the face of changing climate.
2. Many adaptation actions have long-term benefits, and it is often a challenge to assess their effectiveness within short- and medium-term evaluation cycles of the project.
3. Adaptation has inherent uncertainties which increase exponentially from a single adaptation measure output to the envisaged outcome to the broader desired impact on the future, leading to challenges with attributing observed change to specific activities.
4. Determining and measuring avoided impact is very complex.
5. Adaptation and its related concept of vulnerability are not well defined, with different institutions viewing and defining them in ways that do not allow comparability.
6. Uncertainty relating to climate and shifting baselines: Natural and socio-ecological systems are constantly undergoing change, making the use of fixed baselines to lose validity.
7. In some cases, the need and difficulty of separating out the effects of current climate variability from climate change.
8. Adaptation spans multiple scales and sectors, with diverse priorities and view-points, making it difficult to compare or aggregate results on progress and impact in an effective way.
9. Assessing attribution vs. contribution of a single adaptation programme to the observed overall outcome is incredibly complex, if at all possible.
10. No single, common measure or set of indicators of impacts.
11. If done badly, adaptation interventions can lead to maladaptation – exacerbating the effects of climate change instead of reducing them.
12. Climate change adaptation may sometimes conflict with sustainable development, where adaptation becomes superficial “window dressing” with which to attract funding but does not necessarily enhance sustainable development in the long term.

What makes MRV of adaptation even more challenging is that there is no guidance for it under the UNFCCC. The Adaptation Committee under the UNFCCC has produced various guidance tools and have

collected case studies, but they focus on adaptation planning and practice instead of adaptation MRV (UNFCCC, 2022b). Various researchers at the OECD have studied approaches and methods used by different countries for MRV of adaptation and seem to be in agreement that standard M&E approaches and methods are adequate for MRV of adaptation, and these include outcome evaluation approaches, adaptation readiness approaches, process-based approaches and approaches that examine measures of changing vulnerability (OECD, 2015; Dinshaw, et al., 2014; Lamhauge, et al., 2012).

The inclusion of adaptation in the transparency article of the Paris Agreement, albeit as an encouragement and not as a mandatory requirement, is seen by many adaptation MRV practitioners as an explicit intent to embed MRV of adaptation in the architecture of the UNFCCC.

Furthermore, the related and often overlapping process of assessing climate risks, impacts and vulnerabilities is also often understood to be part of MRV of adaptation (UNFCCC, 2015; OECD, 2015). Unlike the former process, there are a number of guidance documents and tools for undertaking the assessment of climate risks, impacts and vulnerabilities under the UNFCCC, including the CGE set of Training Materials for Vulnerability and Adaptation Assessment (CGE, 2022) as well as the UNFCCC Compendium on methods and tools to evaluate impacts of, and vulnerability and adaptation to, climate change (UNFCCC, 2008).

2.4.4 MRV of Finance and other means of implementation

The fourth MRV theme is that of means of implementation, covering climate finance, Capacity building and technology development and transfer. Means of implementation for a country may come in the form of support given through bilateral or multilateral mechanisms, through trade with other countries, by means that the Party itself assigns and appropriates for climate change response or through private climate finance. In cases where the primary focus is on support, as in the case of the UNFCCC MRV Framework, this type of MRV is often referred to as MRV of support (UNFCCC, 2015).

The most common type of MRV in this group is the MRV of climate finance, however, there exists no standardized guidance on this type of MRV, nor on the MRV of other types of means of implementation. The UNFCCC has, however, established a Finance Mechanism which assists with MRV of climate finance in at least two ways: 1) through the climate finance portal, which contains information on climate finance communicated by countries as well as information on climate finance disbursed through various multilateral mechanisms, and 2) through the Standing Committee of Finance, which undertakes and publishes periodic assessments and overview of global climate finance (UNFCCC, 2022)

Despite these initiatives by the UNFCCC, there is a general agreement by climate finance researchers and practitioners that MRV of climate finance remains difficult to undertake because of a number of reasons, as summarized in the table below (Jachnick, 2013; Atteridge, 2012; Yila, 2021; Ellis & Moarif, 2016).

Table 4: Expressed challenges of MRV of climate finance

***Source**: (Jachnick, 2013; Atteridge, 2012; Yila, 2021; Ellis & Moarif, 2016).*

Technical issues	Political shortcomings
• data-sources and tracking methods either do not exist, overlapping or inconsistent • Management, tracking and accountability of finance is often divided among many different institutions, which are not always part of government systems • I can be difficult, if possible, to separate public climate flows from private flows • Many countries have systems for budgeting, tracking and reporting on financial flows and expenditures, but because they were not designed for climate finance they often struggle to identify and separate out climate-related finance • The receiving party and the financing party may measure climate finance at different timeframes, leading to data that is not comparable • Different climate finance databases may duplicate data, leading to double-counting when reporting Parties use them	• The are no agreed or standardized definitions of "climate finance", "leveraging" or "mobilization" • It is often difficult to determine which or whether private climate finance has been enabled or mobilized by public interventions • No single platform that collects all the required climate finance data; UNFCCC Finance mechanism covers only part of the picture or flows • There are no agreed reporting formats that apply universally to all countries • Uncertainty on reporting level: national vs. collective • Questions of acceptability of private flows towards the pledged $100billion

Ciplet, et al. (2018) analysed the climate finance chapters of developed countries in their 2016 Biennial Reports and found that other than on ensuring no double counting of previous years' data, on reporting information about funding channels and indicating the methods used for tracking climate finance, most developed countries are struggling with reporting on all other aspects of climate finance. For that assessment, Ciplet, et al. categorized climate finance reporting areas for developed countries into four groups as follows: 1) Justice-related criteria, which is made up of 14 criteria, including double-counting, clarity on total finance provided and clarity on how 'new and additional' finance was determined; 2) Responsibility criteria, covering proportion of grants vs loans and proportion of public vs private finance; 3) summary information about funding channels; and 4) Cross-cutting criteria, including timeliness and the use of common tabular format (ibid). Using this categorization, they found that, on average, more than fifty percent of the developed countries were non-compliant on justice-related criteria and responsibility criteria (ibid). It is only on information about funding channels and cross-cutting criteria that about seventy percent of the countries were found to be compliant (ibid). This shows that challenges with climate finance MRV is not only prevalent in developing countries but across all countries.

Many researchers, however, believe that the Paris Agreement's enhanced transparency framework has brought about crucial enhancements in climate finance reporting with the potential to improve the transparency and completeness of reported information. For instance, the requirement for developing countries that provide support to other developing countries to report on such support, is seen as an enhancement with the potential of improving overall completeness provided that those countries do report on such flows (van Asselt, et al., 2017). In addition, the requirement for information on provided financial support to be included in a multilateral consideration as well as the

establishment of global stocktake are also seen as other enhancements in the ETF with the potential to improve the MRV and global accounting of climate finance (Weikmans & Roberts, 2019).

As part of contributing to improvement in climate finance MRV, the OECD has established several initiatives, including:

1) The OECD Development Assistance Committee (DAC) has developed markers for reporting on climate finance provided, termed the "Rio markers for Climate". DAC member countries and other non-DAC members who voluntarily report, use the Rio markers to report into the OECD's Creditor Reporting System (CRS) project-specific flows that are marked as having climate change mitigation and/or adaptation as a "principal" or a "significant" purpose. Many countries also use the Rio markers for reporting on capacity building and technology transfer (Garrett & Moarif, 2018; OECD DAC, 2016a).
2) The OECD has made recommendations on definitions that can be adopted for private climate finance MRV, particularly definitions of the terms "publicly mobilized private finance", "direct private finance mobilization", "intermediated-direct private finance mobilization" and "indirect private finance mobilization" (Brown, et al., 2015).

On MRV of technology transfer and development as well as MRV of capacity building, although technology transfer and capacity building have been defined within both the UNFCCC and the IPCCC, it does not necessarily make their MRV easier than that of climate finance (Garrett & Moarif, 2018).

Researchers at the OECD (Garrett & Moarif, 2018) and the Institute for Global Environmental Strategies (IGES) (2011) have studied the operationalization of MRV of support and concluded that:

i. "Given the way support is currently delivered, it will continue to be challenging for countries to differentiate technology and capacity building support from climate finance, but also between each other".
ii. "Governments' partial view of technology development and transfer activity, as well as lack of visibility on the use of multilateral funds to which they may contribute will continue to create limitations in the way that technology transfer MRV may be done."
iii. The CGE guidance on reporting of support received or needed by developing countries is complex, making it difficult for countries to adopt its recommendations.
iv. Guidance for the Technology Needs Assessment (TNA) process under the UNFCCC provides a good basis for countries to identify and report on their technology needs under the UNFCCC MRV Framework.

Having summarized the different MRV themes as well as their related challenges, the thesis now turns into institutionalization of these MRV themes at domestic level, in the form of domestic MRV systems.

2.5 Domestic MRV systems

This section reviews literature on the need for domestic MRV systems, after which it proceeds to present findings on how domestic MRV systems have been established or may be established, as well as available guidance to support establishment of relevant and high-quality systems.

2.5.1 The need for domestic MRV systems

Institutional, legislative, policy and governance arrangements and structures for climate change information, collectively termed domestic MRV systems, play an important role in ensuring data-collection, communication and production of good climate change reports (Touchard, 2019). As Schoenefeld, et al. (2019) put it, "institutional settings, implementation and quality of reported climate change information are closely interlinked". MRV practitioners agree that enhanced requirements of the ETF require enhanced domestic MRV systems compared to the Cancun MRV Framework (Winkler, et al., 2017; Ministy of Environment Lebanon, 2017). It is therefore unsurprising that the MPGs of the ETF call for establishment of and reporting on the countries' domestic MRV systems for the different MRV themes (UNFCCC, 2018).

According to the CGE (2020), the long-term benefits of strong domestic MRV systems are at least four-fold:

i. *"To inform national decision makers on climate action progress and the level of climate ambition*
ii. *To equip decision makers with the continually improved evidence they need to choose the right course of action and secure investments.*
iii. *To provide reliable and quality information to the international community through regular national reporting which, among other functions, shows national achievements in planning and implementing ambitious climate action, contributes to building trust and understanding, and attracts public and private investment*
iv. *To fulfil international reporting requirements in a timely manner and on a sustainable basis*."

The next sub-section summarizes findings from literature on how to establish domestic MRV systems that are relevant and of quality.

2.5.2 Establishing Domestic MRV systems

The UNFCCC database is the largest repository of information about established domestic MRV systems; it has information about domestic MRV systems of all the developing countries that have submitted Biennial Update Reports (BURs), and it has information about national GHG inventory systems of developed countries submitted as part of annual National GHG Inventory Reports. Of the 154 developing countries, 37 had submitted at least one BUR by the 31st of March 2017 and only 17 of them had declared existence of domestic MRV systems. In total, about 136 Parties to the Convention had not established domestic MRV systems yet by that time (UNFCCC, 2021). Apart from the UNFCCC database there is relatively little information about domestic MRV systems in peer-reviewed published literature. Peer reviewed literature mostly focuses on the establishment of national GHG inventory systems or REDD+ MRV systems.

Since 2013 the UNFCCC has developed various tools to assist Parties, particularly developing countries, to establish domestic MRV systems. The first, published in 2013, was a toolkit for non-Annex1 Parties on establishing and maintaining institutional arrangements for preparing national communications

and BURs (UNFCCC, 2013). It is based on the Cancun MRV Framework, and it focuses on building sustainable institutional, official, procedural and legal arrangements for reporting (ibid). It does not, however, give guidance on ensuring the relevance or quality of the systems.

The second and latest tool, compiled by the CGE, was published in 2020 and entitled "Handbook on institutional arrangements to support MRV/transparency of climate action and support" (Consultative Group of Experts, 2020). It is aimed at helping experts and practitioners to implement "existing MRV arrangements under the Convention and the ETF under the Paris Agreement in a timely and sustainable manner" (ibid). Although it presents information that may assist in improving relevance and quality of domestic MRV systems, particularly in the context of the UNFCCC MRV Framework, it too focuses primarily on establishing and ensuring the sustainability of the MRV systems with no specific guidance on what relevance and quality means for domestic MRV systems and how they can be ensured (ibid).

Other than these initiatives within the UNFCCC, there are other tools developed by other institutions to assist countries with establishing domestic MRV systems. One such initiative is the Partnerships on Transparency in the Paris Agreement, which was established by the governments of Germany, South Africa and South Korea in 2010, and managed by the GIZ (PATPA, 2017). It "facilitates the exchange of good practice between climate negotiators, policymakers and practitioners from more than 40 developing, emerging and developed countries", and has become the second largest repository of information and tools about domestic MRV systems (ibid). Through the partnership, the GIZ has also developed a tool on how to set up national (or domestic) MRV systems (GIZ, 2014). While the tool acknowledges the fact that domestic MRV systems are useful for both international reporting under the UNFCCC and for supporting domestic policy development and implementation, it, however, focuses on developing MRV systems in the context of international reporting under the UNFCCC and does not give any guidance on how such systems can be made relevant for domestic information requirements. On quality, the tool provides information on the success factors for each MRV theme, including quality, but it does not give any guidance on how such quality can be defined, ensured and monitored (ibid).

Outside the climate change space, literature in the public domain mostly focuses on establishment of government-wide results-based M&E systems and the World Bank, which has been the leading organization in researching and supporting the implementation of such systems, has produced publications that touch on the relevance and quality of such systems. According to Gorgens and Kusek (2009) at the World Bank, for M&E systems to be useful, they should be accessible, understandable and relevant, and establishing systems that can produce quality (in terms transparency, trustworthiness and timeliness) and relevant information requires experience, skill and real institutional capacity which can take a long time to build. This is confirmed by Lahey (2010), also at the World bank, who adds that data quality and development of communication skills of M&E personnel are critical for the credibility of the systems, but both are often overlooked or not adequately addressed.

World bank researchers have also developed various tools to assist governments to establish functional M&E systems (Gorgens & Kusek, 2009; Kusek & Rist, 2004). In their capacity development toolkit for making M&E systems work, Gorgens and Kusek (2009) argue that relevance of an M&E system can be ensured by identifying end-users of the system and designing the system for a

specific target audience. On quality, the tool defines six dimensions of data quality as "validity, reliability, completeness, precision, timeliness and integrity" (ibid). These dimensions of data quality are further interrogated in Chapter 4.5.1 of this thesis.

Other than these, no other guidance on establishing relevant and high-quality domestic MRV systems was found in literature. The next and final section of this literature review looks at existing studies that assess relevance and quality of domestic MRV systems.

2.5.3 Literature on Relevance and Quality of Domestic MRV systems

There have been few studies undertaken to assess the relevance and quality of existing domestic MRV systems. Just after the adoption of the Cancun MRV Framework, and long before the adoption of the Paris Agreement, researchers of the Climate Policy Initiative (CPI) undertook a study looking at MRV systems that existed in four countries – China, Germany, Italy and the United States (Falconer, et al., 2012a; Falcolner, et al., 2012b). Focusing on MRV of emissions and MRV of mitigation actions, the study looked at the following:

1. The level of preparedness to meet emerging MRV needs in the four countries (Falconer, et al., 2012a). It identified emerging international, regional and domestic MRV needs of each country and assessed whether countries are prepared to meet those needs. It found that:
    a. The developed countries were generally well placed to meet the emerging GHG emission demands but need to improve in relation to MRV of mitigation actions.
    b. China, the only developing country assessed, is likely to face challenges on biennial reporting, particularly of emissions, since is more frequent than their current practices.

2. An evaluation of the existing MRV systems in terms of tracking emissions and mitigation actions (Falcolner, et al., 2012b): The study evaluated the quality of the systems using the following criteria – transparency, comparability, reliability, usefulness, timeliness and completeness. The study found that:
    a. "Existing MRV systems in those four countries allow the countries to determine if they are meeting emission reduction targets, but do not allow them to identify the most effective and resource-efficient policies;"
    b. "Systems tracking emissions are more transparent and comparable than systems tracking mitigation actions;"
    c. "Tracking systems are stronger for mitigation actions that relate to international policies or major mandatory domestic policies" (ibid).

Other than this study, no other relevant studies were found in both peer-reviewed and grey literature. The next section presents a summary of the finding of this literature review.

2.6 Summary of Literature Review

A review of literature showed that good and reliable information is critical for climate change response both at international and domestic levels, hence MRV is one of the key elements of the UNFCCC. While there is no formal definition of MRV under the UNFCCC, it was found that it is the same process that is generally known as M&E but applied to climate-related information. Similarly, a domestic MRV system can be defined as a set of institutional, procedural and legal arrangements for MRV.

The UNFCCC has established an MRV framework for climate information that has been evolving since 2007, requiring countries to report at given frequencies under the Convention. The Paris Agreement, which presents a global approach to long term climate action, has enhanced this UNFCCC MRV framework, adding additional areas for reporting. The MRV framework under the Convention which existed before the Paris Agreement already required Parties to set up domestic MRV systems to be able to respond to international and domestic MRV requirements in a proper, timely and sustainable manner. Domestic MRV systems are more important under the under the Paris Agreement because of the additional transparency requirements. It is therefore not surprising that MPGs of the Paris Agreement's enhanced transparency framework reiterate the need for reporting on the countries' domestic MRV systems for different MRV themes: emissions, mitigation, adaptation and support.

The literature review further revealed that domestic MRV systems need not only be sustainable, but it is critical that they are also relevant, and they produce outputs of high quality. While various toolkits and guidelines have been developed to support the design and implementation of domestic MRV systems, they all focus on ensuring sustainability of the systems, with none giving guidance on how relevance and quality of MRV systems can be defined, embedded in the design of the systems or sustained over time.

Furthermore, the literature review showed that the most comprehensive study that sought to understand the relevance and quality of domestic MRV systems to date covered only two MRV themes and four countries, and it was carried out before the adoption of the Paris Agreement, hence it has not incorporated the enhanced transparency requirements of the Paris Agreement. There is thus no comprehensive framework for relevant and high quality domestic MRV systems. This thesis seeks to fill this knowledge gap, by providing a more comprehensive study of domestic MRV systems to understand factors that affect the success and failure of establishing domestic MRV systems, considering the Paris Agreement MRV requirements in addition to domestic MRV requirements. Moreover, the study seeks to determine a guiding framework that can be used by countries in practice, to ensure relevance and quality of their domestic MRV systems.

3 Theoretical Framework

In the previous chapter key concepts were discussed, working definitions were presented and relevant literature was critically assessed. In this chapter, the theoretical basis underpinning the research is presented and discussed. The theory of programme planning and evaluation, drawing on the logic model, is first discussed, leading to the development of a hypothesis to be investigated. This is followed by a conclusion of this chapter, before turning to the methodology in the next chapter.

3.1 Programme Planning

A programme is defined as any means-to-end chain or a set of resources and activities directed towards bringing about a specified change or achieving one or more common goals (Newcomer, et al., 2015; Owen & Rogers, 1999; McDavid, et al., 2013; Markiewicz & Patrick, 2016). In the preceding chapter, a domestic MRV system was defined as a set of domestic institutional, procedural and legal arrangements (resources) for monitoring and evaluating climate change information (activities), and the overall goals that are to be achieved from MRV are specified in Section 2.2.3. This definition therefore classifies domestic MRV systems as programmes.

While there are various programme management life cycle models, the following three phases are common to all the models: 1) Programme planning, 2) Programme implementation, and 3) Programme evaluation (UNODC, 2017; Villanova University, 2018; Labuschagne & Brent, 2005; Exforsys Inc, n.d.).

Programme planning is defined as "the process of setting goals, developing strategies, outlining the implementation arrangements and allocating resources to achieve those goals" (UNDP, 2009). Rational planning is the most common approach to programme planning, and it has formed the basis for most decision-making and planning models since the 1990s (Netting, et al., 2008). As defined by Pawlak and Vinter (2004), programme planning is essentially a rational decision because it is a means-ends driven process. Rational planning entails "an intentional, systematic and carefully conceived movement, from problem analysis to completion of the plan that results in measurable resolution of the problem" (Netting, et al., 2008). It generally follows a logical process through five steps (ibid):

1) Assessing needs,
2) defining and analysing the problem,
3) selecting the intervention strategy,
4) defining objectives, and
5) programme design.

One of the distinct features of rational planning is that evaluation is integrated into every step of the programme cycle (Netting, et al., 2008; UNODC, 2017). According to the UNDP handbook on Planning, Monitoring and Evaluation, good planning together with effective programme evaluation "play a major role in enhancing the effectiveness of programmes" (UNDP, 2009).

Programme evaluation is broadly defined as:

> *"The application of systematic methods to address questions about program[me] operations and results. It may include ongoing monitoring of a program[me] as well as one-shot studies of program[me] processes or program[me] impact. … Program[me] evaluation provides processes and tools that agencies of all kinds can apply to obtain valid, reliable, and credible*

data to address a variety of questions about the performance of … program[me]s" (Newcomer, et al., 2015).

In programme evaluation, every programme that is to be evaluated needs to be clearly conceptualized into a set of activities that are expected to lead to some identifiable and measurable outcomes, and the link between those activities and outcomes should be both logical and testable (Patton, 2008; Rossi & Freeman, 1989).

In order, therefore, to simultaneously meet the logical requirements of rational planning and programme evaluation, logic models – also known variously as programme logic, logic modelling, programme logic model, theory of action and theory-based evaluation – are used as central planning elements during the programme design stage (Netting, et al., 2008; UNDP, 2009; Julian, 1997; W.K. Kellogg Foundation, 2004).

The following section presents the logic model in detail.

3.1.1 The Logic Model

A programme logic model is "a visual representation of the structure of the programme that describes and explains the intended cause-and-effect linkages connecting the elements of the programme: resources, activities, outputs and outcomes" (often short-term, intermediate and long-term outcomes) (McDavid, et al., 2013).

While the term programme theory is sometimes used interchangeably with logic model, the two describe separate but related approaches for understanding the causal associations underpinning a programme (Patton, 2008; Markiewicz & Patrick, 2016). A logic model simply describes a logical sequence from cause to effect, while a programme theory includes an explicit explanation of why and how the sequence operates as it does (Patton, 2008; Markiewicz & Patrick, 2016). The two approaches also differ in purpose, with the former intended to assist with the development of improved and better managed programmes, while the latter is conceptual in orientation and is concerned with establishing the elements that make a programme sound or otherwise (Chen, 2005; Knowlton & Phillips, 2013). Because this thesis is concerned with supporting the development of improved domestic MRV systems (in terms of relevance and quality), this chapter will only focus on the logic model, not going into causal mechanisms or underlying theories.

Figure 4 below presents the general structure of logic models as presented by McLaughlin & Jordan (2015).

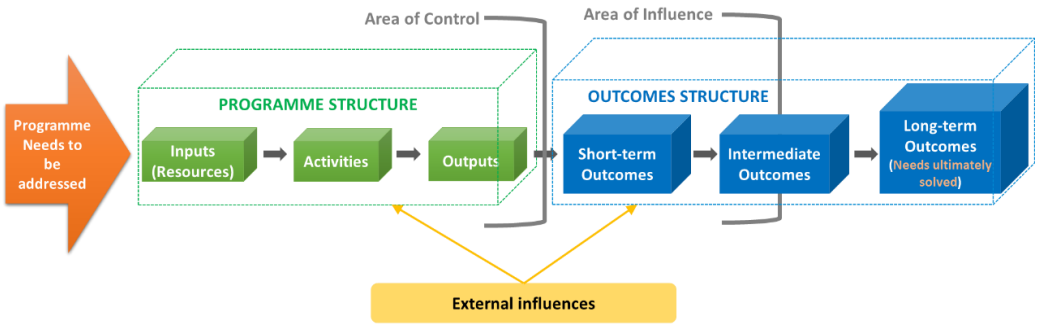


Figure 4: Typical structure of a logic model
***Source**: (McLaughlin & Jordan, 2015).*

Figure 4 shows that the logic model is composed of two sections: the programme structure and the outcomes structure.

The programme structure represents the area that the developers and implementers of the programme have control over, and is composed of the following (McDavid, et al., 2013; McLaughlin & Jordan, 2015):

- **Inputs:** These are resources and other inputs required to operate the programme, including financial resources, human resources, equipment, facilities, partnerships and knowledge.
- **Activities** are the essential action steps necessary to produce outputs of the programme.
- **Outputs:** While activities represent what the programme does, outputs are what the programme produces. These can be documents, information, services and other direct results of the activities of the programme.

Informing the conceptualization and design of the programme are the "needs". **Needs**, also referred to as "problems" or "concerns", are defined as gaps or discrepancies between the present situation or future situation in the absence of the programme on the one hand, and the desired state of affairs on the other (McDavid, et al., 2013).

The outcomes structure is composed of **outcomes**, often differentiated by when they occur or when they are expected to occur. Short-term outcomes are the results "caused" or directly influenced by the outputs of the programme, while the intermediate outcomes are expected to result from the short-term outcomes, and finally long-term outcomes, also known as programme impacts, are expected to follow from the benefits accrued though the short term and intermediate outcomes (Netting, et al., 2008; McLaughlin & Jordan, 2015). While some needs may be solved or addressed by short-term and intermediate outcomes, the long-term outcomes should ultimately lead to or contribute to the solution of the needs.

Programme inputs, activities and outputs are within the control of the programme developers and managers, while short-term outcomes and intermediate outcomes fall within the area of influence in full and in part respectively. Long-term outcomes are outside the area of control or influence of the developers and managers.

The logic model also takes into consideration external influences, thereby acknowledging that programmes do not exist in isolation but rather as part of a broader environment with factors that may enhance or inhibit the likelihood of programmes to achieve their intended outcomes.

3.1.2 Planning for Results using the Logic Model

The five steps for rational planning 1) Assessing needs, 2) defining and analysing the problem, 3) selecting the intervention strategies, 4) writing goals and objectives) and 5) programme design, comprise what is called performance-based planning, also known as outcome-based or results-based programming or planning (Netting, et al., 2008; UNDP, 2009). In this section the use of logic models in results-based planning is presented.

3.1.2.1 Steps 1 and 2: Assessing needs, defining and analysing the problem

The first two steps in programme planning are to clearly define the needs and to translate them into problem statements that can be targeted (Netting, et al., 2008). According to literature there are four types of programme needs (McDavid, et al., 2013; Netting, et al., 2008):

1. *Normative needs*: These arise when a deficiency in comparison to a generally acceptable standard or norm, often defined by experts, is observed.
2. *Expressed needs*: These are needs that have been presented or demanded in some way by current or potential programme beneficiaries.
3. *Perceived needs*: These are invisible needs that have not yet been formally expressed. They usually need to be translated into expressed needs in order to be addressed.
4. *Relative needs*: Also known as comparative needs, these are needs that have been automatically adopted for one stakeholder group from another stakeholder group that is in a similar or better situation.

Regardless of the type of need, needs assessment and problem analysis must be done carefully and properly because the rest of the planning process depends on them. To complete these steps appropriately there is a need to know the situation in detail as well as the conditions, so that "it is clear what the anticipated future situation will look like when the desired change is achieved" (Netting, et al., 2008). According to Netting, "if possible, the planner will want to locate all four types of needs assessment data because they reveal different aspects of the problem "(ibid).

3.1.2.2 Step 3: Selecting the intervention strategy

The next step in the planning process is to determine the intervention strategy, also known as a programme hypothesis. A programme hypothesis is a series of "if-then" statements that help solidify what must be undertaken to achieve the desired change; it sets up the logical basis on which the programme logic model will be based (Netting, et al., 2008).

3.1.2.3 Step 4: Defining Objectives

Having assessed the needs, analysed the problems and determined the logic of the intervention to address those needs, the next step is to define objectives. Objectives are defined as specific statements detailing the desired outcomes of a programme together with one or more measurable criteria of success (Rossi, et al., 2004). A desired outcome, sometimes referred to as an expected outcome or intended outcome, should be expressed as a clear statement of the targeted change in circumstances, status, level of functioning, behaviour, attitude, knowledge or skills (Patton, 2008). It must indicate the pertinent characteristic, behaviour, or condition that the programme is expected to change (Rossi, et al., 2004). Ideal programme objectives should have at least five characteristics as follows (McDavid, et al., 2013):

1. "They should specify the target population or domain over which the expected programme outcomes should occur.
2. They should specify the direction of the intended effects (positive, negative, increase, decrease).
3. They should specify the magnitude of the expected change.
4. They should specify the timeframe over which expected changes will occur, and
5. The outcomes embedded in the objectives should be measurable."

The programme hypothesis can be used to guide the specification of objectives and outcomes in that the "then" statements, or consequences of the hypothesis become the programme outcomes (Netting, et al., 2008).

3.1.2.4 Step 5: Constructing the Logic Model - programme design

Regardless of the approach used to generate a programme logic model, its actual construction, requires reverse logic to effectively plan for the desired results (Netting, et al., 2008; CDEMA, 2012). This means determining the elements of the logic model in reverse order. Having established the programme needs, the problems, the objectives and outcomes that should be achieved through the programme, the programme planner then works their way back to determine the outputs, activities and resources required to achieve those objectives and outcomes (Netting, et al., 2008; CDEMA, 2012).

Figure 5 below illustrates this reverse logic approach

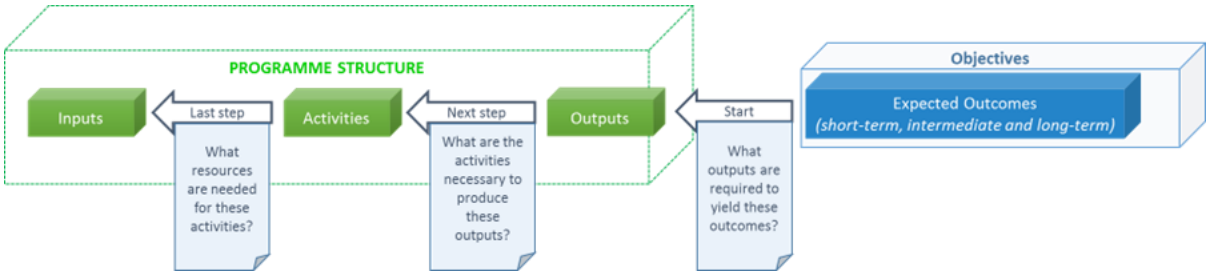


Figure 5: Illustration of the reverse logic approach for constructing the programme logic model
***Source**: Constructed by author based on literature*

Once programme design has been completed, the planner then proceeds to plan for programme evaluation (Netting, et al., 2008). According to UNDP (2009), results-based planning together with planning and implementation of programme planning make up what is referred to as Results-based Management. The next section presents a summary of the key considerations in programme evaluation planning.

3.1.3 Planning for Programme Evaluation

As discussed in the previous chapter, programme evaluation or M&E serves multiple purposes, including supporting accountability, transparency, learning, empowerment as well as strategic and operational management. According to the UNDP (2009) and Poister (2015), when "programme evaluations are used effectively, they support programme improvements, knowledge generation and accountability"; they provide meaningful information that supports improvement of programme performance. For a programme evaluation to achieve this, a clear programme evaluation framework needs to be developed at the planning stage, which will serve as a plan for the monitoring and evaluation of that programme (UNDP, 2009). The key elements of such a framework should include (ibid):

- The programme performance measures (key questions to be answered by the evaluation)
- The activities needed for the evaluation
- People and institutions responsible for the evaluation
- Timing of the evaluation activities

- Methods for undertaking the evaluation
- Resources required to complete the evaluation and where they are committed, and
- Feedback mechanism to ensure effective use and dissemination of programme evaluation results in future planning and programme improvements.

Performance measures for which programmes may be evaluated include adequacy, cost-effectiveness, effectiveness, net social value, quality, relevance and technical efficiency (McDavid, et al., 2013; Poister, 2015). Because the scope of this thesis is limited to the relevance and quality of domestic MRV systems, only these two performance measures are discussed in more detail below and considered in the rest of the thesis.

3.1.3.1 Relevance

Relevance is defined as the extent to which the objectives, and by extension the expected outcomes, of the programme are consistent with the needs that the programme is meant to address (Independent Evaluation Group - World Bank, 2007). Thus, the more aligned the desired or expected outcomes of the programme are to its needs, as defined in its objectives, the more relevant the programme is. Assessments of relevance are almost always qualitative and rely substantially on the experience and judgement of the evaluators and stakeholders (McDavid, et al., 2013).

3.1.3.2 Quality

While output measures "typically focus on the quantity or volume of outputs produced, indicators of quality typically measure the quality of those outputs" (Poister, 2015). Quality has various dimensions including "timeliness, turnaround time, accuracy, thoroughness, accessibility, convenience, courtesy and safety" (ibid). The specific principles and criteria that may be used for assessing the quality of domestic MRV systems have been presented and discussed in section 4.5.1 of this thesis.

3.1.4 Summary of the theoretical framework of programme planning applied to MRV

Figure 6 below presents a visual summary of the theoretical concepts presented in this chapter, showing the linkages between the five steps in rational planning, the programme structure and the key performance measures for programme evaluation. This constitutes the general theoretical framework for programme planning that has been used throughout this study.

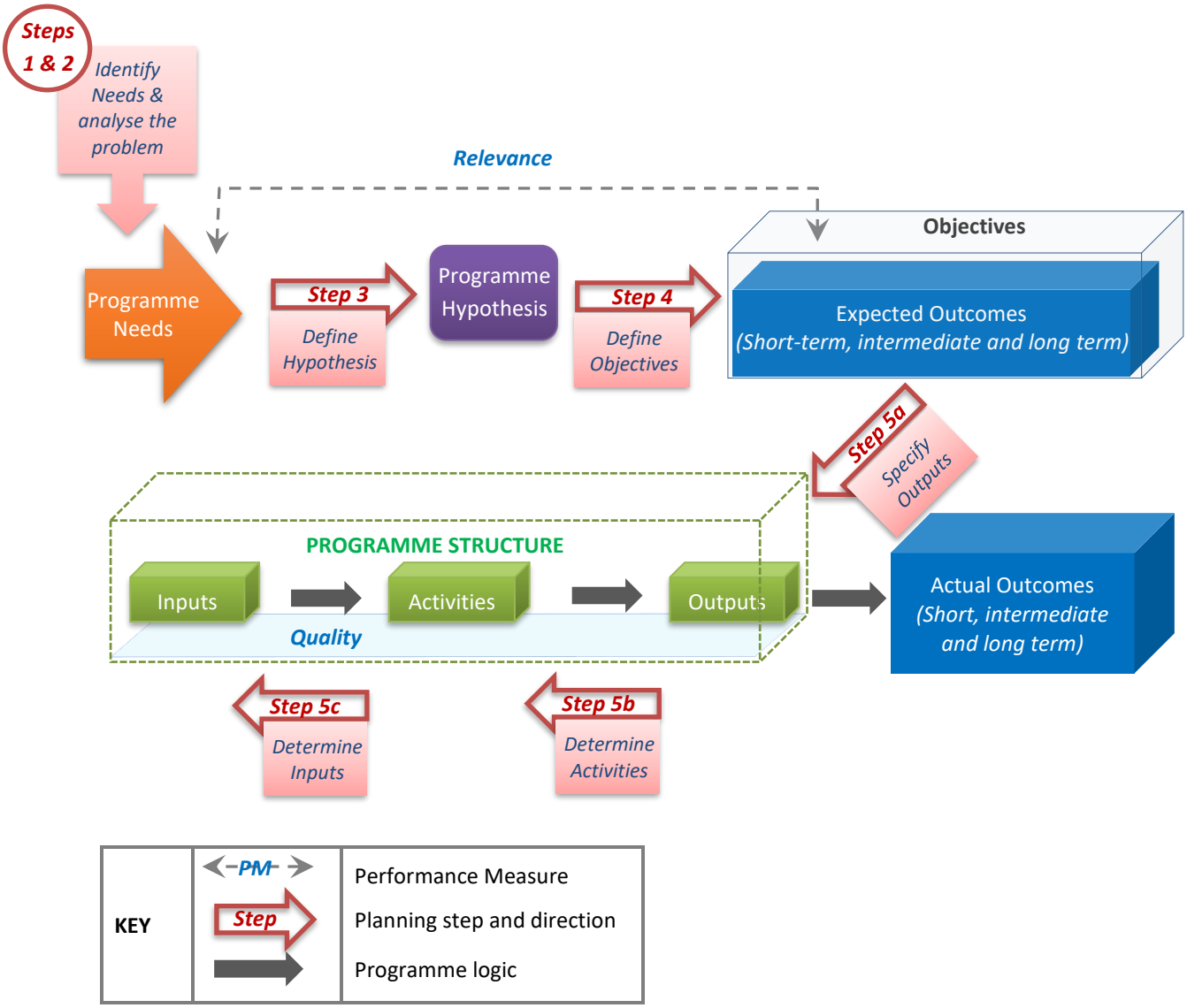


Figure 6: Illustration of the general theoretical framework for result-based programme planning

***Source**: Developed by author, based on literature*

Applying this general theoretical framework presented in Figure 6 to the establishment of domestic MRV systems yields a theoretical framework for results-based planning of domestic MRV systems as depicted in Figure 7 below.

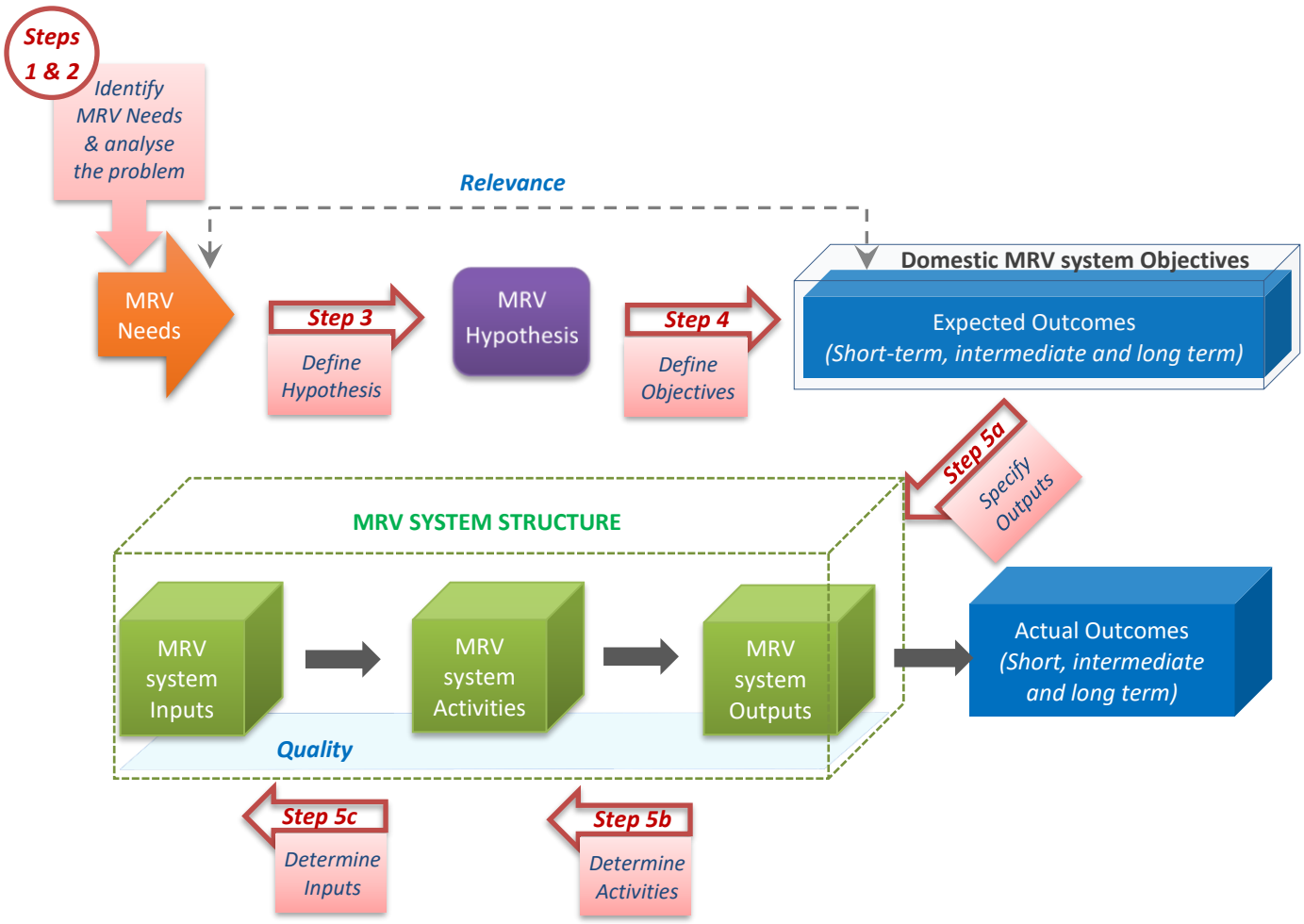


Figure 7: Theoretical framework for results-based planning of domestic MRV systems

This results-based planning framework for domestic MRV systems illustrated in Figure 7 above forms the theoretical framework adopted and applied in the rest of this thesis to answer the key research questions. It is the basis upon which the methodology presented in the next chapter is based, as well as interpretation of all the results in this thesis.

From this adopted theoretical framework, it can be noted that of the two performance measures studied in this thesis – relevance and quality – only relevance can be fully ensured at the planning stage because it is not dependent on the inputs, activities and outputs of the MRV system, nor is it dependent on how or whether the MRV system has been implemented. Instead, it only depends on the design of the system based on its needs, objectives and expected outcomes, all of which can be determined at the planning stage.

Quality, on the other hand, is dependent on how the domestic MRV systems have been setup and implemented, including their inputs, activities and outputs. Hence, quality can only be properly assessed once the systems have been sufficiently implemented and yielded actual outputs.

With this understanding, the next section then presents the proposed hypothesis.

3.2 Hypothesis

From this adopted theoretical framework, a hypothesis for this study can be stated as follows:

> **'Results-based planning through logical modelling ensures maximum relevance of domestic MRV systems and improves their quality.'**

This hypothesis is directly related to the last part of the overarching research question of this thesis, which seeks to know a framework that can be used to establish relevant and high quality domestic MRV systems (Section 1.4), in that the hypothesis claims that results-based planning is one such framework that can be used. As such, if the hypothesis is proven to hold, then that part of the overarching research question will be answered.

This hypothesis has been investigated and tested in the remainder of this thesis, in addition to answering the key research questions.

3.3 Conclusion and next steps

This chapter has presented the theoretical principles of results-based planning and evaluation upon which the rest of the thesis is based. It has presented a five-step approach to rational planning of programmes through logical modelling and applied it to domestic MRV systems to form a theoretical framework for results-based planning of domestic MRV systems. From this adopted theoretical framework, the hypothesis investigated in this study has also been stated.

With the theoretical framework underpinning the thesis outlined in this chapter, the next step was to test this framework empirically using planned and existing domestic MRV systems. The next chapter presents the detailed methodology used in this thesis.

4 Research Design and Methodology

In the three preceding chapters, the purpose of the research has been stated, a review of the relevant literature has been presented, the theoretical framework underpinning the study has been defined and a hypothesis has been stated. This chapter presents the approach and methodology that was used to answer the key questions of the thesis and to test the hypothesis. It covers the overall approach, the sampling techniques as well as methods used for data-collection and analysis.

4.1 Overall Approach

The overall approach entailed studying existing or established domestic MRV systems from different countries and complementing it with a detailed case study of a system that was in its design stage. It utilized mixed qualitative and quantitative methods for analysis of data related to the relevance and quality of domestic MRV systems.

This overall approach was executed in four phases which are presented in Table 5 below, including specific techniques and methods:

Table 5: Overview of the four phases used to undertake this study

1st Phase	**1. Determining how and why MRV systems have been set up**
Overview	• Determining MRV needs of all selected countries • Studying established domestic MRV systems of the selected countries
Country selection	11 Parties to the UNFCCC with domestic MRV systems that can be studied
Research methods	**Data collection:** a. Questionnaires, and b. document reviews **Data analysis techniques**: • Qualitative content analysis • Trend analysis
2nd Phase	**2. Assessing Relevance of the domestic MRV systems**
Overview	• Assessing and comparing the relevance of the established domestic MRV systems, based on a defined quantitative indicator • Testing the first part of the hypothesis
Scope	Domestic MRV systems of the 11 Parties selected
Research methods and techniques	Three **mixed qualitative and quantitative** methods have been employed, using data collected under Phase 1: a. Descriptive analysis of each country b. Trend analysis between countries and MRV systems c. Correlational research method
3rd Phase	**3. Case Study – focusing on relevance**
Overview	Studying the process of designing a domestic MRV system of one country
Scope	One country that is in the process of designing its domestic MRV system

Research methods and techniques	A case study approach employing the following techniques: **Data collection:** a. Questionnaires b. Gaps filled with document reviews **Data analysis**: • Content analysis • Critical analysis • Thematic analysis
4th Phase	**4. Assessing Quality of the domestic MRV systems**
Overview	• Assessing and comparing the quality of the established domestic MRV systems, based on a semi-quantitative indicator • Testing the second part of the hypothesis
Scope	Domestic MRV systems that meet the minimum assessment requirements from the 11 Parties selected in Phase 1
Research methods and techniques	The following **mixed qualitative and quantitative** methods were employed, using data collected in Phase 1: a. Descriptive analysis of each MRV system and country b. Trend analysis between countries and MRV systems c. Correlational research method

Each phase has been outlined in detail in the sections below.

4.2 Phase 1: Determining how and why systems have been established

This first phase was carried out in four steps covering 1) country selection; 2) Data-collection; 3) Determining MRV needs and 4) Studying established domestic MRV systems.

4.2.1 Country selection

The first step in this phase was to select the countries whose domestic MRV systems could be studied to answer the key questions and to test the hypothesis.

This first key criterion used in the selection process was "evaluability" of the countries' domestic MRV systems. According to Rossi and Freeman (1989) there are two key indicators of evaluability for any intervention:

1. **"Establishment of objectives**: Either the objectives of the intervention should be sufficiently well articulated to make it possible to specify measures of goal achievement, or the evaluator must be able to establish a reasonable set of objectives; and
2. **Level of implementation**: The intervention should be sufficiently well implemented that there is no question that its critical elements have been delivered to appropriate targets."

The first indicator means that the domestic MRV system to be studied must have its objectives either clearly documented in respective design documents, or in national reports submitted under the UNFCCC (e.g., BUR) or in other relevant national documentation. Alternatively, the indicator requires that it should be reasonably possible to determine the objectives of the domestic MRV system from

other sources like interviews with relevant stakeholders. This first evaluability indicator is particularly important for the assessment of relevance (see section 3.1.3.1).

The second indicator, on the other hand, requires the domestic MRV system to be studied to have been in operation for at least two reporting cycles with outputs available for each cycle. This is to allow for their inputs, activities, processes and outputs to be evaluated for performance in respect of the various reporting cycles. As it will be seen in section 4.5, this evaluability indicator is particularly important for assessing quality of the domestic MRV systems.

Implicit in both evaluability indicators is the need for existence of a domestic MRV system, at least in design form.

For countries to be included in this thesis, they had to meet at least one of the two evaluability indicators so that their domestic MRV systems can be evaluated for at least one of the two performance measures studied (i.e., relevance and quality).

To identify countries that meet the above evaluability indicators, a combination of the following was used:

a) A review of all the latest biennial update reports of non-Annex 1 countries and biennial reports of Annex 1 countries published on the UNFCCC website by 30th September 2019.
b) A review of the countries' latest national communications submitted and published on the UNFCCC website by 30th September 2019, and
c) A review of documentation and presentations about countries' domestic MRV systems shared in various platforms, meetings and workshops of the Partnership on Transparency in the Paris Agreement (PATPA), including those shared under the previous version of PATPA - International Partnership on Mitigation and MRV.

All UNFCCC Parties that were not found to meet at least one of the evaluability requirements, based on the above sources, were then eliminated. Those countries that were successfully confirmed to meet at least one evaluability requirement, the following additional criteria were applied to select the final list of countries:

- **Coverage**: The domestic MRV systems should cover more than one area of MRV (e.g. GHG inventory).
- **Availability of information**: Preferably, there should be at least one person from the key institution involved in the establishment of the country's domestic MRV system available and willing to provide the information to the researcher in English. Alternatively, information about the domestic MRV system of the country should be readily available in documents or online, in English.

Finally, it was also desirable for the full sample to have **representative** geographical distribution, and to include both developing and developed countries, with the developing countries ideally representing various levels of economic development.

Based on these criteria a sampling decision tree was developed, and using that decision tree, a total of 11 Parties to the UNFCCC were selected, composed of 10 country Parties and one regional Party. Figure 8 below presents the sampling decision tree used in the selection process.

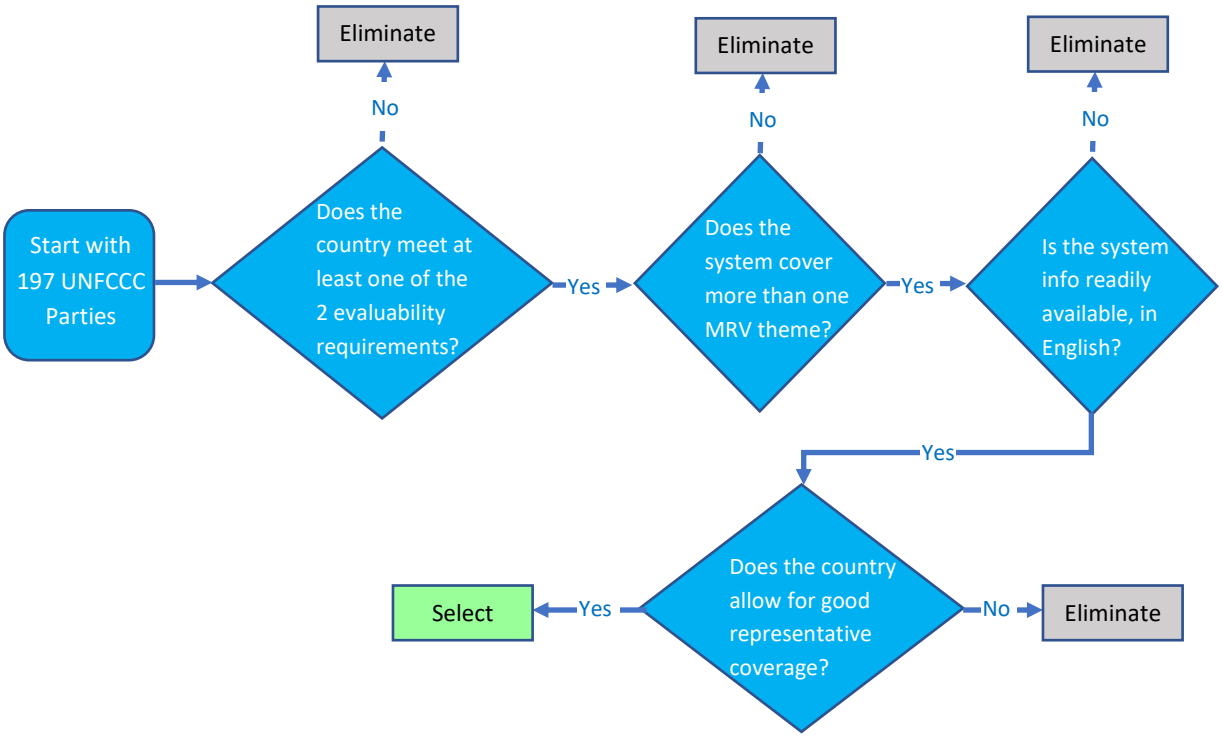


Figure 8: Decision tree used to select countries to be included in the study

The final selected sample consists of six developing countries as follows: Brazil, China, Colombia, Indonesia, Kenya and South Africa; and five developed country Parties as follows: European Union (EU), Germany, New Zealand (NZ), the United Kingdom (UK) and the United States of America (USA). Figure 9 below shows a graphical representation of these countries and regions.

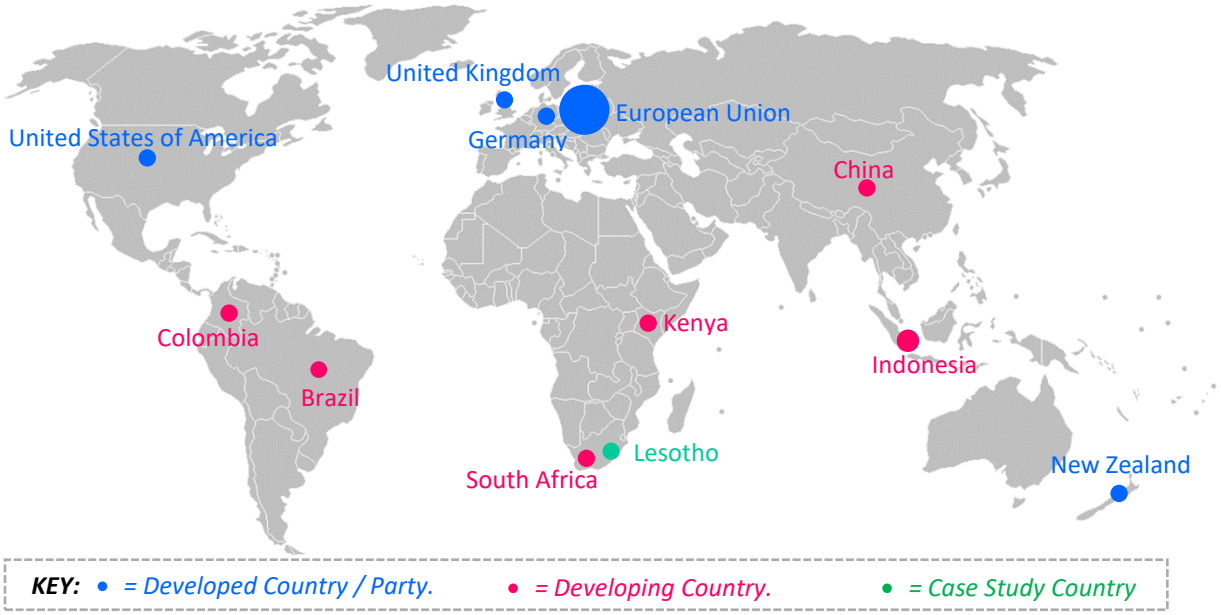


Figure 9: Graphical representation of the countries selected for the study

Also highlighted in the figure is Lesotho – the country used for the case study. Further details about the case study can be found in 4.4.1 below.

From this selection process it was observed that most countries have not developed domestic MRV systems beyond GHG inventory systems: Of the 48 developing countries that had submitted their BURs by 30th September 2019, only a few of them (about 25%) had developed domestic MRV systems, with even fewer countries having implemented the systems; the others just had the design of the systems. For developed countries, it was found that at least 10 non-EU developed countries did not have domestic MRV systems, other than national GHG inventory systems; these were Belarus, Canada, Iceland, Kazakhstan, Liechtenstein, Monaco, Switzerland, Turkey, Ukraine and the Russian Federation. As such, the 11 selected Parties represent a large proportion of countries that had established domestic MRV systems, beyond just GHG inventory systems, and beyond conceptual stages by 30th September 2019.

4.2.2 Data-collection

The second step was data-collection. Two broad types of data-collection methods were employed as follows:

1. **Questionnaires:** A questionnaire, covering both qualitative and quantitative information (Appendix A.1), was developed and populated from information supplied by people who are involved in the design and/or implementation of the domestic MRV systems of the 11 selected countries (hereinafter referred to as respondents). The questionnaires were populated in one or a combination of the following ways:
    a. The questionnaire was sent to the respondents, who completed it on their own, and returned it, and/or
    b. The respondents were asked the questions in the questionnaire during an interview setting and the researcher populated the questionnaire based on the information provided by the respondents. Questionnaires that were populated by the researcher based on the interviews were sent or shown to the respondents to confirm the information captured in the questionnaires.

    Regardless of the way the questionnaire was populated, a copy of the questionnaire was shared with the respondents as well as a project information sheet introducing the project, specifying how the supplied information will be used and outlining the rights and responsibilities of the respondent and the researcher. A copy of the project information sheet can be found in Appendix A.1 of this thesis, while the full list of respondents is attached in Appendix A.2.

2. **Document Reviews:** This entailed reviewing:
    a. documentation containing information on the MRV needs of the different countries, including relevant multilateral agreements, regional agreement documents as well as national policies, strategies, actions and plans for climate change response; and
    b. documentation relevant to each domestic MRV system, including design documentation, domestic MRV System implementation plans, national policies and strategies, Biennial Update Reports, Biennial Reports, National Communications under the UNFCCC, as well as relevant publications by NGOs and academic institutions.

    The specific sources of data and information used have been referenced throughout the thesis.

4.2.3 Determining MRV needs

Having selected the countries and collected the data, the third step was to determine the countries' MRV needs. A qualitative content analysis of the different information sources was carried out to identify and extract each country's normative and expressed needs and categorize them as follows:

1. **International MRV needs**: These are MRV needs of a country arising from international agreements, protocols, and conventions.

2. **Regional MRV needs**: These are MRV needs arising from reporting requirements of regional climate change policies, strategies, laws, plans and other formal agreements.

3. **Domestic MRV needs**: These are MRV needs within the country, expressed through climate-related national policies, strategies, laws, plans, reports or other national publications or platforms. They may be at national or sub-national levels for different stakeholders (GIZ, 2014).

In all the cases, information or MRV needs required less frequently than biennially, like information in the National Communications, was deemed not to require institutionalization or continuous systematic monitoring since the long periods between reporting cycles allow countries to compile the required information using project approaches, hence it was excluded. Also, the monitoring and reporting requirements of the Kyoto Protocol have been excluded from this study.

Finally, a trend analysis was undertaken to identify any observable trends in the MRV needs of the countries.

4.2.4 Studying established MRV systems

The final step in this phase focused on studying the domestic MRV systems of all the countries. This included extracting relevant information about the domestic MRV systems from the collected data to identify the name or title of each domestic MRV system, to determine its objectives and intended outcomes, to identify the key drivers and reasons for its establishment, to understand how and when it was established, its status, and any lessons that can be learnt from its establishment. A trend analysis was also carried out between the systems to identify any emerging trends.

Proper determination of objectives and intended outcomes of the domestic MRV systems was a critical part of this step because this information is required for assessment of relevance in Phase 2. Primarily, these were determined by identifying areas where they were explicitly expressed in the respective documents and questionnaires, and in cases where they were not, they were inferred either from descriptions of the domestic MRV systems in national reports (e.g., BUR) or from the web-based platforms of the respective domestic MRV systems or from the actual outputs of the systems.

4.3 Phase 2: Assessing relevance

The second phase of the research focused on answering key questions related to relevance of domestic MRV systems and to test the first part of the hypothesis.

As outlined in section 3.1.3.1, relevance is a measure of the extent to which objectives and envisaged outcomes of domestic MRV systems are consistent with their needs. Because objectives, envisaged

outcomes and needs can all be determined from the design information of domestic MRV systems, the systems do not have to be at implementation stage for relevance to be assessed. As such, assessments of relevance were carried out for all domestic MRV systems whose objectives and intended outcomes could be determined in the preceding step, whether they've only been designed but not implemented yet or they have already been implemented.

This phase was undertaken in two steps: Firstly, MRV systems of each country were evaluated for relevance, after which trend analyses were carried out on those results; Secondly, correlation assessments were undertaken. Each step is described in more detail below.

4.3.1 Evaluating of relevance

Both qualitative and quantitative evaluations were carried out in this step.

A qualitative evaluation assessed the extent to which the objectives and envisaged outcomes of each domestic MRV system address the MRV needs of the respective country.

Then a quantifiable MRV relevance index was defined and determined for each country as follows:

MRV relevance index of country X = The percentage of country X's MRV needs to which its domestic MRV system is relevant

$$= \frac{Number\ of\ country\ X's\ MRV\ needs\ to\ which\ its\ domestic\ MRV\ system\ is\ relevant}{Total\ number\ of\ Country\ X's\ MRV\ needs.} * 100$$

Where:

- *"Number of Country X's MRV needs to which its domestic MRV system is relevant"* = Number of MRV needs which the objectives and intended outcomes a country's domestic MRV system addresses. It accounts for multiple independent occurrences of the same need in that if the same need arises from two different legal or statutory requirements (e.g., UNFCCC and domestic legislation) they are counted as two distinct needs. This does not apply in cases where two government documents (e.g., a country's climate change policy and a climate change strategy of the same country) both state the same need. In the latter case it is understood to be a reiteration of the same need, hence only counted once in the calculation of the relevance index.
- *"Total number of Country X's MRV needs"* = the sum of all the needs of the country, accounting for multiple independent occurrences of the same need as multiple distinct needs, as explained in the bullet point above.

4.3.2 Correlational assessments related to relevance

The last step in this second phase was to undertake correlation assessments. Correlational assessment method is a research method used to find relation between two or more variables; this can be positive, negative or neutral correlation (Bhat, 2019).

In this thesis, correlational assessments were undertaken to examine two types of relevance relationships as follows:

1. Correlation between results-based planning approach in developing domestic MRV systems on the one hand, and the relevance index score of domestic MRV systems (defined above) on the other hand, to determine whether results-based planning has any influence on relevance of the systems as hypothesized. In other words, the extent to which rational planning though logic modelling was used in the design of the systems (used fully, partially or not used at all) as the first variable and relevance index score as another variable.

2. Correlation between the drivers for establishing domestic MRV systems on the one hand, and the way these systems have been designed on the other hand.

4.4 Phase 3: Case Study

The third phase sought to complement the previous phase by answering the key research questions and test the hypothesis using an in-depth study of a country that was in the process of developing its domestic MRV system during the time this PhD study was undertaken. Below is an outline of the activities undertaken in this phase.

4.4.1 Country selection

The key criteria used in selecting the case study country was: 1) the country should be in the process of developing its MRV system during the study period; and 2) data and information related to that process should be available to the researcher; and 3) the researcher should have access to the team and stakeholders involved in that process for data collection.

The kingdom of Lesotho (Lesotho, in short) was identified as the appropriate pilot country that met all the three criteria. Lesotho started designing its domestic MRV system in 2018, and the MRV Framework design was included in the country's first Biennial Update Report submitted under the UNFCCC in 2021. The case study has been described in full in Chapter 8.1 of this thesis. Because Lesotho's domestic MRV system has not been implemented yet, and therefore does not meet the minimum evaluability requirements for assessing quality of domestic MRV systems, this case study only covers relevance of the domestic MRV system.

4.4.2 Data-collection

Three primary data-collection methods were used in this phase of the thesis as follows:

1. **Observations**: the researcher studied the process of designing the MRV system without participating or interfering with the process. The observations included taking note of the "who", "when" and "how" of this process.

2. **Questionnaire:** A case study questionnaire was developed for population by the key local stakeholders involved in the development of the MRV framework (hereinafter referred to as case-study respondents).

   The country held a national MRV stakeholder workshop on the 06th of June 2019, and a list of key stakeholders that attended that workshop was obtained from the Government of Lesotho, which confirmed it to be the list of the key stakeholders in the development of the country's

domestic MRV system. It is to those stakeholders that invitations to complete the questionnaire were sent.

The questionnaires were populated in one or a combination of the following ways:

a. The questionnaire was sent to the case-study respondents, who completed it on their own, and returned it, or
b. Interviews: The case-study respondents were asked the questions in the questionnaire during structured interviews and the researcher populated the questionnaire based on the information provided by the respondents. Every questionnaire that was populated by the researcher based on an interview was sent to the case-study respondent or shown to them to check and confirm the information.

The questionnaire and the list of case-study respondents who accepted and honoured the invitation to complete the questionnaire can be found in Appendix A.1 and A.2 of this thesis respectively.

3. **Document Review**: The following documents were reviewed as part of data-collection for the case-study:
    a. Lesotho's 2nd National Communication under the UNFCCC
    b. Lesotho's national GHG inventory reports: For 2000, 2005 – 2010 and 2011 - 2017.
    c. Terms of references for the development of the domestic MRV system
    d. The draft domestic MRV framework report
    e. Lesotho's National Climate Change Policy 2017 – 2027
    f. National Climate Change Policy Implementation Strategy 2017
    g. Lesotho's Nationally Determined Contribution under the Paris Agreement.
    h. The Final MRV system Framework report 2019
    i. The Kingdom of Lesotho's First Biennial Update Report, 2021
    j. The Kingdom of Lesotho's Third National Communication to the UNFCCC, 2021.

4.4.3 Analysis

The collected data was then analysed critically and thematically to identify key information related to the country's MRV needs, the key drivers for establishing Lesotho's domestic MRV system, the approach taken, the objectives and envisaged outcomes of the systems, the description of the system and key relevance information.

4.5 Phase 4: Assessing quality

The fourth and last phase of the methodology focused on answering key questions related to quality of domestic MRV systems and to test the second part of the hypothesis.

4.5.1 Evaluation of quality

There is no single, universally acceptable set of quality principles or criteria. To determine the appropriate quality principles for domestic MRV systems, an assessment of relevant literature was carried out, starting with UNFCCC literature.

Paragraph 92 of decision 1/CP.21 of the Decisions that give effect to the Paris Agreement, identifies transparency, accuracy, completeness, consistency, comparability, avoiding duplication, maintaining at least the frequency and quality of reporting under the Convention, avoiding double counting and ensuring environmental integrity as the key principles that should guide the Enhanced Transparency Framework (UNFCCC, 2015). The first five are the same TACCC principles used to assess the quality of national GHG inventories as specified in the 2006 IPCC guidelines. Except for consistency, these first five are also quality principles mentioned in paragraph 41 of the Cancun Agreements (decision 1/CP.16) in relation to reporting of information in national communications (UNFCCC, 2010). As defined in relation to national GHG inventories, accuracy encompasses integrity and avoiding double counting by ensuring that the estimates are neither over nor under the true values (Todorova, et al., 2003). The principle of maintaining the frequency under the Convention highlights the timing that should be adhered to, while avoiding duplication and avoiding undue burden on Parties can be seen as a practical consideration of the overall UNFCCC MRV system rather than a quality principle applicable to the outputs of the domestic MRV systems.

Researchers at the Climate Policy Initiative also proposed a set of quality indicators for domestic MRV systems as follows, drawing from the UNFCCC guidelines and a review of other literature (Falcolner, et al., 2012b):

1. **Transparency**: Referring to the openness, accessibility and comprehensibility of the process to relevant audiences
2. **Comparability**: Covering comparability across time, agencies, different levels of government and other countries' data or reports. They asserted that comparability across time is often termed **consistency** in other literature.
3. **Reliability**: Referring to the **accuracy** of the information
4. **Usefulness:** Referring to the extent to which the system connects to the policymaking process. This relates more to what domestic MRV systems aim to achieve, as outlined in section 2.2.3, than to the quality of their outputs.
5. **Timeliness:** The extent to which information is collected and delivered at the right frequency to support decision-making and other MRV needs
6. **Completeness:** The extent to which the system provides sufficient information to support decision-making at all important sectors.

In addition to these, the following literature was also reviewed:

a) The Institute of Global Environmental Strategies (IGES) report on operationalizing MRV of support (IGES, 2011): This report identifies the following evaluation criteria for the design of MRV of support: 1) Scope of **transparency;** 2) **predictability** – which relates more to what the system should be able to do than the quality of the system and its outputs; 3) **consistency** with the **timeframes** of current and future UNFCCC reporting; 4) **collectability of the data -** which relates more to the practicality and smartness of the system and its indicators rather than the quality of the system and its outputs; 5) **accuracy** of the data; 6) **completeness**, and 7) **comparability**.

b) Six Dimensions of data quality (Gorgens & Kusek, 2009): These are **accuracy, integrity, reliability, timeliness, completeness** and **precision**. Integrity requires data to be protected from deliberate bias or manipulation for political or personal reasons, and may be seen as

defining the accuracy and consistency of the data (Ortega, 2017; Gorgens & Kusek, 2009), while precision refers to the extent to which results can be replicated, which in MRV, is accomplished by ensuring consistency and transparency in the data and measurement methods used.

c) Lastly, the EU uses what they refer to as the "TTACCC" principles to assess the quality of the mitigation MRV information they receive from the member states. (European Topic Centre on Climate change mitigation and energy, 2019). Specifically, that assessment covers **timeliness; transparency; accuracy; completeness** – where they check that all mandatory reporting requirements of the MMR have been fulfilled; **consistency** and **comparability** – which focuses on consistency; and **coherence** – which looks at whether reported projections were coherent with policies and measures (ibid).

Table 6 below presents a summary of this assessment.

As shown in the table, six quality principles were selected from the assessment as the most common and appropriate for domestic MRV systems. These are transparency, accuracy, comparability, consistency, completeness and timeliness (herein after also referred to as TACCCT), which is an addition of the timeliness principle to the typical TACCC quality principles for GHG inventories and those specified in the decisions that established the Paris Agreement.

Table 6: Summary of the author's assessment of appropriate quality principles for domestic MRV systems

Principles REVIEWED in Literature	Assessed literature						Quality Principles SELECTED for use in the thesis
	1	2	3	4	5	6	
	Decision 1/CP.21, Paragraph 92	Decision 1/CP.16, Paragraph 41	GHG Inventory principles	CPI Evaluation of domestic MRV systems	6 Dimensions of Data Quality	Evaluation criteria for MRV of Support	
	(UNFCCC, 2015)	(UNFCCC, 2010)	(Todorova, et al., 2003)	(Falcolner, et al., 2012b)	(Gorgens & Kusek, 2009)	(IGES, 2011)	
1. Transparency	Transparency	Transparency	Transparency	Transparency	Precision through transparency	Scope of transparency	✓
2. Accuracy	Accuracy; avoiding double-counting; Ensuring Environmental Integrity	Accuracy	Accuracy	Reliability	Accuracy, Reliability & Integrity	Accuracy	✓
3. Comparability	Comparability	Comparability	Comparability	Comparability		Comparability	✓
4. Consistency	Consistency		Consistency	Consistency included in CPI's definition of comparability	Precision & integrity through consistency	Consistency	✓
5. Completeness	Completeness	Completeness	Completeness	Completeness	Completeness	Scope and completeness	✓
6. Usefulness				Usefulness			Not selected - *It is already included in other criteria*
7. Timeliness	Frequency of reporting in line with respective obligations			Timeliness	Timeliness		✓
8. Avoiding duplication	Avoid duplication						Not selected – *it does not describe quality*
9. Collectability						Collectability.	Not selected – *it does not describe quality*

The definition of each of these quality principles as used in this thesis is presented in Table 7 below, together with the specific set of criteria defined for each principle.

Table 7: Descriptions and key criteria of the principles used to assess quality of domestic MRV systems in this study

***Source**: Adapted from Falconer, et al. (2012b) &Todorova et al. (2003)*

	Description and key criteria
Transparency	**Description:** The domestic MRV system is open and accessible by relevant audiences and the system's data, assumptions, methodologies and results are clearly explained and available to be tested and scrutinized by the public and other stakeholders as may be determined by local and regional policies, laws and agreements.
	Selected transparency criteria: 1. Are underlying data publicly available for review, scrutiny and use? 2. Are the processes and methods used clearly described and publicly available? 3. Is there systematic record-keeping of key documents and data?
Comparability	**Description:** The system's methodologies and results are comparable across institutions that form part of the institutional arrangements of the system, and to other countries' data or reports.
	Selected comparability criteria: 1. Are comparable calculation methods used across institutions that make calculations within the system? 2. Are comparable calculation methods used across sectors? 3. Does the system use internationally accepted units, protocols and methods? (Protocol and methods not applicable to adaptation MRV)
Consistency	**Description:** The domestic MRV system is internally consistent in how data are calculated and presented over time. Consistent methodologies are used over time and whenever updates to methods are done, they are applied to previous years as far as possible and documented.
	Selected consistency criteria: 1. Are consistent calculation and reporting methods used over time? 2. Are methodological changes documented and applied to all previous years' data?
Accuracy	**Description:** The system, its methodologies and data are well-vetted, independently reviewed and assured as accurate and reliable. The results are systematically neither over estimated nor underestimated as far as can be judged, and uncertainties are reduced to the minimum practical levels.
	Selected accuracy criteria: • Are data and methods subjected to independent 3rd party or public review? • Are the most up-to-date methods and protocols used? • Is the competency of the personnel and institutions that collect the data and/or make calculations ensured? • Is there a documented process for identifying and measuring uncertainty?
Completeness	**Description:** The system covers all data required for effective domestic climate action, and for international reporting. The system has full coverage in terms of sources, sinks, sectors and geographic areas
	Selected completeness criteria: • Are all relevant economic sectors covered? • Is the geographical coverage complete?
Timeliness	**Description:** The system collects data and delivers results in a timely manner and at the frequency required for proper climate change action and reporting at domestic and international levels.
	Selected timeliness criteria: • Is the information and data delivered at the time and frequency required by domestic laws and/or policies? • Is the information delivered at the time required for reporting under the UNFCCC and its Paris Agreement?

The different MRV areas of each domestic MRV system were assessed for each of the quality principles and criteria presented in the table above. The assessment focused on the extent to which each quality criterion has been achieved or adhered to through implementation of the systems as at 31st of December 2021. As such, only those MRV systems which had been in operation for at least two reporting cycles by that time were assessed for quality as per minimum evaluability requirements specified in section 4.2.1. The reporting cycles used here are those of the system itself, not under the UNFCCC. Hence the cycle here refers to the frequency at which the system produces its outputs.

To objectively determine and compare the extent to which each domestic MRV system adheres to the different quality criteria, a rating approach similar to that used in technical reviews of Biennial Reports and national communications of developed Parties under the UNFCCC was adopted (UNFCCC, 2022b). However, unlike the qualitative rating used in those technical reviews, a numerical score has been assigned to the qualitative rating in this thesis to create a 'semi-quantitative' scoring scale. Below is the five-level scoring scale that was adopted and used in this thesis:

0 = Quality criterion not adhered to (i.e., 0% achievement)
1 = Quality criterion minimally adhered to (i.e., 0% < achievement < about 50%)
2 = Quality criterion adhered to about half the time (i.e., about 50% achievement)
3 = Quality criterion mostly adhered to (i.e., about 50% < achievement < 100%)
4 = Quality criterion fully adhered to (100% achievement).

The quality assessment for each country's MRV system was based on the latest MRV cycle of that system (i.e., the system's latest set of inputs, activities and outputs), and for those quality principles and criteria that require assessment over time, covering more than one MRV cycle (e.g., frequency timeliness and consistency), the MRV cycles preceding those latest ones were also assessed. To determine the systems that are eligible for quality analysis, an evaluability assessment was carried out for all the domestic MRV systems of the countries included in this thesis, and the results of that evaluability assessment can be found in Appendix C, showing details of how each system meets or does not meet the quality evaluability requirements.

4.5.2 Correlational assessment on quality

The last activity in this phase was a correlation assessment between the planning for results approach in establishing domestic MRV systems on the one hand, and the levels of quality of domestic MRV systems on the other hand was carried out for all countries. This correlation was aimed at answering the second part of the hypothesis.

4.6 Chapter Conclusion

This chapter presented the approach and methodology that was used in this thesis. The next five chapters present the results, discussions and findings of the thesis determined through the approach and methodology presented in the current chapter. Chapters 5 and 6 respectively present the MRV needs of the countries and domestic MRV systems that the countries have established to *inter alia* respond to these needs. Then chapters 7 and 8 present and discuss the results of the relevance assessments of the 11 selected domestic MRV systems and the Lesotho case study respectively. The last results chapter then focuses on the assessment of quality of the 11 domestic MRV systems.

5 MRV Needs

In section 3.1.1, the needs are referred to as problems or gaps that a programme ought to address to get to the desired state of affairs. As such, MRV needs are climate change problems or gaps that require measurement and/or reporting and/or verification processes and solutions. This chapter presents and discusses the normative international and regional MRV needs as well as the expressed domestic MRV needs for each country included in this thesis, except for the measurement, reporting and verification needs under the Kyoto Protocol which have been excluded from the study.

The Paris Agreement was a key milestone in enhancing MRV needs for countries and regions that are Party to the UNFCCC. The sections below will show that it not only altered the UNFCCC MRV needs of the countries, but it also affected the domestic and regional MRV needs of some Parties as well. In this chapter, both the MRV needs that were in place before the reporting requirements of the Paris Agreement came into force and those that were brought about by the Paris Agreement are presented. The former needs are referred to as "pre-Paris needs" while the latter are designated "Paris era needs".

5.1 International MRV needs

According to Winkler, Mantlana and Letete (2017), UNFCCC reporting requirements are the primary international reporting needs that domestic MRV systems should be able to respond to, without distinguishing between the "shall" and "should" requirements. Based on the MPGs of the Paris Agreement ETF (UNFCCC, 2018), the Cancun MRV Framework (UNFCCC, 2010) and the annual reporting requirements under the Convention (UNFCCC, 1995), UNFCCC MRV needs can be categorized as shown in Table 8 below.

The reporting obligations under the Organization for Economic Co-operation and Development (OECD) also fall under international MRV needs for members of the OECD Development Assistance Committee (DAC). The DAC is an international forum of the OECD, made up of 30 of the largest providers of aid in the world, and it was created by a Ministerial Resolution on 23 July 1960 (OECD, 2019). OECD members have historically been developed countries, though some developing countries have recently gained membership. The DAC monitors, assesses and reports on "*provision of resources that support sustainable development by collecting and analysing data and information on Official Development Assistance (ODA) and other official and private flows*" (ibid). This information is collected annually from all DAC member states, and it includes finance, capacity building and other in-donor expenditures delivered to developing countries for climate change mitigation and adaptation activities (OECD DAC, 2016). These MRV needs are relevant to reporting on climate-related support by Germany, New Zealand, UK and USA, because they are members of the OECD DAC (See Table 8 below).

Both UNFCCC and OECD MRV needs are normative for the countries that are party to the respective agreements because the parties that sign up to those agreements and conventions bind themselves to the relevant requirements of the agreements, including the reporting obligations.

Table 8 shows that the UNFCCC and OECD DAC reporting requirements can be disaggregated into eight and 15 international MRV needs for developing countries in the pre-Paris and Paris era respectively. For the four developed countries included in this study, which are DAC members, the disaggregation in Table 8 leads to 10 independent pre-Paris MRV needs and 16 Paris era needs.

Table 8: Biennial or more frequent international MRV needs for domestic MRV systems
***Source**: own analysis**

MRV THEME (*Applicability in the Paris Agreement*)	UNFCCC MRV Needs				OECD DAC MRV needs
	Paris –era Biennial Transparency Report requirements (MPGs of the ETF)	Pre-Paris biennial reporting		Annual GHG inventory reporting	
		BURs	BRs		
1. GHG inventory *(All)*	1.1 National GHG inventory	Developing Cs	Developed Cs	Developed Cs	
2. Information necessary to track progress in implementing and achieving the mitigation target / contribution *(All)*	2.1. Mitigation policies, actions, measures and plans	Developing Cs	Developed Cs		
	2.2. Projections of GHG emissions & removals		Developed Cs		
3. Information related to climate change impacts and adaptation *(All)*	3.1. Climate impacts, risks and vulnerabilities				
	3.2. Adaptation priorities and barriers				
	3.3. Adaptation strategies, policies, plans, goals & actions				
	3.4. Progress on implementation of adaptation				
	3.5. Monitoring and evaluation of adaptation actions & processes				
	3.6. Management of loss and damage				
4. Information on support provided to developing countries (*Developed countries and developing countries that provide support*)	4.1. Financial support		Developed Cs		DAC Members
	4.2. Capacity-building support		Developed Cs		DAC Members
	4.3. Technology development and transfer		Developed Cs		DAC Members
5. Information on support needed (*Developing countries*)	5.1. Financial support	Developing Cs			
	5.2. Capacity-building support	Developing Cs			
	5.3. Technology development and transfer	Developing Cs			
6. Information on support received (*Developing countries*)	6.1. Financial support	Developing Cs			
	6.2. Capacity-building support	Developing Cs			
	6.3. Technology development and transfer	Developing Cs			

**Developing Cs = Developing countries; Developed Cs = Developed countries; All = All Parties to the Paris Agreement*

5.2 Regional MRV needs

The 10 countries included in this thesis fall under different regional trading blocs, including the European Union, African Union, Southern African Development Community, Union of South American Nations, Association of South-eastern Nations and the South Pacific Regional Trade and Economic Co-operation Agreement, but only the European Union was found to have regional reporting requirements for climate change information. As such, regional domestic MRV needs only exist for the EU and its member states.

The pre-Paris regional MRV needs for the EU and its member states stem from EU decision 280/2004/EC of the European Parliament, which established a mechanism for monitoring community greenhouse gas emissions and for implementing the Kyoto Protocol (European Parliament and Council of the European Union, 2004). That decision, however, was repealed and replaced by decision 525/2013 which established a mechanism for monitoring and reporting of GHG emissions and other relevant climate change information at national and Union levels (European Union, 2013). The reporting requirements of this latter regulation, commonly known as the Mechanism for Monitoring and Reporting (MMR), are considered as pre-Paris MRV needs because they were established to support the implementation of pre-Paris reporting requirements of the UNFCCC (ibid). Because regulations adopted by the European Parliament and Council are automatically binding as law on its member states (European Commission, 2019), the MMR reporting requirements were therefore binding MRV needs for Germany and the United Kingdom (UK) as long as these countries remained EU member states.

Chapter 5 of the MMR (Articles 5, 6, 7 and 8) require the EU (Union) and its member states to "establish, operate and continuously seek to improve national GHG inventory systems in accordance with UNFCCC requirements of national systems for GHG inventories" (European Union, 2013). It further requires annual submission of national GHG inventories by member states to the European Commission (Commission) and the UNFCCC (ibid).

Article 12 requires the establishment, operation and continuous improvement of national and Union systems for reporting on mitigation policies and measures and for reporting on GHG projections. The respective biennial reporting requirements for these are described in detail in Articles 13 and 14. Article 16 requires member states to report to the EU Commission information on support provided to developing countries in the form of finance, capacity-building and technology transfer (ibid).

The last MRV requirements of the MMR relate to annual reporting of information on the use of auctioning revenues and project credits of the EU Emissions Trading Scheme (ETS) as well as submission of biennial reports as required under the UNFCCC (ibid).

While Article 15 of the Regulation also calls for reporting on national adaptation actions by member states, the frequency at which this reporting is required is four years, which is not considered as an MRV need as stated in Section 4.2.3 of this thesis.

In December 2018, the European Union reviewed, repealed and replaced the MMR with EU Regulation 2018/1999 on the Governance of the Energy Union and Climate Action (European Union, 2018). This new Regulation, commonly referred to as the Governance Regulation, has a dual focus on Energy Union and Climate Action. Its core objectives in relation to climate action are: i) to establish a

governance mechanism for implementing strategies and measures to meet the objectives and targets of the Union's GHG commitments under the Paris Agreement; ii) to ensure timely, transparent, accurate, consistent, comparable and complete reporting by the Union and its member states under the UNFCCC and Paris Agreement (ibid). As such, its reporting requirements can be termed the Paris-era EU MRV needs that are binding on all the EU member states. Because this new regulation came into effect when the UK was no longer an EU member state, the regulation does not apply to the UK.

Article 3 of the Governance Regulation requires every EU member state to prepare and submit integrated national energy and climate plans by December 2019 and every ten years thereafter. The plans need to cover, inter-alia, "national energy and climate change objectives, targets and contributions to the Energy Union; planned policies and measures to achieve them; a description of the current situation in respect of energy and GHGs; barriers and hurdles to implementation as well as a general assessment of the impacts of the planned policies and measures" (ibid). Article 17 then establishes a reporting mechanism to monitor progress in implementing these plans in the form of integrated national energy and climate progress reports submitted on a biennial basis from 2023. In relation to climate action, these reports need contain "information on the progress accomplished towards reaching the objectives, targets and contributions set out in the plans; progress towards financing and implementing the policies and measures in the plans; national GHG inventories; information on policies and measures as well as information on projections of anthropogenic GHG emissions" (ibid). While there are linkages and overlaps between the Energy Union and climate action, the reporting requirements relating to the Energy Union are not considered MRV needs. This approach of excluding reporting requirements that are not climate-specific has been applied uniformly and consistently throughout this study to avoid ambiguity where national and regional legislation and policies as well as multi-lateral agreements that do not have climate change objectives require the monitoring and reporting of data that may also have relevance to climate change. Examples include reporting requirements of the Montreal Protocol on Substances that deplete the ozone layer or reporting requirements of domestic energy, waste or disaster management legislation.

Article 19 of the Governance Regulation requires "integrated reporting on national adaptation actions, financial, capacity-building and technology support provided to developing countries as well as the use auctioning of revenues generated through the EU ETS by member states" (ibid). Reporting on adaptation is required on a biennial basis, while information on the use of auctioning allowances and support given to developing countries is required annually from 2021. For the most part, the information requirements of adaptation reporting are aligned with those of the Paris Agreement's ETF as expanded in the MPGs. Article 26 of the Governance regulation requires annual reporting of different versions of greenhouse gas inventories by member states (ibid).

Table 9 below presents a summary of the pre-Paris and Paris era EU regional MRV needs. As shown in the table, a total of seven regional pre-Paris needs can be individually isolated for Germany and the UK, while 13 MRV needs have been identified for Germany alone in the Paris era. Of these, only three pre-Paris needs and one Paris era need are applicable to the European Union as well.

Table 9: Overview of EU regional MRV needs

	Needs		European Union	Germany	UK
Pre-Paris	A. Greenhouse gas inventories (Art 5, 6, 7 & 8)		Yes	Yes	Yes
	B. National mitigation policies and measures (Art 12 & 13)		Yes	Yes	Yes
	C. Emission & removal projections (Art 12 & 14)		Yes	Yes	Yes
	D. Financial and technology support to developing countries (Art 16)	• Financial support	-	Yes	Yes
		• Technology transfer	-	Yes	Yes
		• Capacity Building	-	Yes	Yes
	E. Use of EU ETS auctioning revenue and project credits (Art 17)		-	Yes	Yes
Paris era	1. Integrated Energy & climate change (E&CC) progress report (Art 17)	i. Progress towards objectives, targets and contributions in the E&CC plan (2)	-	Yes	-
		ii. Progress towards financing and implementing policies and measures to meet objectives and targets in the E&CC plan (2)	-	Yes	-
		iii. National GHG mitigation policies & measures (3)	-	Yes	-
		iv. Projections of GHG emissions & removals (3)	-	Yes	-
	2. Reporting on Adaptation planning, strategies and actions (Art 19)	a) Adaptation goals and objectives	-	Yes	-
		b) Projections of weather extremes, climate impacts, vulnerability, risks and hazards.	-	Yes	-
		c) adaptive capacity	-	Yes	-
		d) progress in implementation	-	Yes	-
	3. Use of EU ETS auctioning revenues (Art 19)		-	Yes	-
	4. Support provided to developing countries (Art 19 – 2, Annex VIII, part 2)	• Public & mobilized financial resources	-	Yes	-
		• Public-funded technology transfer projects	-	Yes	-
		• Public-funded capacity-building projects	-	Yes	-
	5. National GHG inventories (Art 26 and Art 17-3)		Yes	Yes	-

5.3 Domestic MRV needs

Domestic MRV needs for each country were primarily obtained from published national documentation including domestic legislation, policies, strategies, executive orders, BURs, BRs and national communications. In addition, domestic MRV needs were obtained from responses to the questionnaires and interviews by respective national MRV experts.

The following sections present the domestic MRV needs of each country in detail, which are then consolidated and discussed at the end.

5.3.1 Brazil

Between 2007 and 2010, Brazil published several key policy documents and legislation related to climate change response. The first of these was Decree 6,263 of November 2007, which established the Inter-ministerial Committee on Climate Change (Presidency of the Republic of Brazil, 2007), and this was followed by law number 12,187 of 2009, establishing the National Policy on Climate Change (PNMC in Portuguese) and a national voluntary GHG emission reduction target of between 36.1% and

38.9% below projected business-as-usual emissions for 2020 (Presidency of the Republic of Brazil, 2009). The latter was complimented by regulation number 7,390 of 2010, which outlines the projected 2020 emissions and provides more details on the national voluntary commitment (Federative Republic of Brazil, 2019). Lastly, the country promulgated law number 12,114 of December 2009, which created the National Fund on Climate Change (Presidency of the Republic of Brazil, 2009a). None of these policies, laws and decrees that were passed between 2007 and 2010, however, contain explicit monitoring and reporting requirements for the country.

The first explicitly legislated domestic reporting requirements for Brazil can be found in the 2016 National Adaptation Plan (NAP), established by Ministry of Environment Order 150 of 10th May 2016. Objectives 1.5 and 2.2 of this NAP explicitly require the establishment and implementation of systems to monitor and observe impacts of climate change, and to monitor and evaluate progress in the implementation of the NAP respectively (Ministry of Environment, 2016). Furthermore, the NAP requires the development and implementation of an Agricultural Risk and Vulnerability Monitoring Simulation System in article 3.1 (ibid).

The latest set of reporting requirements can be found in Decree number 9,578 of 22 November 2018. Article 24 of this decree requires the publishing of annual estimates of GHGs for the country for purposes of monitoring compliance and to facilitate understanding by the segments of the society concerned (Presidency of the Republic of Brazil, 2018). The Decree further designates the National Bank for Economic and Social Development as the financial agent of the National Climate Change Fund, which shall prepare annual activity and performance reports, non-repayable manager reports and consolidated reports, and have them approved by the fund's Management committee (ibid).

5.3.2 China

China does not have a climate change law, although it has been working towards establishing one as early as 2009 (Zhang, et al., 2019). In 2015, the National Development and Reform Commission (NDRC), along with relevant departments drafted a national climate change law and circulated it nationally among key stakeholders (China, 2016), but due to the country's "*slow legislative process*" there has not been much progress in enacting the law beyond that (Zhang, et al., 2019).

In the absence of a national climate change law, the strongest and most influential policy tools that guide China's response to climate change are in the form of Five-year Plans for National Economic and Social Development; simply referred to as "Five-Year Plans". The objective of these plans is to "*arrange national key construction projects, manage the distribution of productive forces and individual sector's contributions to the national economy, map the direction of future development, and set targets*" (Government of China, 2006). While historically these have almost exclusively had an economic focus, significant attention has increasingly been given to environmental protection and climate change issues in recent years (The Economist, 2015). The 12th and 13th Five-Year Plans, covering the periods of 2011 – 2015 and 2016 – 2020 respectively, contain the country's most explicit long-term plans and focus areas for climate change response.

Published in 2011, the 12th Five-Year plan explicitly required the establishment and improvement of statistical monitoring systems for GHG emissions, energy savings and emission reductions (Government of China, 2011). The improvement of statistical accounting, performance evaluation and accountability systems and carbon standards is further called for by the 13th Five-Year Plan, which goes

further to call for "the establishment of a carbon emissions trading scheme and a system for carbon reporting, inspection, verification and quota emissions for major carbon emitters" (Government of China, 2016). The 12th Five-Year Plan also called for the enhancement of monitoring and reporting of extreme weather and climate change incidents (ibid).

In 2013, the NDRC, together with the National Bureau of Statistics (NBS), released a policy paper entitled Opinions for Strengthening Climate Change Statistics. This document requires various provinces and departments to acknowledge the importance of climate statistics, and to strengthen, improve and scale up management, leadership, institutional arrangements, financial resources and capacity-building in relation to those statistics (China, 2016). It further contained explicit requirements on enhancing climate change monitoring processes and statistics related to "climate change and impacts, adaptation to climate change, GHG emission control, financial inputs for addressing climate change and relevant management of climate change actions" (ibid). In the same year, the Chinese Government also published the country's National Climate Adaptation Strategy (China, 2013), which repeatedly called for strengthening of China's climate observation systems and systems for monitoring climate change and its impacts, including droughts, glaciers, disaster monitoring and pest monitoring. Furthermore, the adaptation strategy calls for the strengthening of climate change risk and vulnerability assessments (ibid).

In 2014, the country published its National Climate Change Plan for 2014 – 2020, which reiterated the domestic MRV needs stipulated in the 12th Five-Year Plan and in the Opinions for Strengthening Climate Change Statistics (China, 2014). In 2015 China Submitted its first NDC and updated it in 2021, and it reiterated the importance of having a strong national monitoring and evaluation system covering GHG inventories and climate change impacts (Ministry of Ecology and Environment, 2021).

5.3.3 Colombia

The 2011 publication of the National Council for Economic and Social Policy (abbreviated CONPES in Spanish), termed CONPES 3700, is one of the earliest climate change policy documents to be published by the Colombian government to include explicit references to the country's domestic MRV needs. Section V(2) of that document calls for the generation of information for decision-making, including basic statistical information required in the analysis of climate change and GHG emission accounts under environmental accounting (CONPES, 2011).

Between 2012 and 2016, the Colombian government developed and published different phases of the National Climate Change Adaptation Plan (Abbreviated PNACC in Spanish), which requires the monitoring and evaluation of the progress of the adaptation activities proposed in the Action Plan and accounts for the country's adaptation processes both nationally and sectorially (PNACC Coordinating Committee, 2016).

Also, in 2015 the Colombian government published the National Development Plan (NDP) 2014-2018 entitled "Todos por un Nuevo Pais" (translated "All for a New Country"). It contained three articles that focused on climate change as follows: 1) Article 145, which talks about the Adaptation Fund; 2) Article 157 that focuses on strategizing long term green growth; and 3) Article 161 that focuses on establishing a national register of GHG emission reduction (Colombia Congress, 2015). In particular, Article 161 outlines the country's need for monitoring, reporting and verification of mitigation actions at national level and creation of a National Registry for GHG emission reductions as part of the

National Registry of programs and Projects of Actions for the Reduction of Emissions due to Deforestation and Forest Degradation (REDD+) (ibid).

In 2016 the country then published its first National Policy on Climate Change (Abbreviated PNCC in Spanish). Chapter 8.2.1 of that Policy outlines the country's need for a national climate change information system that covers MRV of GHG emissions, MRV of emission reductions, M&E system for adaptation actions, MRV of climate finance, MRV of capacity building and technical assistance as well as information required to monitor progress towards the country's NDC (Government of Colombia, 2016). According to the Policy, the MRV of climate finance needs to focus on both national (public and private) and international funding sources (ibid).

Then in 2018, the Colombian government published Law 1931 of 2018, which establishes guidelines for management of climate change. In Article 7.5, this Law identifies the need to generate and collect information necessary for the regular update of the national GHG inventory (Colombia Congress, 2018). In addition, the Law outlines a couple of needs for MRV of mitigation actions: Article 26 expresses the need for a registry to manage and monitor GHG mitigation initiatives as part of the National Information System on Climate Change, while Article 30 establishes a national emissions trading program that requires a verification and certification system (ibid).

Moreover, the financial management committee of the Colombian National Climate Change System published a National Climate Financing Strategy in 2018, highlighting the country's need for a climate finance MRV system with strong mechanisms for tracking domestic private climate finance investments (SISCLIMA Financial Management Comittee, 2018).

In 2015, Colombia submitted its first NDC, which it updated in 2020, and it reiterated the need for monitoring and evaluation of GHG emissions, mitigation and adaptation actions (Government of Colombia, 2020). Further on adaptation monitoring, the NDC also specified the need for an integrated system on vulnerability, risk and adaptation, which will "facilitate the monitoring of adaptation through management indicators and indicators of change in vulnerability." (ibid).

5.3.4 Indonesia

Indonesia published its first climate change response policy document in 2007 in the form of a National Climate Change Action Plan (Abbreviated RAN-PI in Bahasa Indonesia) (Republic of Indonesia, 2017). This was followed by the publication of various presidential regulations, instructions and decrees aimed at supporting its implementation. The first policy document to explicitly contain domestic MRV needs was Presidential Regulation 61 of 2011 on the National Action Plan for Reduction of Greenhouse Gas Emissions (Abbreviated RAN-GRK in Bahasa Indonesia). Article 3 of this regulation establishes RAN-GRK as a reference tool for nationwide planning and implementation of GHG emission reductions, and requires Government institutions to monitor and evaluate their GHG emission reduction action plans (President of the Republic of Indonesia, 2011). This regulation was followed by Regulation 71 of 2011 on the Implementation of a National GHG Inventory System, which requires and gives effect to periodic compilation and reporting of National GHG inventories (ibid).

In 2012 the Indonesian Government then published the country's National Action Plan for Climate Change Adaptation (Abbreviated RAN-API in Bahasa Indonesia). In Chapter 4 the RAN-API contains several domestic MRV needs as follows (Republic of Indonesia, 2012):

- The need for a climate information system for analysis, prediction and estimation of climate change.
- The need for data and information on climate change, vulnerability and climate risks, as wells as vulnerability mapping for urban areas, marine areas, coastal areas and islands.
- The need for a system for monitoring and evaluation of activities on adaptation to climate change, including tracking progress in attaining the national climate change targets.

In 2015, at a session on Operationalization of technology and system in Directorate general of Climate Change (Directorate), the Directorate reiterated the country's need for systematic and easily accessible information on vulnerability level in specific areas or sectors (Ministry of Environment and Forestry, 2015).

Finally, in 2016 the country submitted its Nationally Determined Contribution under the Paris Agreement, where the Indonesian Government committed to "reducing the country's GHG emissions by 29% compared to the business as usual scenario by 2030, with domestic efforts, and up to 41% with international support" (Republic of Indonesia, 2016; Republic of Indonesia, 2017). As a result, Government then identified the need to monitor and report on the domestic means of implementation, in addition to monitoring and reporting on international means of implementation as required by Article 13 of the Paris Agreement, to enhance transparency (Republic of Indonesia, 2016). In 2021, Indonesia submitted its updated NDC, containing no new MRV requirements.

5.3.5 Kenya

The earliest consolidated policy document published by the Government of Kenya to guide the country's climate change response was the 2010 National Climate Change Response Strategy. This Strategy identified the country's need to develop and implement "*GHG Monitoring and Reporting Programmes*" to assess, quantify and report sectoral GHG emissions (Government of Kenya, 2010). It also proposed a climate change governance structure that includes a monitoring and evaluation unit to be charged with monitoring the implementation of all climate change activities, evaluation of all programmes, assessment of the outcomes of all climate programmes and supporting the development of relevant policy and legislative framework. The unit would also compile and present periodic reports on the activities of the respective climate change programme divisions to the secretariat at the Ministry of Environment and Mineral Resources (ibid).

Guided by the Response Strategy, Kenya then published its first National Climate Change Action Plan in 2013, covering the period of 2013 – 2017. Known as the first NCCAP (or NCCAP 1), this action plan included a proposed National Performance and Benefit Measurement Framework (NPBMF) which is meant to be an "integrated framework for measuring, monitoring, evaluating, verifying and reporting GHG emissions, results of mitigation actions, adaptation actions and the synergies between them" (Government of Kenya, 2013). In addition, the first NCCAP expressed the country's need for tracking and assessing the effectiveness of investments in mitigation and adaptation, and to determine whether the money is being spent wisely (Government of Kenya, 2013). The Action Plan argued that "continuance of international funding for climate change depends on the existence of an effective MRV system", whose results are needed by funders for validation of the effectiveness of the funding they provide (ibid).

In May 2016, the country published and enacted a climate change law: Climate Change Act No. 11 of 2016, which contains various MRV provisions. Firstly, it establishes a Climate Change Council and makes provision for it to impose on all public entities reporting on sectoral GHG emissions for the national inventory (The Republic of Kenya, 2016). Then the Council is required to prepare and submit annual climate change reports to the President, Parliament and the county assemblies containing progress towards implementation of the climate change plans and recommendations of actions and measures to advance climate change response (ibid). Secondly, it calls for the Cabinet Secretary responsible for climate change affairs to "report biannually to Parliament on the status of implementation of national and international climate change obligations, and progress towards low carbon climate resilience development, and also to make regulations to guide the reporting and verification of climate change actions" (ibid). Thirdly, it calls for the Climate Change Directorate to establish a national registry of mitigation actions by public and private entities. Finally, the law establishes a Climate Change Fund for financing of priority climate change actions and interventions approved by the Council, and then calls for the establishment of a tracking, accounting, monitoring and evaluation mechanism for the Fund (ibid).

In 2016, the Ministry of Environment and Natural Resources also published the country's National Adaptation Plan 2015 – 2030, with a full chapter dedicated to adaptation monitoring and evaluation. The chapter highlights the need to track progress in building adaptive capacity and as a result proposes several adaptation indicators that need to be tracked by the country's adaptation M&E system (Government of Kenya, 2016). Seventeen indicators have been proposed, composed of top-down country level adaptive capacity indicators and bottom-up vulnerability indicators (ibid). According to the plan, each government ministry is expected to integrate adaptation actions into their sectoral plans and report progress on the implementation of those actions annually to the Climate Change Secretariat. Finally, the plan highlights the need for the establishment of a knowledge management system to collect and submit learnings from implementation of adaptation activities to policy makers to influence decision-making (ibid).

In 2018, the Government of Kenya released its second National Climate Change Action plan (2nd NCCAP), covering the period of 2018 – 2022. This action plan identifies M&E as one of its key delivery and coordination mechanisms and calls for the establishment of a NCCAP M&E system that will focus on tracking the implementation, results and climate finance raised under the NCCAP. According to the plan, the M&E system should demonstrate and check whether investment in adaptation and mitigation actions leads to real climate change results and related development benefits, to "*provide evidence base for planning and implementation of future actions, seeking support as well as domestic and international reporting*" (Government of Kenya, 2018). Specifically, the action plan calls for reporting of progress and achievement of NCCAP actions by all state departments; reporting on climate finance for supporting the NCCAP; tracking the impacts of climate actions and the related co-benefits; and tracking and measurement of GHG emissions at sectoral level. (ibid).

Still in 2018, the Kenyan Government published a Climate Finance Policy (2018 CF Policy) which requires the National treasury to monitor and track financial, technology transfer and capacity building support received, integrating the system with sustainable development monitoring systems, and to report to Parliament on the implementation of the Policy (Murphy & Oduol, 2019) .

Kenya submitted its first NDC in 2020, containing no MRV requirements.

5.3.6 South Africa

The South African government published its first National Climate Change Response Strategy in 2004. This strategy identified two requirements for MRV, specifically: 1) the need for an information handling system for national GHG inventories; and 2) an information management system for registration, coordination and reporting of climate change related projects undertaken using donor funding (Department of Enviromental Affairs and Tourism, 2004).

In 2011, this Strategy was replaced with the National Climate Change Response White Paper (NCCRWP), which is the main national policy that has been guiding the country's climate change response since then. The NCCRWP identifies two overarching objectives of climate change response in South Africa: 1) effectively managing inevitable climate change through building and maintaining the country's climate resilience and 2) making a fair contribution to global climate change mitigation (Government of South Africa, 2011). Among the key elements of the country's approach to climate change mitigation is the MRV requirement to establish "*a national system of data-collection to provide detailed, complete, accurate and up-to-date emissions data"* in the form of:

- Annual GHG inventories that conform to the IPCC's guidelines (2006 or later as published), to track the country's performance against a defined benchmark national GHG emission trajectory range; and
- A Monitoring and Evaluation System to support the analysis of the impact of mitigation measures, with outcomes published annually. This system needs to track the cost, outcome and impact of mitigation measures in order to monitor the success of responses and to replicate the ones that have worked well (ibid).

In order to support the effective management of inevitable climate change, the NCCRWP identifies the following monitoring and evaluation needs:

1. Maintenance and strengthening of nationwide climate change and atmosphere monitoring systems.
2. Establishment of a system for monitoring climate change impacts at appropriate spatial density and frequency.
3. Establishment of a system for monitoring and reporting of adaptation actions, including progress in their implementation; This is to be integrated into the quarterly reporting requirements of government through the outcomes-based M&E system of the Presidency, and
4. Modelling and assessment of the country's vulnerability to climate change, including continuous updating and maintenance of the South African Risk and Vulnerability Atlas (ibid).

The NCCRWP also identifies the need for a tracking facility to monitor and coordinate climate finance flows and the use and impact of funds as part of a comprehensive resource mobilization and management package for adaptation and mitigation responses (ibid). Finally, the NCCRWP identifies the need for "a robust and functional climate change science and technology platform to enable the development of appropriate responses to climate change" (ibid). As part of the governance of that platform, the NCCRWP requires that a Scientific Advisory Council be established and that the Council produce and submits "a biennial report to Cabinet on the state of climate change science and technology in South Africa" (ibid).

In 2012, the National Planning Commission within the Presidency of the Republic of South Africa published the National Development Plan (NDP) 2030, entitled "Our future – make it work" (National Planning Commission, 2012). One of the focus areas of this NDP is "*Ensuring environmental sustainability and an equitable transition to a low-carbon economy*", whereby the country's "*just transition to an environmentally sustainable, climate-resilient, low-carbon economy and society is anticipated to be well underway by 2030*" (ibid). As one of the guiding principles for this just transition, the NDP has identified the need for accountability and transparency through management, monitoring, verification and reporting. Particularly, it specifies the need for monitoring, reporting and verification of carbon emissions for the sectors that have been allocated carbon budgets, the inclusion of carbon intensity and emission reduction indicators into government's outcome-based M&E system and establishment of a framework for reporting on GHG emissions by industry (ibid). It envisaged that by 2020 "*Comprehensive reporting on carbon emissions… by the government and business*" will be underway, and "*annual data on emissions levels and climate impact feeds into policy and regulatory processes*" (ibid).

Then in 2020, Government published South Africa's National Climate Change Adaptation Strategy (NCCAS), which contained an overarching monitoring and evaluation objective of "developing and implementing an M&E system to track implementation of adaptation actions and their effectiveness", using nine desired adaptation outcomes (DFFE, 2020a).

South Africa's NDC, updated in 2021, does not contain any MRV needs.

5.3.7 Germany

The Federal Republic of Germany's first climate change policy came in the form of a cabinet decision passed on 7 November 1990 to reduce the country's GHG emissions by 25% below 1987 levels (GIZ, 2018). To align with the 1990 base year adopted by the IPCC's first assessment report, the German government adjusted this target to 25% below 1990 levels by 2005 and announced it at the first UNFCCC COP in Berlin on the 5th of April 1995 (ibid). There was, however, no domestic legislative requirement to monitor, track and report progress towards this target. In 2001, the German government began a process to develop a law on climate protection statistics aimed at creating a legal basis for collecting and using data for national GHG inventories, but this was abandoned in 2007 when major political and legal reservations became apparent within the country (ibid).

Between 2007 and 2010 the German government updated its GHG emission targets to a reduction of 40% below 1990 levels in 2020, 55% below 1990 levels in 2030 and 80% - 95% reduction by 2050 and backed these new targets with more than 100 mitigation measures (Wilkes, et al., 2018; Wikipedia, 2019). One of the main vehicles proposed for achieving these targets was the Energy Concept, which serves as a compass for steering the country's energy transition towards renewable energy sources. In addition to achieving climate targets, the goals of the Energy Concept are to phase-out nuclear electricity generation, to guarantee competitiveness and to ensure security of supply. The Energy Concept requires the monitoring of this energy transition by tracking indicators related to deployment of renewable energy sources, greenhouse gas emissions, greenhouse gases avoided using renewables, energy consumption and efficiency, security of supply, affordability of energy, grid infrastructure, sector coupling, digitization, energy innovation, investment and jobs in the energy sector (Federal Ministry for Economic Affairs and Energy, 2019).

In 2008, the German Government also adopted and published a German Strategy for Adaptation to Climate Change, with the aim of reducing the country's vulnerability to the impacts of climate change and to improve the adaptability of its systems (Federal Government of Germany, 2008). To improve the country's knowledge base, this Strategy includes four MRV requirements: 1) The need for a climate impact monitoring system; 2) the need for indicator systems that represent climate change, their scale and interactions; 3) the need for vulnerability assessments and 4) the need for evaluating adaptation measures and assessing their effectiveness (ibid).

In December 2014, Government adopted and published its Climate Action Programme 2020 (CAP 2020), with the intention of ensuring that it met its 2020 reduction target (BMUB, 2017). As part of monitoring the implementation of this Programme, the Federal Ministry for Environment, Nature Conservation, Building and Nuclear Safety (Abbreviated BUMB in German) is required to produce and publish an annual climate action report containing GHG emissions information, progress in implementation of the mitigation measures as well as projected emission reductions expected for 2020 (BMUB, 2014). Then in 2016, Government published the Climate Action Plan 2050, which outlines the basic principles for implementing the country's long-term climate action strategy, with a focus on the vision for 2050 for each area of action and specific milestones for 2030 (BMUB, 2016a). This Action Plan reiterates the MRV requirements outlined in the Climate Action Programme 2020.

Finally, on 17 December 2019, Germany enacted and published a Climate Change Law to ensure compliance with national climate protection goals and compliance with European and UNFCCC targets, obligations and commitments. In addition to reiterating the MRV requirements specified in the Climate Action Programme 2020 and Climate Action Plan 2050, the law further requires the publication of an emissions projection report every two years from 2021, according to the requirements of the EU Governance regulation (Federal Republic of Germany, 2019). 2019 was also the year in which the country published its Climate Action Programme 2030, which also reiterated the need for the publication of annual climate action reports to continue beyond the period of the Climate Action Programme 2020 (BMU, 2019)

Germany submitted its first NDC, together with the EU in 2020, and this NDC had no reporting requirements.

5.3.8 New Zealand

New Zealand was one of the first countries in the world to enact a climate change law when it passed its Climate Change Act in 2002. The main objectives of this Act were to enable the country to meet its international obligations under the convention and the Kyoto Protocol, to establish the country's emissions trading scheme and to establish a levy on specified synthetic greenhouse gases (New Zealand Government, 2019). This Act requires the compilation of New Zealand's national GHG inventory and publication of the inventory report on annual basis. Furthermore, the Act establishes an emissions trading scheme wherein participants are required to calculate, monitor and, where required by regulations, verify the emissions and removals achieved through their mitigation activities in accordance with the methodologies prescribed in regulations made under the Act (ibid).

While the Act was amended several times over the years, the most significant amendment came in 2019 in the form of the Climate Change Response (Zero Carbon) Amendment Act. This Amendment Act amends the purpose of the 2002 Act to include the following: 1) to assist New Zealand to

"implement policies to support Paris Agreement efforts to limit global temperature increase to below 1.5° Celsius above pre-industrial levels, and 2) to allow the country to prepare for, and adapt to, the effects of climate change" (ibid). As part of ensuring that these objectives are met, the Amendment Act establishes a Climate Change Commission to "provide independent expert advice to government, and to monitor and review Government's progress towards achieving the country's climate change goals" (ibid).

In relation to mitigation, the Act starts by specifying the country's 2050 target, compared to the 2017 base year, and then mandates Government to set GHG emission budgets required to meet the target (ibid). Then it goes on to identify MRV requirements for monitoring progress towards meeting those targets. Specifically, it requires the Commission to prepare annual monitoring reports, for the most recent year for which information is available from the national GHG inventory report, and submit to the Minister of Environment, who should then present the reports to parliament (ibid). The reports should contain measured emissions, measured removals, latest projections of emissions and removals, an assessment of the adequacy of the GHG mitigation plan, progress in implementation of the mitigation plan as well as any new opportunities to reduce emissions (ibid).

In terms of adaptation, the Amendment Act requires the preparation of national climate change risk assessments every six years as well as national adaptation plans that respond to the respective climate change risk assessments. In terms of MRV, the Amendment Act requires that progress reports for the national adaptation plans be compiled biennially by the Commission and be submitted to the responsible Minister (ibid). Specifically, each progress report must include the following (ibid):

1) "An assessment of progress made in implementing the measures in the plan.
2) An assessment of the extent to which the objectives of the plan have been achieved and how well the plan responds to the most significant climate change risks.
3) An assessment of the effectiveness of the plan, and
4) Barriers to implementation of the plan and ways to overcome those barriers."

Finally, New Zealand published its Development Aid Programme Policy Statement and Action Plan in 2014. Aligned with the principles of the Global partnership for Effective Development Cooperation and the Cairns Compact on Strengthening Development Coordination in the Pacific, this policy statement and action plan includes the country's commitment to the following (New Zealand Ministry of Foreign Affairs and Trade, 2014):

a. To systematize collection of, and reporting on, development effectiveness data and include this information in its annual programme planning and reporting process; and
b. To strengthen the annual tracking and reporting on development results.

Because New Zealand delivers climate change related support through its official development assistance programme, these commitments in the policy statement and action plan also apply to climate change related support (Principal Development Manager - Environment and Climate Change, 2011).

New Zealand's NDC, submitted in 2015 and updated in 2021, does not contain any MRV requirements for the country.

5.3.9 United Kingdom

The United Kingdom's primary guiding document for responding to climate change is its Climate Change Act of 2008. This Act starts by establishing the country's 2050 emissions target of 80% reduction from 1990 levels and the associated carbon budgeting system, then it provides a system for annual reporting on the country's GHG emissions and progress towards meeting the target (UK Government, 2008).

MRV requirements related to mitigation are set out in sections 16 and 36 of the law. Specifically, section 16 requires the Secretary of State to compile and present annually to Parliament a GHG inventory of the UK, an assessment of the net carbon account from credited and debited carbon credits for the year and an assessment of whether the emissions have increased or decreased compared to the preceding year and the base year (ibid). On the other hand, Section 36 requires the Climate Change Committee, which is an independent body created by the Section 32 of the Act, to present a report to Parliament and other legislatures, on annual basis, advising them on progress made towards achieving the mitigation targets. Specifically, the law requires the report to outline the Committee's views on progress towards meeting the carbon budgets and the 2050 target, further progress needed to meet them and the likelihood of meeting those targets (ibid).

In Part 4, the law then focuses on climate change impacts and adaptation. It calls for the Secretary of State to compile and present a report on climate change risks and impacts for the UK every five years. It further calls for the Secretary of State to put together programmes for adapting to climate change impacts and to present them before Parliament. Then Section 59 of the law stipulates the MRV requirements related to climate change adaptation. It calls on the Committee on Climate Change to report biennially to Parliament on its assessment of the progress made towards implementation of the adaptation programmes (ibid).

Other explicit domestic MRV needs of the UK relate to climate support to other countries. The UK provides International Climate Finance (ICF) to developing countries as part of its ODA. In 2006 the UK Government passed the International Development Reporting and Transparency Act of 2006 requiring the Secretary of State to report annually to Parliament on the country's international aid expenditure, disaggregated by type of aid, channel of aid, region, country and sector (sections 2 and 3) (UK Government, 2006). In 2015, the UK Government adopted another law in relation to ODA entitled "International Development (Official Development Assistance Target) Act of 2015 with the primary objective of ensuring that the UK meets its target for its annual ODA to constitute 0.7% of gross national income. Section 5 of this 2015 Act has a requirement for the Secretary of State to make arrangements for an independent evaluation of the extent to which UK's ODA represents value for money in relation to its intended purposes (UK Government, 2015). This section essentially requires an evaluation of the impact of the international climate finance provided by the UK.

Then in 2019, on the eve of its exit from the European Union, the UK amended its Climate Change Act of 2008 with a focus on changing the country's long-term target to net zero by 2050, but this change was not accompanied by any new or changes to the existing MRV provisions (Legislation.gov.uk, 2019).

The UK's NDC, submitted in 2015 and updated in 2020, does not contain any reporting requirements.

5.3.10 United States of America

To date, domestic response of the United States of America (USA or US) to climate change has been primarily guided by presidential executive orders (EOs) and commitments, because attempts to pass congressional legislation have failed on multiple occasions (US Government Accountability Office, 2016).

In 2009 and 2015, the Obama administration made two main commitments to reduce the country's GHG emissions, which he expressed through various executive orders. The first was a pledge following the Copenhagen Accord in 2009 to reduce US GHG emissions by 17% below 2005 levels by 2020, while the second was part of the country's Intended Nationally Determined Contribution (INDC) submitted in 2015 prior to the Paris COP, which included a mitigation target to reduce emissions by 26 – 28% below 2005 levels by 2025 (The White House - Office of the Press Secretary, 2015). To accompany these GHG reduction targets, the administration identified the need to track and report progress towards meeting the targets using annual national GHG inventories (Executive Office of the President, 2013; USA, 2015). This need has been reiterated in numerous US GHG inventories (US Environmental Protection Agency, 1997; US Environmental Protection Agency, 1998), as well as by a 2009 US Government Accountability Office (GAO) report entitled "High Quality Greenhouse Gas Emissions Data are a Cornerstone of Programs to Address Climate Change", which emphasized the country's need for reliable GHG emissions data to assist the US to understand baselines and track emissions overtime whenever mitigation programs are implemented (US Government Accountability Office, 2009).

Between 2009 and 2015 the Obama administration also published several "*adaptation-relevant executive orders and policies*" that contain MRV requirements (US Global Change Research Program, 2019). The first such was Executive Order 13514 of 2019, entitled "Federal Leadership in Environmental, Energy and Economic Performance". This Executive Order required all Federal agencies to develop their respective adaptation plans, but did not require the agencies to monitor progress in implementation of these adaptation plans (The President, 2009). That MRV requirement only came in 2013, in Executive Order 13653, entitled "Preparing the United States for the Impacts of Climate Change" (The President, 2013). The latter EO required the agencies to report progress made on implementing those adaptation plans on annual basis (ibid). EO 13514 was later replaced with EO 13693 by the Obama administration, but by 2019, both EOs 13693 and 13653 had been revoked by the Trump administration only for President Joe Biden to reinstate them in his first day in office in January 2021 (The President, 2017; The President, 2018; The President, 2015; Havard Law School, 2021). The same MRV needs have also been expressed in the National Global Change Research Plan of 2012 – 2021, published by the US Global Change Research Program (USGCRP) in 2012. Specifically, the plan outlines the need for developing indicators of climate change that encompass metrics for progress in adaptation and mitigation activities of the country (US Global Change Research Program, 2012).

The need for monitoring the country's climate-related risks and vulnerabilities was expressed in 2015 in a GAO report to congressional requesters entitled "Climate Information: A National System Could Help Federal, State, Local, and Private Sector Decision makers Use Climate Information". This report found that climate information needs of federal, state, and private sector decision-makers are not being fully met, hence there is a need for a national climate information system that presents reliable

and up-to-date information on observed climate conditions, climate risks and vulnerabilities, as well as observed and projected climate change impacts (US Government Accountability Office, 2015).

Finally, the country's domestic MRV needs related to means of implementation can be traced back to the 1990 Global Change Research Act, which included requirements for government to annually budget for and report on climate change expenditures of the United States Global Change Research Program (USGCRP) – an interagency long-term climate change science program (US Government Accountability Office, 2005). In 1998 and in 1999 Congress requested the Office of Management and Budget (OMB) located within the Presidency to prepare and present detailed accounts of all climate change expenditures and obligations, beyond USGCRP. Since then, "Congress has included a provision in annual appropriation laws requiring OMB to monitor and report in detail on all federal agency obligations and expenditures for climate change programs and activities", covering both domestic spend and international climate change assistance (ibid).

The USA's first NDC, since re-joining the Paris Agreement, submitted in 2021, does not contain any MRV needs.

5.3.11 Synthesis and analysis

Table 10 below presents a synthesis of the domestic MRV needs of the different countries based on the individual country assessments above. The Table shows that the countries' domestic MRV needs can be classified into 11 different MRV needs.

Table 10: Pre-Paris and Paris era MRV needs at domestic country level

***Source:** own analysis **

Needs	Brazil	China	Colombia	Indonesia	Kenya	South Africa	Germany	New Zealand	UK	USA
A. GHG inventory & national mitigation target tracking	Decree 9578 of 2018	• 12th FYP • 13th FYP • NDC	• CONPES 3700 • 2018 CC Law • 2016 PNCC	Presidential Regulation 71 of 2011	• CC Strategy • NCCAP 1 • 2016 Act • NCCAP 2	• CC Strategy • NCCRWP • NDP	• 2050 CAP • 2020 CAP • CC Law 2019 • Energy concept	2002 CC Law	2008 CC Act	• Obama, 2009 • Obama, 2015 • 1997 GHG inventory • 1998 GHG inventory
B. Mitigation actions monitoring and evaluation	SMMARE	12th FYP	• 2018 CC Law • 2016 PNCC • NDP 2014-18	Presidential Regulation 61 of 2011 (RAN-GRK)	• CC Strategy • NCCAP 1 • 2016 Act	• CC Strategy • NCCRWP • NDP	• 2050 CAP • 2020 CAP • Energy concept • CC Law 2019	• 2002 CC Law • 2019 Zero C amendment	2008 CC Act	USGCRP 2012
C. GHG emission projections	-	-	-	-	-	-	• CC law 2019	2019 zero C amendment	-	-
D. Climate impacts, risks and vulnerability monitoring	2016 NAP	• 2013 NAS • 12th FYP • NDC	• interview • NDC	RAN-API	NAP 2015	NCCRWP	NAS 2008	-	-	2015 GAO report
E. M&E of Adaptation actions and targets	2016 NAP	Opinions on CC Statistics	• 2016 PNACC • 2012 NAP	RAN-API	• NCCAP 1 • NAP 2015 • NCCAP 2 • 2016 Act	• NCCRWP • NCCAS	NAS 2008	2019 zero C amendment	2008 CC Act	• EO 13653 • USGCRP 2012
F. Climate change monitoring	-	• Opinions on CC Statistics • 2013 NAS	-	RAN-API	-	NCCRWP	NAS 2008	-	-	2015 GAO report
G. Climate support provided: (i) Finance (ii) Capacity building & (iii) Technology transfer	-	-	-	-	-	-	-	Policy on Aid effectiveness	2006 T&R Act	Appropriations Acts
H. Impact and effectiveness of climate funds monitored	-	-	-	-	• NCCAP 1 • NCCAP 2	NCCRWP	-	Policy on aid effectiveness	• 2006 T&R Act • 2015 ODA Target Act	2012 USAID CC Strategy
I. Domestic climate finance tracking	Decree 9578 of 2018	Opinions on CC Statistics	• 2016 PNCC • CF strategy	Nationally Determined Contribution	• 2016 Act • NCCAP 2	NCCRWP	-	-	-	• 1990 GCR Act • Appropriations Acts
J. International climate finance received	-	-	• 2016 PNCC • CF strategy	-	• NCCAP 2 • 2018 CF Policy	NCCRWP	-	-	-	-
K. Capacity building & technology transfer received	-	-	2016 PNCC	-	2018 CF Policy	-	-	-	-	-

* Green means domestic needs that were expressed before Paris, and are applicable to both pre-Paris and Paris eras; Orange means domestic needs that were only expressed post Paris.

The first three needs (A to C) relate to GHG emissions and mitigation actions, and the results show that all countries have expressed the need to track domestic mitigation targets through national GHG inventories and the need to monitor and assess the impact of the mitigation actions contributing towards achievement of those targets. The results also show that all the countries expressed these two needs well before the Paris Agreement came to be, and in some cases in multiple publications. The domestic need for projection of GHG emissions has only been expressed by Germany and New Zealand, and in both cases only in the Paris era.

The next set of domestic MRV needs identified in Table 10 relates to climate risks, impacts, vulnerability and adaptation (D to G). The results show that all countries included in this study have expressed the need for monitoring and evaluation of adaptation actions and targets as important for supporting their response to climate change at domestic level. Furthermore, the Table shows that those needs were expressed by the countries before the Paris Agreement came to be, except for New Zealand's adaptation M&E need, which was only explicitly expressed in country's Zero Carbon Amendment bill in 2019. China, South Africa, Germany and the US have all expressed their domestic needs for monitoring climate change indicators, impacts, risks and vulnerability, while Brazil and Kenya have only expressed their need for monitoring climate impacts, risks and vulnerabilities in their 2016 and 2016 National Adaptation Plans respectively.

The last five domestic MRV needs (H to L) relate to means of implementation. As expected, only developed countries have expressed the need to track climate support they provide to other countries. However, Germany is not one of them. This is because the developed countries included in this study disburse and monitor their climate-related support to other countries using their respective policies and laws for general Official Development Assistance (ODA), but according to Palmer (2011), of the Global Legal Research Centre, Germany's ODA policy is different from those of the other three developed countries. For Germany, granting of ODA is not enshrined in any statute, but is a matter of policy formulated by the Federal Chancellor as head of the executive branch of government, who then needs to account to Parliament and the Federal Court of Audit on the implementation of the policy (ibid). While this is similar to the appropriations process in the USA, the main difference is that since 1999, the US Congress has included provisions in its annual appropriation laws specifically requiring detailed monitoring and reporting of all federal agency obligations and expenditures for domestic and international climate change spending. There is no such legal requirement in Germany.

Still on means of implementation, the results show that all developing countries have expressed the need for monitoring climate finance from domestic sources, while the USA is the only developed country to express such a need. Furthermore, all developed countries, except for Germany, as well as Kenya and South Africa, have a domestic MRV need to assess and monitor the impact and effectiveness of climate finance, with the developed countries focusing on international climate finance they provide to developing countries while the developing countries' focus is on both received international climate finance as well as domestic climate finance. The last two domestic MRV needs related to means of implementation are the need to monitor received climate finance support, capacity building support and technology transfer support, which have been expressed by Colombia and Kenya, while South Africa has only expressed the need to track climate finance support received.

Finally, what can be observed in Table 10 is that most of the expressed domestic MRV needs are aligned to or similar to the normative international MRV needs under the UNFCCC MRV Framework.

There are only three unique needs that do not align with the UNFCCC MRV needs, that some countries have identified as critical for domestic climate action. Specifically, these are the need for climate change monitoring, the need for monitoring the effectiveness of climate finance as well as the need for tracking domestic climate finance. Almost all needs in Table 10 were expressed pre-Paris, with only three having been expressed post-Paris.

5.4 Summary

This chapter has presented the countries' international, regional and domestic MRV needs. It revealed that the Paris Agreement has been a key defining moment for MRV needs at all levels, so much that every country's needs can be classified into pre-Paris and Paris era needs. For all the countries that are party to the UNFCCC and the OECD, it was found that all the monitoring and reporting needs, required biennially or more frequently under the UNFCCC and the OECD DAC, can be classified as normative international needs for those countries.

It was also found that only EU countries have regional needs resulting from the EU MMR and Governance Regulation, and that those needs are normative to them since they're automatically binding to those countries if they remain EU member states. In addition, this chapter presented the domestic MRV needs expressed by the different countries through their climate related legislation, policies, strategies, executive orders or other government documentation. A total of 11 unique domestic MRV needs were identified, with varying applicability to the countries. Many of the domestic MRV needs are expressed in more than one government publication. The results further showed that all countries have expressed domestic MRV needs to track their mitigation targets using both national GHG inventories and individual mitigation measures. Furthermore, all countries have also expressed the need to monitor and evaluate their adaptation actions and targets. Finally, the results revealed that there are some MRV needs that some countries have expressed, that do not appear under the UNFCCC MRV framework, but the countries deem them important for their domestic climate change response.

The next chapter presents the domestic MRV systems that the countries have established *inter alia* to respond to these needs.

6 Domestic MRV systems

Having discussed the international, regional and domestic MRV needs of each country in the preceding chapter, this chapter turns to domestic MRV systems of the 11 countries included in this thesis. The chapter focuses on why and how the different countries have developed the systems. It also identifies information required for better understanding of the results of the relevance and quality assessments, which will be discussed in chapters 7 and 9 of this thesis respectively.

This chapter starts by presenting domestic MRV systems of each of the developing countries included in this thesis, after which MRV systems of developed countries are discussed. To the extent possible, a consistent order of discussing the systems is followed for each country, starting with GHG inventory and mitigation systems, then systems focusing on climate risk, impact, vulnerability and adaptation, and finally means of implementation systems analysed at the end.

6.1 Developing countries

For most developing countries, the primary sources of the information contained herein have been the MRV chapters of the respective countries in their Biennial Update Reports, which were complemented by the MRV system design documents, the web platforms of those systems as well as the questionnaires and interviews completed by different country MRV experts and/or government officials.

6.1.1 Brazil

There are three independent systems that form Brazil's overall domestic MRV system: One focuses on compilation of national GHG inventories, while the second and third focus on monitoring and evaluating the impact of mitigation actions and the country's adaptation plan respectively. Table 11 below outlines the name, status, objectives and envisaged outcomes of each of these systems.

Table 11: Objectives and intended outcomes of the systems that make up Brazil's domestic MRV system

No	Name	Status	Objectives, envisaged outcomes & other relevant information
1	National Emissions Registry System (SIRENE – Portuguese abbreviation)	In operation since 2017	**Objectives and envisaged outcomes** (Federative Republic of Brazil, 2017; Ministry of Science and Technology, 2020)**::** • To manage, quantify and monitor the results of the National Inventory of anthropogenic emissions by sources and removals by sinks of Greenhouse Gases not Controlled by the Protocol of Montreal, and to providing information related to other emissions accounting initiatives • To protect information and manage accessibility of the country's national GHG inventories • To support decision-making in the scope of policies, plans, programs and projects in climate change, particularly in the adoption of mitigation actions. • To monitor the fulfilment of the objectives to be achieved through the implementation of public policies by the states within the federal republic. **Web portal:** http://sirene.mctic.gov.br
2	Modular System for Monitoring Actions and	Pilot stage since 2018	**Objectives and envisaged outcomes** (Federative Republic of Brazil, 2019; Federative Republic of Brazil, 2014) • To monitor actions and GHG emission reductions to be achieved through the Brazilian Climate Change Mitigation Plans.

	GHG Emission Reductions (SMMARE, in the Portuguese acronym)		• To support the analysis and management of the mitigation actions implemented by Brazil • It is intended to provide information on mitigation actions, methodologies for analysis, assumptions, progress made in their implementation and information on MRV of the actions **Web portal:** http://educaclima.mma.gov.br/transparencia/
3	National Adaptation Plan Monitoring & Evaluation System (NAP M&E System)	Piloted in 2017	**Objectives and envisaged outcomes** (Camarinha, 2018) • To monitor the integration of adaptation into planning • To assess progress toward adaptation at national level • To monitor the achievement of the goals proposed in the National Adaptation Plan as well as challenges towards their achievement • To monitor the sectorial guidelines and the adaptation actions of local governments, private sector and society • To promote extensive information on adaptation actions.

None of these systems include MRV of means of implementation, whether needed, received or allocated to climate change response from Brazil's domestic sources. The absence of such a system is highlighted in Brazil's fourth Biennial Update Report under the UNFCCC, where it is stated that the country is encountering "*considerable challenges related to any in-depth consideration and identification of constraints and gaps, and related financial, technical and capacity needs at a comprehensive scale*" (Federative Republic of Brazil, 2020). Furthermore, the 4th BUR states that data and information on support received was collected specifically for the compilation of the BUR, and confessed that it lacks the necessary completeness, transparency and comparability (ibid).

The sections below give further details on each of the sub-systems that make up Brazil's overall domestic MRV system.

6.1.1.1 National Emissions Registry System (SIRENE)

Established by Decree No. 9,172/2017 and developed by the Ministry of Science, Technology and Innovation (MCTI), SIRENE was launched in 2016 and started operating in 2017. It has since been used to compile and manage Brazil's annual national GHG inventories covering all the greenhouse gases not controlled by the Montreal Protocol (Ministry of Science and Technology, 2020). While SIRENE primarily uses the Revised 1996 IPCC guidelines for National GHG inventories, it also uses the 2006 IPCC Guidelines for some of the emission estimates (ibid).

There is no information on the approach that was used to develop SIRENE, and there is no information suggesting that logical modelling approach was employed.

6.1.1.2 Modular System for Monitoring Actions and GHG Emission Reductions (SMMARE)

Brazil first designed SMMARE in 2013 after which it also developed guidelines and methodological bases to support it. However, the development of the system was later halted to allow for information on the ETF under the Paris Agreement to be concluded so the system can be aligned to its MRV requirements and avoid duplication (Federative Republic of Brazil, 2020). According to the 4th BUR there has not been any further progress in developing this system (ibid).

6.1.1.3 National Adaptation Plan Monitoring & Evaluation System (NAP M&E System)

A Thematic Technical Group (TTG) for monitoring Brazil's National Adaptation Plan was established by government in November 2016, comprising representatives of ministries, other federal agencies, states, municipalities, private sector and civil society organizations (Ministry of Environment, 2017). Since then the TTG worked towards compilation of the first NAP M&E report, which was published in June 2017, covering the period 2016 – 2017. While M&E reports were intended to be released annually (Ibid), the second publication was only planned to be published in July 2019, but still had not be published by March 2020 (Camarinha, 2018). The collection of the data for compiling the 1st M&E report was undertaken through data collection cards that were sent out to the 13 Ministries of the Federal government (ibid). The NAP M&E system is meant to be improved overtime, with significant improvements planned between the 1st M&E report and the 2nd one (ibid).

6.1.2 China

In 2013 China set up a 23-member Leading Group on Climate Change Statistics, which identified the country's climate related information needs, from which the National Development and Reform Commission (NDRC) and the National Bureau of Statistics (NBS) jointly published a report on "Opinions on Strengthening Climate Change Statistics", which was approved by the State Council (China, 2016). It is on the outcomes of this report that China's domestic MRV system has been based (ibid).

According to China's first BUR, the country's overall domestic MRV system is composed of two main systems: 1) The GHG Emission Accounting and Reporting system, and 2) the Statistical Indicators and Basic Statistical System (China, 2016). Table 12 below outlines the objectives, envisaged outcomes and status of these two systems.

Table 12: Objectives and intended outcomes of the systems that make up China's domestic MRV system

No	Name	Status	Objectives, envisaged outcomes & other relevant details
1	GHG Emission Accounting and Reporting System (GHG Inventory System)	Being developed	**Objectives and envisaged outcomes** (China, 2016) • To support the preparation of national and provincial GHG inventories on a regular basis • To support accounting the CO2 emission control targets and filing annual analysis reports • To formulate the guidelines for local GHG inventory preparation and key enterprise GHG emissions accounting • To serve as a reporting platform for GHG emissions from key enterprises and local online reporting system
2	Climate Change Statistical Indicators and Basic Statistical System (Statistical Indicator system)	In trial phase since 2014	**Objectives and envisaged outcomes** (China, 2016) • To support the preparation of national GHG inventories • To enhance climate change statistics using indicators scientifically reflecting climate change characteristics and the actual status of climate change responses • To present a full picture of China's efforts and achievements in coping with climate change • Covers five categories of indicators: 1. Climate Change and Impacts, 2. Adaptation to Climate Change, 3. GHG Emission Control, 4. Financial Inputs for Addressing Climate Change (including capacity building inputs, science and technology inputs), and 5. Relevant Management on Climate Change Actions.

These two systems that make up China's overall domestic MRV system are presented in detail below.

6.1.2.1 GHG Emission Accounting and Reporting System

China is in the process of establishing its GHG emissions accounting and reporting system, and as such its inventories are currently being compiled on a project basis (People's Republic of China, 2018). When complete, the system is intended to be a 3-level system that enables the regular preparation of national GHG inventories, the preparation of provincial GHG inventories and the reporting of GHG emissions by key industries (China, 2016). For the 2012 GHG inventory, The NDRC, as the GHG inventory coordinating agency, selected and appointed institutions to prepare the GHG inventory through a bidding and tendering process (ibid), and the same team has remained in charge of the preparation of the 2014 GHG inventory (People's Republic of China, 2018). A National GHG Inventory Data Management System is being developed to support the normalization and standardization of the inventory preparation process going forward (China, 2016).

6.1.2.2 Basic Indicators and Basic Statistical System

This system was established by incorporating the basic statistical indicators for GHG emissions into the overall government statistical indicators system, and then identifying further statistical indicators relevant to climate change and the country's response to it (China, 2016). The system covers five categories of indicators, consists of 19 sub-categories and 36 specific indicators. The five categories of indicators are 1) Climate Change and Impacts; 2) Adaptation to Climate Change; 3) GHG Emission Control; 4) Financial Inputs for Addressing Climate, and 5) Relevant Management on Climate Change Actions (ibid). These indicators were based on the "Opinions on Strengthening Climate Change Statistics" report (ibid). Since 2014, the NBS, together with the NDRC published various key documents to support establishment of the system (ibid).

6.1.3 Colombia

Between 2015 and 2016 Colombia conceptualized its national domestic MRV system made up of the main domestic MRV system covering GHG emissions, mitigation actions and climate finance, as well as a supporting system for monitoring and evaluation of climate change adaptation to climate change impacts (Vargas & Arbelaez, 2017). Table 13 below presents the objectives, intended outcomes and status of these systems.

Table 13: Objectives and intended outcomes of the systems that make up Colombia's domestic MRV system

No	Name	Status	Objectives, envisaged outcomes & other relevant details
1	Colombian MRV System	In development since 2015. Some parts started operating from 2020.	**Objectives and envisaged outcomes** (Government of Colombia, 2018; Vargas & Arbelaez, 2017) • To monitor progress in the implementation of mitigation activities • To contribute to the analysis and reporting on GHG emissions, emission reductions and climate finance (public and private sources from international, national and sub-national sources) • Platforms & components of the system: 1. National GHG Inventory System (Abbreviated SINGEI in Spanish) 2. Regional GHG Inventory System 3. Voluntary Corporate Reporting Program (Abbr. PRCV in Spanish) 4. National Registry of Mitigation Actions (Abbr. RENARE in Spanish): http://renare.siac.gov.co/GPY-web/#/ingresar 5. Finance MRV Platform: https://mrv.dnp.gov.co/Paginas/inicio.aspx

2	Adaptation M&E System	In design phase	**Objectives and envisaged outcomes** (Vallejo, 2018) • To provide updated information related to the processes, results and impacts of the actions developed to reduce vulnerability and increase climate-resilient development • To deliver results regarding the cost-effectiveness of such interventions. • M&E results needed to support decision making processes at the local, regional and national levels • Composed of 134 indicators that cover climate risk and vulnerability, adaptation, adaptive capacity and climate finance.

According to the Colombian Ministry of Environment (Rodriguez, 2019), the establishment of the domestic MRV system was motivated by four main factors: 1) Losing the information that was used to compile the first and second national communications, 2) the need to implement the transparency framework at the national level, 3) the need to implement a tracking system for the NDC, and 4) the need for M&E data to support national policies and decision-making processes (ibid). In approaching the design of the system, the Ministry of Environment explained that a logical framework approach was followed as is the norm in developing all national policies and systems (ibid). Specifically, inputs, outcomes and outputs of the domestic MRV system were explicitly mapped out in the form of a logical framework (ibid). While the design document outlining the logical framework of the domestic MRV system is not publicly available, government has included as much of that information in words in Regulation 1447 of 2018 published by the Ministry of Environment and Sustainable Development to regulate the MRV of mitigation actions at national level (ibid). Further details about Colombia's domestic MRV system is presented in the sections below.

6.1.3.1 Colombian MRV System

The GHG emission component of the system is composed of the GHG Inventory System (Abbreviated SINGEI in Spanish), and the Regional GHG Inventory System and the Voluntary Corporate Reporting Program – PRCV (Government of Colombia, 2018). The GHG inventories are coordinated by the Institute of Hydrology, Meteorology and Environmental Studies (abbreviated IDEAM in Spanish) and prepared by consultants. Because IDEAM has limited personnel resource, there is no plan to fully in-source the compilation of the national GHG inventories (Arbelaez, 2017). The web-based platform of SINGEI was prototyped in 2019 and it is planned that it will be fully functional by 2023 (USAID, 2019).

The National Registry of Mitigation Actions (RENARE) is envisaged to be a registry of NAMAs from the public sector, CDM projects and programmes of activities, programmes and projects for reducing emissions from deforestation and land degradation (REDD+) as well as other low carbon development projects (ibid). This registry will also support the implementation of the Carbon Tax law (Law 926 of 2017) in that all projects and programmes implemented by companies to reduce their tax liability will be registered in this registry, then undergo internal verification followed by certification of emission reductions (ibid). Having been conceptualized since 2017, RENARE was launched on the 8th of September 2020 (Ministry of Environment Colombia, 2020).

The climate finance MRV system was developed before the Paris Agreement came to be, and is now being updated to address both the national climate finance MRV needs and the MPGs of the ETF (Rodriguez, 2019). It currently covers international public and private climate finance, as well as domestic private and public climate finance (ibid). The system uses existing financial management systems to track domestic public finance, while the tracking of private finance is carried out through information from the National Administrative Department of Statistics, which captures investments

made in mitigation and adaptation by the private sector (Government of Colombia, 2018). The reporting and monitoring of international climate finance is undertaken through the country's Information System on International Cooperation, which tracks the destination and origin of all financial resources coming into the country (ibid).

6.1.3.2 Adaptation M&E System

The Colombian national M&E system is envisaged to be a "*multi-scale (territorial and sectorial), process and outcome-oriented tool*" (Vallejo, 2018). It is also envisaged that it will align and link with the Colombian MRV system as far as possible (ibid). So far, a national M&E strategy for climate change adaptation has been developed, comprising of a national adaptation indicator system, which focuses on indicators of climate threat, exposure, vulnerability and adaptive capacity (ibid).

6.1.4 Indonesia

Indonesia's main domestic MRV system is called the National Registry System for Climate Change (NRS-CC), which is complemented by three other systems: 1) the National GHG Inventory System (abbreviated SIGN-SMART in Bahasa Indonesia), 2) the Vulnerability Index Data and Information System (abbreviated SIDIK) and 3) the Climate Information System. The objectives and envisaged outcomes of these systems are presented in Table 14 below.

Table 14: Objectives and intended outcomes of the systems that make up Indonesia's domestic MRV system

No	Name	Status	Objectives, envisaged outcomes & other relevant details
1	National GHG Inventory System (Abbreviated SIGN-SMART in Bahasa Indonesia)	In operation since 2014	**Objectives and envisaged outcomes** (Government of Indonesia, 2017) • To "improve the effectiveness of data management and GHG emissions estimation with integrated database systems". • to meet the TACCC principles • It produces "information on the levels, status and trends of GHG emissions and uptake at national, sector, provincial and district levels" **Web portal**: https://signsmart.menlhk.go.id/v2.1/app/
2	National Registry System for Climate Change (NRS - CC)	In operation since 2016	**Objectives and envisaged outcomes** (Government of Indonesia, 2017; Republic of Indonesia, 2018; Prihatno, 2019) • To document climate change Adaptation and Mitigation actions and resources in Indonesia. • For Government recognition of the contribution of various Parties' efforts on adaptation, mitigation, finance, technology and capacity building in Indonesia. • To provide data and information to the public on action and resources for climate change Adaptation and Mitigation action and their achievements. • To avoid double counting of climate change Adaptation and Mitigation action and resources as part of the implementation of the clarity, transparency and understanding (CTU) principle • To implement the transparency framework in Article 13 of the Paris Agreement and to translate it into national context • Outputs to include needed and received domestic and international climate-finance, capacity building and technology transfer. • It also monitors the contribution of the different mitigation actions towards achievement of NDC targets **Web portal**: http://ditjenppi.menlhk.go.id/srn/

3	Vulnerability Index Data and Information System (SIDIK)	In operation since 2012	**Objectives and envisaged outcomes** (Government of Indonesia, 2017; Boer, 2019; Ministry of Environment and Forestry, 2015) • To provide information on the vulnerability of villages and wards throughout Indonesia and to understand the relative vulnerability of one region compared to other areas • To assist local governments to develop adaptation strategies and plans • To monitor the impact and effectiveness of adaptation policies and measures to changes in the level of vulnerability • Outcomes include projected climate risks, impacts and vulnerabilities **Web portal:** http://sidik.menlhk.go.id/
4	Climate Information System (Climate Info System)	In operation since 2014	**Objectives and envisaged outcomes** (BMKG, 2022) • To provide information on climate change • Outputs grouped into four themes as follows: 1. **"Climate forecast**: Monthly Precipitation forecast, Seasonal forecast, potential floods 2. **Climate analysis**: Monthly precipitation, atmosphere dynamics, extreme climate analysis, Standardized Precipitation Index, Water balance 3. **Climate information**: Sea surface temperature, El Nino Index, Pacific Subsurface temperature 4. **Climate change**: Precipitation and temperature trends, normal precipitation shift, climate change extremes, climate change projections and climate change reports." **Web portal:** https://www.bmkg.go.id/?lang=EN

Because these systems were all developed before the MPGs of the ETF were finalized, the government of Indonesia has been working to ensure that by the first Biennial Transparency Reporting cycle the country's MRV system will be fully aligned with the MPGs (Prihatno, 2019). Below is a summary of each of these systems.

6.1.4.1 SIGN-SMART

The implementation of the country's GHG inventory system is mandated by Regulation No 73 of 2017, which outlines the institutional arrangements and responsibilities. According to the Regulation, each sector department is responsible for collection of activity data within its sector, emission calculation and QA/QC (Republic of Indonesia, 2018).

6.1.4.2 NRS - CC

The establishment of this system is regulated and supported by two main regulations of the Ministry of Environment and Forestry (MoEF): i) Regulation No 71 of 2017 and Regulation No 72 of 2017 (ibid). Implementers of mitigation measures develop and use their own methodologies for mitigation assessment, but Government has developed guidelines to assist project owners to determine whether their projects fit the definition and requirements for mitigation and adaptation projects, and to determine the project stage (Boer, 2019). The mitigation component of the system is currently operational while the adaptation component only captures basic information but not progress tracking nor impact assessment (Ministry of Environment and Forestry of the Republic of Indonesia, 2018). Results-based planning was used in designing this system, and it has been presented as a logical model in the country's 2nd BUR (Republic of Indonesia, 2018). The system was based on the MRV needs of the Paris Agreement as depicted in the ETF and translated those needs to national context, it was completed before the EFT's MPGs were finalized, hence it does not fully take them into account.

According to Prihatno (2019) the country will initiate a process to align this system with the MRV requirements in the MPGs and translate the latter into national context by the first BTR in 2024.

6.1.4.3 SIDIK

Every three years, government, through the Bureau of Statistics, collects data on village potency and vulnerability, including socio-economic, demographic, geographic, and infrastructure environmental data to feed into SIDIK (Boer, 2019). Local governments utilize these vulnerability indicators to develop adaptation strategies and plans and to respond to forest fires (Republic of Indonesia, 2016). While the plan is also to use this vulnerability data to assess the impact of adaptation measures, the system is currently unable to do this due to challenges in ascertaining whether the planned projects have actually been implemented in the correct way to correct stakeholders (Boer, 2019).

6.1.4.4 Climate Information System

The Climate Information System was developed by the Indonesian Weather, Climate and Geophysics Agency (BMKG), in cooperation with the GIZ.

6.1.5 Kenya

Kenya developed and published the National Performance and Benefit Measurement Framework (NPBMF) in 2012, as a sub-component of its Climate Change Action Plan. The NPBMF outlines the design of the country' MRV+ System with objectives and intended outcomes as presented in Table 15 below.

Table 15: Objectives and intended outcomes of the systems that make up Kenya's domestic MRV system

No	Name	Status	Objectives, envisaged outcomes & other relevant details
1	Kenya's MRV+ System (MRV+ System)	Design completed in 2012. It has been in setup mode since then.	**Objectives and envisaged outcomes** (Republic of Kenya, 2012; King'uyu & Adegu, 2017; Ouma, 2019) • Tracking the implementation of mitigation and adaptation actions, and to effectively report, primarily for domestic purposes, for the country to be able to hold itself accountable to its domestic commitments and targets (e.g., NCCAP targets) • To facilitate meeting international obligations, including the preparation of National Communications, BURs and the Enhanced Transparency Framework • Outcomes: climate change outcomes with respect to project, programme and policy related activities (mitigation, adaptation and development) and the MRV of sources of GHG emissions and sinks that are needed to compile the GHG inventory. Includes the MRV of socio-economic impacts of adaptation and mitigation actions.
2	Climate change budget coding and tracking tool for climate finance (budget & CF tool)	In design phase since 2018	**Objectives and envisaged outcomes** (Republic of Kenya, 2012; King'uyu & Adegu, 2017; Ouma, 2019) • To monitor and assess international climate finance received as well as domestic climate finance • Climate public expenditure & Budgetary review results to provide baseline • Domestication of Rio Markers and development of a budget coding system for climate change actions • To also capture support for capacity building and technology development

The Government of Kenya later identified the climate finance monitoring gap in the MRV+ system and decided to establish a separate system for it and termed it the "Climate Change budget coding and tracking tool for climate finance" (Ouma, 2019). Both systems are still in development phase. The sub-sections below summarize each of these systems.

6.1.5.1 Kenya's MRV+ System

The design of the system was outsourced to Ricardo AEA - an international consultant – which followed a two-step approach, entailing i) review of existing practices, indicators and reporting mechanisms in Kenya and internationally, and ii) designing the system, building on existing M&E structures, and developing the relevant indicators, guidance materials and capacity development plan (GIZ, 2014). An MRV thematic working group, made up of representatives of different stakeholders, was set up to work closely with the consultants (King'uyu & Adegu, 2017). The final design of Kenya's MRV+ system has been presented as a logical framework, outlining inputs to the systems, results level outcomes, outputs and reports, as well as activities (Republic of Kenya, 2012). However, according to Transparency International Kenya, which has been involved throughout the design and implementation stages of the MRV+ system, the development of the system did not follow a logical framework approach (Ouma, 2019). The design was scrutinized by the thematic group and the public, through public participation forums, before it could be finalized (King'uyu & Adegu, 2017). Originally the establishment of the system was meant to be completed by 2017 at the latest (ibid).

6.1.5.2 Climate change budget coding and tracking tool for climate finance

In the original design of the MRV+ system, provision had been made to include additional MRV activities, particularly MRV of climate finance, in the system (Republic of Kenya, 2012). But the Government of Kenya has since decided to setup a separate system for climate finance MRV (Ouma, 2019). Since 2018 Government has been re-calibrating the existing finance information and management system to serve as the climate change budget coding and tracking tool for climate finance. The aim is to code all financial flows so that whoever looks at the budget of any national ministry can be able to determine whether the finance was used towards mitigation or adaptation of climate change (ibid).

6.1.6 South Africa

South Africa has had a National Climate Change Response Database with climate change mitigation and adaptation projects and programmes since 2009. However, there was no systematic way of updating the information therein, including adding new projects or updating the existing ones in relation to progress. Thus, the National Climate Change Response Monitoring and Evaluation System as well as the National GHG Inventory Management systems were designed and implemented with the overall objectives of tracking South Africa's transition towards a low carbon and climate resilient economy and society and fulfilling the country's reporting obligations under the UNFCCC. Table 16 below outlines the specific objectives and outcomes of each system.

Table 16: Objectives and intended outcomes of the systems that make up South Africa's domestic MRV system

No	Name	Status	Objectives, envisaged outcomes & other relevant details
1	National GHG Inventory Management System (NGHGIS)	Operational since 2017	**Objectives and envisaged outcomes** (Department of Environment, Forestry and Fisheries, 2019) • "To ensure the sustainability of the inventory preparation in the country, the consistency of reported emissions and the standard quality of results" • To manage and simplify the country's GHG reporting obligations under the UNFCCC Outcome: GHG inventories are documented and managed centrally
2	National Climate Change Response Monitoring and Evaluation System (M&E System)	In operation since 2016, but most elements still in development	**Objectives and envisaged outcomes** (Republic of South Africa, 2015; Makholela, 2019; DFFE, 2021) • To track SA's transition towards a low carbon economy and society: tracking GHG emissions, mitigation policies, measures and actions and their effectiveness. • To track transition towards a climate resilience economy and society (Adaptation M&E), through three building blocks: climate information and projections; climate risks, impacts and vulnerability; climate resilience response measures (adaptation measures). Indicators of these pulled together into Desired Adaptation Outcomes. • To track climate finance, including finance needs, flows and impact of international and domestic climate finance sources. • Tracking of technology transfer activities related to climate change initiatives (added at a later stage, not during system design). • To provide evidence base to inform effective climate change response planning and implementation Web portal: https://ccis.environment.gov.za/#/cic-trends

6.1.6.1 National GHG Inventory Management System

South Africa's National GHG Inventory Management System (NGHGIS) was set up in 2017 during compilation of the country's 2015 GHG inventory, where it was only partly utilized; It was then used fully during compilation of the 2017 GHG inventory (DFFE, 2021). It utilizes a web based Sharepoint platform for document management, sharing and storage, but the platform is not publicly accessible (ibid). Since the compilation of the 2010 GHG inventory, all South Africa's national GHG inventories have been based on 2006 IPCC guidelines. South Africa's national GHG inventories are subjected to at least two quality assurance processes: The first is an independent 3rd party review by external expert consultancies that were not involved in the compilation of the GHG inventory, and the second is a 30-day public commenting process.

6.1.6.2 The National Climate Change Response M&E System

The development of South Africa's M&E system was outsourced to Ricardo AEA – a consultancy company based in the UK. Logical planning approach was used in the development of the M&E system, as depicted and explained in the National Climate Change Response Monitoring and Evaluation Framework (Republic of South Africa, 2015). Specifically, Section 3 of the Framework document outlines a logical framework of the design of the system. In the system design document, MRV needs were taken from the NCCRWP, the NDP and the various stakeholder workshops have been explicitly spelled out individually and in detail in the Framework document (Chapters 1, 4.4 and 4.5.2 of the

Framework), while the international needs are simply termed BUR requirements or National Communication requirements (ibid).

The climate finance MRV component of this system is fully operational, while the mitigation MRV and technology transfer MRV components are still being setup (Witi, 2021). According to Makholela (Makholela, 2022), who has been leading establishment of the adaptation MRV system, the status of the adaptation component can be characterized as "work in progress". The latter system was implemented for two years between 2019 and 2020, based on indicators termed the Desired Adaptation Outcomes, but the team has now gone back to the drawing board to improve the system, particularly addressing poor update of the system by the stakeholders and aligning the indicators with the recently published National Climate Change Adaptation Strategy (ibid).

6.2 Developed countries

Biennial Reporting requirements for developed countries under the UNFCCC do not include reporting on domestic MRV systems, hence information on these countries' domestic MRV systems was primarily obtained through questionnaires, complemented by other country documents including national communications to the UNFCCC.

6.2.1 European Union

As mentioned in chapter 5.2, the first EU MRV system was established by decision 280/2004/EC of the European Parliament, and entitled Mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol. As the EU's MRV needs evolved, that system was repealed and replaced by the Mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change in 2013.

Then, in response to the reporting requirements of the Enhanced Transparency Framework of the Paris Agreement, the European Parliament and EU Council then adopted the Regulation for Governance of the Energy Union and Climate Action in December 2018 as a new EU system for MRV which came into operation from the 1st of January 2021. Table 17 below outlines the objectives and intended outcomes of the latter two systems.

Table 17: Objectives and intended outcomes of the systems that make up EU's domestic MRV system

No	Name	Status	Objectives, envisaged outcomes & other relevant details
1	Mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change (MMR)	In operation until 31st December 2020	**Objectives and envisaged outcomes** (European Union, 2013) • To ensure the timeliness and TACCC of reporting by the Union and its Member States to the UNFCCC Secretariat • To report and verify information relating to commitments of the Union and its Member States under the UNFCCC and its Kyoto Protocol, and evaluate progress towards meeting those commitments • To monitor and report all anthropogenic emissions by sources and removals by sinks of greenhouse gases controlled under the UNFCCC • To monitor, report, review and verify greenhouse gas emissions and other information pursuant to Article 6 of Decision No 406/2009/EC and evaluate progress towards meeting obligations therein • To monitor and report on the actions taken by EU Member States to adapt to the inevitable consequences of climate change in a cost-effective manner

			• Web portal: https://cdr.eionet.europa.eu/
2	Governance of the Energy Union and Climate Action (Governance)	Replaced the MMR. In operation from 1st January 2021	**Objectives and envisaged outcomes** (European Union, 2018) • To repeal and replace the MMR • To ensure timeliness and TACCC of reporting by the Union and its Member States to the UNFCCC and Paris Agreement secretariat • Outputs include updates on integrated national energy and climate plans; Integrated biennial progress reporting on those plans, GHG measures, emissions projections, national adaptation plans, climate change projections, climate-change impacts, assessment of climate vulnerability, risks and hazards; financial, capacity building and technology support provided; and annual GHG inventories.

Both the MMR and the Governance regulations are primarily based on the UNFCCC reporting requirements. They both follow logic planning by first outlining the different MRV needs of the EU and its member states under the UNFCCC and then mapping the EU reporting requirements to those needs (European Union, 2013; European Union, 2018). The Governance Regulation, however, was developed and adopted at the same time as the MPGs of the ETF, hence it does not make any reference to the MPGs (European Union, 2018). The sections below give brief descriptions of each of the systems.

6.2.1.1 MMR

In order to support the operationalization of the MMR, the EU Commission published a number of documents and regulations including the following: i) A Commission staff working document on the elements of the Union GHG inventory system and the quality assurance and quality control programme; ii) A Commission delegated regulation on establishing requirements for a Union Inventory System and taking into account changes in the global warming potentials and internationally agreed inventory guidelines; and iii) A Commission implementing regulation on the structure, submission process and review of information reported by Member States. These regulations stipulate the institutional arrangements, data format and processes of compiling EU GHG inventories such that they're aligned to the TACCC and timeliness requirements of the UNFCCC (European Commission, 2013; European Commission, 2014; European Commission, 2014a). Under this system, the EU also undertakes the EU-level projections for its member states (Herold, 2019)

6.2.1.2 Governance Regulation

As the primary motivation for its establishment, the Regulation points to the need to respond to the Paris Agreement and its objectives to limit global average temperature increase to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels (European Union, 2018). While the Governance Regulation is generally aligned with the reporting requirements of the ETF as spelled out in the MPGs, there are some specific reporting requirements that are in the MPGs but have not been covered by the Regulation (e.g., information related to averting, minimizing and addressing loss and damage associated with climate change impacts).

6.2.2 Germany

A total of five systems make up Germany's overall domestic MRV system. The first is the National System of Emissions (NaSE) which focuses on compilation of national GHG inventories, followed by the system for monitoring and evaluating the German Government's Climate Action Programmes, and

the systems that monitor the implementation of the national adaptation strategy (abbreviated DAS in German), climate finance provided developing countries as well as the use of revenues from EU ETS auctioning. The objectives and envisaged outcomes of these systems are presented in the table below.

Table 18: Objectives and intended outcomes of the systems that make up Germany's domestic MRV system

No	Name	Status	Objectives, envisaged outcomes & other relevant details
1	National System of Emissions (NaSE)	In operation since 2007	**Objectives and envisaged outcomes** (Roeser, 2014) • To comply with reporting requirements of the UNFCCC and its Kyoto Protocol. • To be a framework under which annual national GHG inventory reports are prepared • to comply with EU requirements for compilation of GHG inventories.
2	Climate Action Programme monitoring (Climate Action M&E)	In operation since 2015	**Objectives and envisaged outcomes** (BMU, 2018) • Objective: To regularly review implementation and progress towards achieving Germany's GHG reduction target, to inform areas where corrective action needs to be taken • It outlines the implementation status of current measures under the Climate Action Plan 2050, emissions trends in the various areas of action, and an estimate of the reductions expected from upcoming steps
3	Monitoring system of the German Adaptation Strategy (DAS monitoring)	In design phase	**Objectives and envisaged outcomes** (BMUB, 2018; BMUB, 2016) • To monitor climate change impacts and progress towards the implementation of the German Adaptation Strategy (Abbreviated DAS in German); this includes assessment of historical climate change in Germany • To fulfil the requirement of the DAS for the development of an indicator system and regular reporting on the progress in the adjustment process in Germany • It comprises 97 indicators, 55 of which are climate impact indicators and 42 are response indicators that include adaptation measures or activities and conditions that support the adaptation process • The primary outputs of this system are periodic monitoring reports.
4	Climate finance MRV (Finance MRV)	In operation	**Objectives and envisaged outcomes** (Herold, 2019) • To monitor climate finance provided to developing countries for mitigation and adaptation activities • It uses OECD DAC guidance and finance classification, which includes classification for climate finance, capacity-building and technology transfer and development
5	Climate and energy fund monitoring (EKF system)	In operation	**Objectives and envisaged outcomes** (Le Den, et al., 2017) • To monitor finances channelled to the special Climate and Energy Fund (abbreviated EKF in German), including revenue generated from the auctioning of ETS allowances • To monitor financial commitments from the EKF in the years 2011-2013 only appear as disbursements

According to German climate change experts, the country does not have a systematic process for projecting GHG emissions and removals (Herold, 2019). Instead, the Ministry for the Environment, Nature Conservation and Nuclear Safety (abbreviated BMUB in German) publishes a tender every time the projections are required (ibid).

The sections below describe each of the system above in more detail.

6.2.2.1 National System of Emissions (NaSE)

Between 2001 and 2007 the German legislature failed to agree on legislation governing climate protection statistics, which would have established a legal basis for national GHG inventories in the country (GIZ, 2018). As a compromise that ensured that the country meets its international GHG reporting obligations, a five-page agreement of the Secretaries of the seven main ministries involved in GHG inventory compilation was compiled and used (ibid). This was the only legal basis for compilation of National GHG inventories in Germany until 2019, when the federal climate protection law was enacted, giving legal basis for annual GHG inventory compilation (Federal Republic of Germany, 2019). Between 30 and 50 GHG inventory experts are involved in the compilation of the country's annual GHG inventories from all the agencies involved, with 13 of them being dedicated to this work at the German Environment Agency (GIZ, 2018; Roeser, 2014). A web-based system called the Central System of Emissions (CSE) is used as a database and working platform for inventory compilation (Herold, 2019).

6.2.2.2 Climate Action Programme monitoring

The Federal German Government intends to compile and publish annual reports detailing implementation status of mitigation programmes, current emission trends in areas of action and anticipated reductions from upcoming steps, to support the implementation of the government's 2020 Climate Action Programme (BMU, 2018). Annual reports containing ex-ante mitigation assessment results were published between 2015 and 2019, however since 2019 there has not been any assessments nor climate action reports published (BMUV, 2021). The 2015 – 2019 reports were carried out by a consortium of experts, with no indication that a system was ever put in place to ensure continuous assessments beyond 2019 (BMU, 2018). Between 2015 and 2019, an assessment of the country's MRV needs was continuously made through this system, and published in the annual reports (ibid).

6.2.2.3 DAS monitoring system

Two years after the publication of the German Adaptation Strategy an indicator-based monitoring system was developed with a total of 97 indicators covering three main areas: i) impact and response level; ii) past, present and future developments and indicators for assessing sensitivities and vulnerabilities; iii) processes relevant to the Federal Republic and indicators for describing problematic issues (Schonthaler, et al., 2010). A "*Driving forces – Pressures – States – Impacts-Response*" approach was used to develop the indicator system, which identifies and maps the relevant indicators required at each of those stages with the aim of ensuring a good understanding of the causes and effects of climate change (OECD, 2013). The development of the indicators and the monitoring system was characterized by broad stakeholder engagement process as well as assessment of information needs for the system (ibid). In 2015 and 2020, the German government published the first and second DAS progress reports, based on the developed indicators (BMUB, 2018; Die Bundesregierung, 2020). The reports present measured data, the climate change that has already been detected in Germany and stock of progress made in implementing adaptation related activities (BMUB, 2018; Die Bundesregierung, 2020). According to the 2nd DAS monitoring report, the institutional and procedural arrangements for the systematic monitoring and evaluation of DAS, to fulfil the reporting requirements of the EU's Governance MRV system is yet to be established, while publicaition of the comprehensive DAS monitoring report is intended to be updated every four years (Die Bundesregierung, 2020).

6.2.2.4 Climate Finance MRV

There is no legislative basis for MRV of climate finance in Germany. But the Ministries of Environment (BMU) and Cooperation monitor and report on climate finance, capacity building and technology transfer provided to developing countries following the OECD DAC Rio Markers (Herold, 2019). This MRV also includes means of implementation from the German private sector, which is collected through agreements with the relevant private sector entities (ibid). There has always been hesitation from government to extent the MRV to resources used for domestic climate change response (ibid).

6.2.2.5 Climate and energy fund monitoring

Germany is one of only a few EU countries to have full earmarking of revenues from EU ETS auctioning for climate change measures (Esch, 2013). In 2010 the German government established a Special Energy and Climate Fund (abbreviated EKF in German), and since 2012 nearly all the EU ETS revenues are channelled to it (ibid). The fund is earmarked to fund climate change response activities. If the fund does not reach the desired cap (from the auctioning revenues), it is topped up by the national budget (ibid). According to a GermanWatch report, the bundling of expenditures for climate action with the EKF makes the national EU ETS revenues easy to track (ibid). The EKF tracking and reporting system has come under scrutiny several times in terms of transparency and accuracy, with a 2016 World Wildlife Fund European Policy Office report finding that Germany reports that the EKF has higher expenses than the auctioning revenues and this "misleading German reporting skews EU figures" (Velten, et al., 2016). Also, a 2017 EU analysis of the use of auction revenues by member states found that the Germany' revenue use values do not add up to the reported total value (Le Den, et al., 2017).

6.2.3 New Zealand

There are two systems that make up New Zealand's overall domestic MRV system: i) The National Inventory System and ii) The Aid Programme Management System. Table 19 below outlines the objectives and envisaged outcomes of these systems.

Table 19: Objectives and intended outcomes of the systems that make up New Zealand's domestic MRV system

No	Name	Status	Objectives, envisaged outcomes & other relevant details
1	National Inventory System (Inventory system)	In operation since 2002	**Objectives and envisaged outcomes** (Plume, 2019) • To enable New Zealand to meet its international GHG emissions reporting obligations under the UNFCCC and Kyoto Protocol • To track progress towards achievement of New Zealand's GHG targets.
2	Aid Programme Management System (AID system)	In operation	**Objectives and envisaged outcomes** (Ministry of Foreign Affairs and Trade, 2012; Ministry of Foreign Affairs and Trade, 2019; Ministry for the Environment, 2017) • To assist government to manage, record and track all international aid • The system includes a Climate Change Operational Policy aimed at: 1. detailing how support for climate change is to be delivered, recorded and quantified in internal systems. 2. enabling climate-related expenditure to be quantified and recorded in the aid programme's climate change inventory, according to the specific classifications and moderation weightings

			3. Ensuring that activities and programmes are assessed for climate change risks, and opportunities explored to support adaptation to and mitigation of climate change • The system uses the OECD DAC Rio markers as a basis for tracking development assistance with climate change adaptation and mitigation outcomes. The DAC Rio markers include capacity building and technology transfer.

The country has also set up MRV systems for specific mitigation programmes, like the monitoring and compliance system of the country's Emissions Trading Scheme, but these are only meant to monitor and evaluate the impacts of the specific interventions and therefore do not make up part of the national MRV system (Leining & Kerr, 2018).

Furthermore, New Zealand neither has a systematic process for projection of GHG emissions and removals, nor that of adaptation MRV (Plume, 2019). Emission and removal projections are carried out as and when necessary, mostly using models that are not open to public scrutiny because of intellectual property issues (ibid).

The sections below give more details on the systems that make up New Zealand's domestic MRV system.

6.2.3.1 National Inventory System

The New Zealand National GHG inventory system was enabled by the Climate Change Response Act of 2002. Various designated agencies across New Zealand's natural resources sector are responsible for collecting activity data, processing it, estimating GHG emissions, preparing common reporting format tables and writing inventory chapters for the respective sectors, and the complete inventory is coordinated, compiled and published by the Ministry for the Environment (MfE) (2017). Where expertise residing outside the relevant sectoral department is required, contractors and consultants are brought into the GHG inventory process through contracts. For experts external to government, a competitive bidding process is used to ensure that the best contractor is selected (ibid).

A Reporting Governance Group, chaired by MfE, has been established to provide cross-agency governance over the climate change reporting, modelling and projections of GHG emissions and removals (ibid). Its duties include guiding, conferring and approving GHG inventory and emissions projections, providing leadership and guidance to the experts and resolving issues and differences between departments that may impact the work (ibid). The main motivation for the establishment of this system was the country's need to respond to UNFCCC reporting, including reporting under the Kyoto Protocol, and was guided by Article 5 of the Kyoto Protocol (Plume, 2019).

6.2.3.2 Aid Programme Management System

Annually the Ministry for Foreign Affairs and trade must monitor and report on the country' foreign aid programme, including on international support provided, pursuant to Section 44(1) of the Public Finance Act of 1989 (Ministry of Foreign Affairs and Trade, 2019). To achieve this, government has established an Aid Programme Management System, using an IT database named "Enquire Aid Management System", which includes indicators of aid-effectiveness and policy objective markers for capacity building, climate change mitigation and climate change adaptation based on the OECD DAC Rio Markers (Ministry of Foreign Affairs and Trade, 2012).

6.2.4 *The United Kingdom*

Four systems can be considered as sub-systems for the UK's overall domestic MRV system, and these are presented in Table 20 below, together with their objectives and envisaged outcomes.

Table 20: Objectives and intended outcomes of the systems that make up UK's domestic MRV system

No	Name	Status	Objectives, envisaged outcomes & other relevant details
1	UK National Inventory System (GHG system)	In operation	**Objectives and envisaged outcomes** (Department for Business, Energy & Industry Strategy, 2014) • To satisfy the requirements of the UNFCCC and the Kyoto Protocol, including the need to establish legal, procedural and institutional arrangements for estimation and reporting of GHG emissions • The primary output of the system is the annual GHG inventory of the UK that is submitted to the EU under the EU Monitoring Mechanism Regulation (MMR) and to the UNFCCC • Web portal: https://naei.beis.gov.uk/
2	Annual projections reporting system by Department of Business, Energy & Industrial Strategy (BEIS projections)	In operation since 2008	**Objectives and envisaged outcomes** (Department for Business, Energy & Industrial Strategy, 2019) • To assist BEIS to compile and publish "updated energy projections, analysing and projecting future energy use and greenhouse gas emissions of the UK" • To allow government to "monitor progress towards meeting the UK's carbon budgets" • To "inform energy policy and associated analytical work across government departments."
3	Climate Change Committee Adaptation Progress Reporting system to Parliament (CCC Adaptation reporting)	In operation since 2009	**Objectives and envisaged outcomes** (Kilroy, et al., 2017; Committee on Climate Change, 2019; Department for Business, Energy and Industrial Strategy, 2017) • To assess progress made in the implementation of the National Adaptation Plan using an assessment framework made up of indicators of climate risk, vulnerability, impacts, adaptation action and decision-making in climate change planning • The primary output of the process is a biennial progress report to Parliament, which includes recommendations by the Climate Change Committee on priority areas and interventions
4	International Climate Finance Monitoring and Evaluation System (ICF M&E System)	In operation	**Objectives and envisaged outcomes** (HM Treasury, 2018; Department for Business, Energy and Industrial Strategy, 2017) • To enable the UK government to collate data and report spend on ICF to the OECD DAC • To help make UK aid more visible to UK taxpayers and beneficiaries, supporting aid coordination and effectiveness, and removing opportunities for wastage or misuse of money • To enable programme specific monitoring and evaluation of activities at portfolio level through its ICF Monitoring, Evaluation and Learning (MEL programme) • To enable government to learn lessons from the successes and failures of ICF projects, and to improve its approach over time • To meet annual reporting requirements of the EU MMR, covering financial, capacity building and technology transfer support given to developing countries. • **Web portal**: https://devtracker.fcdo.gov.uk/

The systems focus on GHG inventory compilation, annual projections of GHG emissions and removals, adaptation MRV as well as MRV of means of implementation. The UK does not have a system whose objectives, outputs or outcomes include ex-post or ex-ante mitigation assessment. The closest to this is the Climate Change Committee annual tracking of progress in reducing the UK's emissions, but this system focuses on tracking overall and underlying indicators of progress towards achievement of the UK's mitigation target and makes recommendations on areas that government should focus on as required by the UK's Climate Change Act (Climate Change Committee, 2021) . Also, although required to monitor and report on its use of ETS auction revenues while an EU member, the UK has decided against earmarking such revenues for climate change measures, hence the revenue fell into the general public coffers where it can neither be tracked nor traced (Le Den, et al., 2017; Greenaironline, 2008).

Each of the systems that make up the UK's overall domestic MRV system have been presented individually in the sections below.

6.2.4.1 UK National Inventory System

The UK's national system for preparing GHG inventories was established under the UK Climate Change Act of 2008. The Department of Business, Energy & Industrial Strategy (BEIS) is the designated national inventory entity which compiles annual GHG inventories through a consortium led by Ricardo Energy and Environment – a consultancy company (BEIS, 2017). Ricardo Energy and Environment has delegated national inventory entity powers and is responsible for planning, preparation and reporting of UK's national GHG inventories (ibid). To ensure quality, every inventory undergoes at least two levels of reviews before publication: i) an annual internal review by the National Inventory Steering Committee, and ii) an external review by the compilers of the EU GHG inventories (ibid).

6.2.4.2 BEIS Annual projections reporting system

Every year, since the 1990s, Government has been modelling and publishing the country's projected energy consumption as well as national GHG emissions and removals (BEIS, 2019). This is done using BEIS set of tools called the Energy and Emissions Projections (EEP) model suite (ibid). The results of the EEP model suite is a set of electricity demand, electricity supply and retail electricity prices from which the related GHG emissions are then calculated by applying the relevant emission factors to the energy types (ibid). With the exception of a few confidential parts, the methodology and all the data used in the modelling process are always made publicly available (ibid).

6.2.4.3 Climate Change Committee Progress in adapting to climate change

Pursuant to the Climate Change Act of 2008, the UK national Adaptation Committee of the Committee on Climate Change (CCC) has been undertaking assessments of government's progress in preparing for and responding to impacts of climate change and publishing the results (Committee on Climate Change, 2019).

The Committee has developed a two-part evaluation framework to undertake the assessment (Committee on Climate Change, 2019). The first part involves an indicator framework made up of indicators of hazards, vulnerability, exposure, climate impacts and trends in adaptation actions (ibid). The second is a decision support analysis where the Committee assesses the extent to which climate change planning is taking place and the adequacy of those plans in terms of responding to the identified climate change risks and opportunities (ibid). For the assessment, the Committee has

developed a dual axis scoring system for the framework that looks at the quality of the plans on y-axis and progress in managing risks on the x-axis, using scores of low, medium and high on both axes (ibid). The committee continuously reviews the scoring system and updates it as and when it deems necessary. In addition to making assessment of progress, the Committee makes specific recommendations on improving the adaptation programme and its implementation thereof (ibid).

6.2.4.4 International Climate Finance Monitoring and Evaluation System

On monthly basis, UK government departments are required to provide "*accurate and timely on outturn and forecast expenditure*" related to their Official Development Assistance (ODA), and this data is collated by Department for International Development (DFID), which is responsible for reporting of ODA to the OECD DAC on biannual basis using the Rio Markers (HM Treasury, 2018).

In addition to departmental information on ODA spend, government has developed a set of 16 Performance indicators to monitor results from programmes where ODA has been spent (DFID, 2019). All supported programmes have their own specific monitoring and evaluation processes that track these indicators, after which the indicator results are consolidated into national level indicators (ibid).

To improve effectiveness of delivering ODA, the UK government has established an Independent Commission for Aid Impact (ICAI), as an independent body to undertake independent evaluation of the effectiveness of the UK ODA spend (HM Treasury, 2018). The ICAI scrutinizes the results of the ICF M&E system in support of Parliament as it holds government to account (ibid).

6.2.5 United States of America

There are three systems that can be categorized as making up the overall domestic MRV system of the United States. The first is a system to produce the country's annual national GHG inventories, while the second is a system for monitoring and reporting on the country's foreign assistance. The third is a system that mostly pulls together climate change, climate risk and vulnerability data from at least four different systems around the country. Table 21 below presents the objectives and envisaged outcomes of these systems.

Table 21: Objectives and intended outcomes of the systems that make up USA's domestic MRV system

No	Name	Status	Objectives, envisaged outcomes & other relevant details
1	GHG Inventory System (GHG system)	Operational since 1993	**Objectives and envisaged outcomes (**US EPA, 2020) • To enable the US government to compile and publish annual national greenhouse gas inventories that are submitted to the UNFCCC in fulfilment of the US obligations under that Convention. **Interactive database:** https://cfpub.epa.gov/ghgdata/inventoryexplorer/
3	Sustained National Climate Change Assessment process (NCCA process)	In operation	**Objectives and envisaged outcomes** (USGCRP, 2020) • To synthesise climate impacts and trends across U.S. regions and sectors every four years and package it in the form of a National Climate Assessment (NCA) • To develop a set of national climate change indicators that track conditions and trends related to climate over time • To track climate-related indicator (physical, ecological, or societal), that can be used to understand how environmental conditions are changing, to assess risks and vulnerabilities, and to help inform resiliency and planning for climate impacts

			Online platform: https://data.globalchange.gov/
2	Standardized Foreign Assistance Tracking system (Foreign assistance tracking)	In operation, with concept in place since 2006. Consolidated version in place since 2017	**Objectives and envisaged outcomes** (Caruso, 2019; US Government, 2020) • For domestic reporting and accountability to congress on foreign assistance spend as required by the Appropriations bills • To measure and illustrate what foreign assistance achieves in the international space • To identify those projects supported by foreign assistance that are working well and having the desired impact, and those that are not. • To respond to the principles of the Paris Declaration on Aid Effectiveness and the Accra Agenda for Action • The system's standard master indicator list includes indicators of climate finance, technology transfer, capacity building and impact. **Online database**: https://www.foreignassistance.gov/

The questionnaires and interviews carried out as part of this thesis revealed that logical framework approach was neither used in the development of the country's overall domestic MRV system nor in any of these three systems (Caruso, 2019; Dragisic, 2019). According to USA's Second Biennial Methodologies report for Quantified Policies and Measures, there is no systematic process for assessing mitigation actions in the country, instead each of the Federal Agencies that implement mitigation actions undertake monitoring and impact evaluation of their programs independently using varying approaches, and whenever this information is needed for reporting, the agencies are invited to submit what they have (US Department of State, 2015). Similarly, interviews with USA climate change experts revealed that the country does not have systematic processes for projection of GHG emissions and removals nor for monitoring and evaluation of adaptation actions. Furthermore, under the Obama administration the OMB used to produce Federal Climate Change Expenditure reports (Office of Management and Budget, 2013), which focused on Federal Government spend on domestic climate change response, but research undertaken during this project showed no evidence of a systematic process of compiling that data.

The sections below give more details about each of the systems in the USA.

6.2.5.1 GHG Inventory System

The USA has been compiling annual inventories of GHG emissions and removals since the early 1990s under the coordination of the Environmental Protection Agency (EPA) as the national inventory entity (US EPA, 2020). The EPA coordinates the annual methodological choice, collection of activity data, calculation of emissions and removals, QA/QC activities and the GHG improvement programme (US EPA, 2019). The EPA is supported by other institutions, including other government institutions, research and academic institutions, industry associations and private consultants in this work (ibid). Depending on the institution, these other institutions are involved through formal agreements or informal relationships (ibid).

To ensure the quality of the annual inventories, "source and sink category leads are also responsible for conducting quality assurance and quality control (QA/QC) checks, and category-level uncertainty analyses" (ibid). Once the inventories have been compiled, they undergo two independent reviews before submission to the UNFCCC: "A 30-day review by a select list of third-party technical experts

outside of the EPA who were not directly involved with the compilation of the inventory", as well as a 30-day public review process (ibid).

6.2.5.2 Sustained National Climate Change Assessment process

The USA conducts a synthesis of climate change impacts and trends across USA regions and sectors every four years, and compiles it in the form of National Climate Assessments (NCAs), under the coordination of the US Global Change Research Program (USGCRP). The USGCRP has started implementing a systematic sustained process for this work, that will "ultimately facilitate continuous and transparent participation of scientists and stakeholders across the country, enabling new information and insights to be synthesized as they emerge" (USGCRP, 2020). Activities that form part of this process include establishing institutional arrangements for development of interim assessments and technical reports, institutionlization of the Climate Scenarios Task Force that works on underlying climate scanarios, establishment of a web-based tool for the system, called the Global Change Information System, as well as establishment of an iteractive indicator platform (ibid).

6.2.5.3 Standardized Foreign Assistance Tracking system

This system focuses on international aid provided to developing countries through Federal agencies only and does not include any ODA disbursed through individual states, cities or non-government institutions (Caruso, 2019). The system utilizes a set of more than 2000 standard foreign assistance indicators, developed by the State Department and the US Agency for International Development (USAID) to identify the objectives of foreign assistance provided (US Department of State, 2017; Caruso, 2019). Within the list of indicators, there are specific climate change indicators including those of climate change mitigation, adaptation, technology development, capacity building and climate vulnerability assessments. On annual basis data to inform these indicators is collected and reported to Office of the US Foreign Assistance Resources (US Department of State, 2017).

The primary output of this system is an annual report to Congress, presenting mostly high-level aggregated data (Caruso, 2019). In 2010 government also established the foreign assistance website to present the annual foreign assistance data generated through this system and improve the transparency of US foreign assistance spending (US Government, 2020).

6.3 Chapter Discussions and Conclusions

From the individual MRV systems of the countries presented in the preceding sections, several observations and conclusions can be made, and these are discussed in the three sections below.

6.3.1 Thematic MRV areas covered by the MRV systems

The first set of observations relates to the thematic MRV areas that the countries' domestic MRV systems cover. There are a total of eight observations, some of which have been summarized in Table 22 below.

Table 22: Comparison of the domestic MRV systems studied

***Source**: Author's assessment of the information presented in the sections above*

	MRV of emissions	MRV of Mitigation theme		MRV of adaptation theme		MRV of means of implementation theme			Results-based planning used?
	GHG Inventory	Mitigation MRV	Emissions Projection	Risks, Impacts & Vulnerability	Adaptation MRV	Climate Finance MRV	Capacity building MRV	Technology transfer MRV	
1. Brazil									No
2. China									Yes, but limited extent
3. Colombia									Yes, but limited extent
4. Indonesia									Yes
5. Kenya									Yes
6. South Africa									Yes
7. EU									Yes, but limited extent
8. Germany									Yes, but limited extent
9. New Zealand									No
10. UK									Yes, but limited extent
11. USA									No

Key:	
System established	
No system established	

Firstly, it was observed that all countries have established systems for compilation of national GHG inventories, and they are either currently in design phase, piloting phase or already operational. Looking into the motivation for their establishment, it was observed that all the developed countries analysed in this study were primarily motivated by the need to meet UNFCCC reporting requirements. By contrast, it was found that for the developing countries included in this study, meeting UNFCCC reporting requirements was only a secondary motivation or not even part of the motivation for establishing national GHG inventory systems. Instead, for developing countries, national objectives and requirements were found to be the primary motivation for establishing national GHG inventory systems.

This first finding is expected to be a trend because of the different GHG inventory requirements for developed and for developing countries by the Convention and the Kyoto Protocol. Specifically, since the Convention came into effect, developed countries have had to compile and submit annual GHG inventories while developing countries only submitted them every four years or less frequently. Also, the Kyoto Protocol has an explicit requirement in Article 5.1 for developed countries to establish domestic GHG inventory systems. These two requirements for developed countries came into effect well before countries had national climate-related strategies, policies or laws and the developed countries had to establish some institutional arrangements to ensure they met these reporting requirements. For most developing countries, however, GHG inventory systems were only set up after the countries had some domestic strategies, policies and laws that explicitly or implicitly require compilation of regular GHG inventories.

Secondly, within the MRV of mitigation theme, Table 22 shows that only two of the 11 countries included in this thesis have established systems for projection of GHG emissions and removals.

Thirdly, still on the mitigation theme, the Table shows that all six developing countries included in the study have established MRV systems with the objective of assessing progress and impact of mitigation actions, while only two of the five developed countries have established them – the EU and Germany. This low uptake of mitigation MRV systems by developed countries was also observed with other developed countries that have not been included in this thesis as follows:

- Within the EU itself, it was found that only 10 out of 27 EU countries reported quantitative data on ex-post emissions savings under the EU MMR in 2021, and according to the European Topic Centre on Climate Change Mitigation and Energy (ETC/CME) (2021), "the reporting on ex-post savings should be considered very incomplete". It will be seen in Section 9.1.5 of this thesis that from those 10 EU countries, even fewer countries submitted supporting technical documentation, which shows that these countries do not have institutional and procedural systems for ex-post MRV of mitigation actions.
- Furthermore, the ETC/CME report (ibid) shows that almost all the EU countries undertake ex-ante assessment of mitigation actions as part of their emissions projection process, and because most of them do not have MRV systems for projection of emissions and removals, this means that even the respective ex-ante MRV systems do not exist. Therefore, this means that most EU countries do not have mitigation MRV systems, whether performing ex-post or ex-ante mitigation assessment.
- Lastly, even most non-EU developed countries do not have mitigation MRV systems because, as stated in Section 4.2.1 of this thesis, Belarus, Canada, Iceland, Kazakhstan, Liechtenstein, Monaco, Switzerland, Turkey, Ukraine and the Russian Federation were not selected for this study because they do not have domestic MRV systems outside GHG inventories, including mitigation MRV systems.

Fourthly, the analysis shows that most countries have established systems that focus on both adaptation MRV as well as MRV of climate risks, impacts and vulnerabilities, with only New Zealand yet to establish any system within the adaptation MRV theme. This is despite reporting on these not being requirements under the Cancun MRV Framework.

Fifthly, still on the adaptation MRV theme, it was observed MRV systems within this theme are less mature than MRV systems in other themes, for all the countries studied, and that none of the countries have successfully established such systems in such a way that they assess the extent to which adaptation measures reduce vulnerability or improve the country's adaptive capacity. Instead, all the adaptation MRV systems studied primarily focus on tracking progress in implementing the adaptation actions. This is expected to be a common trend among countries because adaptation MRV is generally less mature for all countries and there is no standardized approach developed by the IPCC, UNFCCC, or any other think tank for use by countries to directly link adaptation actions with changes in vulnerability and adaptive capacity.

Sixth: In relation to the means of implementation MRV theme, the table also shows that Brazil is the only country that has not established any system for tracking any kind of means of implementation; even for MRV of climate finance, which all other countries have established.

Seventh: the assessment shows that, within the means of implementation MRV theme, developing countries tend to prioritize MRV of climate finance over MRV of capacity building and technology transfer.

Finally, it was found that none of the countries studied in this thesis have established standalone systems for domestic MRV of technical transfer and capacity building. All countries have coupled the MRV of technical transfer and capacity building with that of climate finance

6.3.2 The use of logical modelling in developing the MRV systems

The second set of observations is also captured in Table 22 above and it relates to the approach that the countries have taken in establishing their MRV systems.

Table 22 shows that only the countries can be categorized into three groups as follows: 1) Those that employed results-based planning fully in designing their systems; 2) those that employed results-based planning to a limited extent; and 3) those that did not follow results-based planning and no information was found on the approached followed.

Only Indonesia, Kenya and South Africa followed the logical modelling approach fully in designing their domestic MRV systems. It is only these three countries that followed all the five steps of results-based planning through logical modelling, covering 1) needs assessment, 2) defining and analysing the problem, 3) selecting the intervention strategy, 4) defining objectives, and 5) programme design, while China, Colombia, the EU, Germany and the UK, only went as far as step four of results-based planning and did not visually outline the logic model for their systems, hence depicted as limited extent in Table 22.

Each country's approach is discussed in detail below:

Brazil: Limited information is available on the approach used in developing the Brazilian domestic MRV system, however, the information reported on Brazil's MRV arrangements and systems in the first, second, third and fourth BURs shows that logical modelling was not used in the development the country's MV system. Instead, the 2nd BUR states that the Modular System for Monitoring Actions and GHG Emissions Reductions (SMMARE) was conceptualized in 2013, with the sole aim of monitoring and following up on greenhouse gas emissions reductions associated Sectoral Plans on Climate Change

(Federative Republic of Brazil, 2017). The analysis in this thesis suggests that that Brazil did not follow the five logical modelling steps.

China: The design of China's domestic MRV system, including objectives and envisaged outcomes, was based on an assessment of the country's MRV needs published in the 2013 joint report of the NDRC and the NBS on "Opinions on Strengthening Climate Change Statistics" (China, 2016). That joint report contains a summary of the identified MRV needs, identification and analysis of the problem of not having an MRV system to respond to those needs and the proposed the intervention to address those needs, thereby covering the first three steps of results-based planning. The determination of the objectives and envisaged outcomes was the last step employed in developing this system.

Colombia: Regulation 1447 of 2018, establishing Colombia's domestic MRV systems as well as the country's 3rd BUR present details of the steps that the country undertook as part of the results-based planning process of designing its domestic MRV system (Rodriguez, 2019; IDEAM, Fundación Natura, PNUD, MADS, DNP, CANCILLERÍA, 2021). Essentially the process covered the first four steps of logic modelling, but not the fifth which involves compilation of a visual MRV structure with inputs, activities and outputs.

Indonesia: The 2nd BUR of Indonesia as well as the Indonesia Report on REDD+ Performance summarize the logical planning approach process undertaking in developing the country's domestic MRV system, and they show that an assessment of the MRV needs was carried out, the problem was defined and analysed, the required MRV system was determined, the objectives and envisaged outcomes of that MRV system we specified and finally the system was presented in the form of a logic model (Republic of Indonesia, 2018).

Kenya: Sections 6.1.5.1 clearly shows that results-based planning was adopted in developing the Kenyan domestic MRV system. The process followed has been documented in detail in the NPBMF document. Kenya's MRV+ system has been structured in the form of a full logic model specifying inputs, activities and outputs.

South Africa: The National Climate Change Response M&E system framework details out how results-based planning was used in developing South Africa's domestic MRV system. In that framework document, the system has been presented in the form of a full logic model specifying inputs, activities and outputs of the system.

European Union: Similarly, for the European Union, both the MMR, which outlines EU's pre-Paris domestic MRV system and the Governance Regulation, which establishes the EU's Paris-era MRV system have outlined in depth the country's MRV needs, the problems of not having a system to respond to those needs, the proposed intervention to address those needs as well as the objectives of both MRV systems.

Germany: In the case of the German system, analysis of the annual climate action reports show that the four steps of logic modelling were employed for all reporting requirements and then again in the development of the Monitoring system of the German Adaptation Strategy with a focus on the adaptation MRV theme only.

New Zealand: There are two systems that make up New Zealand's overall domestic MRV system, and according to Plume (2019), the GHG inventory system was established as a requirement under the UNFCCC and its Kyoto Protocol, while the Aid Programme Management System was established pursuant to the OECD aid reporting requirements, well before climate reporting was ever needed. It can therefore be concluded that results-based thinking was not explicitly applied.

United Kingdom: The UK's climate change law, that established the Climate Change Committee and gave effect to the establishment of the country's domestic MRV system, gives details on the rationale followed in establishing the country's domestic MRV system, including the needs and problems assessed at the time. Furthermore, in determining the specific indicators to be monitored as part of their mandate, the Climate Change Committee followed four of the five steps of logical modelling to arrive at the envisaged outcomes of their monitoring and evaluation process.

USA: On the other hand, no evidence was found that results-based planning was used in developing either of the two systems that make up USA's domestic MRV systems.

6.3.3 Other observations related to establishment of the systems

In addition to the two main sets of observations outlined above, several other specific observations were made in this chapter, as outlined in this section.

It was observed that all countries included in this thesis make use external consultants in their GHG inventory systems to some degree. The involvement of consultants in such systems ranges from estimating emissions of only one sub-sector (e.g., agriculture) to supporting the single national entity to manage all aspects of the inventory process. This finding is expected to be a trend for all countries because designated national inventory entities or sectorial inventory agencies often have inadequate capacity and/or skills and/or experience to undertake all the activities required for compiling GHG inventories and managing GHG inventory systems.

Also, it was found that all the developed countries included in this thesis have leveraged off their existing international ODA monitoring systems to track the climate-related support they give to developing countries. They have simply adopted the Rio Markers for climate change into their existing ODA monitoring systems.

Furthermore, it was observed that periodic reviews of the MRV systems play a critical role in the improvement of those systems over time. For instance, the UK's annual reporting by the Climate Change Committee has been beneficial to the UK, particularly in relation to improving the of tracking UK's progress to adapting to climate change. Similarly, the German Climate Action Plan reporting system is set up such that gaps in reporting can be identified on frequent basis. Other systems, like the MRV systems of Indonesia, the EU, Kenya and South Africa, also have also benefitted from such periodic reviews, even though they have not undertaken this process as systematic and as regular as the UK and Germany.

Moreover, it was found that the outputs from the different systems vary significantly in terms of format. Some systems only have reports as their only outputs, while others have online outputs only, in the form of live databases, and others have a combination of the two formats. Related to the

previous point, the format of the output may also determine the ease with which the periodic review is implemented. For instance, annual reports may easily allow for the annual review function of the system or the needs as well as the annual update, which the online systems don't have. But the latter allows for continuous updating and accessibility of a timeseries.

Lastly, a trend was observed that all countries have established several sub-systems that may or may not link to each other, making up the countries' overall domestic MRV systems. An exception was found in the case of the EU at regional scale, which has established one system that covers all the thematic MRV areas.

The next chapter presents the results of the relevance assessment, linking the findings of the current chapter with those of the previous chapter on MRV needs.

7 Relevance of domestic MRV systems

This chapter presents the results of the relevance assessment of the domestic MRV systems discussed in the preceding chapter, based on the MRV needs identified in Chapter 5. Firstly, the chapter presents the overall relevance of the systems in both the pre-Paris and the Paris eras, then it presents the results disaggregated according to the type and origins of the needs. Finally, the results of the correlation analysis between logical planning and relevance of domestic MRV systems is discussed.

7.1 Overall relevance

As defined in section 3.1.3.1, the relevance of a domestic MRV system is determined by the extent to which its objectives and intended outcomes are consistent with the country's MRV needs. This means that relevance is not about what the system is currently able to do or deliver, but how the objectives and the intended outcomes of the system align with the needs, and, in some cases, those outcomes may not have been achieved. Results on relevance to pre-Paris and Paris-era needs are discussed separately in this section.

7.1.1 Are objectives of MRV systems consistent with their pre-Paris needs?

Table 23 below presents an overview of the relevance of the domestic MRV systems of the different countries to their MRV needs in the pre-Paris era. It shows that the countries' international, regional and domestic pre-Paris needs can be split into 18 distinct needs that fall under the four MRV themes of MRV of emissions, MRV of mitigation, MRV of adaptation and MRV of means of implementation as discussed in section 2.4 of this thesis. Furthermore, the means of implementation theme has been disaggregated further into four sub-themes of support provided, support needed, support received and other means of implementation to better align with the disaggregation used in the ETF. In the table the notation N/A (Not applicable) is used where the MRV need is not applicable to the specific country.

The Table shows that the Indonesian and the EU's domestic MRV systems are the only ones that are relevant to all their pre-Paris needs, while the German MRV system comes short on only one MRV need. On the other end, Brazil's domestic MRV system is only relevant to three of its 11 MRV needs, making it the least relevant MRV system among all the systems studied in this thesis. A full relevance assessment at country level, showing the relevance of specific country systems to specific country needs can be found in Appendix B.

The results further show that there are only six pre-Paris needs, out of 19, that are addressed by all domestic MRV systems that need to address them. Those needs addressed by all systems are i) the need to systematically compile national GHG inventories and track progress in implementing and achieving national mitigation targets (need 1.1), the need to monitor climate change indicators (need 3.3), the need to track financial support provided to other countries (need 4.1), the need to track capacity building provided (need 4.2), the need to track technology development and transfer provided to other countries (need 4.3) and the need to track and assess the impact and effectiveness of climate finance provided to other countries or used nationally (need 7.2).

Table 23: Relevance the different countries' domestic MRV systems to pre-Paris needs

MRV THEME		Needs	Brazil	China	Colombia	Indonesia	Kenya	SA	EU	Germany	NZ	UK	US
1. MRV of emissions		1.1. National GHG inventory and mitigation target											
2. MRV of mitigation		2.1 Mitigation policies, actions, measures and plans											
		2.2 Projections of GHG emissions & removals	N/A	N/A	N/A	N/A	N/A	N/A					
3. MRV of Adaptation (Including climate risks, impacts and vulnerabilities)		3.1. Climate impacts, risks and vulnerabilities							N/A		N/A	N/A	
		3.2. M&E of adaptation actions & processes							N/A		N/A		
		3.3. Climate change indicators	N/A		N/A		N/A		N/A		N/A	N/A	
MRV of Means of Implementation	4. Support provided	4.1. Financial support	N/A	N/A	N/A	N/A	N/A	N/A					
		4.2. Capacity-building support	N/A	N/A	N/A	N/A	N/A	N/A					
		4.3. Technology development and transfer	N/A	N/A	N/A	N/A	N/A	N/A					
	5. Support needed	5.1. Financial support							N/A	N/A	N/A	N/A	N/A
		5.2. Capacity-building support							N/A	N/A	N/A	N/A	N/A
		5.3. Technology development and transfer							N/A	N/A	N/A	N/A	N/A
	6. Support received	6.1. Financial support							N/A	N/A	N/A	N/A	N/A
		6.2. Capacity-building support							N/A	N/A	N/A	N/A	N/A
		6.3. Technology development and transfer							N/A	N/A	N/A	N/A	N/A
	7. Other Means of implementation	7.1 Domestic Climate Finance							N/A	N/A	N/A	N/A	
		7.2 Impact & effectiveness of climate finance	N/A	N/A	N/A	N/A			N/A	N/A			
		7.3 Use of EU ETS auctioning revenue and credits	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A		N/A

Key:	
Not relevant	
Relevant	
Not Applicable	N/A

In terms of the mitigation MRV thematic area, Table 23 shows that all the MRV systems of developing countries address all their MRV needs in this theme, while only the EU MRV system addresses all its pre-Paris needs in this theme from developed countries.

In the adaptation MRV theme, the results show that, except for the domestic MRV systems of Brazil, Kenya and the USA, all other countries have domestic MRV systems that are relevant to all their pre-Paris needs within this theme.

In terms of support provided to developing countries, Table 23 shows that domestic MRV systems of all the developed countries included in this thesis are relevant to all the needs within this theme. In terms of support needed by developing countries, however, the results show that developing countries do not prioritize the systematic identification of these in their MRV systems. The table shows that Indonesia and South Africa are the only developing countries with domestic MRV systems intended to address those needs, and even then South Africa's MRV system only focuses on financial support needed.

Finally, Table 23 shows that the USA – the only developed country with an explicitly expressed need to monitor and report on finance used for domestic response to climate change – does not have any system established to do so, while all developing countries have MRV systems to address this need, except for Brazil.

Figure 10 below presents the pre-Paris relevance ranking of the domestic MRV systems of all the countries included in this study, based on their relevance indices. A reminder of the definition and application of a relevance index is presented in the paragraph below.

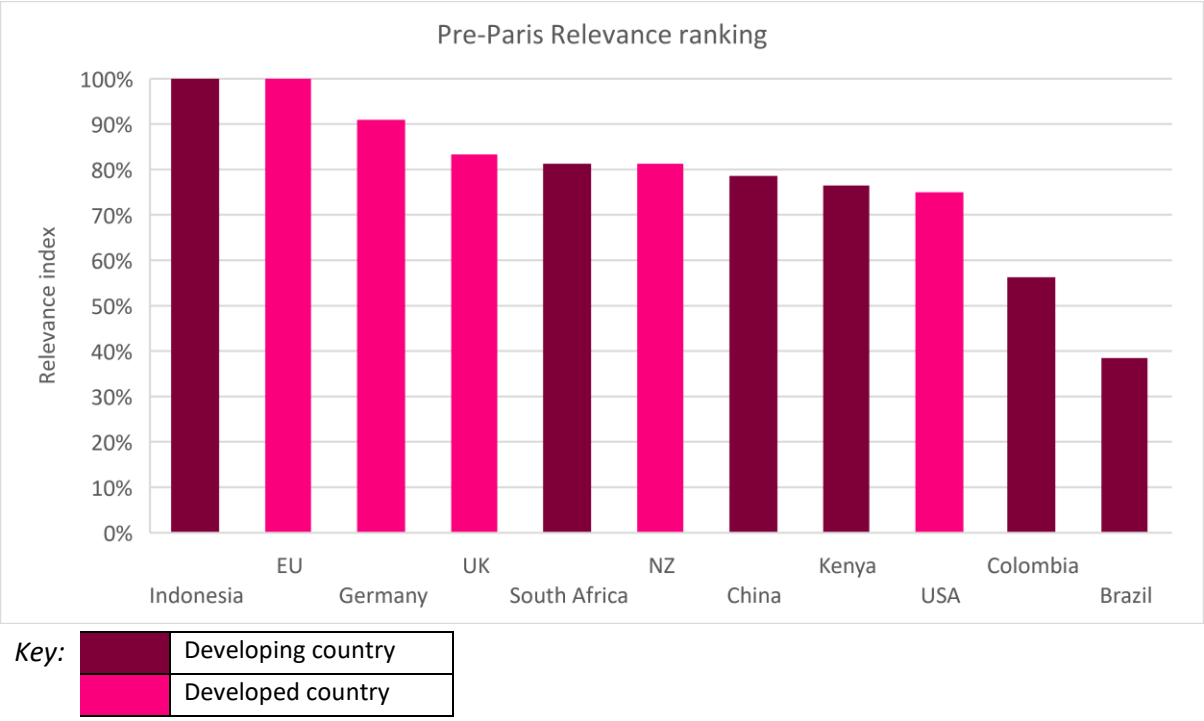


Figure 10: Results comparing the countries' pre-Paris Relevance indices

As described in section 4.3.1, a relevance index depicts the percentage of a country's MRV needs that is addressed by the objectives and intended outcomes of the country's domestic MRV system. Unlike a simple relevance assessment presented in Table 23 above, the relevance index accounts for multiple

independent occurrences of the same 'type' of need. For instance, an international need for a GHG inventory submission under the UNFCCC and a domestic need for GHG inventory publication under the country 's national law are counted as two different needs in calculating the relevance index, while in Table 23 it was only captured as one type of need (Need 1.1), without specifying the number of times and places it appears as a need (e.g. domestic and international).

The ranking in Figure 10 shows that in first place are the domestic MRV systems of Indonesia and the European Union with perfect pre-Paris relevance index scores of 100%. This is because the objectives and intended outcomes of both these systems address all their pre-Paris MRV needs as noted from Table 23 above.

In third place is the domestic MRV system of Germany with a pre-Paris relevance index of 91%. This MRV system comes short of the 100% relevance index score because of the one pre-Paris need that it has not accommodated as noted from Table 23. However, that one need - which is the need for systematic projection of emissions and removals – occurs at two levels (Internationally under the Cancun MRV framework and regionally under the EU MMR) hence it is accounted for as two instances of irrelevance in calculating Germany's relevance index.

These three highest-ranking systems are followed by MRV systems of the UK, South Africa and New Zealand at 83%, 81% and 81% respectively. For South Africa to achieve full relevance to its pre-Paris needs, the assessment of capacity building needed and received, as well as technology development needed will have to be included in its MRV system. New Zealand and the UK, on the other hand, will have to both include mitigation assessment in their MRV systems, as well as projection of emissions and removals in New Zealand's case and monitoring the use of EU ETS auctioning revenue and credits in the case of the UK.

In seventh, eighth and ninth places are the domestic MRV systems with relevance indices within the 70% - 80% range, and these are the MRV systems of China, Kenya and the USA with respective relevance indices of 79%, 76% and 75%. The Chinese and Kenyan systems come short of full relevance because of the absence of systematic identification of all their support needs, and in addition, Kenya's MRV system does not address the domestic need for assessment of climate impacts, risks and vulnerabilities. The USA's MRV system will need to address the needs for assessment of mitigation measures, the need for emission projection, the need for adaptation M&E as well as the need for tracking of domestic climate finance to achieve maximum relevance.

Figure 10 shows that at the bottom of the pre-Paris rankings are the domestic MRV systems of Colombia and Brazil, whose systems are only relevant to 56% and 38% of their pre-Paris MRV needs respectively. This is due to the poor performance of both systems in relation to MRV of means of implementation, wherein the Colombian MRV system's objectives address only three out of its seven needs, while Brazil does not have any system to address any of its needs in that theme.

7.1.2 Are the objectives of existing MRV systems consistent with their Paris-era needs?

All the domestic MRV systems included in this study were designed before MPGs of the Paris Agreement's Enhanced Transparency Framework were finalized. By the time research for this thesis was concluded, none of the countries had updated their systems to accommodate the MPGs. In any case, the reporting requirements of the ETF will only be effective from 2025, hence it is currently not required nor expected that these MRV systems be fully relevant to the Paris-era needs. Thus, the

relevance assessment done for the Paris-era needs in this section focused on the gaps in the countries' existing MRV system in responding to the future Paris era needs when they kick in. It assessed the relevance levels of the existing domestic MRV systems to the Paris era needs, to determine how (ir)relevant the systems would be if they are not updated by the time the Paris-era needs kick-in, and it also identifies the MRV needs which the countries will need to adjust their MRV systems to accommodate by 2024. In other words, in this section, existing domestic MRV systems are assessed for relevance to future MRV needs, with the objective of informing the countries' preparation process for those future needs.

The EU has already updated its domestic MRV system from the MMR to the Governance reporting system to cater for the Paris Agreement needs, but this was based primarily on the wording of Article 13 of the Paris Agreement and not on the MPGs because the latter had not been finalized at the time. Other countries included in this study have also expressed their intention to update their domestic MRV systems to accommodate the Paris-era needs as well. For instance, at an Asia regional workshop on tracking progress on NDCs and reporting under the enhanced transparency framework in 2019, the Director of GHG Inventories and MRV for Indonesia, Joko Prihatno (2019), pointed out that Indonesia is set to align its domestic MRV system with the MPGs of the ETF by the first Biennial Transparency Report deadline of 2024. Colombia, Kenya and New Zealand have also expressed the same intentions (Plume, 2019; Ouma, 2019; Rodriguez, 2019).

Table 24 below presents the results of the relevance assessment of the countries' existing MRV systems to their Paris Era needs. The table shows that the Paris era needs can be disaggregated into 25 unique needs that fall within the four main thematic areas. As was done for the pre-Paris needs, the needs under the means of implementation theme have been further categorized into four sub-themes.

The results show that none of the existing domestic MRV systems included in this study have objectives and intended outcomes that are relevant to all their Paris era needs. This is to be expected given that all the countries are yet to align their systems fully with the MPGs of the ETF.

The results further show that MRV systems of all the countries included in this study will remain fully relevant to the Paris-era need of GHG inventories, while in the mitigation MRV theme the addition of the need to project emissions and removals systematically is the main gap that most countries will need to close in their MRV systems to ensure full relevance in that theme. The other additional needs in the mitigation MRV theme affect only Germany, and they relate to progress towards objectives, financing and implementation of their energy and climate change plans in the Paris era, and the Table shows that these needs have already been catered for within the current objectives and envisaged outcomes of the German MRV system.

Within the adaptation MRV theme, the results show that the systematic identification and monitoring of adaptation priorities and barriers, as well as the systematic management of information related to loss and damage, are the two Paris era needs which most existing MRV systems cannot address in their current form. In fact, none of the systems included in this study have the capability to handle the MRV of loss and damage. Table 24 illustrates this with a red "bar" across MRV need 3.6 on management of loss and damage. The results show that for the Chinese, Colombian, Indonesian, South African, EU, Germany and the UK domestic MRV systems, incorporating those two needs in the objectives and envisaged outcomes is all that is required for these systems to have full relevance to the adaptation MRV thematic needs in the Paris era.

*Table 24: Relevance of the countries' existing or planned domestic MRV systems to Paris-era needs**

MRV THEME		MRV Details	Brazil	China	Colombia	Indonesia	Kenya	SA	EU	Germany	NZ	UK	US
1. MRV of emissions		1.1. National GHG inventory and mitigation target											
2. MRV of mitigation		2.1. Mitigation policies, actions, measures and plans											
		2.2. Projections of GHG emissions & removals											
		2.3. Progress towards objectives of the E&CC plan	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A
		2.4. Progress towards financing and implementing E&CC plan	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A
3. MRV of Adaptation (Including climate risks, impacts and vulnerabilities)		3.1. Climate impacts, risks and vulnerabilities											
		3.2. Adaptation priorities and barriers											
		3.3. Adaptation strategies, policies, plans & actions											
		3.4. Progress on implementation of adaptation											
		3.5. M&E of adaptation actions & processes											
		3.6. Management of loss and damage											
		3.7. Climate change indicators	N/A		N/A		N/A		N/A		N/A	N/A	
		3.8. Adaptive capacity	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A
MRV of Means of Implementation	4. Support provided	5.1. Financial support	N/A	N/A	N/A	N/A	N/A	N/A					
		5.2. Capacity-building support	N/A	N/A	N/A	N/A	N/A	N/A					
		5.3. Technology development and transfer	N/A	N/A	N/A	N/A	N/A	N/A					
	5. Support needed	5.1. Financial support							N/A	N/A	N/A	N/A	N/A
		5.2. Capacity-building support							N/A	N/A	N/A	N/A	N/A
		5.3. Technology development and transfer							N/A	N/A	N/A	N/A	N/A
	6. Support received	6.1. Financial support							N/A	N/A	N/A	N/A	N/A
		6.2. Capacity-building support							N/A	N/A	N/A	N/A	N/A
		6.3. Technology development and transfer							N/A	N/A	N/A	N/A	N/A
	7. Other Means of implementation	7.1. Domestic Climate Finance							N/A	N/A	N/A	N/A	
		7.2. Impact & effectiveness of climate finance	N/A	N/A	N/A	N/A			N/A	N/A			
		7.3. Use of EU ETS auctioning revenue and credits	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A

**See Table 23 for key*

Furthermore, within the adaptation MRV theme, the results show that the monitoring and reporting of climate risks, impacts and vulnerabilities is a new need in the Paris era that for the EU, NZ and the UK, but the new EU MRV system and the UK's domestic MRV system have already incorporated it in their objectives while the New Zealand domestic MRV system has not yet incorporated it. However, according to Plume (2019), the New Zealand government plans to establish a domestic MRV system that will support regular climate risk assessments as well as other Paris era MRV needs within the adaptation MRV theme. In fact, the NZ government already started undertaking the country's first climate risk assessment to support the development of the first adaptation plan even before the Climate Change Response (Zero Carbon) Amendment Act of 2019 was enacted (ibid).

Finally, the table shows that the MoI MRV theme is one of the least affected by the transition from pre-Paris to Paris-era. The Paris-era relevance results in Table 24 remain the same as those of the pre-Paris era in Table 23 for support provided, support needed and support received.

A full Paris era relevance assessment at country level, showing the relevance of specific country systems to specific country needs can be found in Appendix B of this thesis.

Figure 11 below presents the relevance index ranking of the existing domestic MRV systems in addressing their Paris era MRV needs (whereas Figure 10 above showed the relevance to pre-Paris needs).

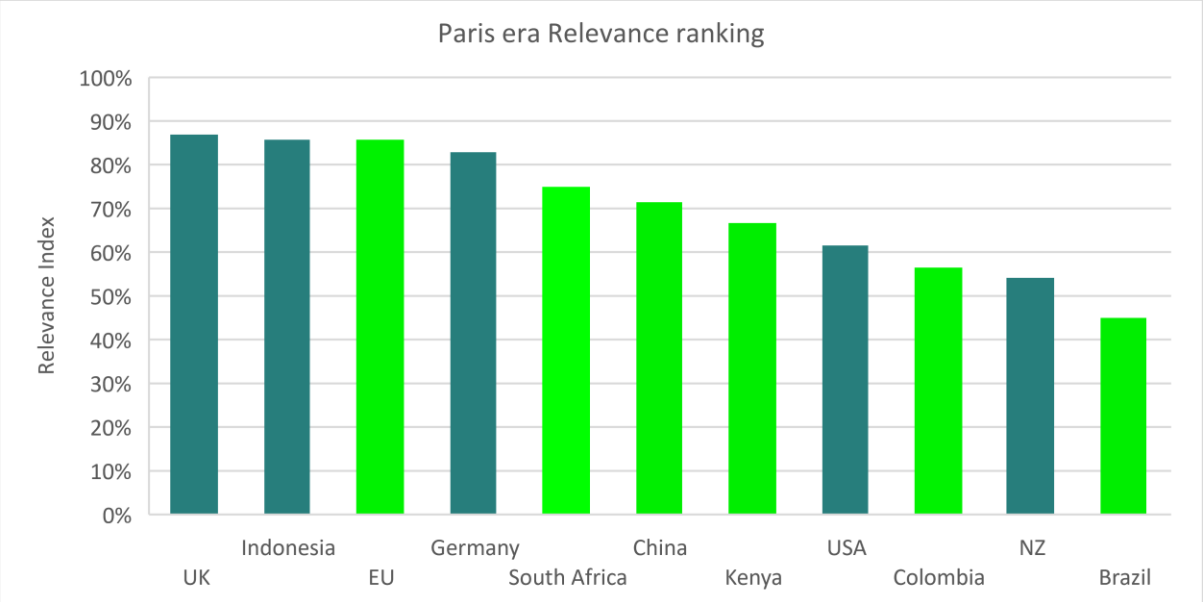


Figure 11: Comparison of the countries' Paris era Relevance indices

According to Figure 11, the UK has the most relevant domestic MRV system for Paris era MRV needs with a relevance index of 87%. This means that the objectives and intended outcomes of the current form of the UK's domestic MRV system address 86% of the country's Paris era MRV needs. For it to achieve a 100% relevance index, it only needs to incorporate the assessment of mitigation actions as

well as the monitoring and reporting of the management of loss and damage in its objectives and intended outcomes.

Closely behind the UK comes three countries with domestic MRV systems of Indonesia and the EU at 86% as well as Germany at 83%. While Table 24 shows that the domestic MRV system of the EU is irrelevant to fewer of its Paris era needs (two needs) compared to the Indonesian domestic MRV system (three needs), Figure 11 shows that the two systems have the same relevance index value. This is because of the number and frequency of occurrence of those needs: Accounting for frequency of occurrence, the Indonesian MRV system lacks relevance to three needs out of 21, which is the same as that of the EU system which is irrelevant to two needs out of 14.

The results show that the South African and Chinese domestic MRV systems come in fifth and sixth places with Paris era relevance indices of 75% and 71% respectively. To attain perfect relevance scores of 100% the two domestic MRV systems need to incorporate the six MRV needs for which they lack relevance, as reflected in Table 24 above.

In seventh and eighth places are the domestic MRV systems of Kenya and the USA with Paris era relevance indices of 67% and 62% respectively, and they are followed by the Colombian and New Zealand domestic MRV systems with relevance indices of 57% and 54% respectively.

As with the pre-Paris ranking, the domestic MRV system of Brazil comes in last here as well, with a Paris era relevance index of 45%.

There are at least two key observations that can be made from comparing the pre-Paris and Paris era rankings:

1. Firstly, both rankings do not show any consistent differences between developing countries compared to developed countries. No group seems to be doing better than the other in terms of the relevance of their domestic MRV systems. This is in line with what is expected because relevance of domestic MRV systems only relates to the incorporation of the country's MRV needs into the objectives and envisaged outcomes of the domestic MRV systems, which is much less resource intensive compared to implementation of the systems, hence the advantages that developed countries typically have over developing countries in terms of financial muscle, capacity or technology resources are not obvious from the relevance of the domestic MRV systems.

2. Secondly, the change in the relevance index scores from the pre-Paris assessment to the Paris era assessment confirms the statements made in the introductory sections of this thesis that the continuous evolution of the UNFCCCC MRV framework as well as changes in domestic and regional MRV needs affect the relevance of the domestic MRV systems. Figure 11 shows that none of the existing domestic MRV systems studied in this thesis achieve more than 90% of their Paris-era needs, while previously two MRV systems had achieved perfect relevance scores for their pre-Paris MRV needs.

Except for Brazil and the UK, the relevance indices of all other countries have decreased or remained the same from the pre-Paris to Paris era, due to additional international, regional and domestic MRV needs being added in the Paris era. For instance, the relevance index of the NZ's existing domestic MRV system has decreases from 81% in the pre-Paris era to 54% in the Paris era. On average, the relevance indices decreased by 8% from the pre-Paris era to the Paris era MRV needs.

Brazil and the UK exhibit a less common case of increasing relevance as new MRV requirements come into effect. In both cases, this is because the existing countries' MRV systems that focus on adaptation MRV are able do more than what is required by the country's pre-Paris needs within that theme. Because the relevance index is a measure of the percentage of the MRV needs that have been addressed by the MRV system, those extra capabilities of the systems cannot be reflected in the pre-Paris era relevance indices because there are no associated MRV needs. Instead, those extra capabilities of the systems can be captured by the Paris era relevance indices because the ETF has added MRV needs associated with them. This leads to a Paris-era relevance index that is higher than the pre-Paris relevance index of the same system in the adaptation MRV theme. In the cases of the Brazilian and UK MRV systems, the positive impact (in terms of increasing relevance index) of this phenomenon outweighs the negative impact brought about by new MRV needs in other thematic areas which the systems may not be able to address in their current form.

7.1.3 Comparing international, regional and domestic relevance

While the preceding sections have focused on the overall relevance of the domestic MRV systems to all the respective countries' needs, this section compares and discusses the relevance of the systems to the countries' domestic, international and regional MRV needs separately.

Figure 12 below compares the relevance indices of the domestic MRV systems in addressing the respective countries' domestic MRV needs versus their international MRV needs. The Figure shows that for all the countries, apart from the UK and the USA, the relevance indices are always higher for domestic MRV needs than for international MRV needs, or at the same level. In fact, for five of the 11 countries included in this study (China, Indonesia, South Africa, EU and Germany), the domestic MRV systems address 100% of their domestic MRV needs either in the pre-Paris era only or in both eras, while only two domestic MRV systems (Indonesia and EU) have 100% relevance to their Paris era international needs. This shows that, when establishing their domestic MRV systems, most countries primarily focus on satisfying their domestic needs for MRV before satisfying the UNFCCC needs or any other international needs.

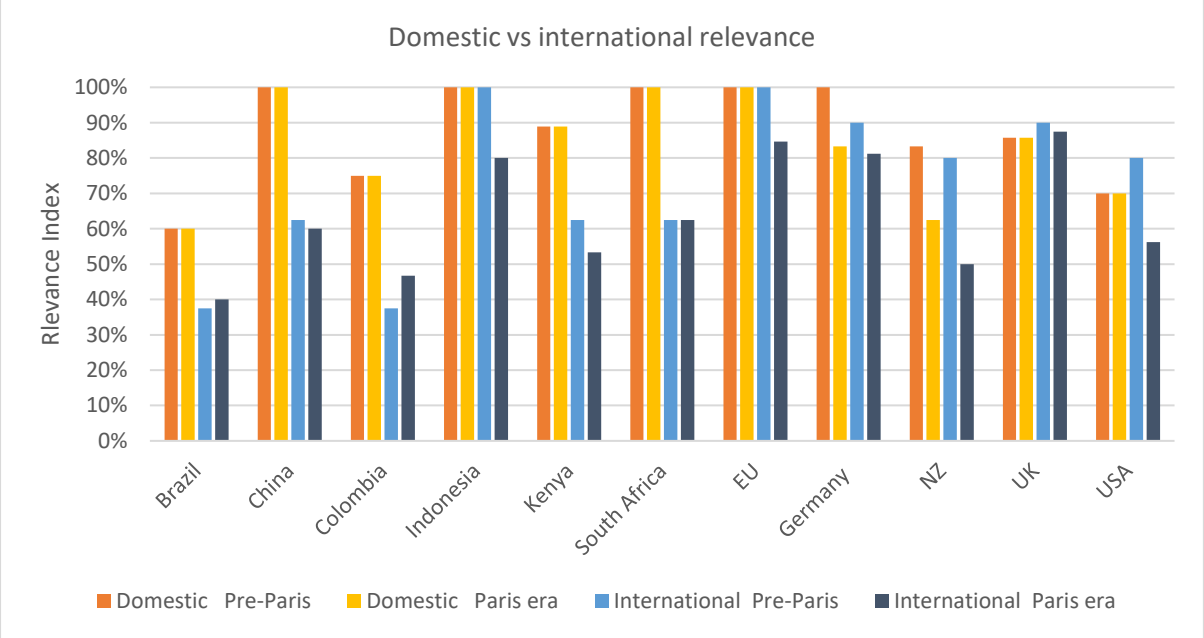


Figure 12: Comparison of relevance indices for international and domestic needs

Furthermore, the Figure shows that this prioritization of domestic MRV needs over international needs, when establishing MRV systems, is more pronounced for developing countries than for developed countries.

Finally, as expected, Figure 12 also shows that it is only in the cases of Germany and New Zealand where the domestic relevance indices in the pre-Paris era are different from those in the Paris era, because it is only these two countries that have added new domestic MRV needs for Paris era compared to the domestic pre-Paris era needs. Both countries have added the need for systematic projection of GHG emissions and removals, explicitly expressed in the new German Climate Change law and the New Zealand 2019 Zero Carbon Amendment Act. The New Zealand Zero carbon amendment act also explicitly expresses the need for monitoring and evaluation of adaptation actions, which the country did not have in the pre-Paris era. For both countries, these newly-added needs have not been accommodated for in the countries' existing domestic MRV systems, hence Paris era domestic relevance indices are lower.

Figure 13 below presents the relevance index scores for regional needs, which are only applicable to Germany and the UK, and compares them to relevance scores of the countries' MRV systems to their domestic and international needs. With the UK no longer an EU member, the regional assessment applies to the UK in the pre-Paris era only.

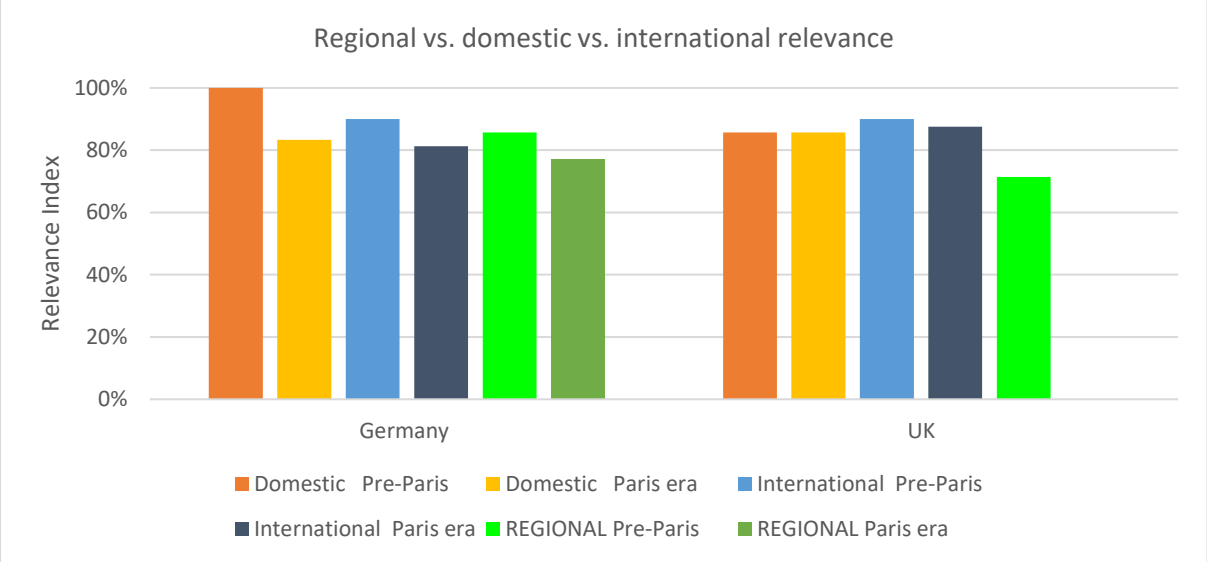


Figure 13: Relevance to EU regional needs vs domestic & international needs

Figure 13 shows that both the German and UK domestic MRV systems have the least relevance to their regional EU MRV needs in both the pre-Paris and Paris eras (only pre-Paris for the UK), compared to their relevance to domestic and international needs. For instance, in the pre-Paris era, Germany's regional relevance index is 86%, while its relevance to domestic and international needs is 100% and 90% respectively. Similarly, the UK's domestic and international relevance indices range from 86% (for domestic needs) to 90% (for the international pre-Paris era), but its only regional relevance index stands at 71%. While this suggests that EU member states, in establishing their domestic MRV systems, may be prioritizing their domestic and international needs over their EU regional needs, it is not possible to conclusively make that determination in this thesis because only two EU member states out of 27 have been studied.

7.2 Relevance indices of the thematic areas

Figure 14 and Figure 15 below present the pre-Paris and Paris era relevance indices of each country respectively, disaggregated by theme and by geographical location.

From the two Figures no geographical relevance trends can be observed in both the pre-Paris and Paris eras.

The results confirm that all the countries achieve the highest relevance index in the emissions MRV theme, and this does not change from the pre-Paris to the Paris era.

In the pre-Paris era, the Figure 14 shows that the MRV systems of all the developing countries achieve 100% relevance in the mitigation MRV theme, while they have the poorest relevance in the means of implementation theme, with relevance indices ranging from 0% for Brazil to 100% for Indonesia and an average of 54%. This contrasts with the developed countries which have the least relevance in the mitigation MRV theme ranging from 0% for the New Zealand and the USA to 100% for the EU, and the second highest relevance in the means of implementation theme achieving between 93% and 100%.

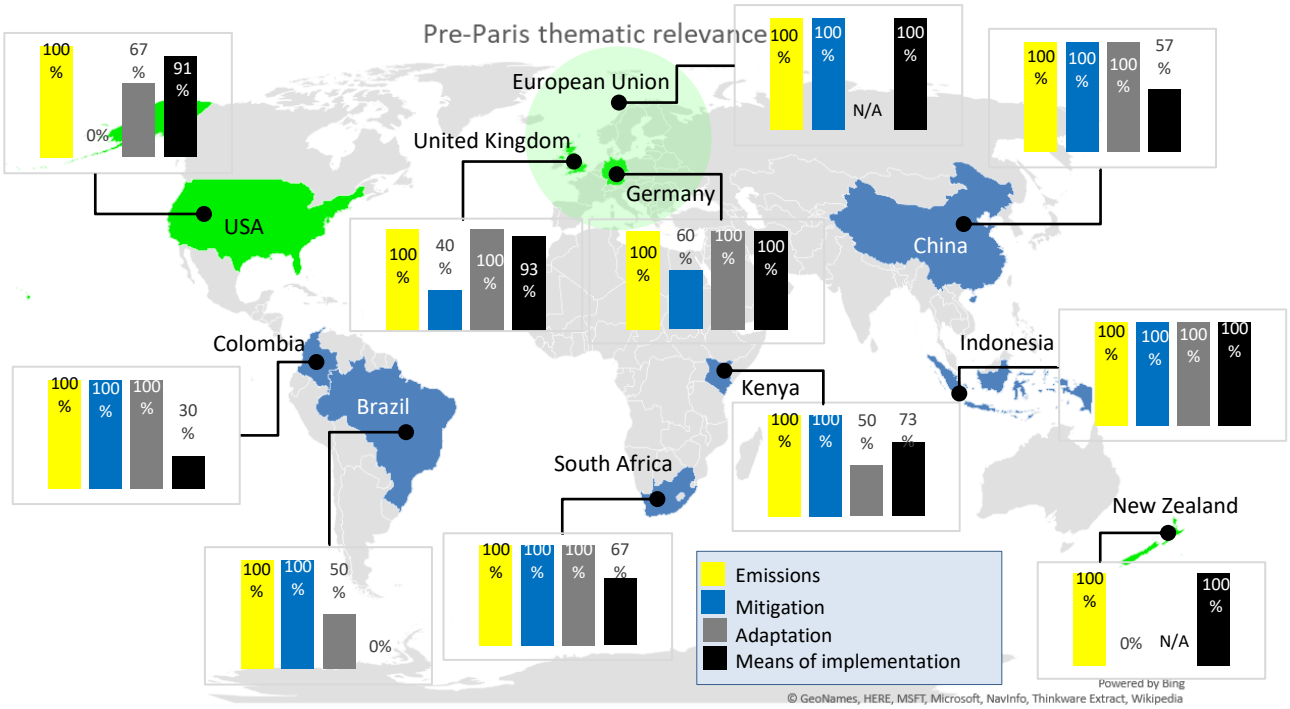


Figure 14: Pre-Paris thematic relevance indices per country

Figure 15 shows that domestic MRV systems of developed countries have the least relevance to their adaptation MRV needs in the Paris era at an average of 53%, while their relevance to means of implementation is the second highest, after their relevance to emissions to the MRV theme, with an average relevance index of 98%.

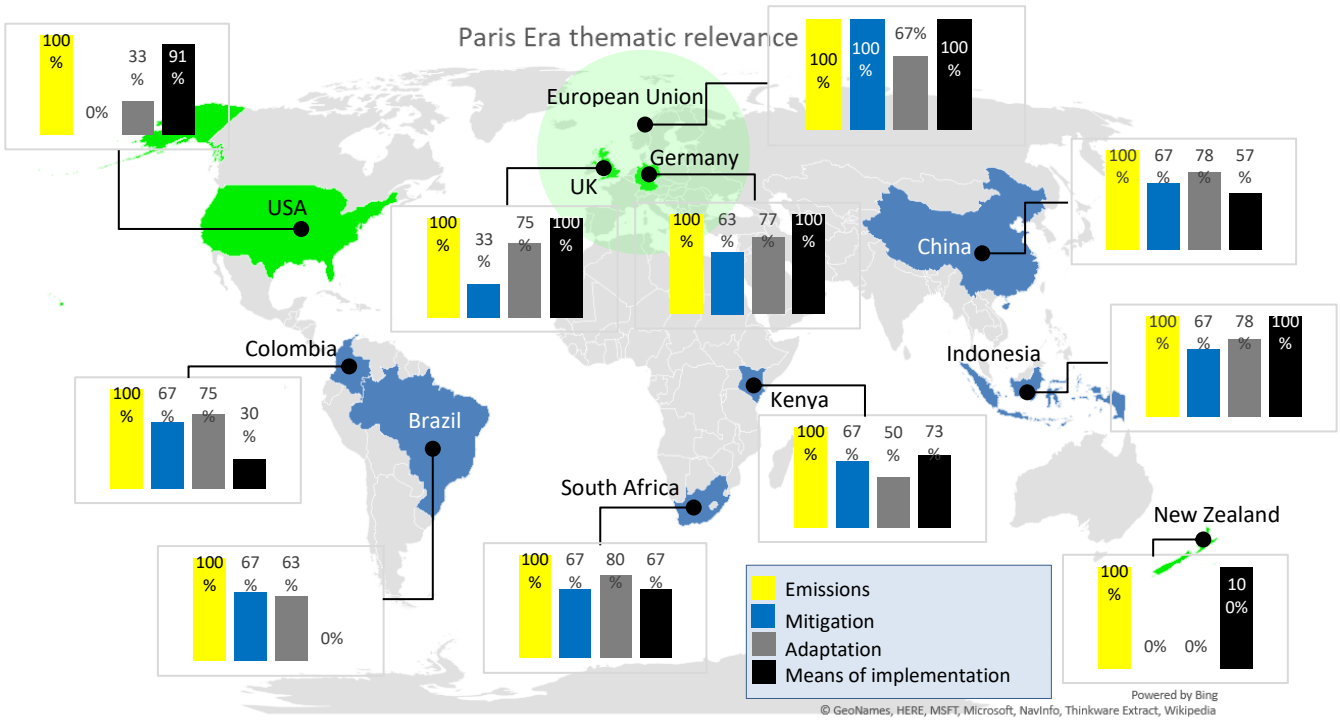


Figure 15: Paris era thematic relevance indices per country

The sections below present the results of each theme in more detail and compares the results across the different countries and themes.

7.2.1 Relevance to Emissions and Mitigation MRV needs

In this section the results of the relevance assessment of the domestic MRV systems to needs within the GHG emissions and mitigation themes are presented and discussed.

Having only one need in both the pre-Paris and Paris-era, which all countries' MRV systems address in their objectives and intended outcomes, puts the emissions MRV theme at the top of the relevance ranking, with 100% achievement by all countries.

A comparison of the relevance assessment results in the mitigation MRV theme is presented in Figure 16 below.

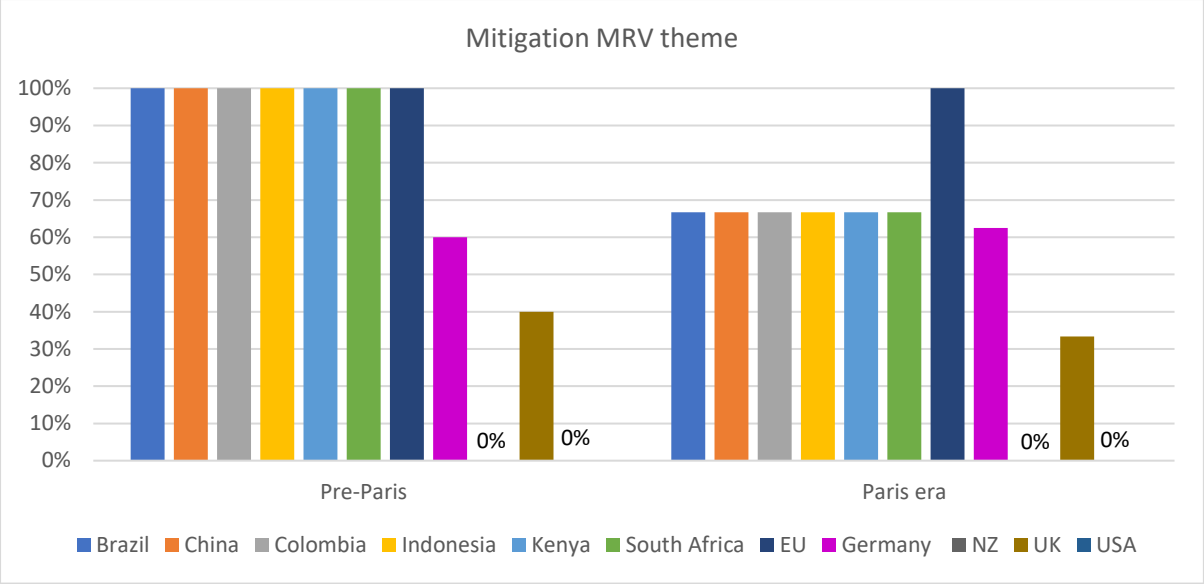


Figure 16: Relevance of the MRV systems towards mitigation MRV needs in the pre-Paris and Paris eras

Consistent with Table 11, Figure 16 above shows that seven out of the 11 domestic MRV systems included in this thesis address all their pre-Paris mitigation MRV needs, thereby achieving 100% relevance scores. This includes all the developing countries. It is only the domestic MRV systems of the four developed countries, namely Germany, New Zealand, the UK and the USA, that fall short of the 100% pre-Paris relevance score at 60%, 0%, 40% and 0% respectively.

The Figure also shows that the introduction of the need for biennial projections of GHG emissions and removals in the Enhanced Transparency Framework will cause a 26% drop in the average relevance index of the countries in the mitigation MRV theme if their existing domestic MRV systems are not updated by the time the Paris-era MRV needs kick in. However, it is the developing countries' systems that will be most affected by this change, with their relevance indices set to drop from 100% to 67% across the board. This is in contrast with the developing countries which will be minimally affected by that change because the Pars era has not added any new MRV needs for most of these countries.

7.2.2 Relevance to adaptation MRV needs

Figure 17 below presents the relevance indices of the domestic MRV systems within the adaptation MRV theme.

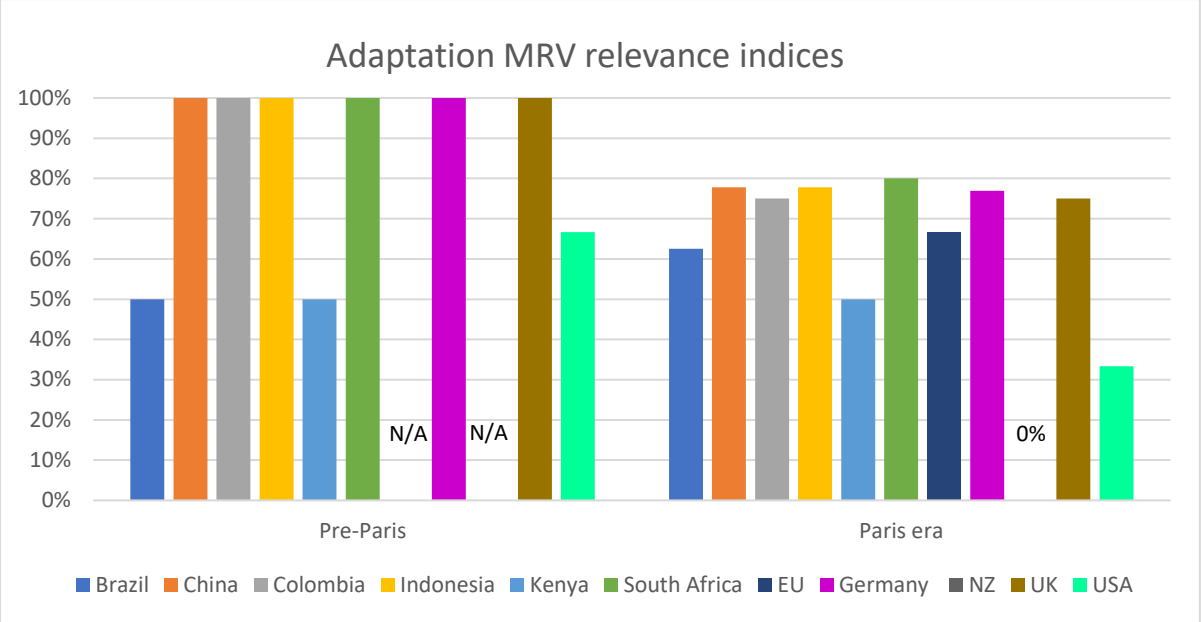


Figure 17: Relevance towards climate change, risk, impacts, vulnerability and adaptation needs

The adaptation MRV theme has been the most affected by the change from the pre-Paris era to the Paris era because of the large number of new MRV requirements in the Paris era (see Table 8, Table 23 and Table 24). This has led to a significant decrease in the average relevance index of the domestic MRV systems for this theme from 85% in the pre-Paris era to 61% in the Paris era. In fact, the domestic MRV systems of China, Colombia, Indonesia, South Africa, Germany and the UK which are relevant to 100% of their pre-Paris MRV needs in this theme, will see this this value reduced to 78%, 75%, 78%, 80%, 77% and 75% respectively if those systems are not updated to capture the newly-introduced Paris-era MRV needs in this theme, particularly monitoring and reporting on adaptation priorities and barriers (not in the case of UK) as well as the management of loss and damage.

7.2.3 Relevance to Means of Implementation needs

In the means of implementation theme, apart from the UK, all other countries' needs (domestic, international and regional needs) and their domestic MRV systems have not changed from the pre-Paris era to the Paris era, hence the relevance indices also remain the same. In the case of the UK, its exit from the EU has led to a reduction in the number of its MRV needs in this theme for the Paris era, because it is no longer affected by the MRV needs under the EU.

Figure 18 below presents a comparison of the relevance of the domestic MRV systems to their MRV needs within the means of implementation theme. Because for all countries, except the UK, the MRV needs in the means of implementation theme are the same for the pre-Paris and Paris eras, only one relevance index is presented in the Figure, which relates to both the pre-Paris and Paris eras.

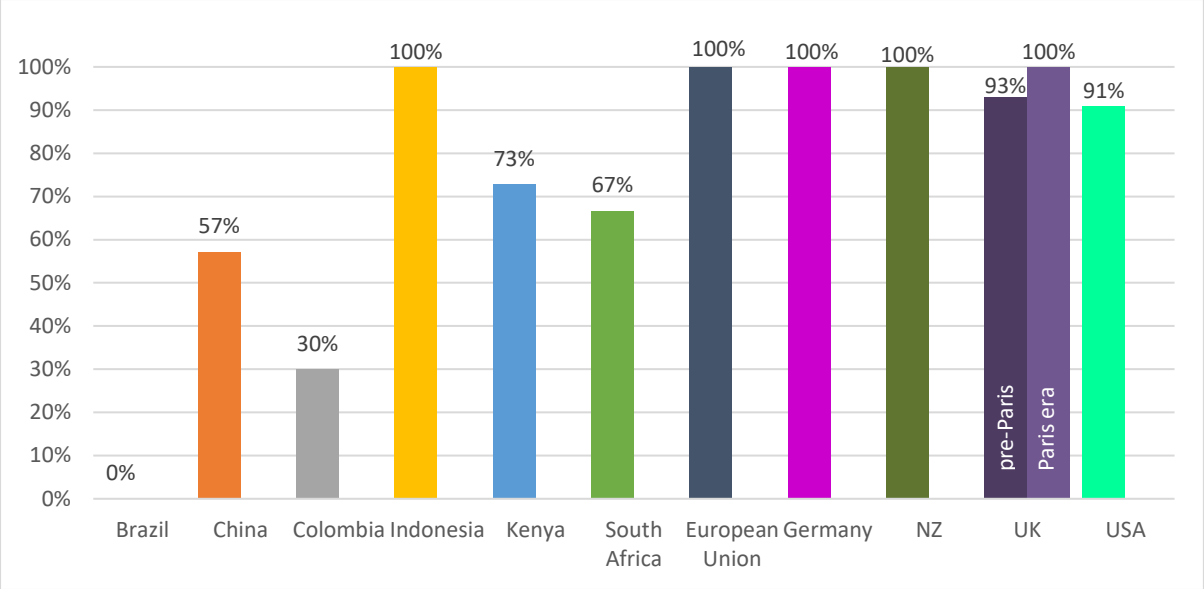


Figure 18: Relevance of the countries' domestic MRV systems towards means of implementation needs

The results show that the UK's exit from the EU has resulted in an increase for the relevance index of the country's MRV system from 96% in the pre-Paris era to 100% in the Paris era. This is because of the EU need to monitor and report on use of EU ETS auctioning revenues and credits which applies in both the pre-Paris and Paris eras. This is the only MRV need in this theme that the UK domestic MRV system does not address, hence its removal from the list of the UK MRV needs in the Paris era has meant that the country's MRV system will be relevant to 100% of its needs in the Paris era (Refer to Table 23 and Table 24 above).

Figure 18 further shows that, in addition to the UK, there are four other countries (Indonesia, EU, Germany and New Zealand) whose domestic MRV systems are relevant to 100% of their MRV needs in this theme.

Finally, the Figure reiterates the observation made from Table 23 and Table 24 that, in general, developed countries perform better than developing countries in terms of relevance to their MRV needs in this theme, with average relevance indices of 97% and 98% for developed countries in the pre-Paris and Paris era respectively, compared to 54% for developing countries.

7.2.4 Comparing Relevance across the themes

This section takes from the preceding thematic discussions and compares the relevance indices across the themes.

Figure 19 below shows that the emissions theme is the only one where all the studied domestic MRV systems have 100% to the MRV needs in both the pre-Paris and Paris eras. It further shows that the enhancements of the UNFCCC MRV framework under the Paris Agreement will lead to reduction in the relevance of the existing systems particularly in the mitigation MRV and adaptation MRV themes, with the former being reduced from an average of 73% to 54% and the latter from an average of 85% to 61% in the Paris era. As captured in the preceding sections, the ETF will have minimal impact on the

relevance of domestic MRV systems in the means of implementation MRV theme because it has not introduced new MRV requirements that were not there in the Cancun MRV framework.

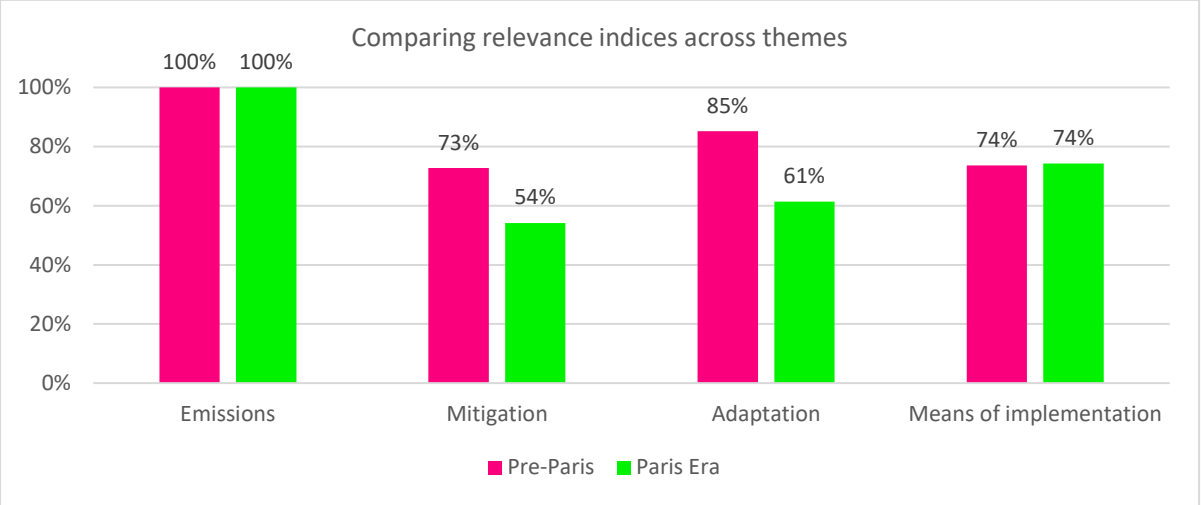


Figure 19: Comparison of the average relevance indices of all the themes

Having discussed the relevance of individual MRV systems in the section and the previous one, this thesis then goes further in the next section to assess how the design approach used for each system might have impacted these relevance results.

7.3 Results-based planning and relevance of domestic MRV systems

In this section the relationship between the relevance index of each domestic MRV system and the way the systems have been planned and designed is assessed, with a focus on result-based planning using the logic model as discussed in Chapter 3, section 3.1.2, thereby testing the first part of the hypothesis outlined in 3.2 of the same chapter.

In section 6.3.2 the extent to which results-based planning through logical modelling has been used by each country in establishing their domestic MRV systems was discussed, and the countries were categorized into three groups as follows: 1) those that followed all the five steps of results-based planning approach; 2) those that followed only the first four steps of results-based planning; and 3) those that did not follow results-based planning. Because relevance of domestic MRV systems is concerned with the extent to which the systems' objectives and envisaged outcomes address the countries' MRV needs, only the four steps of results-based planning affect relevance. This is because the specification of objectives and expected outcomes is carried out in step four, while the fifth step in that process involves the development of a logic model or MRV structure with outputs, activities and inputs, and which has no bearing on the relevance of the system (See Figure 7). Put differently, following four steps in results-based planning yields the same relevance results as following all five steps because the fifth step does not affect relevance. As such, in this section those countries that have followed four steps of results-based planning approach and those that followed all five steps (groups 1 and 2 above) have been grouped together under one title of "Those that used results-based planning".

This means that the groups have been reduced to two in this section as follows: 1) those that used results-based planning and 2) those that did not use results-based planning.

Figure 20 below presents as assessment of the correlation between the pre-Paris relevance indices of the different countries and the use of results-based planning using logical modelling.

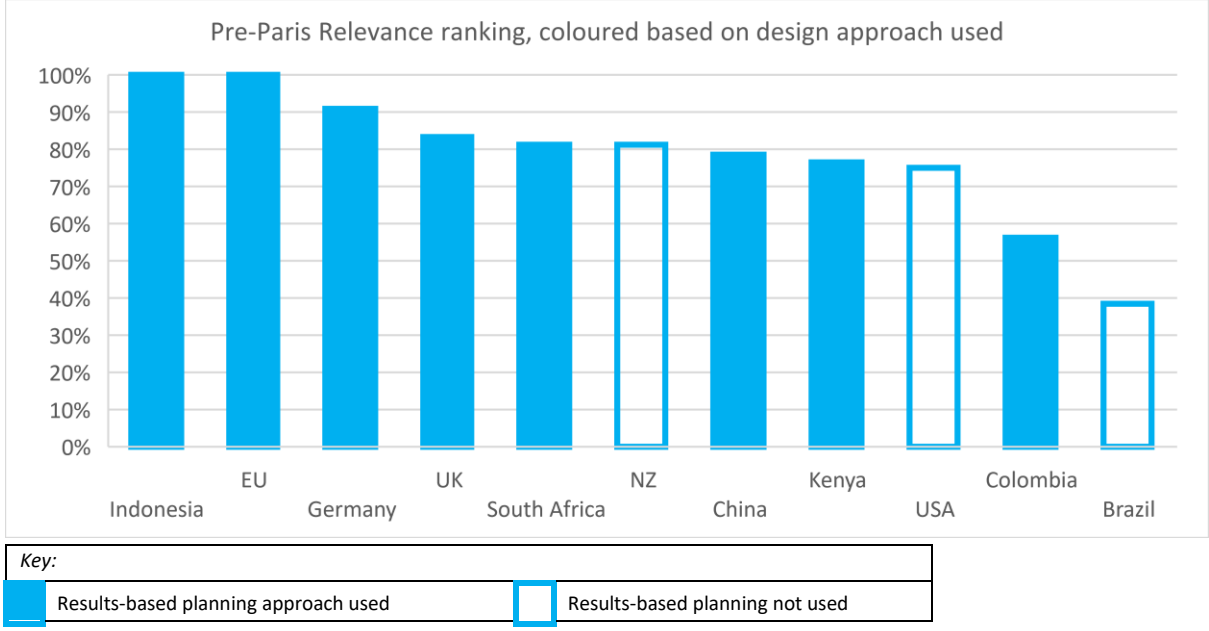


Figure 20: Pre-Paris relevance index ranking showing systems where results-based planning was employed

Figure 20 above shows the same relevance ranking presented in Figure 10, but instead of comparing the countries based on their level of development, the above figure uses the extent to which the use of logical modelling in developing the systems to compare the countries.

The results show that the two countries which have achieved 100% relevance to their pre-Paris MRV needs – Indonesia and the EU – used results-based planning through logical modelling in establishing their systems. However, the Figure also shows that there are six other countries that employed logical modelling in establishing their systems, but those systems have not achieved perfect relevance index scores despite the use of logical modelling. In fact, the Figure shows that it is possible for a country to use results-based planning in establishing its domestic MRV system only for its system to achieve 56% relevance to its MRV needs, as in the case of Colombia.

On the other hand, Figure 20 shows that, while it is possible for countries to achieve up to 81% relevance to their MRV needs without the use of logical modelling, as in the case of New Zealand, the two countries that have not employed results-based planning – the USA and Brazil – are among the countries that have achieved the lowest relevance to their pre-Paris needs with relevance scores of 75% and 38% respectively.

This shows that the use of logical modelling in establishing domestic MRV systems can result in maximum relevance for the system but achieving that 100% relevance level is also dependent on other factors. These other factors are discussed below.

1. **Results-based planning must be undertaken correctly**. As stated in Chapter 3 section 3.1.2.1, it is important that the five steps of results-based planning are carried out correctly, especially steps 1 and 2 on assessing the needs and analysing the problem because the rest of the process depends on these being undertaken properly. For instance, the Biennial Update Report requirements were identified as MRV needs for the Kenyan, South African and Indonesian MRV system, but the way they were disaggregated and assessed, as well as the way that the objectives and envisaged outcomes were defined for the Indonesian domestic MRV system ensured 100% relevance for the Indonesian MRV system in the pre-Paris era and only 81% and 76% relevance for the Kenyan and South African systems. Individual needs in the BUR, like MRV of capacity building and MRV of technology transfer, were not explicitly disaggregated, identified, assessed and addressed in the designs of the Kenyan and South African MRV systems when undertaking the first and second steps, as required by results based planning (see 3.1.2.1), leading to them being missed in the systems' objectives and envisaged outputs. In fact, Kenya's MRV+ system did not have MRV of climate finance as well in its original design, and this was only added at a much later stage. Similarly, the MRV of technology transfer was added later in the South African MRV system.

2. **Competency of the team that undertakes the results-based planning.** This is related to the first point above, in that an experienced and competent team is needed to undertake the logic model process properly. However, the understanding of what constitutes results-based planning through logic modelling, let alone experience in that skill, is still limited within the climate change profession, but that has not stopped many climate change practitioners who do not have full understanding or competency in that area from attempting to develop domestic MRV systems following that approach. This limited understanding also means that consultants can promise country officials domestic MRV systems that have been designed following the logic model approach and the country officials will not notice when the delivered systems are not in line with results-based planning.

   The designs of both Kenya's MRV+ system and South Africa' Climate Change Response M&E system are again cases in point. Both systems were designed by the same consultancy firm, which was expected to be competent in results-based planning, but did not undertake the process properly. Also, in the case of the Kenyan system, stakeholders that had been part of the entire design process of the system – Transparency International Kenya – could not notice that the approach used was that of logic modelling; this means that they would not have been able to pick up the errors in the process also.

3. **The combination of periodic review and results-based planning (or Results-based Management)** plays a significant role in maximizing the relevance of domestic MRV systems. This combination was employed in both the Indonesian and EU MRV systems to ensure maximum relevance. The EU undertook a review of its original MRV system, entitled mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol and established by EU decision 280/2004/EC of the European Parliament, and because of that review replaced it by the MMR, which was more relevant to the pre-Paris MRV needs. Furthermore, before the MPGs of the Paris Agreement's ETF were finalized both the Indonesian and EU systems had already been reviewed and re-designed to account for the

new MRV needs, and the Government of Indonesia's has indicated that their MRV system will be further reviewed and improved to match the progressing needs and requirements, particularly in the ETF's MPGs.

Domestic MRV systems of Kenya and South Africa have also benefitted from periodic reviews, enabling the addition of climate finance MRV in the Kenyan system and technology transfer MRV in South Africa's MRV system and thereby improving their relevance.

Even more effective would be the ability to continuously assess the country's MRV needs and to monitor and evaluate the country's existing MRV system against the needs, thereby continuously identifying areas of improvement for the system as in the case of the UK's climate change committee monitoring process.

7.4 Chapter Summary

This chapter assessed the relevance of the various domestic MRV systems and tested the hypothesis that that results-based planning through logic modelling results in maximum relevance for the domestic MRV systems.

The following is a summary of the key findings from the chapter,

- Firstly, between developing countries and developed countries, neither group seems to be doing better than the other in overall relevance of their domestic MRV systems. This is consistent with expectations because relevance is not heavily dependent on the capacity, financial muscle or technology that the countries have, but on how the objectives and envisaged outcomes of the domestic MRV systems have incorporated the country's MRV needs.
- Secondly, the chapter found that increasing MRV needs generally leads to lower relevance for existing domestic MRV systems. This finding confirmed the expectation that, with continuous evolution of the UNFCCCC MRV framework as well as changes in domestic and regional MRV needs leading to higher requirements / MRV needs, comes reduction of relevance of the existing domestic MRV systems. Enhancements of the UNFCCC MRV framework under the Paris Agreement are likely to lead to significant reduction in the relevance of the existing domestic systems especially in the mitigation and adaptation MRV themes, with average reductions of 26% and 24% respectively, if the systems are not updated to accommodate these enhancements.
- Thirdly, another finding relates to the establishment of domestic MRV systems. The thesis showed that when establishing their domestic MRV systems, most countries primarily focus on satisfying their domestic MRV need, before satisfying the UNFCCC needs or any other international needs. This was found to be more pronounced for developing countries.
- Fourthly, it was observed that, apart from the GHG inventory theme, domestic MRV systems of developing countries have the highest relevance to their mitigation MRV needs and lowest relevance to their means of implementation MRV needs, but the situation is turned around in the case of developed country MRV systems.
- The fifth point is that results from studying the German and UK domestic MRV systems may suggest that EU countries are prioritizing domestic & international MRV needs over EU MRV

needs, but it was not possible to conclusively determine that in this thesis due to the small sample size of EU countries.

- Sixthly, it was determined that utilizing results-based planning through logic modelling in establishing domestic MRV systems can result in maximum relevance for the systems, provided the planning process is undertaken correctly, by competent personnel and is ideally couples with periodic monitoring and review of the system. This confirms the first part of the hypothesis that results-based planning through logical modelling ensures maximum relevance of domestic MRV systems.

From the relevance lessons drawn from studying domestic MRV systems of the 11 countries, the next chapter presents a detailed case study with the aim of drawing further lessons on relevance. Chapter 8 follows Lesotho as it designs its domestic MRV system.

8 Lesotho Case Study

This chapter presents and discusses the Lesotho domestic MRV system case study. It starts by describing the case study, including the background, the process followed in developing the system and a summary of the developed MRV system, and then assesses the relevance of the designed system and concludes with a critical assessment of the relevance findings of the proposed domestic MRV system.

8.1 Case Study description

Lesotho signed the UNFCCC at the Earth Summit in Rio de Janeiro in 1992 and ratified it in February 1995 (LMS, 2017). On the 22nd of April 2016 Lesotho signed the Paris Agreement and then ratified it nine months later on the 20th of January 2017 (UNFCCC, 2017).

As part of fulfilling its commitments under the Convention, Lesotho developed and published several climate-related policies and strategies since ratifying the Convention. In 2004 the country compiled and submitted a Technology Needs Assessment (TNA), then developed and published a National Programme of Action (NAPA) in 2007. 2017 was the busiest year in terms of climate change policies, with the Government of Lesotho publishing the National Climate Change Policy (NCCP) 2017-2027, its associated five-year Implementation Strategy (NCCPIS) as well as the country's first Nationally Determined Contribution (NDC) under the Paris Agreement.

The Government of Lesotho embarked on a journey to develop the country's domestic MRV system from 2018 to include in its first BUR. The final framework report outlining the design of Lesotho's climate change MRV system was submitted on the 21st of August 2019

The diagram below summarises key climate change policy and strategic events and outputs in Lesotho.

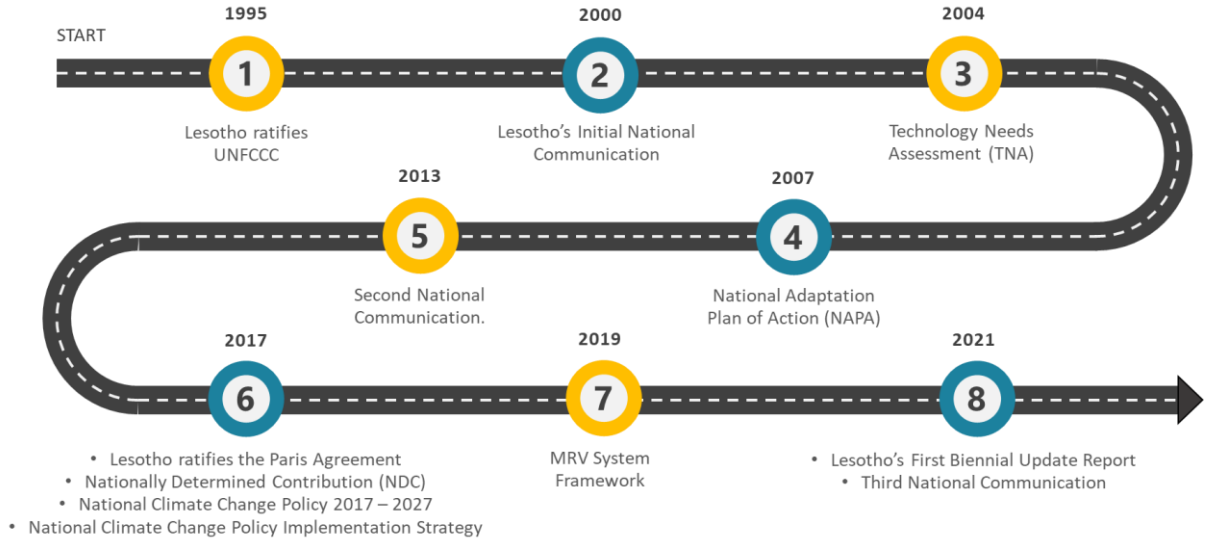


Figure 21: Roadmap of Lesotho's main climate-related policy activities

***Source**: Author's own analysis*

The sub-section below summarizes the steps and methodology employed in developing Lesotho's domestic MRV system.

8.1.1 Process and approach followed in developing Lesotho's MRV system

The development of Lesotho's domestic MRV system started in 2018, with the publication of a tender document inviting consultants to submit "*Technical and Financial Proposals for consulting services required for developing Measuring, Reporting and Verification System*" (LMS, 2018), which was followed by the appointment of a consultant and project inception in March 2019.

The published tender document outlined the objective of the project as *"… to design the MRV system for Lesotho, including defining standardized baseline under the UNFCCC and designing the national climate change MRV system to enhance tracking of:*

- *greenhouse gas emission levels;*
- *the impact of mitigation and adaptation actions;*
- *technology transfer and capacity building support needed and received; and*
- *international, regional and domestic climate finance flows."* (Promethium Carbon, 2019).

Table 25 below summarizes the tasks undertaken in developing Lesotho's domestic MRV system.

Table 25: Key Tasks undertaken in developing Lesotho's MRV system
***Source**: (Promethium Carbon, 2019).*

	Key task	Task Category
i.	**National arrangement**: Review, analyse and identify gaps in existing national arrangement for managing, processing and archiving national climate change information.	**Preliminary review and assessment of information**
ii.	**Existing mechanism and frameworks**: Review, analyse and identify gaps in existing mechanism and frameworks for the collection and management of all data relevant to the development of national greenhouse gas inventories and mitigation and adaptation measures.	
iii.	**Tracking financial support**: Review and analyse gaps in tracking of financial and technical support for climate change activities received by government from developed countries or international organizations.	
iv.	**Technology transfer**: Review and analyse gaps in tracking arrangements to capture information on technology transfer and capacity building support needed and received in the country.	
v.	**Stakeholder consultation**: Review and analyze gaps in the national system for consultation with organizations and stakeholders outside the country in the assessment of climate change reports submitted to relevant national, regional and international organizations. The main national stakeholder engagement workshop was held on the 06th of June 2019.	
vi.	**National MRV system**: Design the national MRV System to support tracking of greenhouse emissions, the impact of mitigation and adaptation actions, climate finance flows, technology transfer and capacity building support.	**MRV Framework design**
vii.	**Prioritized actions**: Design and develop MRV plans for prioritized mitigation and adaptation actions to support the climate change policies and strategies.	

	Key task	Task Category
viii.	**Policy recommendations**: Provide recommendations on the policy, identified gaps, legal and institutional frameworks necessary for the development and implementation of the MRV system.	
ix.	**Linking mechanisms**: Provide advice on mechanisms at the national and institutional levels to link mitigation and adaptation actions with MRV-related activities.	
x.	**Capacity building**: Design and conduct a course of consultation, training and workshops on the development and implementation of the MRV system.	**Additional tasks**

According to Lesotho's first BUR, the primary focus of the country's MRV Framework is information required for the compilation of BURs, but it is expected that the designed MRV system will also "facilitate the identification of policy misalignment or gaps in implementation of climate actions" (LMS, 2021). In fact, the designed system is referred to as Lesotho's BUR MRV system (ibid). As a result, a comprehensive assessment of the country's MRV needs and analysis of the problem as required by the first two steps of results-based planning (see Section 3.1.2) were not followed, instead the focus was on identifying and satisfying the information requirements of BURs only.

The section below presents Lesotho's designed BUR MRV system as contained in the MRV framework report.

8.1.2 Summary of Lesotho's designed MRV system

As mentioned above, primary objective of Lesotho's MRV system is to assist the Kingdom to compile international reports, especially BURs (LMS, 2021). It is proposed that the system will have three components covering 1) National GHG inventories, 2) Adaptation and Mitigation measures and 3) support needed and received (ibid). The Figure below outlines the components of Lesotho's proposed domestic MRV system as well as the purpose of each component.

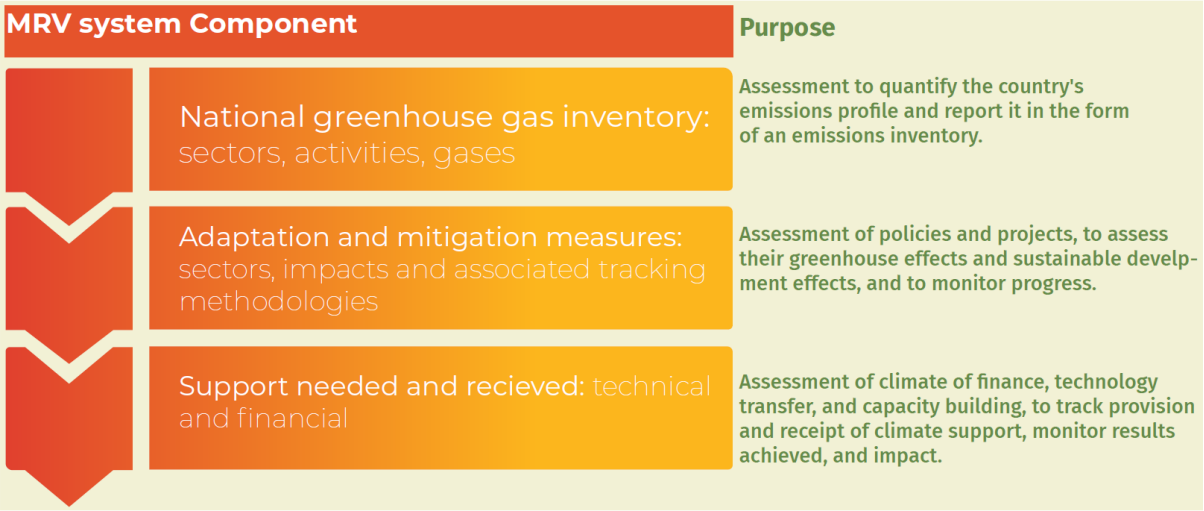


Figure 22: Lesotho's BUR MRV system components and purpose

***Source**: (LMS, 2021)*

The conceptual framework of the system envisages that the monitoring of these system components will be undertaken through formalized institutional arrangements for data collection, processing, analysis, storage and archiving, and internal data reports after which the data and resulting reports will undergo domestic verification before being used to compile BURs, National Communications, Biennial Transparency Reports under the UNFCCC as well as other international reports (ibid).

The MRV framework document outlines the proposed institutional arrangements, MRV indicators and their data requirements, data sources, and measurement approaches for each of the three components (Promethium Carbon, 2019).

The key next steps in establishing Lesotho's domestic MRV include formalizing the institutional arrangements and developing an IT-based database for data evaluation and storage (ibid).

In the sections that follow, a relevance assessment of this MRV system is presented, as well as a critical assessment of the proposed quality features of the system.

8.2 Relevance of Lesotho's domestic MRV system

In this section, an assessment of the relevance of the designed MRV system is presented. In assessing the relevance of Lesotho's designed domestic MRV system, the country's normative and expressed MRV needs were first determined. Then the relevance of Lesotho's designed MRV system as described in the preceding section was assessed based on the extent to which the system's objectives and envisaged outcomes respond to these needs. The detailed approach and results are presented below.

8.2.1 Determining Lesotho's MRV Needs

Like the MRV needs assessment for the 11 countries carried out in chapter 5, Lesotho's MRV needs were determined at international, regional, and domestic levels.

Outside the MRV needs under the Convention and its Paris agreement, Lesotho does not have any other international MRV needs, therefore its international MRV needs are the same as those of all other developing country Parties to the Convention and the Paris Agreement. These are the BUR reporting requirements in the pre-Paris era and the BTR reporting requirements in the post-Paris era as shown in Table 8 in Section 5.1.

At regional level, whether at African regional level or at Southern African Development Community (SADC) level, there are no climate-related reporting requirements, hence Lesotho does not have any regional MRV needs.

The country's domestic MRV needs were determined in two ways: 1) From national stakeholders and 2) from published national documents. The needs expressed through each of these sources are summarized in the sub-sections below.

8.2.1.1 Needs Expressed by Key Stakeholders

The stakeholders expressed general MRV needs and problems that are currently being experienced in the country, as well as specific MRV needs for the country.

A total of eight general MRV needs and problems were expressed by the stakeholders as shown in Figure 23 below.

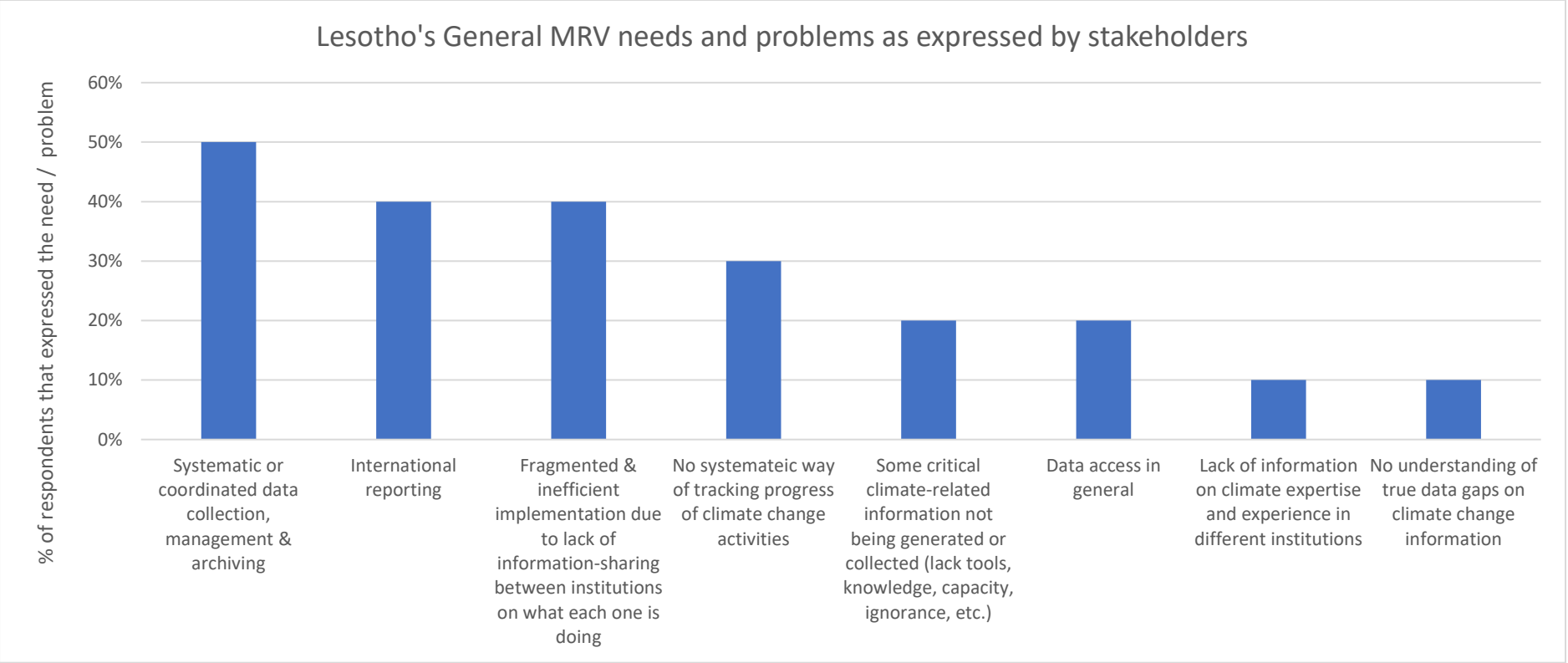


Figure 23: Lesotho's general MRV needs and problems as expressed by stakeholders

The most common general need raised was that of a systematic or coordinated data-collection, management, and archiving system for climate-related data in the country. It was raised by 50 percent of the respondents. 40 percent of the respondents expressed the need for a system to support Lesotho's international reporting obligations, and the same number of respondents expressed the problem of fragmented and inefficient implementation of climate change response in the country due to lack of information-sharing between institutions that are involved in climate change response.

The other MRV needs and problems that were expressed by the stakeholders relate to absence of a systematic way to track progress of climate change activities; the problem of having some critical or important climate-related data not being generated or collected in the country due to lack of knowledge, lack of tools or lack of capacity; the problem of data access in general; lack of information on climate expertise and experience in the various institutions as well as the problem that real or true data gaps on climate change in Lesotho are not well understood. This list of general needs and problems constitutes what key stakeholders in the country see as overarching problems that a domestic MRV system will ultimately need to solve or at least address.

In terms of specific MRV needs, the respondents expressed seven of them as shown in Figure 24 below.

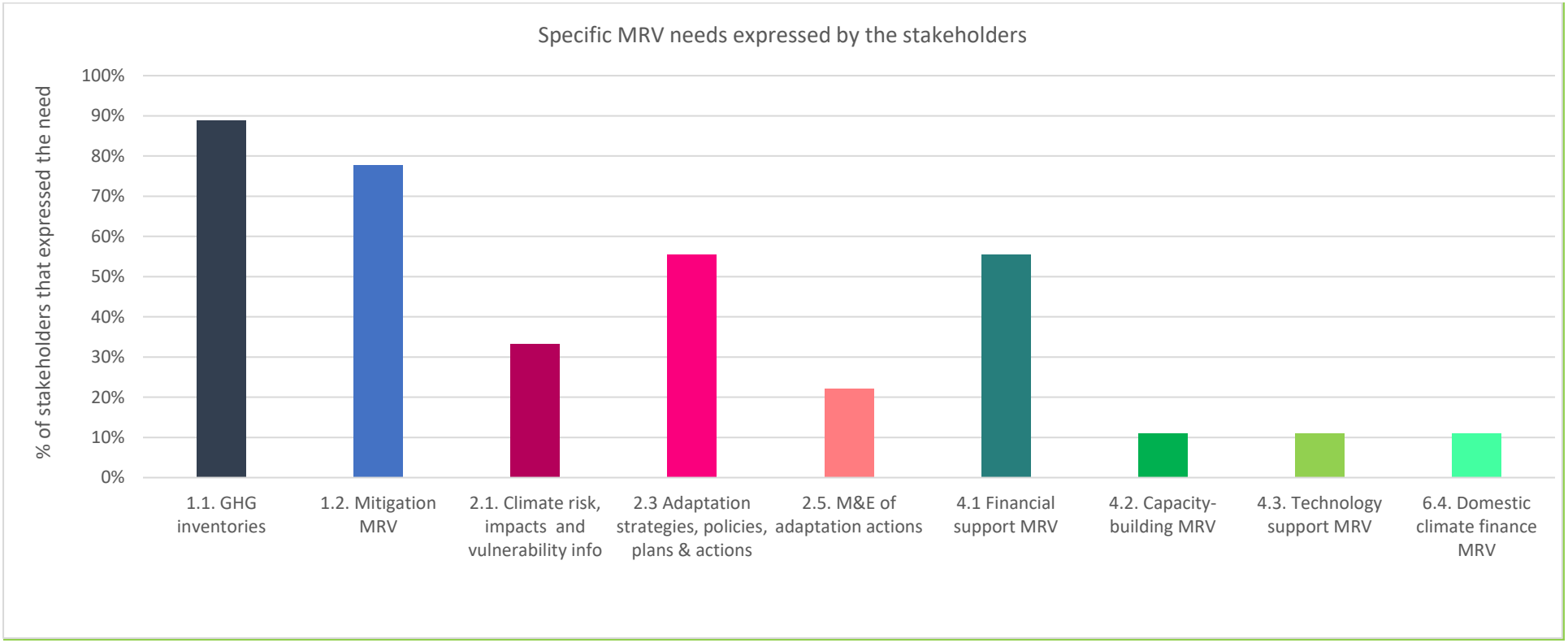


Figure 24: Specific MRV needs for Lesotho as expressed by the stakeholders

The most expressed need was that of GHG inventories, mentioned by about 90% percent of the respondents. This was followed by Mitigation MRV, Adaptation MRV and Finance MRV, which were expressed by 77%, 55% and 55% of the respondents respectively. 20% of the respondents express the need for climate risk, impacts and vulnerability information, while 10% expressed the need for Technology MRV and Capacity building MRV information. The popularity of GHG inventories and mitigation MRV over all others is likely due to better understanding of these two by the stakeholders compared to others because there have been more projects in the country focusing on these two than all others.

8.2.1.2 Needs Expressed in Published National Documents

Lesotho's NAPA is the earliest published document that explicitly expresses Lesotho's domestic MRV needs. In it the country expresses the need for extensive data collection and review of progress reports of adaptation projects. For each adaptation project included in the NAPA, the document outlines the required process for monitoring and evaluation including the frequency and key stakeholders (LMS, 2007).

Then in 2015, the INDC included Lesotho's expressed need to "*design a national inventory system and to develop a framework for domestic MRV of GHG emissions*" as part of gaps, barriers and needs for Lesotho's climate change contribution under the Paris Agreement (LMS, 2017a).

With the publication of the National Climate Change Policy and its implementation strategy in 2017, Lesotho included the most comprehensive list of expressed MRV needs for the country. Specifically, the Policy requires that:

- the ability to monitor climatic changes and changes in climate variability be strengthened, and the existing meteorological observation network be strengthened and a sound climate observing system for monitoring climate and climate change be developed;
- an institutional and regulatory framework to monitor and regulate GHG emissions from the transport sector be established, and
- effective information, monitoring and assessment tools to evaluate the resilience of settlements to climate change be developed (LMS, 2017).

Building on and adding to these MRV requirements in the Policy, the Implementation Strategy expresses the need for a monitoring and evaluation framework that will enable Lesotho to track climate risks, climate impacts, vulnerabilities, adaptation measures, sectorial mitigation measures, flows of climate finance from donors, public and private funds, support on technology transfer, capacity building, and also enable the country to generate GHG inventories and emission projections (The Kingdom of Lesotho, 2017).

8.2.1.3 Lesotho's consolidated MRV needs

Table 26 below presents a consolidation of all the normative and expressed specific MRV needs for Lesotho from stakeholders and publications as outlined in the sections above.

Table 26: Lesotho's normative and expressed specific MRV needs

MRV THEME		MRV Needs	UNFCCC needs		Expressed as a domestic need by / in
			BUR	ETF	
1. MRV of emissions		1.1 National GHG inventory and mitigation target	Yes	Yes	NDC 2015; NCCP 2017; NCCPIS 2017 and Stakeholders
2. MRV of mitigation		2.1 Mitigation policies, actions, measures and plans	Yes	Yes	NCCP 2017; NCCPIS 2017 and Stakeholders
		2.2. Projections of GHG emissions & removals		Yes	NCCPIS 2017
3. MRV of Adaptation (Including climate risks, impacts and vulnerabilities)		1.1. Climate impacts, risks and vulnerabilities		Yes	NCCPIS 2017 and Stakeholders
		1.2. Adaptation priorities and barriers		Yes	
		1.3. Adaptation strategies, policies, plans & actions		Yes	NCCPIS 2017 and Stakeholders
		1.4. Progress in implementation of adaptation policies & actions		Yes	NAPA, 2007
		1.5. M&E of adaptation actions & processes		Yes	NAPA 2007; NCCP 2017; NCCPIS 2017 and Stakeholders
		1.6. Climate change indicators		Yes	NCCP 2017; NCCPIS 2017
MRV of Means of	5. Support needed	5.1. Financial support	Yes	Yes	
		5.2. Capacity-building support	Yes	Yes	
		5.3. Technology development and transfer	Yes	Yes	
	6. Support received (NA1) / provided (A1)	6.1. Financial support	Yes	Yes	NCCPIS 2017 and Stakeholders
		6.2. Capacity-building support	Yes	Yes	NCCPIS 2017 and Stakeholders
		6.3. Technology development and transfer	Yes	Yes	NCCPIS 2017 and Stakeholders
	7. Other Means of implementation	7.1. Domestic climate finance			NCCPI Plan, 2017 and Stakeholders

From Table 26 above, it can be observed that all the MRV needs that have been expressed by the stakeholders through questionnaires and interviews had already been expressed by the country elsewhere in published national documents. This means that using published national documentation only, without collecting primary information from the stakeholders, can be sufficient for determining expressed domestic MRV needs of countries. This is because countries generally undertake stakeholder engagements when they compile their climate-related strategies, policies, plans, and other published documentation, hence the needs and views of the stakeholders will already be addressed or incorporated in the published versions of those documents.

This finding strengthens and supports the approach that was used in Chapter 5 of this thesis in assessing the domestic MRV needs of the 11 countries, where those needs were determined solely from published national documentation and statements.

In the next section, the extent to which the country's designed MRV system, as presented in the Climate Change MRV System Framework document, is relevant to these MRV needs is assessed.

8.2.2 Relevance assessment results

Table 27 below presents the pre-Paris and Paris-era relevance assessment results for Lesotho's MRV system as designed. The Table shows that the system's stated objectives and objectives addresses 11 of the country's 15 and 17 specific pre-Paris and Paris era needs respectively.

In both the pre-Paris and Paris eras, Lesotho's designed MRV system comes short on one MRV need in the Mitigation MRV theme and this relates to projections of GHG emissions and removals. In the Adaptation MRV theme, the designed system does not address climate risks, impacts, vulnerabilities, climate change indicators in both the pre-Paris and Paris eras, as well as the two Paris era needs of adaptation priorities and barriers and management of loss and damage. In terms of the country's MRV needs related to means of implementation, the table shows that the designed system comes short on only one need – that of tracking domestic climate finance flows.

Table 27: Relevance assessment of Lesotho's MRV System

MRV THEME		MRV Details	Lesotho's MRV System	Assessment	
				Pre-Paris	Paris era
1. MRV of emissions		1.1. National GHG inventory and mitigation target	Yes		
2. MRV of mitigation		2.1. Assessment of mitigation policies, actions, measures and plans	Yes		
		2.2. Projections of GHG emissions & removals	-		
3. MRV of Adaptation (Including climate risks, impacts and vulnerabilities)		3.1. Climate impacts, risks and vulnerabilities	-		
		3.2. Adaptation priorities and barriers	-	N/A	
		3.3. Adaptation strategies, policies, plans & actions	Yes		
		3.4. Progress on implementation of adaptation	Yes		
		3.5. M&E of adaptation actions & processes	Yes		
		3.6. Management of loss and damage	-	N/A	
		3.7. Climate change indicators	-		
MRV of MoI	5. Support Needed	5.1. Financial support	Yes		
		5.2. Capacity-building support	Yes		
		5.3. Technology development and transfer	Yes		
	6. Support received	6.1. Financial support	Yes		
		6.2. Capacity-building support	Yes		
		6.3. Technology development and transfer	Yes		
	7. Other Means of implementation	7.1. Domestic Climate Finance	-		

Figure 25 below shows the relevance index scores of Lesotho's designed MRV system. Overall, the system's objectives and intended outcomes are relevant to 80% and 68% of the Lesotho's pre-Paris and Paris-era MRV needs respectively. In terms of the country's domestic MRV needs, which are the same in both the pre-Paris and the Paris eras, the designed MRV system is relevant to eight out of the 12 domestic MRV needs, achieving a relevance index score of 67%. Finally, Figure 25 shows that the system is relevant to all BUR reporting requirements (relevance index of 100%), and 11 of the 16 Paris

Agreement reporting requirements, thereby achieving an international relevance index of 69% in the Paris era.

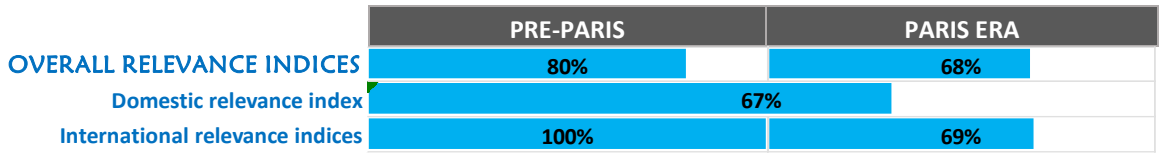


Figure 25: Relevance index scores of Lesotho's MRV system

Compared to the other countries included in this thesis, Lesotho's designed MRV system ranks seventh in terms of its relevant index in both the pre-Paris and Paris eras, behind that of New Zealand in the former and behind that of China in the latter (see Figure 10 and Figure 11 respectively in Chapter 7).

Thematic relevance index results for Lesotho's domestic MRV system are presented in Figure 26 below. The results show that for both the pre-Paris and Paris eras the designed MRV system has highest relevance indices for the GHG emissions theme with full relevance in that theme, followed by the means of implementation MRV theme at 90%. Lesotho's designed MRV system has the lowest relevance to the adaptation MRV themes with relevance of 60% of the needs in that theme in the pre-Paris era and 50% relevance in the Paris era.

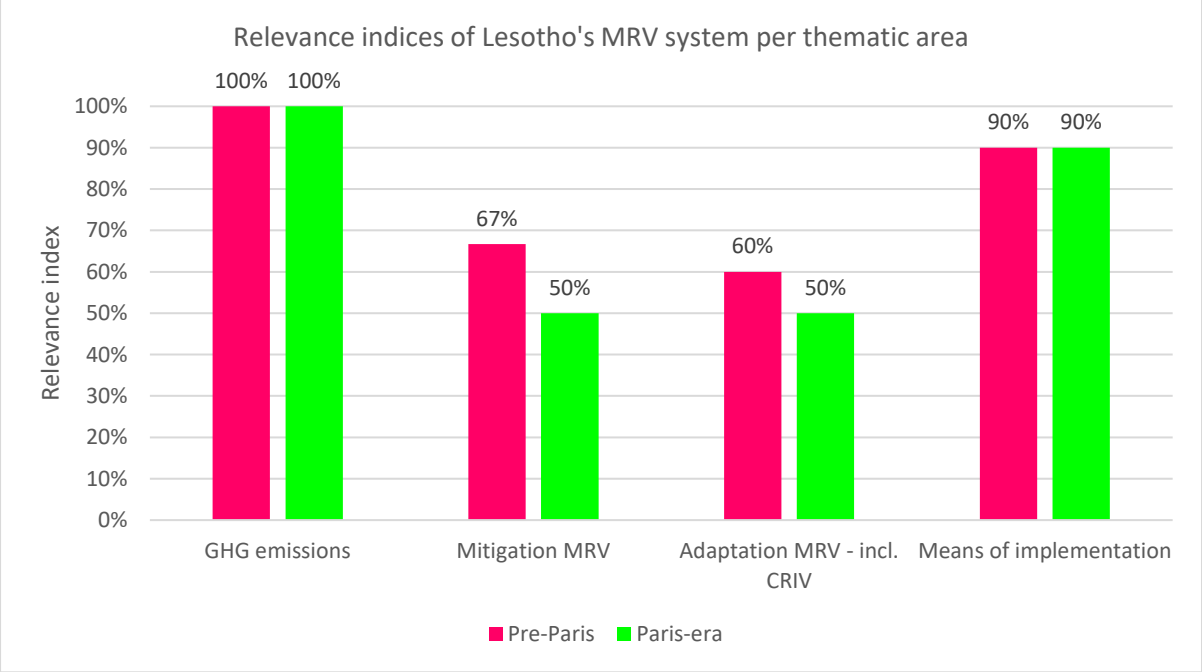


Figure 26: Thematic relevance indices for Lesotho's MRV system

The section that follows presents a critical analysis of these relevance results for Lesotho's MRV system.

8.2.3 A critical analysis of the relevance results

In this section, five points related to the relevance results above as well as the way the system has been designed are presented and critically analysed.

Firstly, the results show that the designed domestic MRV system for Lesotho achieves its primary intention in terms of relevance, by having full relevance to all the MRV needs associated with its primary objective of supporting BUR compilation. This is because, as outlined in the framework document, the information needs of BURs were mapped out and explicitly specified individually, then directly translated into the three components of the proposed system (Promethium Carbon, 2019). According to the framework document, adaptation MRV components were then added to the system's objectives for two reasons:

1) Because "there is a strong and compelling argument to include an adaptation component in Lesotho's climate MRV framework design considering the Kingdom's national circumstances and priorities as a developing state" (ibid), and
2) Because "the MRV system may be used to report to the UNFCCC in other frameworks, such as national communications or Article 13 of the Paris Agreement" (ibid).

Secondly, the first point above demonstrates the first four steps of results-based planning were employed in developing Lesotho's domestic MRV system, except that the scope of its application was limited to only the MRV needs that are relevant to BUR compilation. As such this further supports the findings of chapter 7, that show that the use of results-based planning in establishing domestic MRV systems can result in maximum relevance for the systems, if undertaken properly and by competent personnel.

The third point relates to the second reason that was used as motivation for inclusion of adaptation MRV component in Lesotho's domestic MRV – that the system may be used for other reporting needs. Quite frankly the system is unlikely to be used for BUR reporting at all, but rather for ETF reporting. This was already evident before Lesotho's MRV framework document was finalized in 2019, because it was already known, from the 2018 Katowice decisions, that BUR reporting will be obsolete from 2025 and be replaced by BTRs under the Paris Agreement (UNFCCC, 2018). Furthermore, biennial reports submitted under the UNFCCC show that it takes longer than five years for a typical developing country to establish its domestic MRV system and implement it to a level where it produces useful results for BUR reporting. For instance, Kenya completed its MRV system design in 2013 but by 2022 the system had not been implemented. Similarly, South Africa completed its MRV system design in 2015 and only launched its IT database at the end of 2019, with only a few elements of the system operational (DFFE, 2021).

Fourthly, the Terms of Reference contained in the tender document that was published to invite consultants for the development of Lesotho's MRV system explicitly specified certain MRV needs that the country's system will need to respond to. While those needs were mainly based on the reporting requirements in BURs, they also included an additional need for the system to support tracking of domestic climate finance flows (see section 8.1.1 of this thesis). This additional MRV requirement was specified in the Framework report as one of the objectives that Lesotho's domestic MRV system should address, but it completely disappeared in the final design and specification of the system.

Lastly, Lesotho was found to be different from the other developing countries studied in this thesis in establishing its MRV system in that it successfully prioritized international BUR reporting over its domestic MRV needs, while in Chapter 7 of this thesis all other developing countries were found to prioritize their domestic MRV needs over international needs.

8.3 Chapter Conclusion

This case-study chapter has focused on the development of Lesotho's domestic MRV system. The process followed in designing the system has been outlined, and the designed system has been presented and assessed for relevance. In this process, several findings that are relevant to the key objectives of this thesis were made, and these can be summarized as follows:

- Using only published national documentation is sufficient for determining expressed domestic MRV needs of a country. There is generally no need for primary collection of expressed needs from stakeholders.
- Based on the first point above, the approach that was used in Chapter 5 of this thesis in assessing the domestic MRV needs of the 11 countries is then justified.
- Narrowing down the scope of the country's only domestic MRV system to only one set of needs is not a good idea because the rest of the MRV needs will remain unmet
- Finally, this case study has also reiterated the findings made earlier in this thesis, that show that the use of results-based planning in establishing domestic MRV systems can result in maximum relevance for the systems, if undertaken properly and by competent personnel. This further confirms the finding in the preceding chapter that the first part of the hypothesis related to maximizing relevance of domestic MRV systems through results-based planning has been proven in this thesis.

Having focused on relevance in this chapter and the preceding one, the next chapter turns the focus to quality of domestic MRV systems. Like the two relevance chapters, it assesses the quality of the different domestic MRV systems and tests the second part of the hypothesis.

9 Quality of Domestic MRV Systems

This chapter presents the results of the quality assessment of the domestic MRV systems in terms of the six quality principles of transparency, accuracy, comparability, consistency, completeness, and timeliness (TACCCT) that were selected in section 4.5.1. The specific criteria identified for each of these six principles, as presented in Table 7, have been used to assess quality of each domestic MRV system at input, activity and output levels as applicable.

Unlike the relevance assessments carried out in the two preceding chapters, which focused on the extent to which the objectives and expected outcomes of the systems are aligned with the country's MRV needs, the quality assessment in this chapter focuses on the extent to which each quality criterion has been achieved or adhered to through implementation of the systems up to the 31st of December 2021.

As specified in section 4.5.1, a five-level rating scale was adopted for this assessment as shown in Table 28 below.

Table 28: Quality scoring criteria used

Score	0	1	2	3	4
Level of criteria achievement	0% Achievement	More than 0%, but less than about 50%	About 50% achievement (+/- 50%)	more than 50%, but less than 100% achievement	100% achievement
Qualitative Description	Quality criterion **not adhered to**	Quality criterion **minimally adhered to**	Quality criterion **adhered to about half the time**	Quality criterion **mostly adhered to**	Quality criterion **fully adhered to**

The chapter first presents the results of quality assessments of domestic MRV systems of each country, and then moves on to present and compare thematic and principle level results. The chapter concludes by assessing the relationship between results-based planning and the quality of domestic MRV systems, thereby responding to the second part of the hypothesis.

9.1 Individual Country Results

Quality assessment for each country's MRV system was based on the latest MRV cycle for that system (i.e., the system's latest set of inputs, activities and outputs), and for those quality principles and criteria that require assessment over time, covering more than one MRV cycle (e.g., frequency timeliness and consistency), two MRV cycles preceding that latest one were also assessed. As such, only those domestic MRV systems which had been in operation for at least two reporting cycles by the 31st of December 2021 have been assessed for quality. This was the minimum evaluability requirement for countries to be included in this quality assessment as specified in Chapter 4, section 4.5.1 of this thesis. Appendix C contains the results of the evaluability assessment of all the domestic MRV systems of the countries included in this thesis, giving details of how each system meets or does not meet the minimum evaluability requirements

The Table below shows the domestic MRV systems which met the evaluability requirement and have therefore been assessed for quality in this thesis, together with the latest MRV cycle year on which the assessment was based.

*Table 29: Thematic MRV systems that have been assessed for quality and the latest publication/cycle years assessed**

	GHG Inventory	Ex-post Mitigation	Ex-ante Mitigation	Projections	Risk, Impacts & Vulnerability	Adaptation MRV	MoI MRV✡
Brazil	2020	-	-	-	-	-	-
China	-	-	-	-	-	-	-
Colombia	2021	-			-		2020
Indonesia	2021	2020	-	-	2018		2020
Kenya	-	-	-	-	-		
South Africa	2021	-	-	-	-	2020	2021
EU	2021	2021	2021	2021	-		2021
Germany	2021	-	2019	-	-		2021
New Zealand	2021	-	-	-	-		2021
UK	2021	-	-	2020	-	2021	2021
USA	2021	-	-	-	-		2020

* *Coloured cells show the MRV systems which have been assessed for quality. Colours have been differentiated by MRV theme. The colours also align with the colours used in this chapter for results of respective MRV themes.*

✡ *Means of Implementation (MoI) MRV includes climate finance, capacity building and technology transfer for all countries apart from Columbia and South Africa, where it only covers climate finance.*

From the Table it can be observed that the domestic MRV systems of China and Kenya have not been assessed for quality. This is because none of their thematic components met the minimum evaluability requirements, and hence there are no results for those systems in this chapter.

Table 29 shows that mitigation assessment MRV systems have been split into systems that undertake ex-post MRV and those that undertake ex-ante MRV. This is because these were found to be two separate systems in countries that undertake both.

9.1.1 Brazil

Brazil's GHG inventory system is the only component of the country's domestic MRV system that met the minimum evaluability criteria. Figure 27 below presents the results of the quality assessment of Brazil's GHG inventory system in the form of a spider chart.

The spider chart used in this assessment, and all other quality assessments in this chapter, has two axes as follows:

1) The first axis, that is equivalent to the x-axis in the typical cartesian coordinates, goes around the graph and has 16 points, each capturing one of the quality criteria used in this thesis (e.g. TRANSPARENT - Activity Data publicly available), and
2) the second axis, is equivalent to the Y-axis of the cartesian coordinates, and radiates from 0 at the centre of the graph out to the maximum value of 4 on the outermost part of the graph.

Figure 27 shows that Brazil's GHG inventory fully adheres to the quality principles of comparability, consistency, completeness and timeliness, hence achieving a score of 4 for all the criteria underlying these four quality principles.

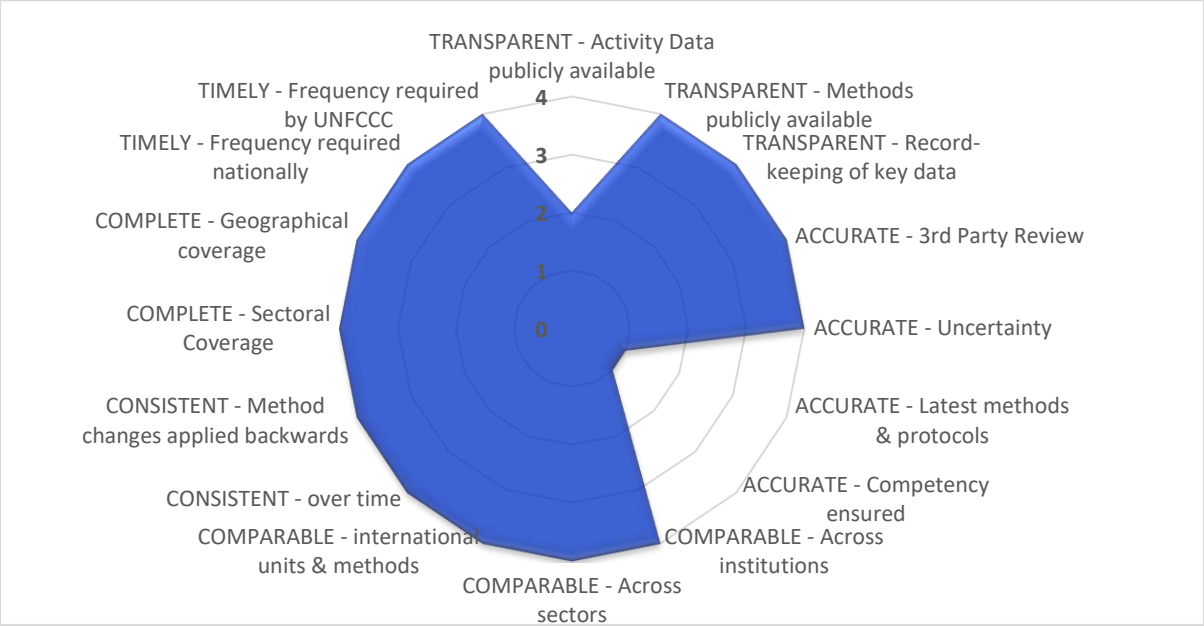


Figure 27: Quality assessment of Brazil's GHG inventory system

In terms of transparency, Figure 27 shows that the system fully adheres to two of the three quality criteria under this principle thereby scoring 4 for both, but in relation to the criteria on publicly available activity data the system adheres to it only about half the time (hence a score of 2). This is because there is no activity data in the system's publicly accessible online database, and only about half of the activity data links and information presented in the 4th BUR is publicly accessible. In particular, in the 4th BUR, the main Energy sector activity data source – the energy balance – is inaccessible, almost all of the IPPU activity data sources have no publicly accessible links or reports, but most of the AFOLU and waste sector activity data sources are publicly accessible documents and links, leading to about half of the activity data used in that inventory being publicly accessible (Federative Republic of Brazil, 2020).

In terms of accuracy, Brazil's GHG inventory system fully adheres to the criteria on 3rd party reviews and uncertainty analysis, but only minimally adheres to the criteria on the use of latest methods and protocols as well as ensuring competency of the team that compiles the inventory, hence scoring 1 for these latter two criteria. This is because the system primarily uses the 1996 IPCC guidelines, with only a few estimates being carried out based on the latest 2006 IPCC guidelines (Federative Republic of Brazil, 2020). Regarding ensuring the competency of personnel and institutions compiling the GHG inventory, the 4th National Communication of Brazil states that over 300 specialists in about 185 institutions are involved in the compilation process, rendering it impossible to ensure competency of personnel in most of the sectors, however in some sectors they appoint consultants to support the compilation process based on their competency and expertise in the respective sectors (Federative Republic of Brazil, 2021).

While the defined scores are only whole numbers between 0 (not adhering) and 4 (fully adhering), inclusively, determining average scores from various criteria can be useful in giving an idea of the overall adherence of the system, although it will result in scores that are not whole numbers, and therefore have no official definition in terms of the adopted scoring system. Based on this approach,

overall, Brazil's GHG inventory system achieves an average quality score of 3.5, implying that it mostly adheres to the TACCCT quality principles, since it achieves a score greater than 3 but not reaching 4.

9.1.2 Colombia

Only two components of Colombia's MRV system meet the minimum evaluability requirements; these are the GHG inventory system (SINGEI) and the climate finance MRV system. Figure 28 below presents quality assessment results of these two systems, keeping to the colours of the different MRV themes as outlined in Table 29.

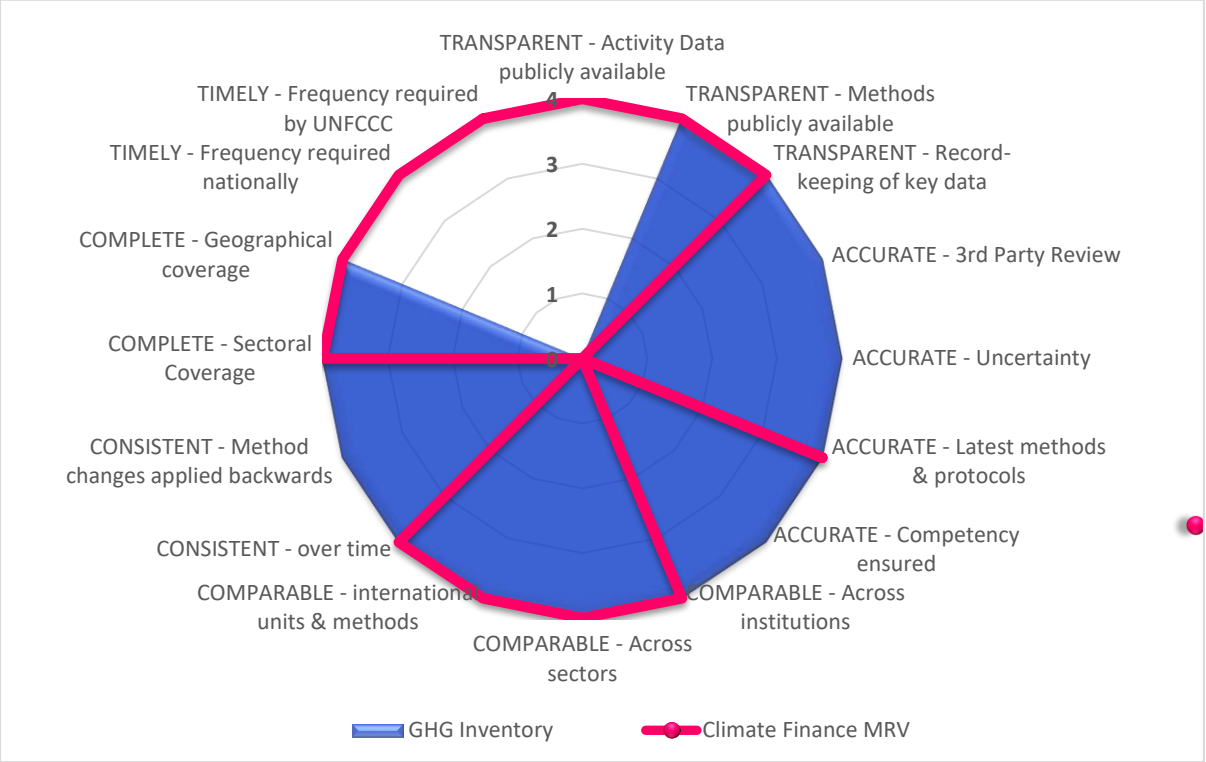


Figure 28: Quality assessment of the GHG inventory and Climate finance components of Colombia's MRV system

The Figure shows that both Colombia's GHG inventory and climate finance MRV systems fully adhere to all the comparability and completeness criteria for which MRV systems were assessed in this thesis, hence scoring 4 on all the criteria underlying both of those principles.

In terms of transparency, the climate finance system adheres fully (score: 4) to all three transparency criteria, while the GHG inventory system adheres fully to the two criteria on availability of methods publicly and systematic record-keeping of key documents and data. Colombia's GHG inventory activity data is neither publicly available in the published National Inventory Report, through an online database nor in the country's Biennial Update Report (Pulido, et al., 2019; Government of Colombia, 2019), hence the GHG inventory system does not adhere to the criterion related to availability of activity data publicly, thereby scoring 0.

Accuracy: While Colombia's GHG inventory system adheres to all four accuracy criteria assessed in this research, the climate finance MRV system fully adheres to only the criterion on the use of latest methods and protocols. According to Rodriquez (2019), whenever there is doubt about the accuracy

of some of the climate finance data in the climate finance MRV portal, climate change experts from different government entities are invited to validate that information, but generally the results of Colombia's climate finance MRV are never systematically subjected to independent 3rd party reviews or public reviews (Rodriguez, 2019). Furthermore, there exists a guideline on how allocations of climate finance should be made towards mitigation and adaptation should made, that is made available to the personnel making these calculations and estimations, but their competency is never ensured, and neither is uncertainty analysis ever carried out (ibid).

In terms of consistency, the national GHG inventory system of Colombia fully adheres to all the consistency criteria for which the systems have been assessed, while the climate finance MRV system only fully adheres to the criterion on consistent calculation and reporting methods over time. There is no requirement for applying methodological changes to previous years' data, hence this is never done (ibid).

In terms of timeliness, MRV of climate finance happens on an ongoing process, hence it fully adheres to all the timeliness criteria. The GHG inventory system, on the other hand, does not adhere to any of the timeliness criteria. This is because Colombia's first BUR was submitted in Dec 2015 and as such the second BUR was meant to be submitted by Dec 2017 at the latest, but instead was submitted a year later. According to Rodriguez (ibid), the main cause of this delay was the compilation of the National GHG inventory, particularly the forest information. Similarly, the next GHG inventory after that was published in 2021, in the country's 3rd BUR, and was based on 2018 data compared to the 2014 data contained in the 2nd BUR (IDEAM, Fundación Natura, PNUD, MADS, DNP, CANCILLERÍA, 2021). This means that the Colombia's MRV system fails to meet the biennial publication requirements of the Convention and of the domestic policy.

A comparison between the GHG inventory and climate finance MRV components of Colombia's MRV system shows Colombia's GHG inventory and climate finance MRV systems have average quality scores of 3.3 and 3.0 respectively over 4 (Figure 29). This means that the two MRV system components mostly adhere to the quality criteria used in this research.

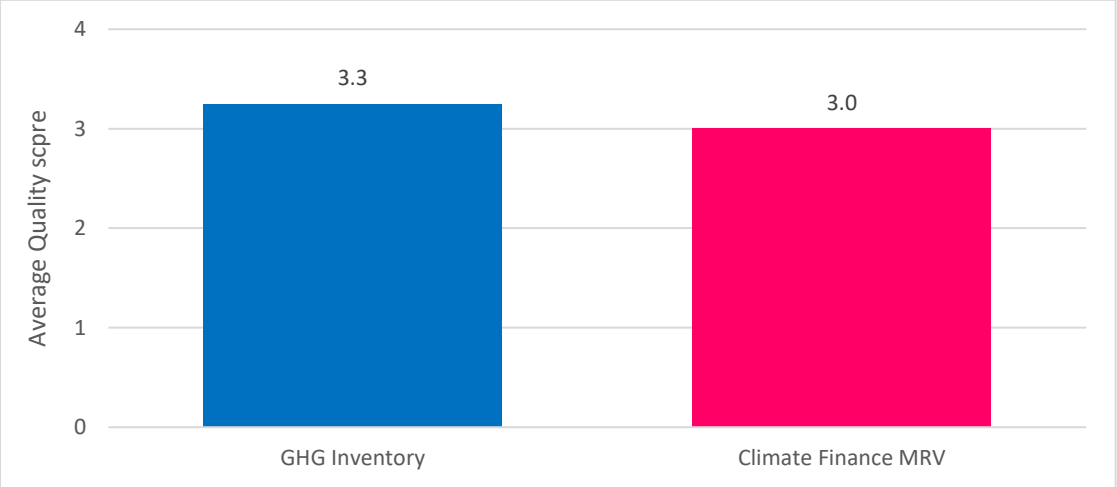


Figure 29: Comparing average quality score of two components of Colombia's MRV system

9.1.3 Indonesia

Indonesia's mitigation MRV system, means of implementation MRV system, GHG inventory system as well as climate risk, impacts and vulnerability (CRIV) MRV system were all assessed for quality. In terms of mitigation MRV, Indonesia's MRV system only undertakes ex-post mitigation assessment (Ministry of Environment and Forestry of the Republic of Indonesia, 2018).

Figure 30 below presents results of the quality assessment of the GHG inventory and mitigation MRV systems.

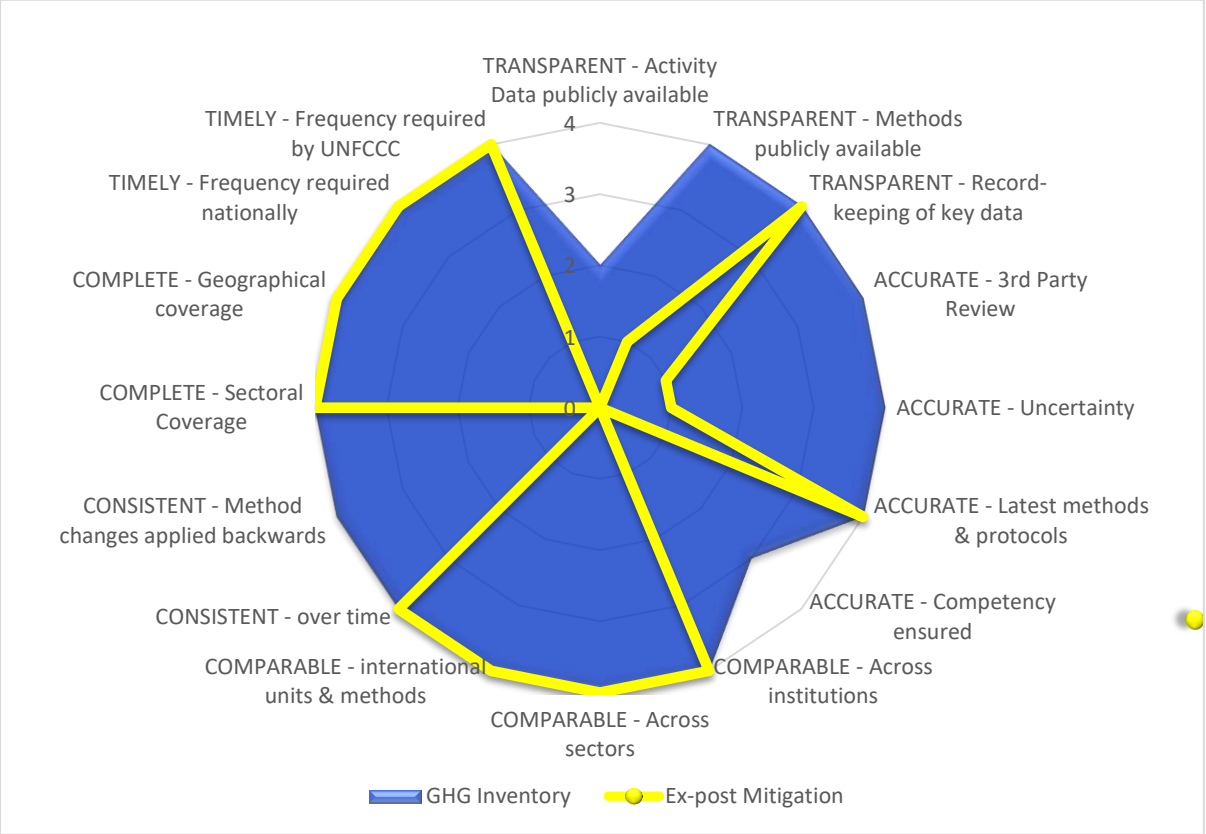


Figure 30: Quality assessment of the GHG inventory and ex-post mitigation components of Indonesia's MRV system

Figure 30 shows that Indonesia's GHG inventory system fully achieves all the comparability, consistency, completeness and timeliness criteria for which MRV systems were assessed, while the mitigation MRV system fully achieves all the comparability, completeness and timeliness criteria.

In terms of transparency, the GHG inventory system adheres to all the criteria, except for availability of activity data publicly to which it has about 50% achievement. The latter is because there is no GHG inventory activity data publicly accessible through the online GHG database – the NRS-CC, while in the third National Communication about half of the activity is included in the report (Ministry of Environment and Forestry of the Republic of Indonesia, 2018; Republic of Indonesia, 2017). The mitigation MRV system, on the other hand, only adheres to the criterion on record-keeping of data, while it adheres minimally and not at all to the criteria of publicly available methods and activity data respectively. This is because activity data is neither publicly available in the online NRS-CC database nor in the BUR, while only REDD+ methodology has been included as annexure in the second BUR

(Ministry of Environment and Forestry of the Republic of Indonesia, 2018; Republic of Indonesia, 2018).

Accuracy: Indonesia's GHG inventory system adheres to all accuracy criteria, except for ensuring competency of personnel and institutions compiling GHG inventories. In terms of the latter, the third National Communication reports that "*for the time being, relevant ministries are responsible for data collection which [is] then compiled by the MoEF to determine the emissions estimation… in the future, each respective ministerial sector, through its working group, must conduct the estimation and the result will be validated by the MoEF"* (Republic of Indonesia, 2017). According to Boer (2019), government has been conducting a series of training workshops for the departments and personnel involved in the compilation of national GHG inventories such that most of them can currently be classified as competent in GHG inventory compilation. Hence the GHG inventory mostly adheres to this criterion.

Still on accuracy, the mitigation assessment component of Indonesia's MRV system fully adheres to only one of the four accuracy criteria assessed in this study, and this is the use of latest methods and protocols, following the published guideline that aligns with the GHG Protocol – Policy and Action standard approach (Boer, 2019; Ministry of Environment and Forestry of the Republic of Indonesia, 2018). In terms of the criteria on competency and 3rd party or public review, mitigation assessment is carried out by the respective project managers whose competency is not ensured, but the system is setup such that mitigation assessment results are taken through third party verification before being uploaded onto the online database (Ministry of Environment and Forestry of the Republic of Indonesia, 2018). In 2021 the SRN showed that only 3.4% of emission reductions had been verified in 2017 and less than 1% in 2018 (ibid). This is consistent with information in the BUR which states that by 2017 most of the emission reductions had not been verified (Republic of Indonesia, 2018). Regarding uncertainty analysis, only uncertainty measurement processes for REDD+ mitigation measures were documented in BUR2, which constitute less than half of all the mitigation measures monitoring in Indonesia (ibid), as such the system minimally adheres to this criterion (score: 1).

In terms of consistency, the mitigation assessment component of Indonesia's MRV system adheres fully to the criterial on consistent calculation and reporting methods over time, while according to Boer (2019), there was no requirement for documentation of methodological changes and application of the new methodologies to all previous years' data. In the SRN it could not be picked up during the study whether some project owners had voluntarily done this, hence, the system was not found to adhere to this criterion.

Figure 31 below presents results of the quality assessments of Indonesia's climate risk, impacts and vulnerability (CRIV) system as well as the means of implementation MRV system. The figure shows that both systems fully adhere to all the completeness quality indicators assessed in this study. In addition, the CRIV MRV system also fully adheres to all the timeliness criteria, while the MoI MRV system adheres fully to all the transparency and comparability criteria.

On transparency, Indonesia's CRIV MRV system fully adheres to the criterion on publicly availing methods and processes, while mostly adhering to the criterion on record-keeping of key data and documents and not adhering to the criterion on publicly availing underlying data. This is because in SIDIK – the CRIV MRV system database – activity data is not publicly accessible and according to Boer (2019), despite the existence of SIDIK which is supposed to systematically keep all the relevant data

and document, there is still a problem of disappearing data either at the collection stage or between collection and archiving in SIDIK.

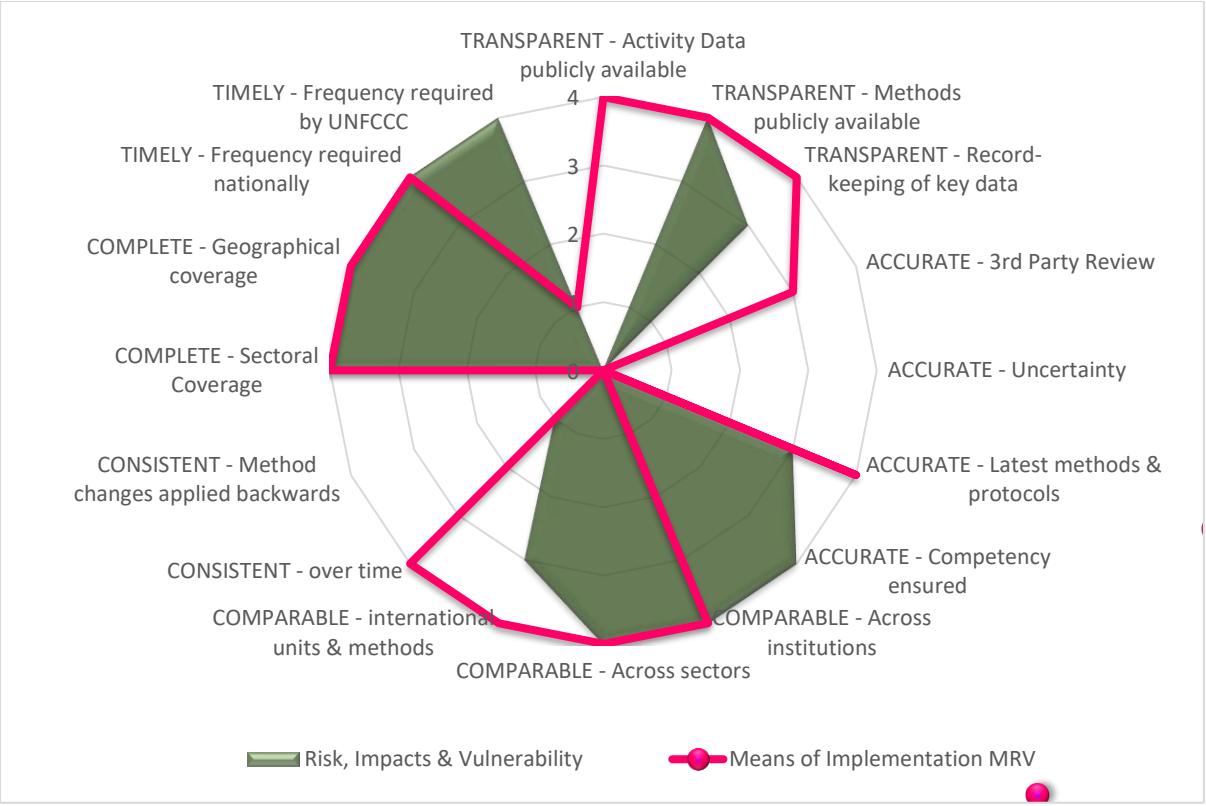


Figure 31: Quality assessment of the CRIV and MoI components of Indonesia's MRV system

Accuracy: Indonesia's MoI MRV system does not adhere to the criteria on conducting uncertainty analyses as well as ensuring competency of personnel and institutions, while mostly adhering to the criteria of 3rd party or public review. The latter is because the SRN-CC website states that only climate change actions that meet the criteria to be verified in terms of emission reduction, financial support, technology transfer and capacity development will proceed to the verification stage of data and information by 3rd parties, and 326 actions out of 343 had been verified by 2020 (Ministry of Environment and Forestry of the Republic of Indonesia, 2018).

Still on accuracy, the CRIV MRV system fully adheres to the criterion on ensuring competency, while mostly adhering to the use of latest methods and protocols (score: 3). This is because the system uses latest indicators and indices (e.g. exposure index, precipitation, etc), however, it primarily focuses on current climate risks and vulnerabilities and does not use the latest good practice approach of assessing future vulnerability based on the publicly available Representative Concentration Pathway (RCP) scenarios (e.g RCP 4.5 or RCP 8.5) (Ministry of Environment and Forestry of the Republic of Indonesia, 2018). Indonesia's CRIV MRV system does not adhere to the criteria of undertaking uncertainty analysis or the 3rd party or public review.

In terms of comparability, Indonesia's CRIV MRV system fully adheres to the criteria on using comparable methods across institutions and sectors, while mostly adhering to the criterion on the use international methods. The latter is because of not following the internationally acceptable approach of assessing future climate vulnerability based on RCP scenarios.

Consistency: Both the CRIV and MoI MRV systems do not adhere to the criteria on applying methodological changes to historical data. Regarding consistent reporting approach and methods over time, the MoI MRV system fully adheres to it, while the CRIV system minimally adheres to it. According to Boer, there is a lot of climate risks, impacts and vulnerability data, spanning many years, but "*the biggest problem is consistency of data*, *which government ministries are currently trying to address by agreeing on one set of key indicators that will not change in the future*" (Boer, 2019).

Finally, in terms of timeliness, Indonesia's MoI MRV system follows a self-reporting approach by project owners, and it was found that most of them report into the system every three to four years, which does not meet the required UNFCCC frequency (Ministry of Environment and Forestry of the Republic of Indonesia, 2018). This means that the system minimally adheres to the criterion on meeting the frequency required for UNFCCC reporting. On the other hand, there is no specified domestic frequency for generation or publication of MoI data.

Taken together, all the quality assessment results presented above show that Indonesia's GHG inventory system and MoI MRV system mostly adhere to the TACCCT principles with scores of 3.8 and 3 respectively, while the mitigation MRV system as well as the CRIV MRV system adhere to the TACCCT principles about half the time, with average quality scores of 2.7 and 2.6 respectively (Figure 32).

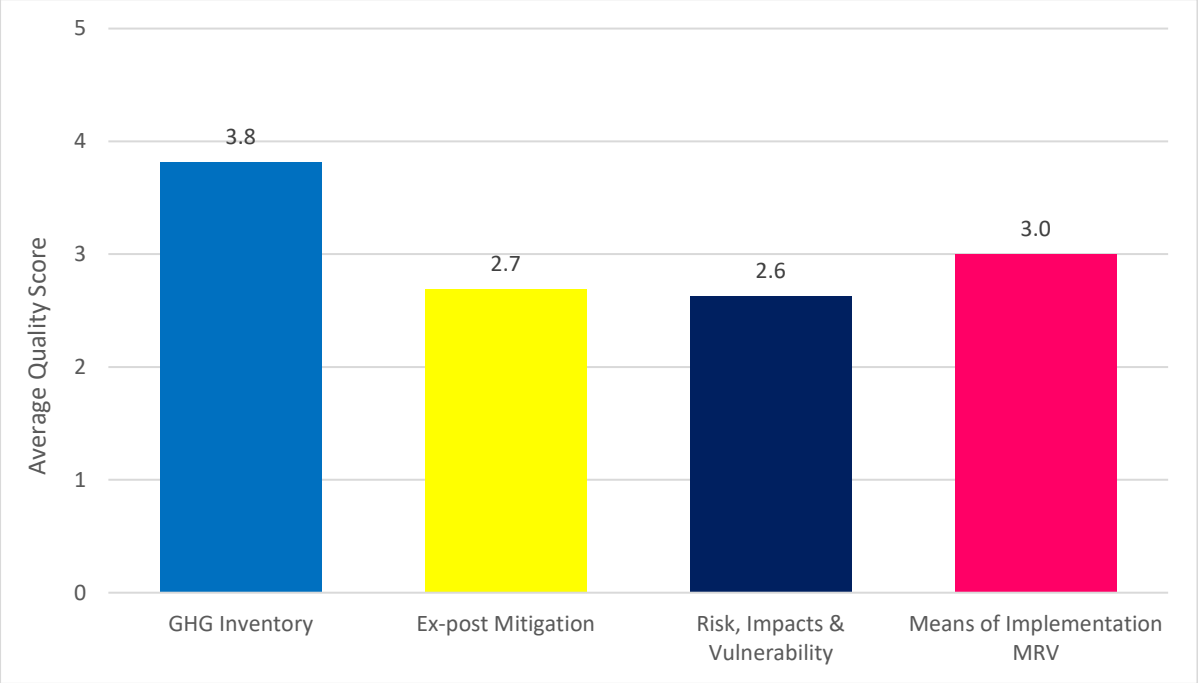


Figure 32: Average quality score for Indonesia's domestic MRV system

9.1.4 South Africa

Only South Africa's GHG inventory, climate finance MRV and adaptation MRV systems meet the minimum evaluability requirements. Figure 33 below presents results of the quality assessment of GHG inventory and climate finance MRV systems.

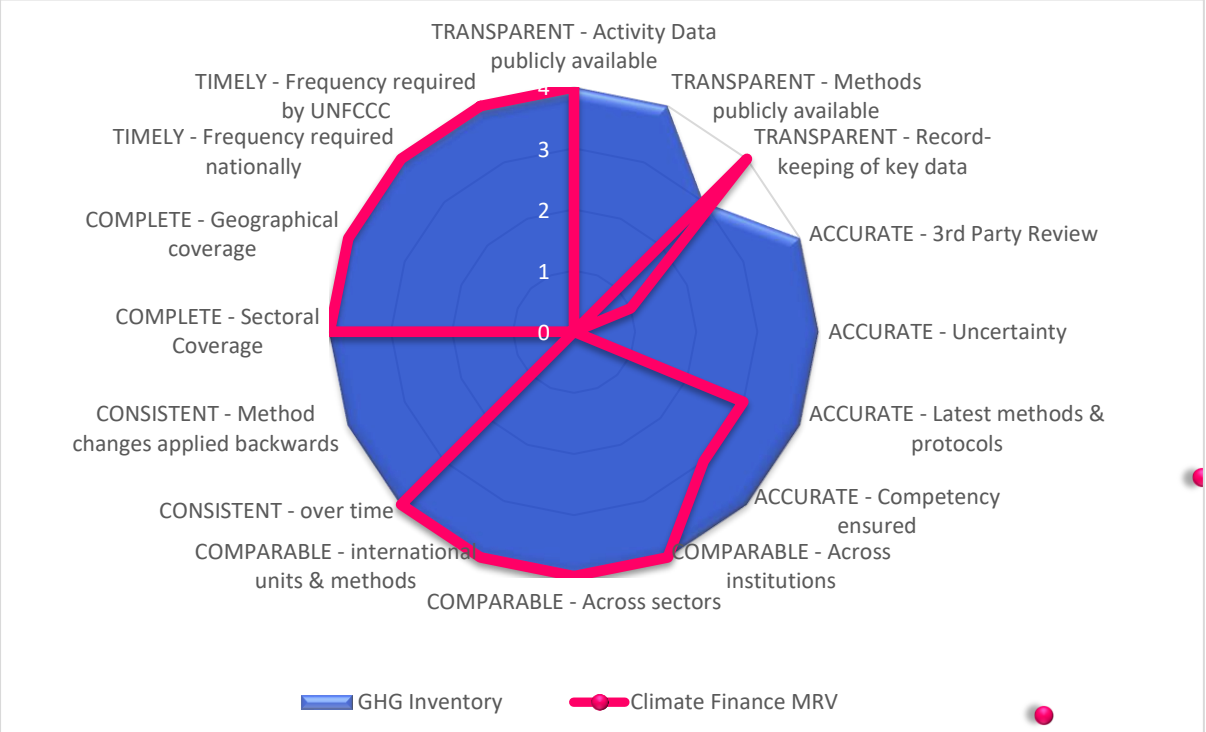


Figure 33: Quality assessment of the GHG inventory and Climate finance components of South Africa's MRV system

The results show that South Africa's national GHG inventory system adheres fully to all the quality criteria assessed in this study, except for record keeping of key decisions, documents and data, which is mostly achieved. This is because, while there is a sharepoint database established for record-keeping of GHG inventory data and information, as well as the South African GHG emissions reporting system (SAGERS) established to support private sector reporting of annual GHG emissions, there remains some data and documents which have not been stored in any of those systems (Letete, et al., 2021).

The country's climate finance MRV system, on the other hand, adheres fully to all the comparability, completeness and timeliness criteria for which systems have been assessed in this study, scoring 4 in all of them.

In terms of transparency, the climate finance MRV system fully adheres to criteria on publicly accessible activity data and record-keeping of key data and documentation, while not adhering to publicly accessible methods and processes (score: 0) (Witi, 2021; DFFE, 2021). This is because, the newly-developed Tracking and Evaluation Portal for climate finance is currently not accessible to the public and the BURs only contain programme/project level information on climate finance but not information on how data was collected and the methodologies that were used to allocate the finance into mitigation, adaptation or cross-cutting (DFFE, 2021).

Accuracy: The climate finance MRV system mostly adheres to the criteria on the use of latest methods and protocols and ensuring competency of personnel and institutions undertaking the assessments, while it does not adhere to the criterion on uncertainty analysis at all. According to Witi (2021), most of the personnel that undertake climate finance MRV are highly-trained, with some even having doctoral qualifications. In terms of methodology, the OECD DAC Rio markers approach has recently been adopted but is yet to be fully implemented in the coming years (ibid). Lastly on accuracy, the climate finance MRV system minimally adheres to the criterion on 3rd party or public review (score: 1) because every BUR is subjected to 3rd party review, which includes review of the climate finance chapter and information therein, but without information on the methodology and processes used for climate finance MRV the review is not very detailed (Witi, 2021; DFFE, 2021).

Finally, in terms of consistency, South Africa's climate finance MRV system fully adheres to the criterion on consistent reporting over time, hence a rating of four, but does not adhere to the one on application of method changes to previous years' data, resulting in a score of zero.

Figure 34 below presents the quality assessment of South Africa's adaptation MRV system.

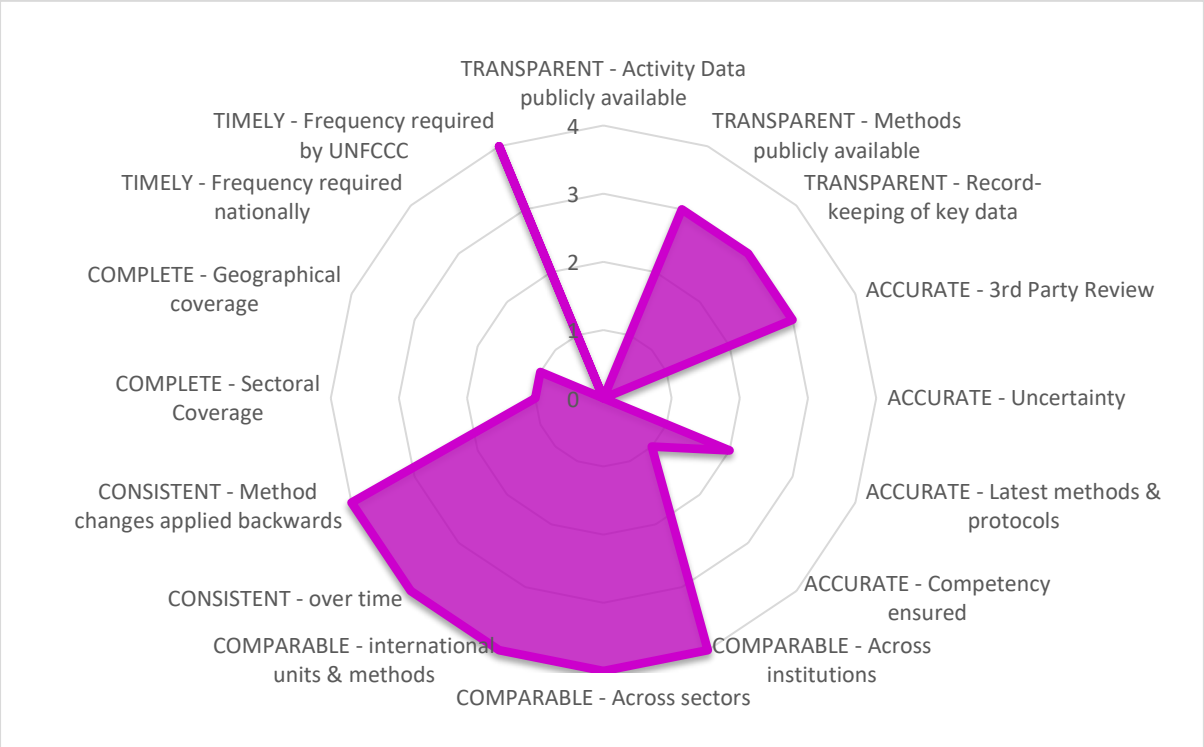


Figure 34: Quality assessment of South Africa's adaptation MRV system

The Figure shows that the system has full adherence to all the criteria used for comparability and consistency, thereby scoring 4 across those two quality principles.

The only other criteria which the system has full adherence to is the timeliness criteria on frequency required by the UNFCCC. This is because there has not been any assessment or outputs from the system since 2020, and while this constitutes non-adherence to the annual frequency required domestically (score:0), it is still within the four-year reporting cycle of the national communications because biennial reporting of this information under the Paris Agreement will only kick-in from 2024.

In terms of transparency, the web-based National Climate Change Information System (NCCIS) is supposed to be the depository of all data and documents related to the system (Makholela, 2022), but it was found that some of the links and attachments are missing or inaccessible, meaning the system mostly adheres to the criterion on record keeping (Score:3). Still on transparency, while the NCCIS contains most of the information on the methodology used to assess each Desired Adaptation Outcome, it is missing information on how provincial scores relate to or are aggregated to national scores as well as the activity data used for the assessments, thereby mostly adhering to the criterion on publicly available methodology (Score:3) and failing to adhere to the criterion on publicly accessible activity data (Score:0).

On accuracy, Figure 34 shows that South Africa's adaptation MRV system mostly adheres to the criterion on 3rd party or public review, while adhering to the use of latest methods and protocols about half the time, and minimally adhering to the criterion on ensuring the competency of the personnel, but not adhering to the need for uncertainty analysis, scoring 3, 2, 1 and 0 respectively. This is because the data owners mostly undertake the assessments themselves while the officials of the Department of Forestry, Fisheries and the Environment (DFFE) managing the system review those assessments and undertake assessments where there are any gaps, which means that most of the assessments are reviewed save those carried out by the DFFE team (ibid). It also means that it is only the competency of the DFFE team that is ensured. Regarding methods and protocols, while there are no standardized methods and protocols for undertaking adaptation MRV, it is commonly understood that it should at least cover progress in implementation as well as impact evaluation of the adaptation actions, but the South African adaptation MRV system only focuses on the former.

Finally, Figure 34 shows that South Africa' adaptation MRV system minimally adheres to both quality criteria related to completeness (Score:1). This is because in the latest results from the system show that there was no assessment done at provincial or sectorial level, but only at national level and even then, only done for the public sector.

On average, South Africa's GHG inventory system almost fully adheres to the TACCCT principles with a score of 3.9, while the adaptation and the climate finance MRV systems can be classified as adhering about half the time and mostly adhering with scores of 2.4 and 2.9 respectively (Figure 35).

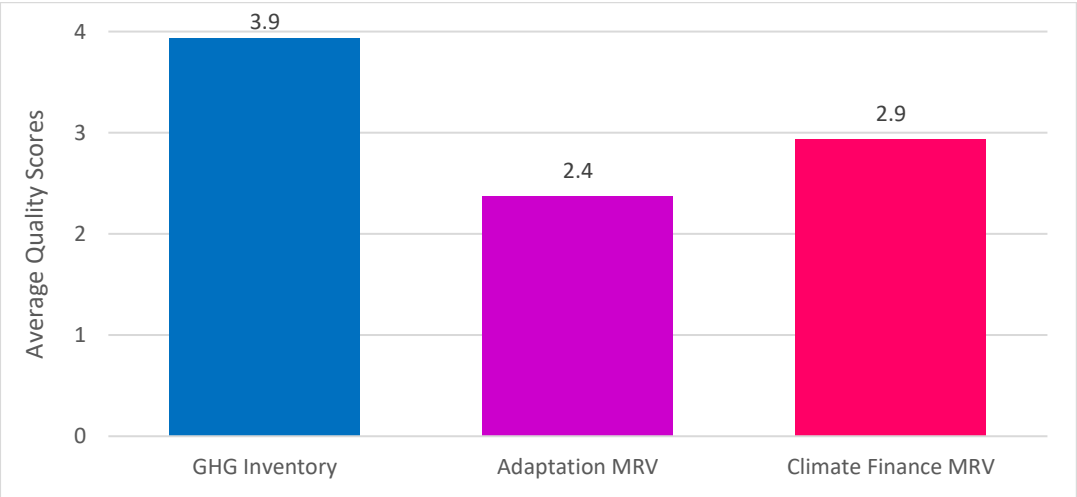


Figure 35: Average quality score for the two evaluated components of South Africa's MRV system

9.1.5 European Union

The GHG inventory, ex-post mitigation MRV, ex-ante mitigation MRV, projections MRV and means of implementation MRV components of the EU MMR system were all found to meet the minimum evaluability requirements. Note that a member state of the EU, Germany, is assessed in section 9.1.6 below.

Figure 36 below presents the results of the quality assessment of the EU's GHG inventory and projections MRV systems. The Figure shows that the EU's GHG inventory system adheres fully to all the quality criteria assessed in this study, except for third-party review which it mostly adheres to. This adherence to 3rd party reviews is also the same for the projections MRV system. This is because EU member states submit their GHG inventories and emission projections to the European Environment Agency (EEA), and then consolidates them into EU level GHG inventories and projections after making additions, adjustments and additions to those submissions. The EEA undertakes full 3rd party assessments on the submissions of the member states, but there is no 3rd party independent review on the additions, adjustments, and amendments that they make in compiling final EU GHG inventories or projections, hence ratings of three for both systems in terms of this criterion (European Topic Centre on Climate change mitigation and energy, 2021).

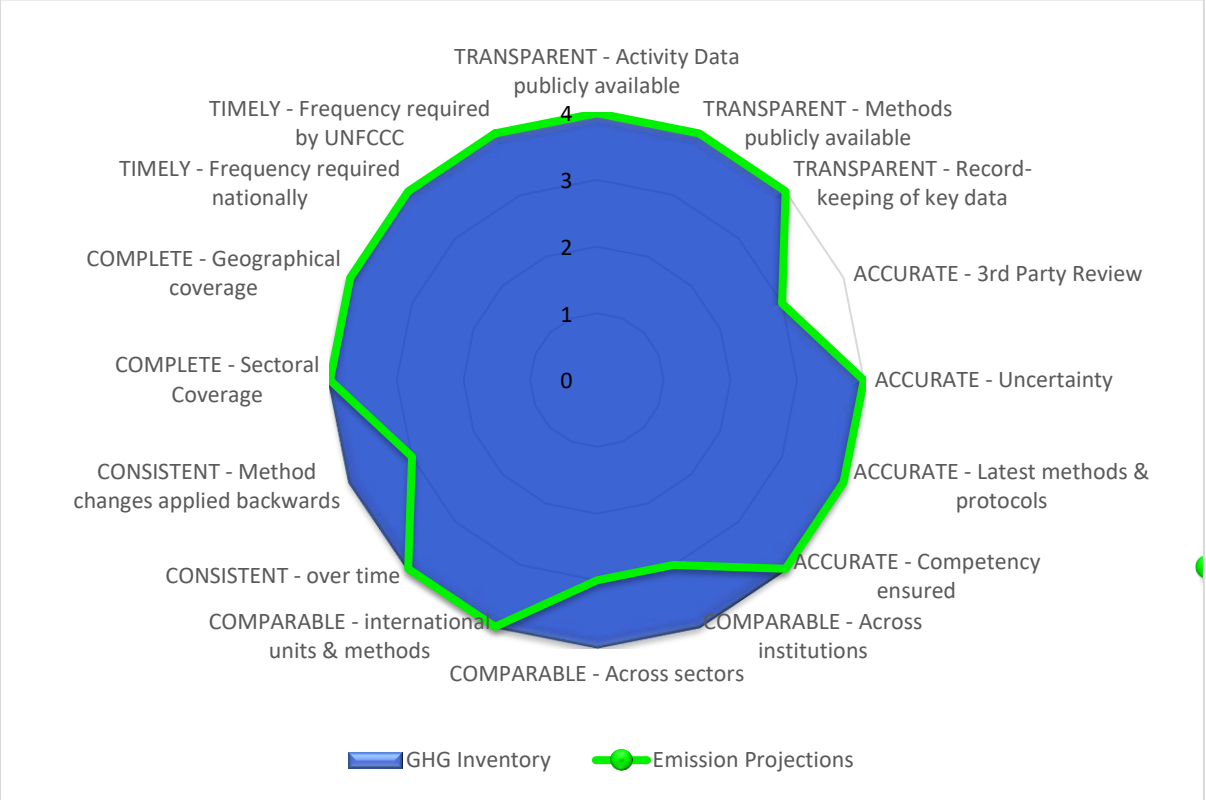


Figure 36: Quality assessment of the GHG inventory and emission projection components of the EU's MRV system

The projections component of the MRV system fully adheres to all completeness and timeliness quality criteria assessed in this study.

In terms of comparability, the projections MRV system fully adheres to the use of comparable international units and method, but mostly adheres to the criteria on comparability across institutions that make calculations as well as comparability across the sectors. This is because, according to the EEA's Topic Centre on Climate Change Mitigation and Energy (ETC/CME) (European Topic Centre on Climate change mitigation and energy, 2019), the differences between the With Existing Measures (WEM) and With Additional Measures (WAM) projections submitted by member states can be explained by planned policies and measures (PaMs) for most of the member states. However, there are a few member states for which those differences do not reflect the impact of new, planned PaMs, but reflect differences in assumptions on the impact of existing PaMs. This means that for most countries there is consistency, but there are a few that do change assumptions/methods over time, affecting the comparability of methods and assumptions used across sectors and institutions within the EU.

In terms of consistency, the projections MRV system fully adheres to consistent reporting approach over time but mostly adheres to the application of method changes to historical data. This is a result of the WAM and WEM differences explained in the paragraph above, because for those few member states that change assumptions between WEM and WAM, it means that they have not recalculated the WEM based on the updated method used for WAM.

Results of the quality assessment of the EU's mitigation MRV, separated into ex-ante and ex-post mitigation, are presented in Figure 37 below.

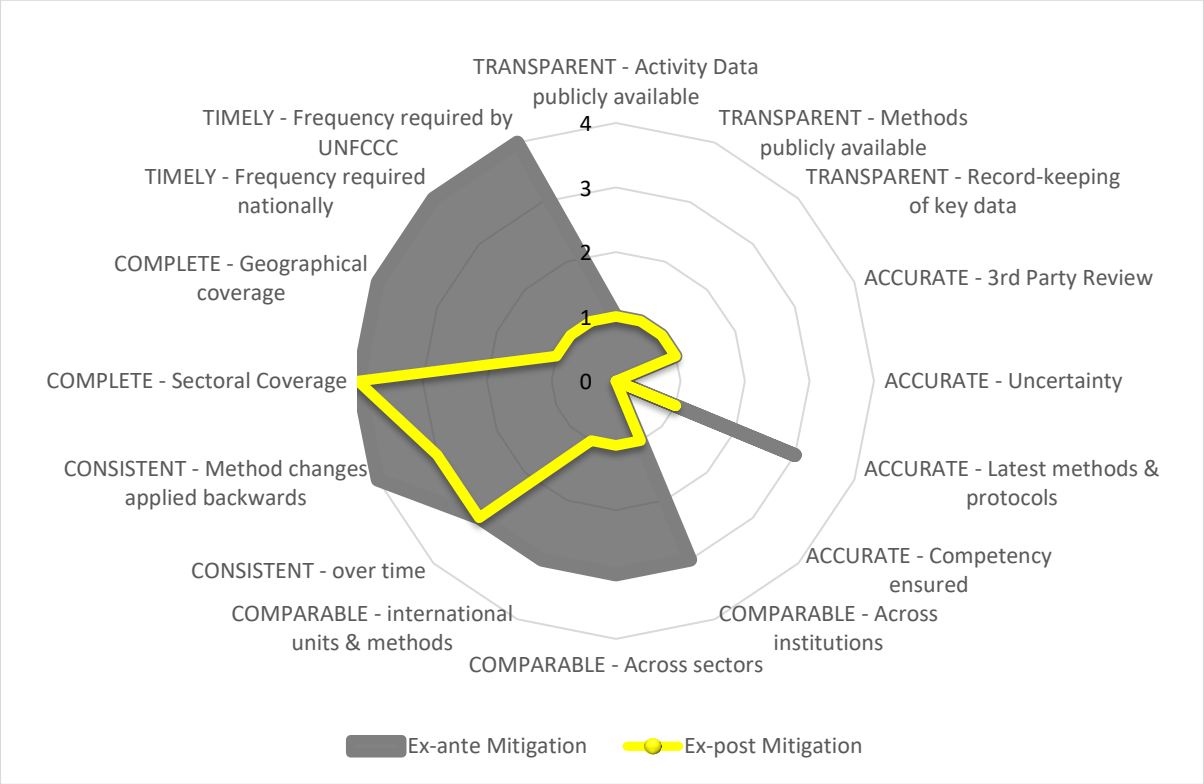


Figure 37: Quality Assessment of the EU's ex-post and ex-ante mitigation MRV

The Figure shows that both ex-post and ex-ante assessments minimally adhere to all the three transparency indicators assessed in this study (score: 1). This is because the EEA database, containing

all mitigation actions submitted by member states, has a column for submitted "*ex-post explanation for the mitigation estimates, reference for it and weblink for it*" and for the 2021 reporting cycle it was found that this information had been provided for only about 40% of the mitigation measures, some of which are not even relevant to ex-post assessment but rather to ex-ante. This means that for at least 60% of the mitigation measures member states have not provided information on methods or activity data used to the EEA (European Environment Agency, 2021). So, while the EU itself keeps, maintains and publishes a good database of mitigation actions and their respective documentation and decisions, the member states are very poor at this, hence the overall rating of the EU system for all three criteria can only be as good as that of the member states, which is minimal adherence (score: 1). For instance, Germany – the only current EU member included in this thesis – does not have a national system for ex-post assessment of mitigation actions, including systematic process for managing the activity data and methods used for ex-post assessment of mitigation actions; instead, every now and then the German government commissions studies to assess ex-post impact of mitigation actions but neither publishes the results, the activity data nor the methods used for fear of public criticism in cases where mitigation actions have not performed as planned (Herold, 2019).

In terms of accuracy, both the ex-post and ex-ante mitigation MRV systems do not adhere to the criterion on conducting uncertainty analyses, while minimally adhering to the two criteria on 3rd Party or public review and ensuring competency of personnel and institutions. The rating related to reviews is because the data quality of the mitigation information reported to the EEA is the responsibility of members states, and the EEA ETC/CME only provides a high-level TACCCT quality or plausibility check on new submissions and communicates with Member States where potential errors are found. In relation to competency, both the ex-ante and ex-post assessments are carried out by the member states themselves, the EU does not ensure competency of the personnel and institutions that undertake these assessments in those member states. Rather the EU only ensures the competency of the ETC/CME personnel that consolidates the member states data, makes the necessary adjustments and compiles it into EU level submission, hence a rating of minimal adherence (ibid). Finally on accuracy, the ex-ante MRV system mostly adheres to the use of latest methods and protocols, while the ex-post MRV system minimally adheres to it.

Comparability: The ex-ante mitigation MRV system mostly adheres to all the comparability criteria (score: 3), while the ex-post mitigation MRV system minimally adheres to all three criteria, scoring two. For ex-ante MRV, this rating is based on the fact that, as discussed in the preceding paragraphs, these assessments are carried out in parallel with the projections and the EEA reviews them for TACCCT together, and in most cases differences between WEM scenario and WAM scenario can be explained by planned PaMs. Because projection methods are mostly comparable, it follows that the ex-ante assessments of PaMs are also mostly comparable across the three criteria (European Topic Centre on Climate change mitigation and energy, 2021). For ex-post assessment, on the other hand, there is no methodology specified for assessment of ex-post impacts, which means that there could be considerable differences across member states in their approach and assumptions (ibid). This, combined with the lack of information on methodologies used for assessing most PaMs, means that the comparability across sectors, institutions, methods and assumptions will only be per chance and will be minimal.

In terms of consistency, the ex-ante and ex-post mitigation MRV systems both mostly adhere (score of 3) to the criterion on consistent reporting over time, while they have full (score of 4) and most

(score of 3) adherence respectively on application of method changes to historical data. Again, the fact that there are some countries for which difference between the WEM and WAM scenario is a result of differences in the assumptions and methods used for impact assessment of PaMs means that there is a small percentage of countries which do not maintain consistent reporting and calculation methods over time for mitigation assessment, and also do not apply methodological changes for ex-post assessment. For ex-ante assessment the application of methodological changes does not really apply, hence the rating of four.

Completeness: The EU's ex-ante mitigation MRV system fully adheres to both completeness criteria assessed herein. The ex-post assessment MRV system, on the other hand only adheres fully to sectoral coverage, while minimally adhering to the criteria on geographical coverage (Score:1). This is because, according to the ETC/CME (2021), in the 2021 reporting cycle, only ten out of 27 EU countries reported quantitative data on ex-post emissions savings, hence in general, "*the reporting on ex post savings should be considered very incomplete*".

In terms of timeliness, the ex-ante mitigation MRV system fully adheres to both criteria for which system have been assessed in this study, while the ex-post mitigation system minimally adheres to both criteria, hence a score of one. The latter is because out of 152 mitigation actions submitted to the EU with ex-post impact assessment values, only about 44 of those actions had their assessment carried out for 2020. All other assessments were last carried out in 2018, 2015, and even in 1990 (European Environment Agency, 2021). In some cases, the frequency of assessment is even included, showing that only a handful of the assessments are done biennially or more frequently, while most of them are done at much lower frequencies (ibid).

Figure 38 below presents results of the quality assessment of the EU's means of implementation MRV system.

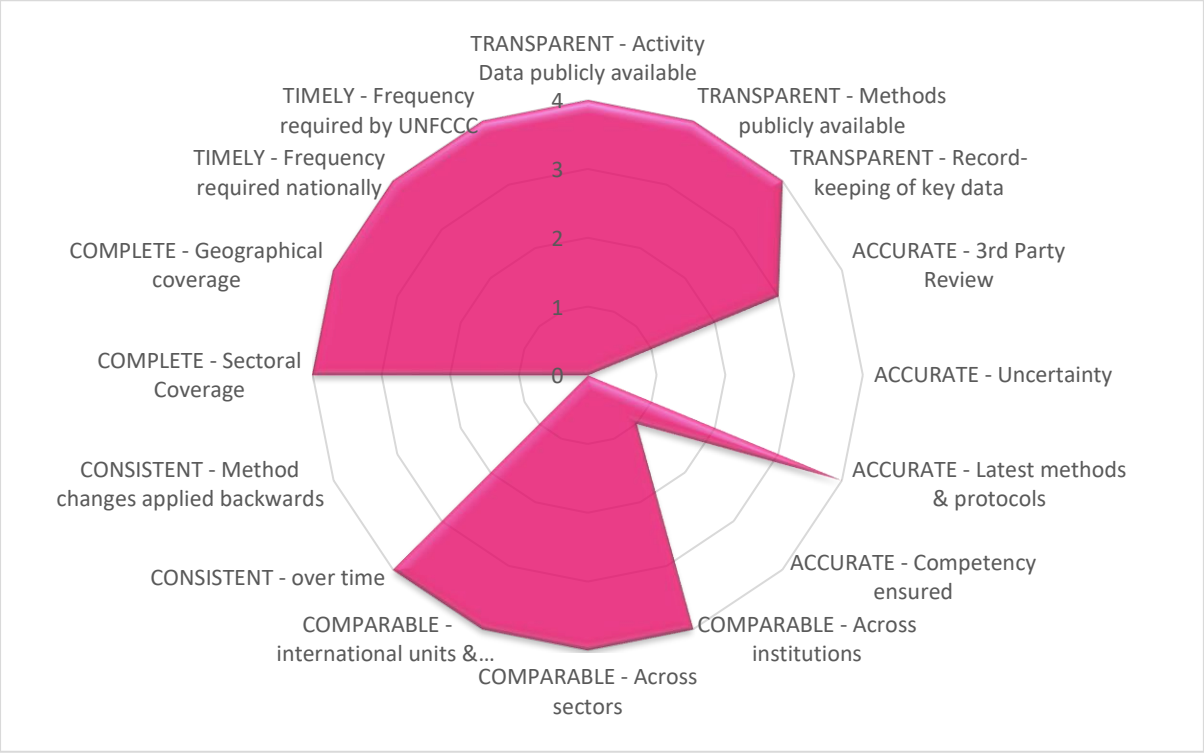


Figure 38: Quality assessment of EU's Means of Implementation MRV system

The results show that EU's MoI MRV system fully adheres to all transparency, comparability, completeness and timeliness indicators for which the systems have been assessed in this study, scoring four across all the respective quality criteria.

On accuracy, the system fully adheres to the criterion on the use of latest methods and protocols, while mostly adhering to the criteria on 3rd party or public review (score: 3), minimally ensuring competency (score: 1) and not adhering to the criteria on uncertainty analysis (score: 0). This is because the ETC/CME undertakes independent quality assessment on the calculations submitted by the member states, but after the ETC/CME makes additions, changes and closes the gaps the final results are not subjected to 3rd party or public review (Dejgaard & Appelt, 2018). Furthermore, the fact that climate finance assessments are carried out by member states means the EEA is only able to ensure competency of its institutions and personnel, which make up a small portion of all the personnel involved in these assessments, hence a rating of 1.

In terms of consistency, the EU's means of implementation MRV system fully adheres to the criteria on consistent reporting over time but does not apply methodological changes to historical data because there is no requirement (score: 0).

A comparison of the average quality scores for each of the EU's domestic MRV system components is shown in Figure 39 below.

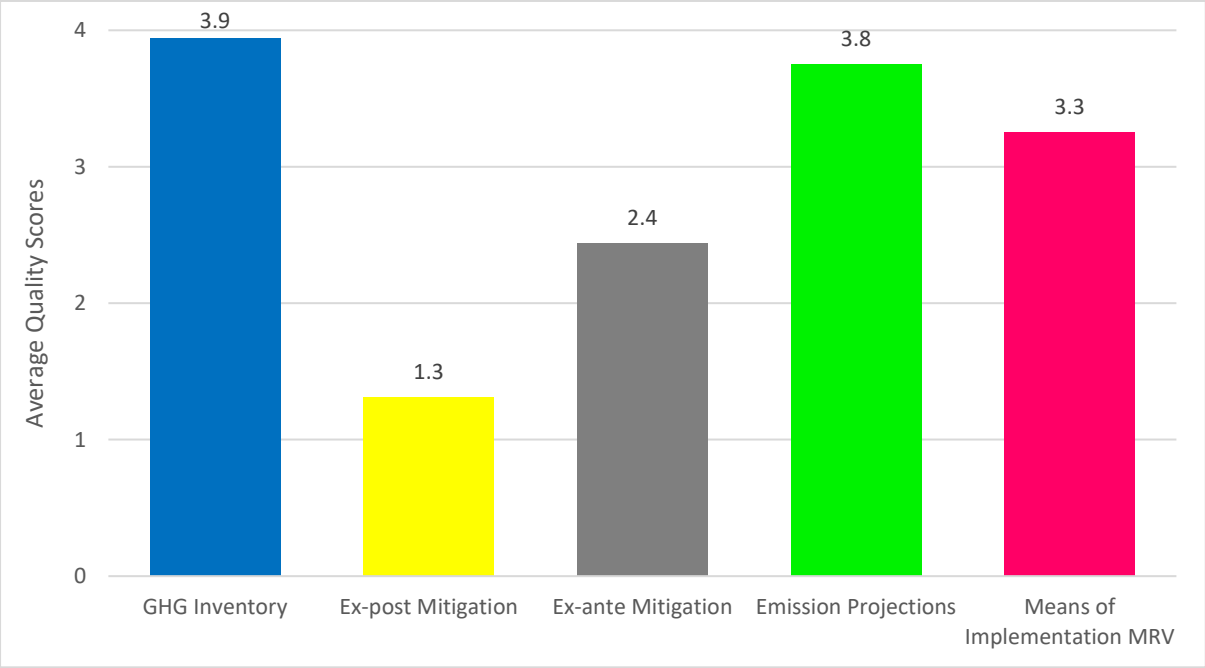


Figure 39: Average quality score of the five evaluated components of the EU's MRV System

The figure shows that the GHG inventory and projections MRV systems almost adhere fully to the TACCCT principles with respective average quality scores of 3.9 and 3.8 out 4. These are followed by means of implementation and ex-ante mitigation system with average scores of 3.3 and 2.4 respectively. The EU's ex-post mitigation MRV assessment scored the lowest average quality score of 1.3, showing minimal overall adherence to the quality principles.

9.1.6 Germany

Only three of Germany's domestic MRV system components met the minimum evaluability requirements, and these are the GHG inventory system, the means of implementation MRV system as well as the ex-ante mitigation MRV system. Figure 40 below presents the results of the quality assessment of GHG inventory and the MoI MRV system.

The results show that both Germany's GHG inventory and means of implementation MRV systems fully adhere to all the transparency, comparability, completeness and timeliness criteria assessed in this study, hence scoring four across all their respective criteria.

On accuracy, both systems fully adhere to the criteria on the use of latest methods and protocols as well as ensuring competency. On the uncertainty analysis criterion, however, only the GHG inventory fully adheres to it, as confirmed by the latest UNFCCC expert review report for Germany's 2020 GHG inventory, while there is no uncertainty analysis (Expert Review Team, 2021). The German MoI MRV system uses the OECD DAC Rio Markers method which requires scoring and weightings to allocate support depending on whether it has gone towards adaptation or mitigation or whether it is cross-cutting or partly climate-related. This process is subject to uncertainty, especially because different EU countries use different weightings (Dejgaard & Appelt, 2018).

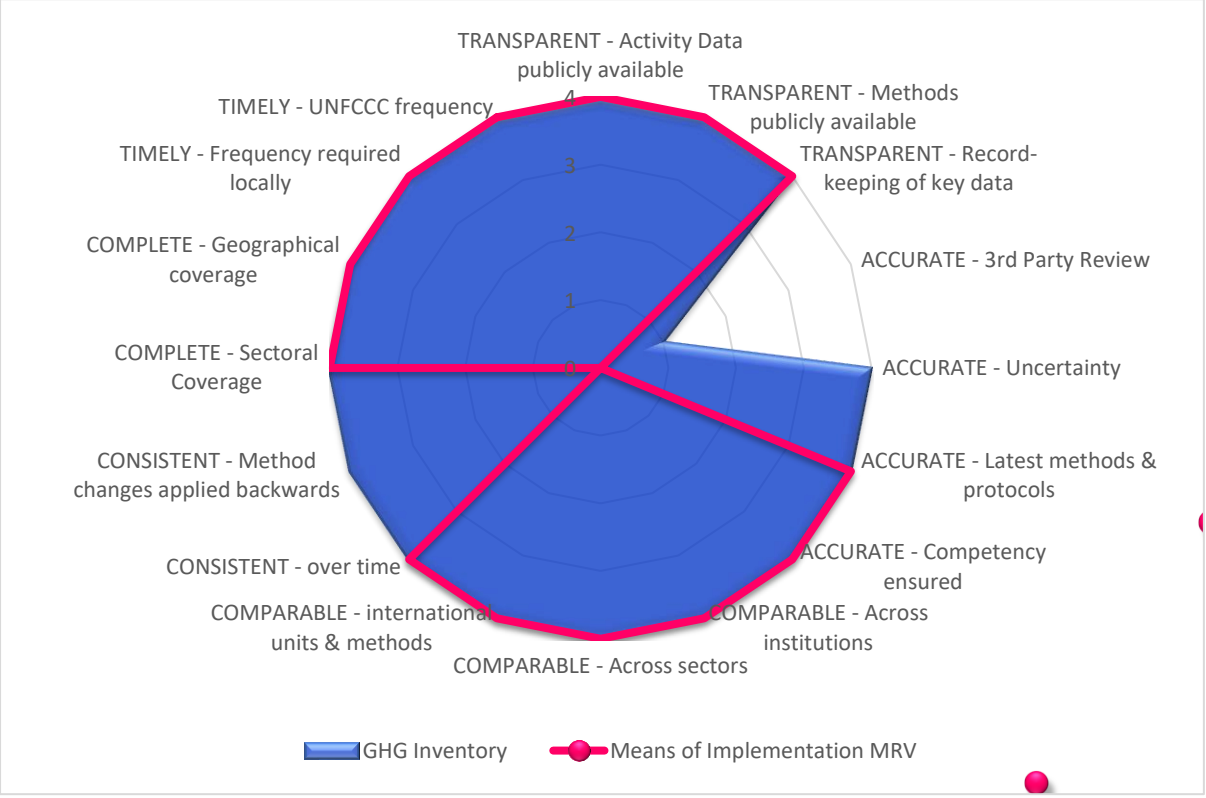


Figure 40: Quality Assessment of Germany's GHG inventory and Means of Implementation MRV systems

Still on accuracy, the MoI MRV system does not adhere to the criterion on 3rd party or public review before submission to the OECD or the UNFCCC, while the GHG inventory system minimally adheres to it (Score: 1). For the GHG inventory system, Germany's 2019 and 2020 GHG inventories state that the requirement of paragraph 15 (b) of the Guidelines for National Systems under Article 5.1 of the Kyoto

Protocol for 3rd Party Peer Reviews of GHG inventories is addressed through "*workshops on the National System [that] are held at irregular intervals. For such workshops, national experts are invited to come to the Federal Environment Agency for discussion with Federal Environment Agency experts (FV) on current inventory issues relative to selected categories*" (Federal Environment Agency, 2020).

On consistency, Germany's GHG inventory system fully adheres to all criteria assessed in this study, while the MoI MRV system only fully adheres to the criterion of consistent reporting over time, but does not adhere to the criterion for applying method changes to historical data. Regarding the latter, there is no requirement for this domestically or under international reporting, hence it is not done.

Figure 41 below presents the quality assessment results for Germany's ex-ante mitigation MRV system.

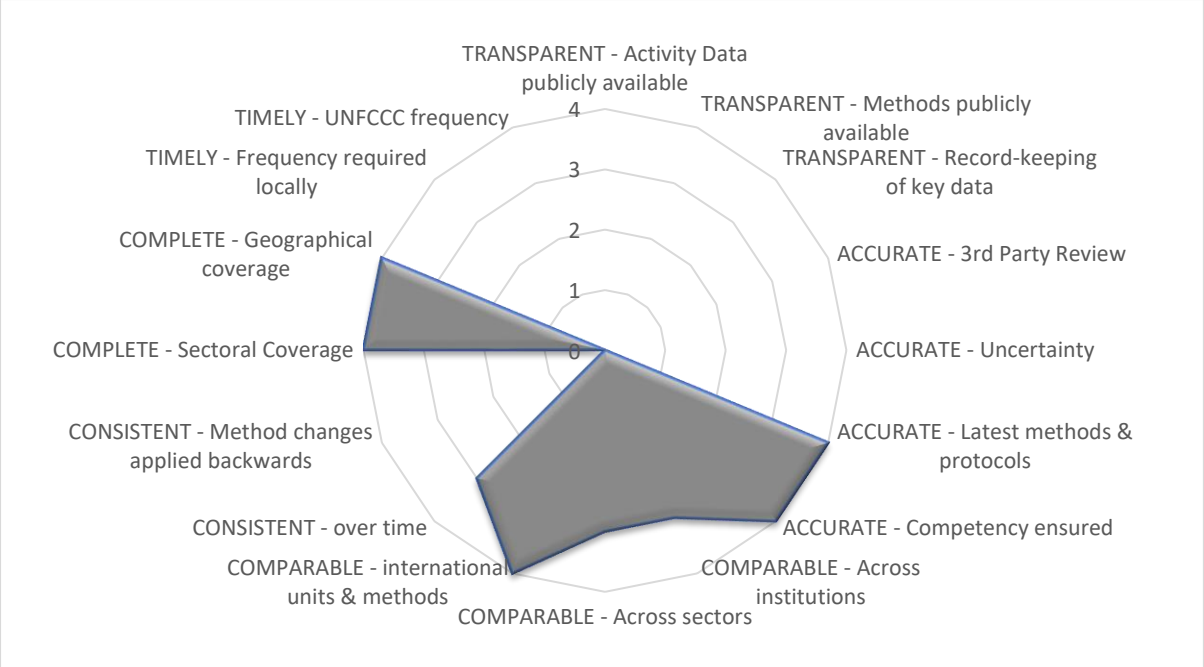


Figure 41: Quality assessment of Germany's ex-ante mitigation MRV system

The Figure shows that the system fully adheres to the two criteria on completeness (Score:4), while it fails to adhere to all transparency criteria assessed in this thesis (Score:0). The latter is because the only output of the system – the annual climate action report – neither contains the activity data used nor the specific methods used for calculating impact of individual mitigation actions, and there is no indication of the existence of a record-keeping hub by the consortium of expert that undertake these assessments.

Regarding the transparency of the system, Figure 41 shows that Germany's ex-ante mitigation MRV system fully adheres to the use of the latest methods and protocols and ensuring the competency of the team (Score:4), but fails to adhere to criteria on undertaken uncertainty analyses and 3rd Party reviews because the latter are not done. On latest methods and protocols, the 2018 climate action report states that the approach used for ex-ante mitigation assessment is aligned with the standardized approach used for emission projections that uses emission scenarios (BMU, 2019a),

while competency of the team that undertakes the assessments is ensured through the competitive tendering process used to appoint the relevant consortium for this purpose (Herold, 2019).

According to Herold (2019), the methods used for ex-post assessment are mostly comparable across institutions and sectors, and apart from a few cases where the methods have improved, these are kept consistent throughout the timeseries. Also, because each annual report does not present results for the preceding years, it means that whatever method changes have taken place cannot be applied retrospectively.

In terms of average quality results, the three German systems differ significantly, from the GHG inventory with a quality score of 3.8, to the MoI MRV system with a score of 3.3 and finally the ex-ante mitigation MRV system with a score of 1.8 (Figure 42).

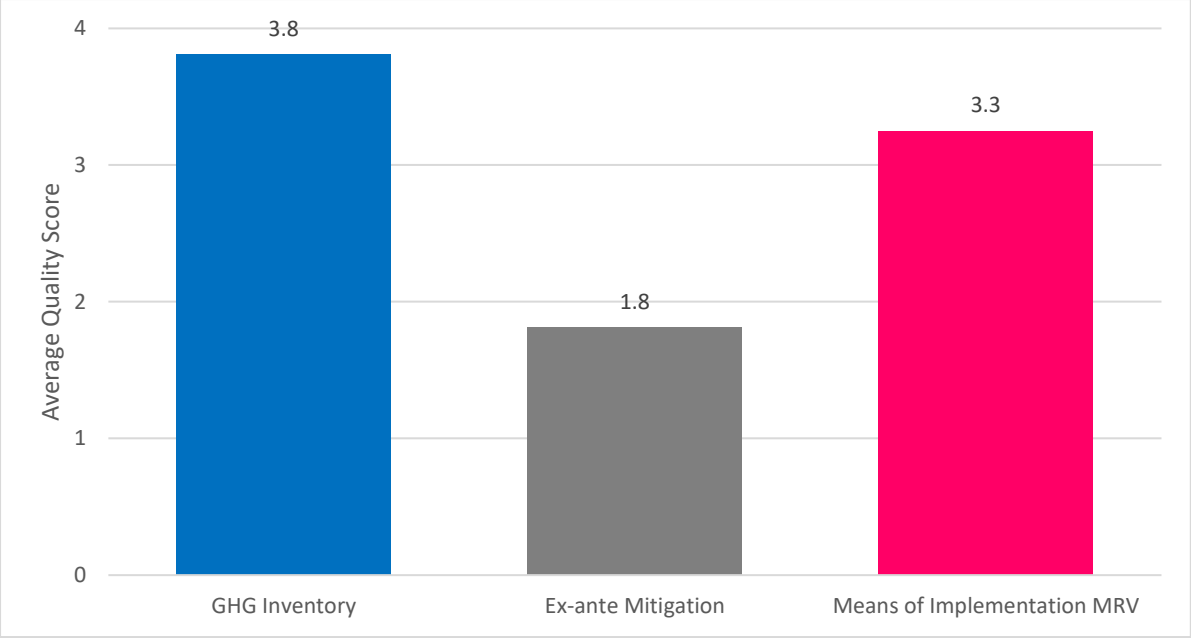


Figure 42: Average quality scores for the three evaluated components of Germany's MRV system

9.1.7 New Zealand

For New Zealand only the GHG inventory and means of implementation components of New Zealand's domestic MRV system met the minimum evaluability requirements. The results of their quality assessment are presented in Figure 43 below.

The Figure shows that both New Zealand's GHG inventory and means of implementation MRV systems fully adhere to the transparency, comparability, completeness and timeliness criteria assessed in this study, hence a score of four across the respective criteria.

On accuracy, both systems fully adhere to the criterion on the use of latest methods and protocols. In terms of the uncertainty analysis criterion, however, only the GHG inventory system fully adheres to it while there is no uncertainty analysis carried out in the MoI MRV system. The New Zealand MoI MRV system uses an updated version of the OECD DAC Rio Markers which still uses scoring and weightings to allocate means of implementation to different climate objectives. Thus, this method is still subject to uncertainty just like to original Rio Markers methodology.

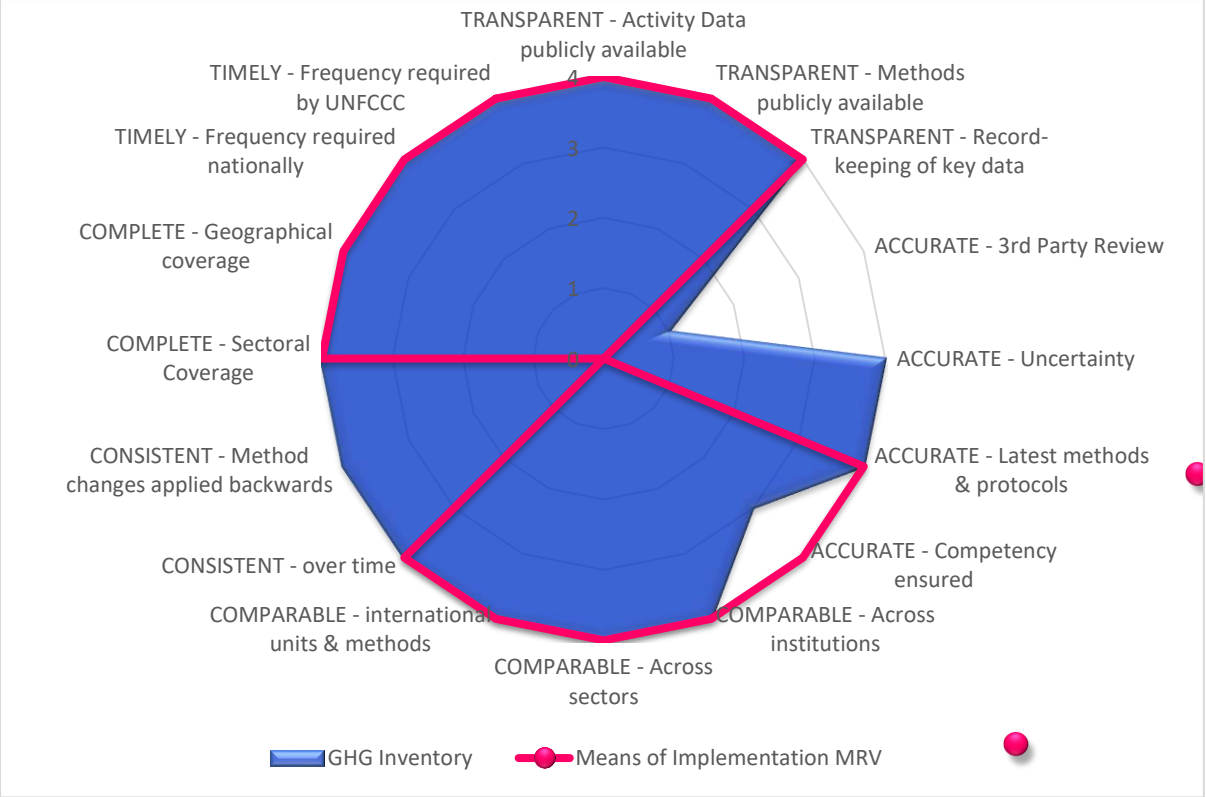


Figure 43: Quality Assessment of New Zealand's GHG inventory and Means of Implementation MRV systems

Furthermore, on accuracy, there is no 3rd party or public review process within NZ's MoI MRV system before submission to either the UNFCCC or the OECD, hence no adherence to this criterion (score: 0). The GHG inventory system, on the other hand, minimally adheres (score: 1) to the 3rd party review criterion because the 1990 – 2019 National GHG inventory Report (Ministry for the Environment New Zealand, 2021) states that in-depth reviews of sector inventories or their components are carried out every 5 to 10 years, while periodic reviews are done for the agriculture sector only, by "*personnel with expertise in climate change policy, international policy, climate change science and livestock farming policy*".

Lastly on the accuracy criterion of ensuring competency of personnel undertaking MRV, the MoI MRV system adheres fully because the country's AID operational policy requires that all recording of AID be carried out internally by qualified AID personnel (Ministry of Foreign Affairs and Trade, 2012). For the GHG inventory system, however, New Zealand uses a hybrid (centralised/distributed) approach for the management of the inventory programme, where "*management and coordination of the inventory programme, as well as compilation, publication and submission of the inventory, are carried out by the inventory agency in a centralised manner, but sector-specific work, including obtaining and processing activity data, estimating emissions, preparing sectoral CRF tables and writing sectoral inventory chapters, is carried out by a number of designated government departments*" (Ministry for the Environment New Zealand, 2021). While continuous development of the expertise of inventory contributors is done through coaching and structured training courses, the competency of the personnel is never fully ensured, hence a rating of three.

In terms of consistency, both systems fully adhere to the criterion on consistent reporting overtime. Also, the national GHG inventory fully adheres to the criterion on applying method changes to historical data (aka recalculations in GHG inventory language). This is confirmed by the latest UNFCCC expert review report of NZ's GHG inventory, which was carried out for the 2019 submission (Expert Review Team, 2020). On the other hand, the country's MoI MRV system, however, does not adhere to the criterion on applying method changes to historical data. The latter is evident in the 2018 method change where NZ developed a method that builds on the DAC Rio markers to better quantify the climate-related support provided by its Aid Programme, including adding new capacity building markers. No recalculations were carried out based on this updated methodology (New Zealand Government, 2020)

Figure 44 below compares the two NZ MRV systems in terms of average quality levels, and shows that they mostly adhere to the TACCCT principles with scores of 3.8 and 3.3 for the GHG inventory system and MoI MRV system respectively.

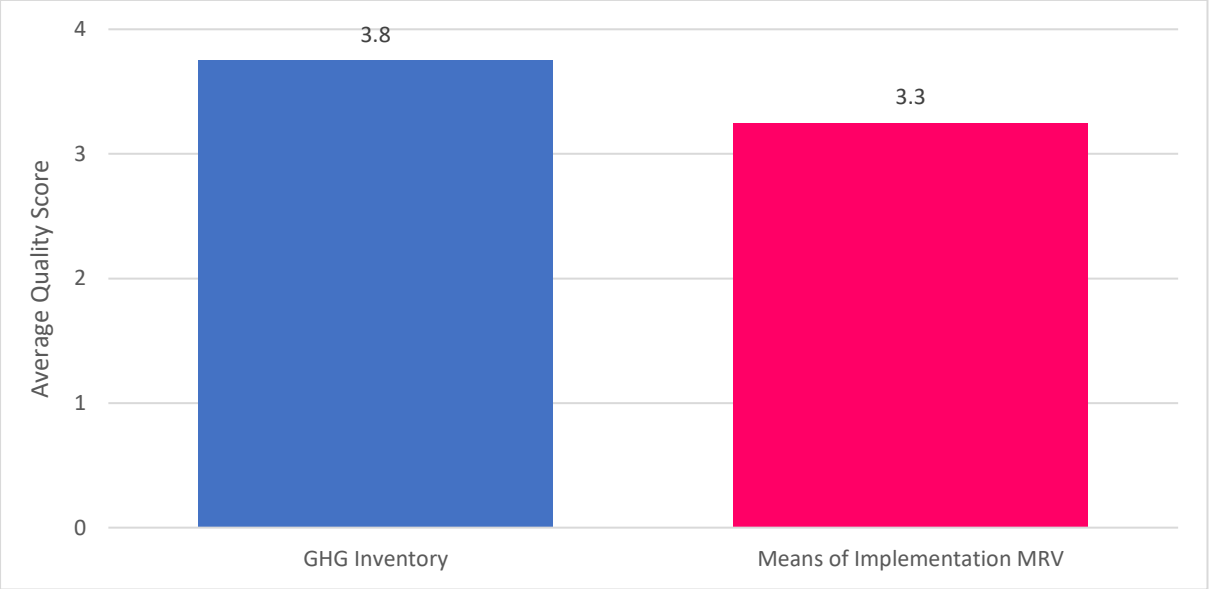


Figure 44: Average quality scores of New Zealand's domestic MRV system components

9.1.8 United Kingdom

Four of the UK's domestic MRV system components met the minimum evaluability requirements. These are the GHG inventory system, the projections system, the adaptation MRV system as well as the means of implementation MRV system.

Figure 45 below presents results of the quality assessment of the UK's GHG inventory and projections systems.

According to the Figure, UK's GHG inventory system fully adheres to all the transparency, accuracy, comparability, consistency, completeness, and timeliness criteria assessed in this study, hence a score of four across the respective criteria.

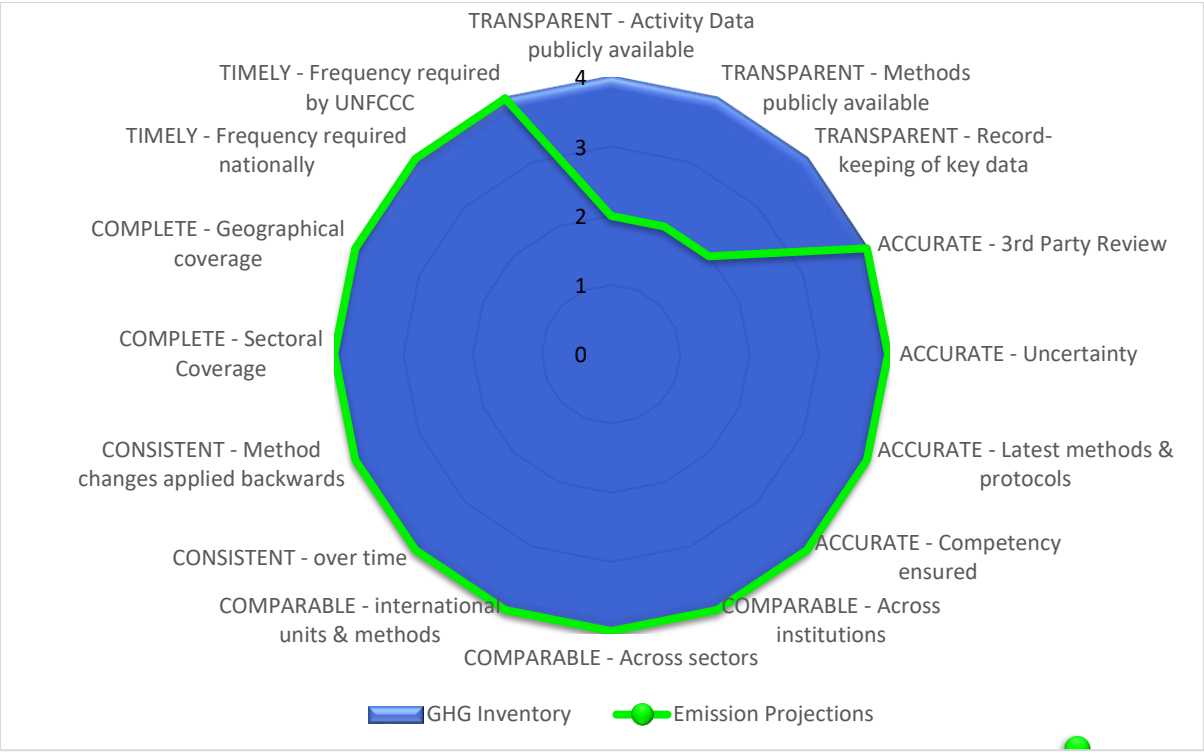


Figure 45: Quality Assessment of UK's GHG inventory and emission projection MRV system

UK's emissions projection system fully adheres to the accuracy, comparability, consistency, completeness and timeliness criteria assessed in this study (Score: 4). In terms of transparency however, the projections system adheres to the three transparency criteria only about half the time, hence a score of two. This is largely because of the data and methods associated with the projected impact of PAMs. The UK's projections are modelled through a combination of top-down and bottom econometric model, where "projections of energy demand by fuel and sector start from a baseline econometric business as usual projection, from which savings due to policies and measures are subtracted. The projections include all firm and funded government environmental policy measures as most recently evaluated" (Department for Business, Energy and Industrial Strategy, 2019a). Data and methods related to the top-down approach is all publicly available in both the Biennial Reports and online (Department of Business, Energy and Industrial Strategy, 2020). However, underlying data and methodologies associated with assessing the impact of those PAMs included in the WEM and WAM scenarios is not publicly available. The information submitted by the UK to the EU under the MMR's 2019 reporting cycle shows that of the 39 PAMs for which ex-ante impact assessments have been reported, only 18 of them have links and "*references to assessment and underpinning technical reports*" (European Topic Centre on Climate change Mitigation and Energy, 2019a).

Even Annexure D of the UK's "Updated energy and emissions projections 2019" (Department of Business, Energy and Industrial Strategy, 2020), entitled "Policy Savings in the Projections" contains calculated mitigation impact of various PAMS but does not give information on how those values were determined.

The EEA itself assessed the UK's 2019 projections and PAMs submission using EEA's own criteria for transparency, accuracy, completeness, coherence and timeliness and also identified the absence of detailed technical information on impact of PAMs and their misalignment with the projections data as

the main transparency and accuracy shortcomings of that submission respectively (European Topic Centre on Climate change Mitigation and Energy, 2019a). In the 2021 reporting cycle of the EU, the UK did not make any submissions, because of its exit from the EU membership the year before.

Figure 46 below presents results of the quality assessment of the UK's adaptation and means of implementation MRV systems.

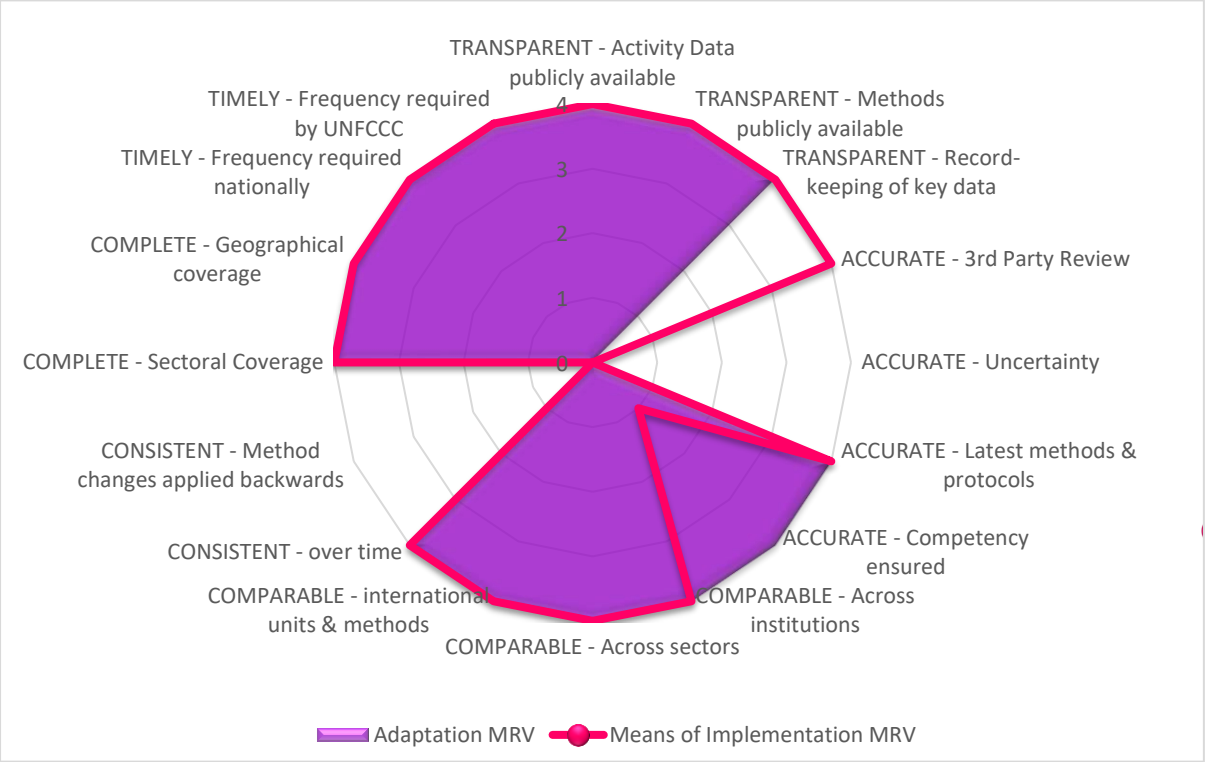


Figure 46: Quality Assessment of UK's Adaptation and Means of Implementation MRV systems

The figure shows that both the UK's adaptation and means of implementation MRV systems fully adhere to all the transparency, comparability, completeness, and timeliness criteria assessed in this study

In terms of consistency, both systems maintain consistent reporting approaches and formats, but do not apply any methodological changes to historical data.

In terms of accuracy, the adaptation MRV system fully adheres to the use of latest methods and protocols as well as ensuring competency of the personnel undertaking the MRV process. However, neither uncertainty analysis nor 3rd party or public reviews are undertaken within that system. For the MoI MRV system, the accuracy criteria related to 3rd party review and the use of latest methods and protocols are fully adhered to, while the criterion for ensuring competency is only minimally adhered to and the uncertainty analysis criterion is not adhered to (rating of 1). The UK uses the OECD DAC Rio Markers method for its MoI MRV process, and according to the UK's Value for Money ODA guidance (HM Treasury, 2018), as part of this MRV process, DFID commissions departments annually to submit the MoI data to them, and these departments have to ensure that their internal systems are set up to meet these reporting timelines and requirements; which means that, although the DFID personnel might be fully capacitated to carry out MRV of climate finance, capacity building and technology

transfer, the majority of the people involved in the MRV process are from these other departments and are mostly not capacitated to understand climate related Rio-markers, hence the rating of 1 for ensuring competency of personnel.

Comparing the average quality scores of the four components of the UK's domestic MRV system shows that the GHG inventory fully adheres to the TACCCT principles with a perfect score, while the projections, adaptation and MoI MRV systems mostly adhere to the principles with average scores of 3.6, 3.3 and 3.3 respectively. This is presented in Figure 47 below.

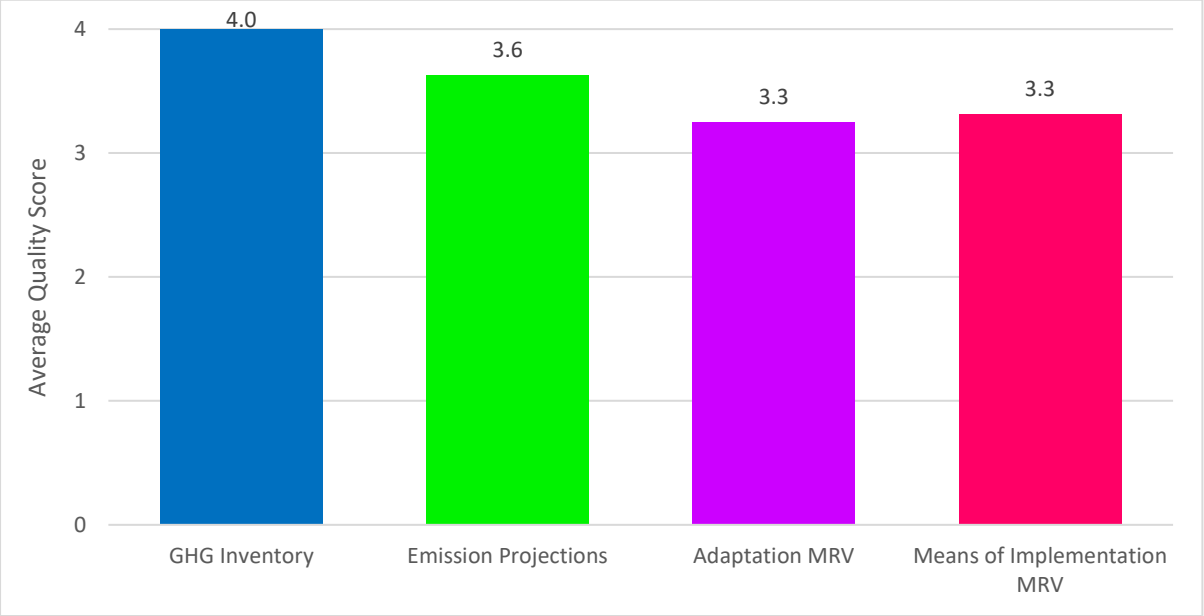


Figure 47: Average quality score of the four evaluated components of UK's MRV system

9.1.9 United States of America

The USA's GHG inventory and means of implementation MRV systems met the minimum evaluability requirements for TACCCT quality assessment. Figure 48 below presents the results of the quality assessment of these two systems.

According to the figure, USA's GHG inventory system fully adheres to all the transparency, accuracy, comparability, consistency, completeness, and timeliness criteria assessed in this study

USA's MoI MRV system fully adheres to the transparency, comparability, completeness and timeliness criteria assessed in this study.

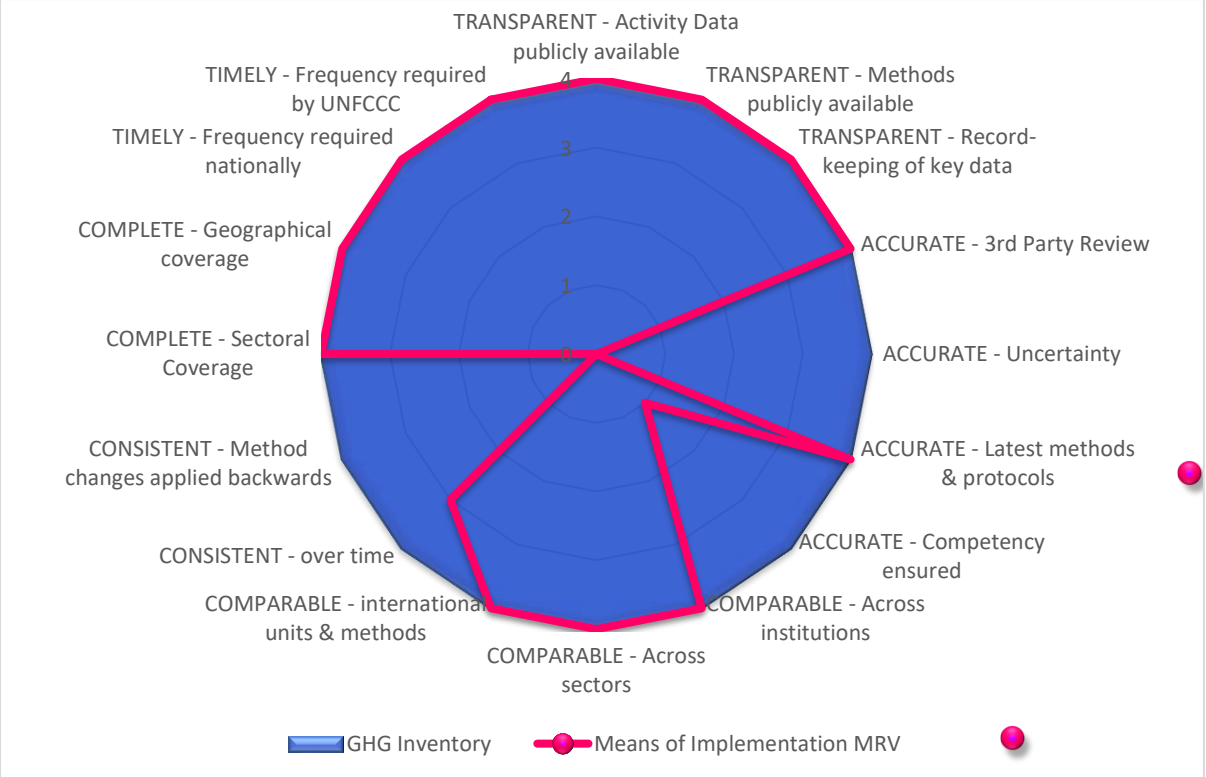


Figure 48: Quality Assessment of USA's GHG inventory and Means of Implementation MRV systems

In terms of accuracy, however, the USA's MoI MRV system fully adheres to the 3rd Party review criterion and the use of latest methods and protocols only. The USA's MoI MRV system does not adhere to uncertainty analysis criterion. Like the other developed countries assessed in this study, the USA's MoI MRV system uses OECD DAC Rio Markers to categorize the different types of means of implementation (e.g. technology transfer, bonds, loans, etc) into mitigation, adaptation and cross-cutting and this requires the use of weightings which are subject to uncertainty, but uncertainty analysis is never carried out (Caruso, 2019). Furthermore, USA's MoI MRV system's adherence to ensuring competency is minimal. This is because the State Department and USAID use a harmonized IT system for tracking climate finance, while all other departments use their own (ibid). This necessitates each department to carry out an initial identification of its climate-related funding before sending that data to the State Department to finalize the assessment. While the team that undertakes this final assessment at the State Department and USAID is fully trained and competent in this work, the personnel in the other departments that undertake the initial identification only have basic guidance to use. Because the number of personnel that undertake the initial identification is much larger than the competent State Department and USAID team, the overall rating for competency is therefore minimal (Score: 1).

In terms of consistency, the USA's MoI MRV system mostly adheres to consistent reporting format (Score: 3), but method changes are never applied to historical because there is no such requirement in either domestic legislation, OECD DAC regulations or UNFCCC reporting requirements.

Figure 49 below compares the two MRV systems in terms of average quality levels, and shows that GHG inventory system fully adheres to the TACCCT quality principles with a perfect score, while the MoI MRV system mostly adheres to those principles with an average score of 3.3.

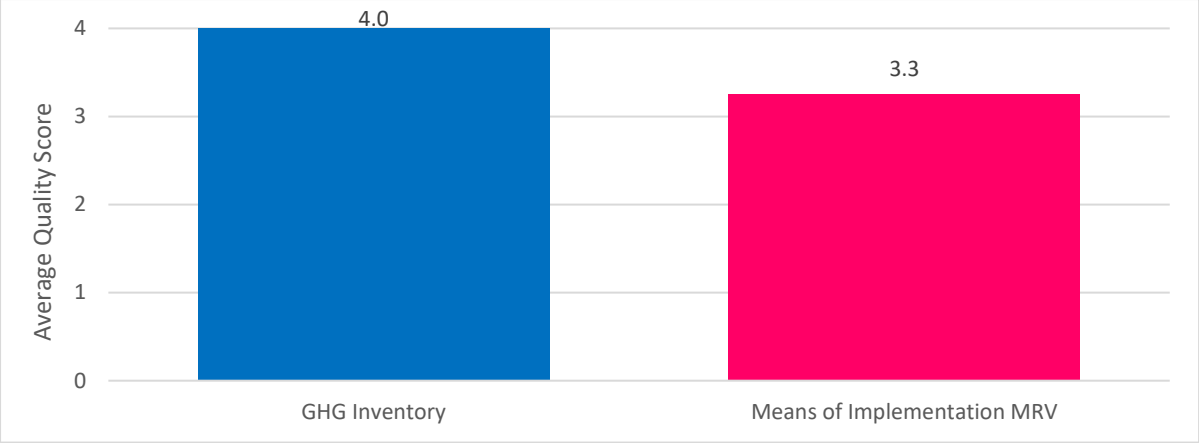


Figure 49: Average quality scores of the two evaluated components of USA's MRV system

9.2 Quality Results per MRV theme

While the preceding section presented and discussed the quality assessment results of individual country MRV systems, this section analyses quality trends and differences observed for the MRV systems within the different MRV themes.

9.2.1 Quality of GHG emissions and mitigation MRV systems

This section presents and discusses the quality results for the systems that fall within the GHG emissions and mitigation MRV themes.

Figure 50 compares the quality of the GHG inventory systems for the different countries by principle.

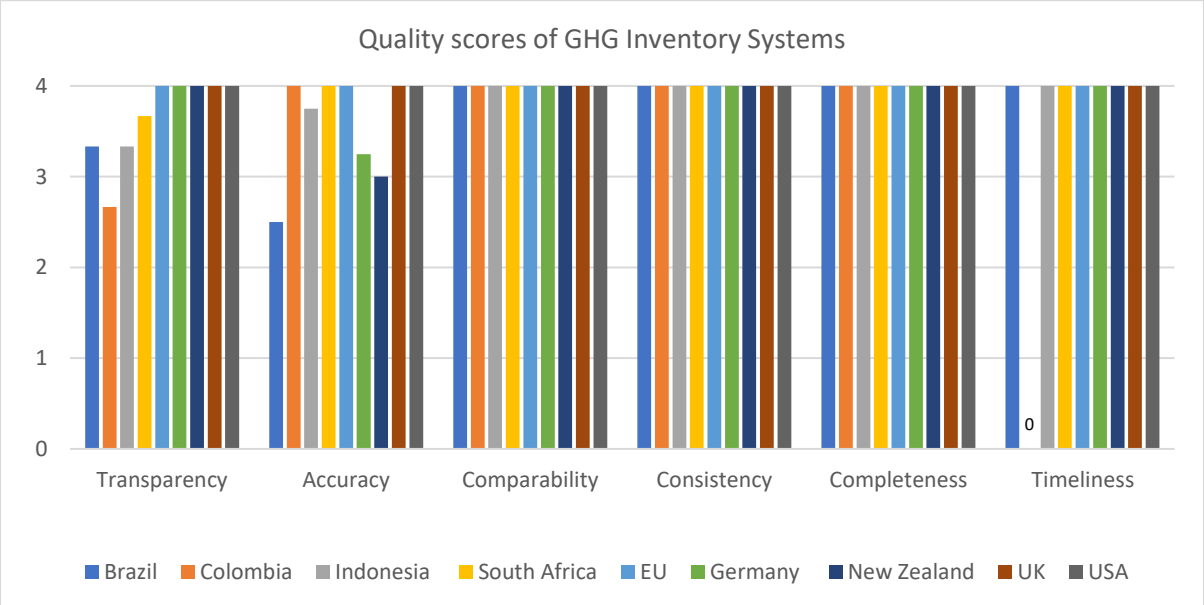


Figure 50: Quality of GHG inventory systems

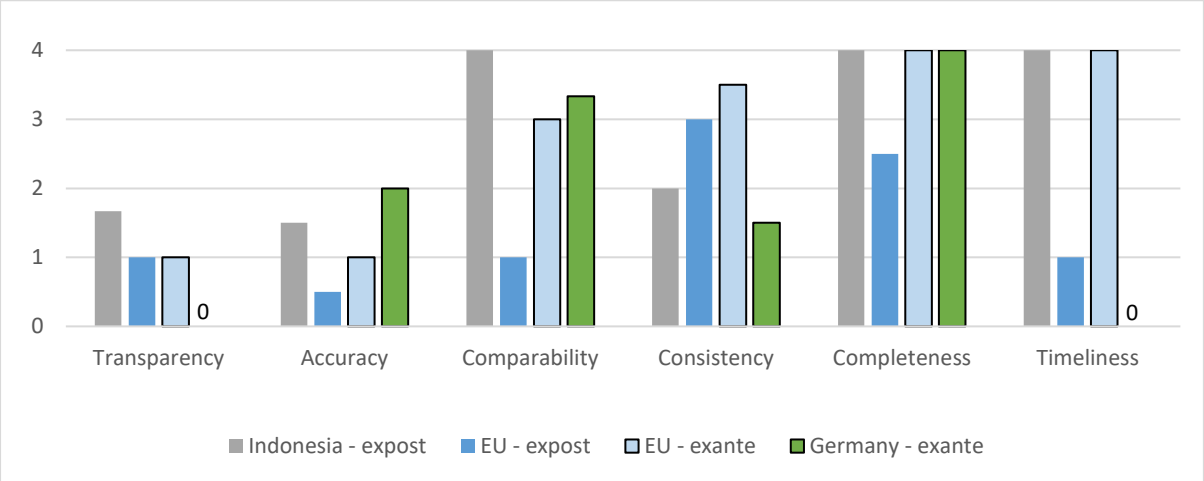
Figure 50 shows that all GHG inventory systems assessed in this study fully adhere to the comparability, consistency and completeness principles. It is in terms of transparency and accuracy where the systems differ considerably. The results show that GHG inventory systems of all developed countries fully adhere to all the transparency criteria assessed, while those of developing countries

range between average scores of 2.7 and 3.7 out of 4. In terms of accuracy, it is the GHG inventory systems of Brazil, Indonesia, Germany and New Zealand that fall short of full adherence with average scores of 2.5, 3.8, 3.3 and 3.9 respectively. The latter is because both developed countries fall short on the third party or public review criteria, while Brazil, New Zealand and Indonesia fall short on ensuring competency of the personnel. These two criteria are similar in that both are required or encouraged by both the IPCC guidelines as well as the Kyoto Protocol guidelines on National Systems but there's no specified frequency, level of adherence or coverage in both guidelines. Brazil also falls short on the use of latest methods and protocols.

The figure also shows that all GHG inventory systems fully adhere to the timeliness principle, except for Colombia's GHG inventory system which does not adhere at all, scoring zero.

Comparing the only two ex-post mitigation MRV systems that met the minimum evaluability requirements – Indonesia and the EU – shows that both systems poorly adhere to transparency and accuracy principles (Figure 51). Figure 51 further shows that the same goes for the two ex-ante mitigation assessment MRV systems of the EU and Germany. On average, all mitigation assessment MRV systems included in this thesis achieve quality scores of 0.9 and 1.3 in terms of transparency and accuracy respectively, which means they minimally adhere to those two principles. This is in contrast with the average values of 2.8, 2.5, 3.6 and 2.3 for comparability, consistency, completeness and timeliness respectively.

Figure 51 further shows that there are no obvious trends in mitigation assessment in relation to developing and developed countries. But because only three countries were assessed for mitigation assessment it is not possible to conclude that this is a general finding between developing and developed countries.



NB: Border lines around the columns depict ex-ante results

Figure 51: Quality of Ex-post and Ex-ante Mitigation MRV systems

Figure 52 below compares the quality of the EU and UK MRV systems for projection of GHG emissions and removals. Up until the 2019 reporting cycle the UK system has been one of the feeder systems to the EU projections MRV systems. The figure shows that both systems fully adhere to the completeness and timeliness principles, and the UK system performs better that the EU system in terms of accuracy, comparability and consistency. The EU system outperforms the UK system in terms of the

transparency system only. Overall, however, the EU system achieves a higher average quality score of 3.8 compared to 3.6 for the UK projections system.

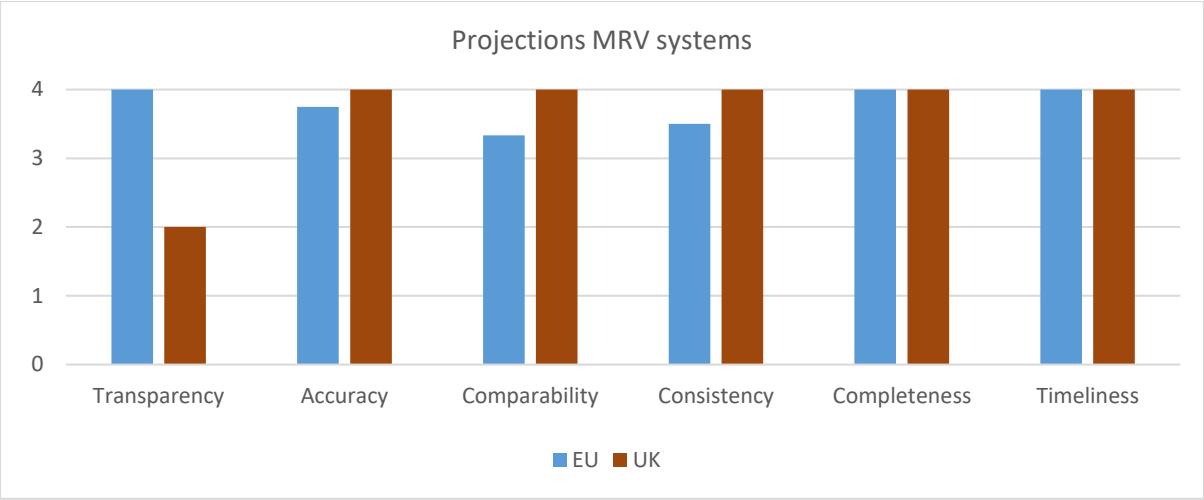


Figure 52: Quality comparison of the EU and UK MRV systems for projection of GHG emissions and removals

9.2.2 Quality of systems within the adaptation MRV thematic area

Within the adaptation three domestic MRV systems met the minimum evaluability requirements. These are the UK and South Africa's adaptation MRV systems as well as Indonesia's CRIV MRV system. Figure 53 below presents quality assessment results of these three systems, disaggregated by quality principle.

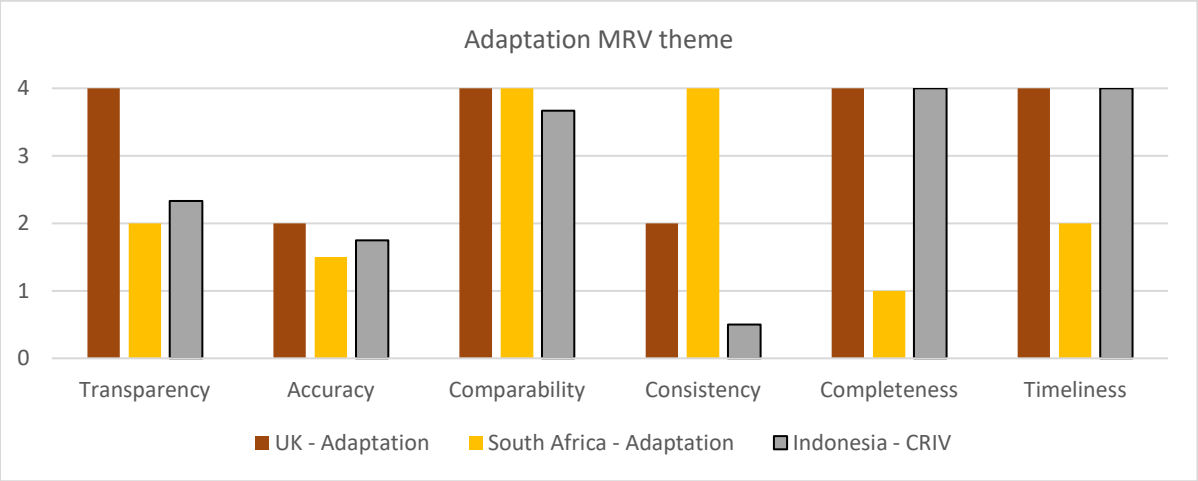
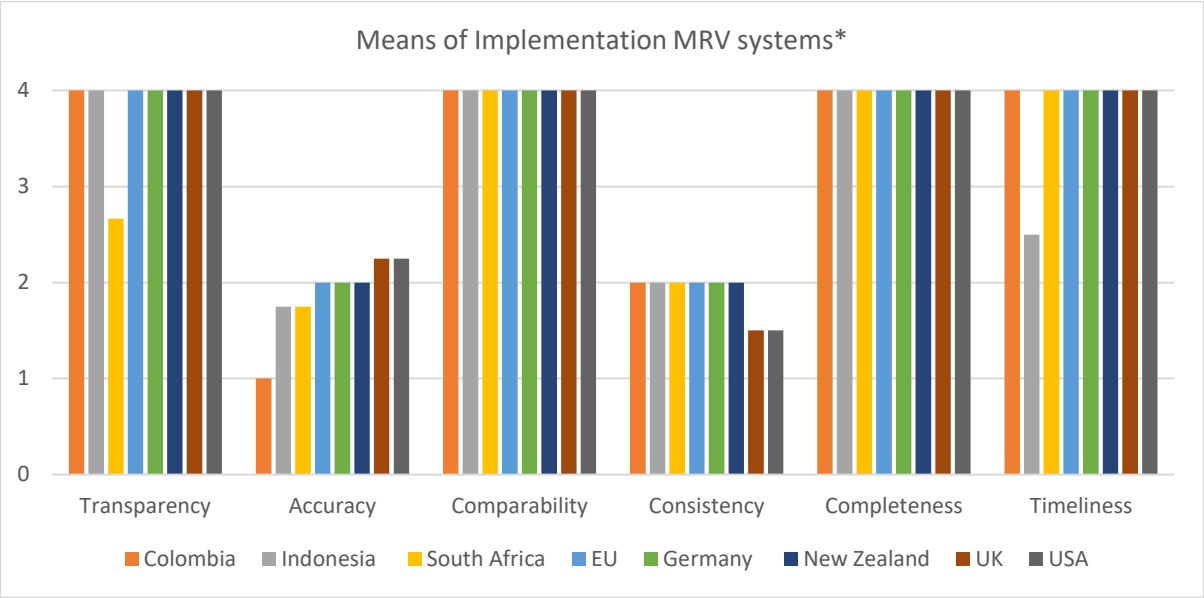


Figure 53: Quality of the three systems assessed within the adaptation MRV theme

The Figure shows that overall, the accuracy principle is the least adhered to by systems within the adaptation MRV theme, with an average score of 1.8 between all the systems, while the comparability principle is the most adhered to with an average score of 3.9. While the results show that only the South African adaptation MRV system is the only one that does not fully adhere to the completeness and timeliness principles, this is not an observation that can be extended to other developing countries to sample size limitations.

9.2.3 Quality of Means of Implementation MRV systems

A comparison of the MoI MRV systems is presented in Figure 54 below and shows that all the MoI MRV systems fully adhere to the comparability and completeness principles, and most of them fully adhere to the transparency and timeliness principles. It is the accuracy and consistency principles where all MoI systems are falling significantly short, achieving average scores of 1.9 for both accuracy and consistency. None of the MoI MRV systems adhere to the accuracy criterion on carrying out uncertainty analysis as well as the consistency criterion on application of methodological changes on historical data.



**For Colombia and South Africa their climate finance MRV systems have been used in this graph.*

Figure 54: Quality of means of implementation MRV systems

9.2.4 Comparison across system types and themes

As shown in Table 29, for eight countries the both the GHG inventory systems and MoI MRV systems met the minimum evaluability requirements; in fact, Brazil is the only country where the GHG inventory met the minimum evaluability requirements with no MoI MRV system. Figure 55 below compares these two thematic systems and shows that the GHG inventory systems achieve higher average quality scores than the respective MoI MRV systems for all countries assessed. The minimum, average and minimum quality scores of GHG inventory systems are 3.3, 3.8 and 4 respectively, while those of MoI MRV systems are 2.9, 3.2 and 3.3 respectively.

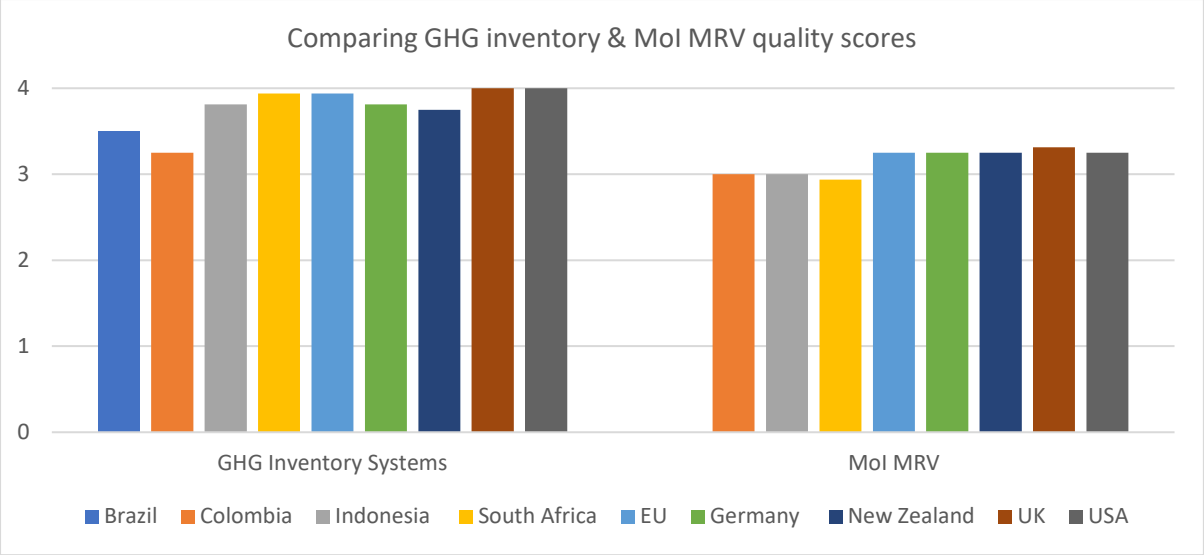


Figure 55: Comparing average quality of GHG inventory systems and MoI MRV systems

Figure 55 also shows that MoI MRV systems of developed countries achieve marginally higher quality scores than those of developing countries.

Figure 56 below compares the average quality scores of the MRV systems in the different thematic areas and shows that GHG inventory systems have the highest overall quality score of 3.8, followed by GHG emission and removal projections systems with an average score of 3.7. This domination by GHG inventory systems is not surprising, particularly for developed countries, which compile and submit GHG inventories that are subjected to comprehensive TACCCT expert reviews under the UNFCCC annually, thereby assisting with the continuous improvement of these systems. Another reason for the domination of GHG inventories is the fact that there are IPCC guidelines for GHG inventory compilation which define what TACCCT means for GHG inventories and how each of those principles can be adhered to and improved over time, but there's nothing comparable to these IPCCC guidelines for MRV systems of other thematic areas.

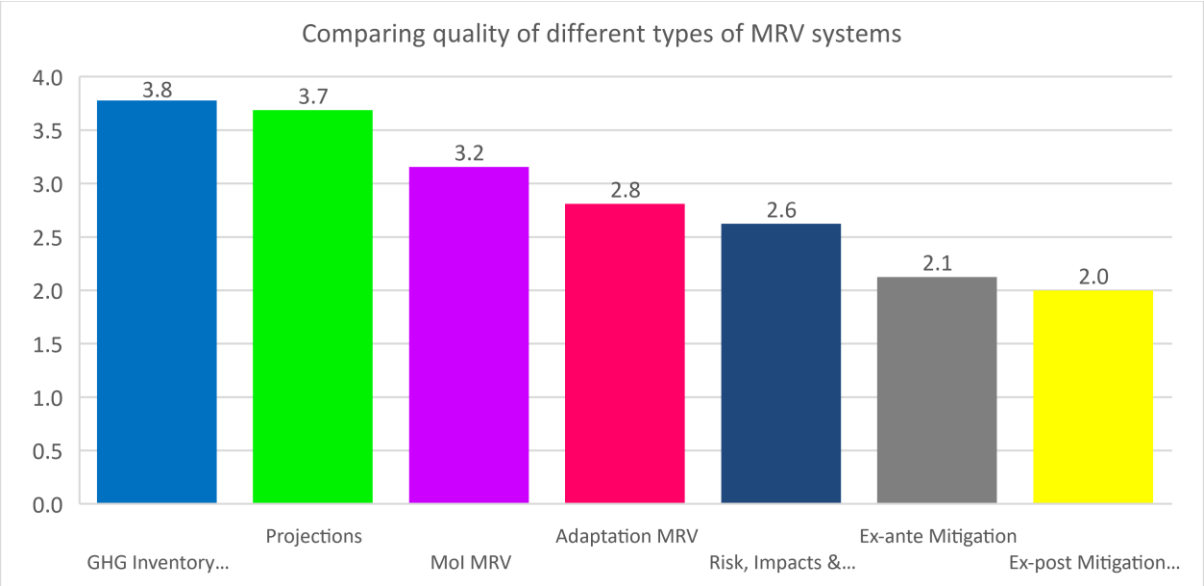


Figure 56: Comparing quality of different types of MRV systems.

In third and fourth places are the MoI and adaptation MRV systems with respective average quality scores of 3.2 and 2.8. At the bottom of the quality scale is the CRIV MRV system with an average score of 2.6, and the two types of mitigation MRV systems at 2.1 and 2.0 for ex-ante and ex-post respectively

9.3 Quality Results per Principle

In this section the overall adherence of each of the studied domestic MRV systems to each quality principle is presented and discussed. Figure 57 below shows the extent to which domestic MRV systems of each country adhere to each of the quality principles.

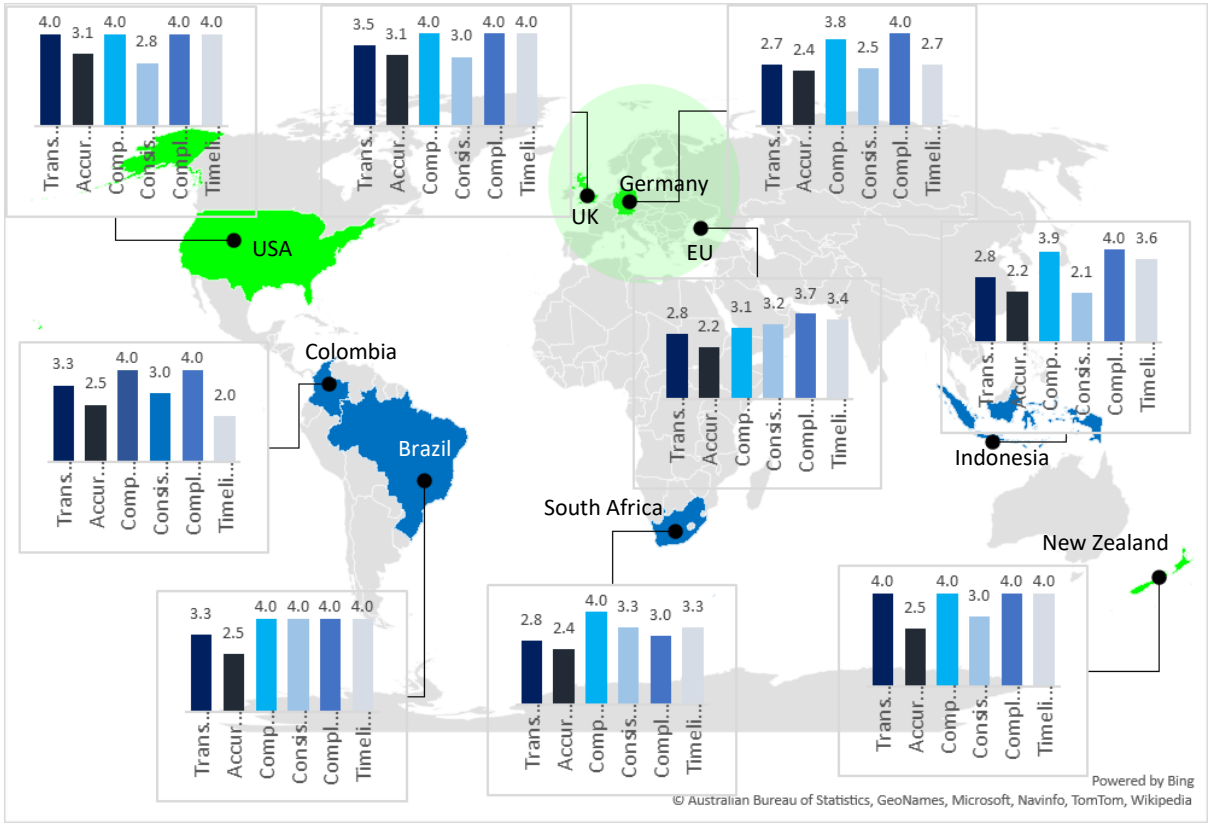


Figure 57: Average adherence to each quality principle by each country

Figure 57 shows that, overall, there is generally good adherence to TACCCT principles by the systems assessed in this thesis. It can also be seen that for each country, there is variation across the principles, adhering more fully to some than others, with no obvious pattern across developed and developing countries on adherence to all quality principles.

The Figure also shows that all domestic MRV systems fully adhere to the completeness principle as defined in this study, except for the EU and South African MRV systems which fall short because of their ex-post MRV system and adaptation MRV system respectively. It was observed, however, that the two indicators of completeness used in this study, focusing on sectorial and geographical coverage, are not able to pick up or show any incompleteness that exists within the sector or within the geographical area. For instance, most MoI MRV systems cover all sectors and relevant geographical areas but are not able to capture all climate finance, capacity building or technology transfer transactions within each sector or geographical area (Caruso, 2019; Witi, 2021). The same is

true for mitigation MRV systems, adaptation MRV systems and GHG inventory systems which may have full sectorial or geographical reach but never able to capture all individual or groups of mitigation and adaptation actions within those sectors or geographical areas, or even all GHG emission sources or gases within some sectors.

Finally, Figure 57 shows that there is no country whose domestic MRV system fully adheres to the accuracy principle as defined in this study.

Comparing all the TACCCT principles, in terms of the level with which the systems assessed in this study adhere to them, Figure 58 below shows that completeness and comparability are the two most adhered to principles with average quality scores of 3.8. These are followed by timeliness, transparency and consistency at 3.4, 3.1 and 2.9 respectively. The Figure shows that accuracy is the least adhered to principle with an average quality score of 2.5.

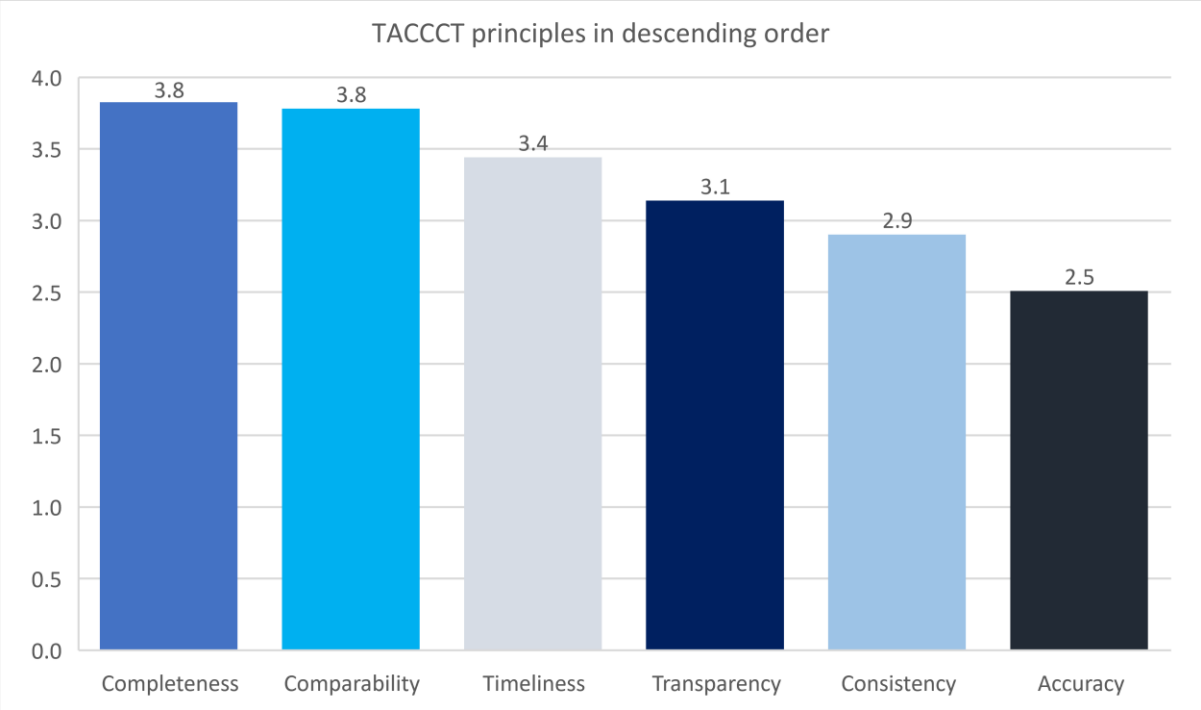


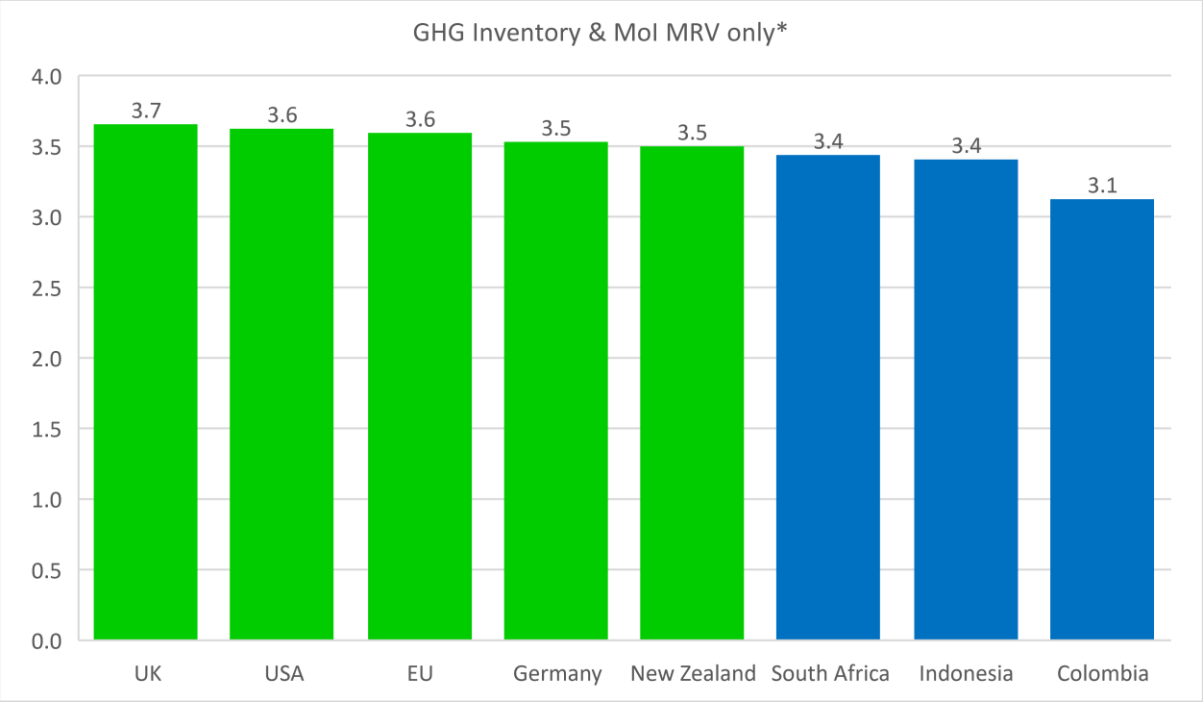
Figure 58: Comparing overall adherence to different quality principles

Having assessed the relevance of individual domestic MRV systems and identified thematic and principle trends, the next sections focuses on the results of correlating the quality results with results-based planning.

9.4 Overall quality of domestic MRV systems and Results-based planning

In this section the countries are compared in terms of the quality levels of their domestic MRV systems and the relationship between those quality levels and results-based planning is assessed as part of testing the second part of the hypothesis. Because, as Table 29 indicates, most GHG inventory systems and means of implementation MRV systems met the minimum quality evaluability requirements, the assessments in this section have been done in two ways: 1) by comparing the countries based on their combined average scores of their GHG inventory and MoI MRV systems only, ensuring a like-for-like comparison of the countries, and 2) by comparing countries based on quality of all their domestic MRV system components.

Figure 59 below compares and ranks the countries in terms of the combined average quality scores of their GHG inventory and MoI MRV systems only.



**MoI for Colombia and South Africa refers to climate finance only*

Figure 59: Ranking of country domestic MRV systems in terms of quality (GHG inventory & MoI MRV systems only)

The Figures shows that in relation to GHG inventory and MoI MRV systems only, developed country systems have higher overall quality compared to developing country systems, with the UK system achieving the highest combined quality score of 3.7 while the Colombian MRV system achieved the lowest quality score of 3.1. This observed trend is consistent with what was expected, because of at least three reasons:

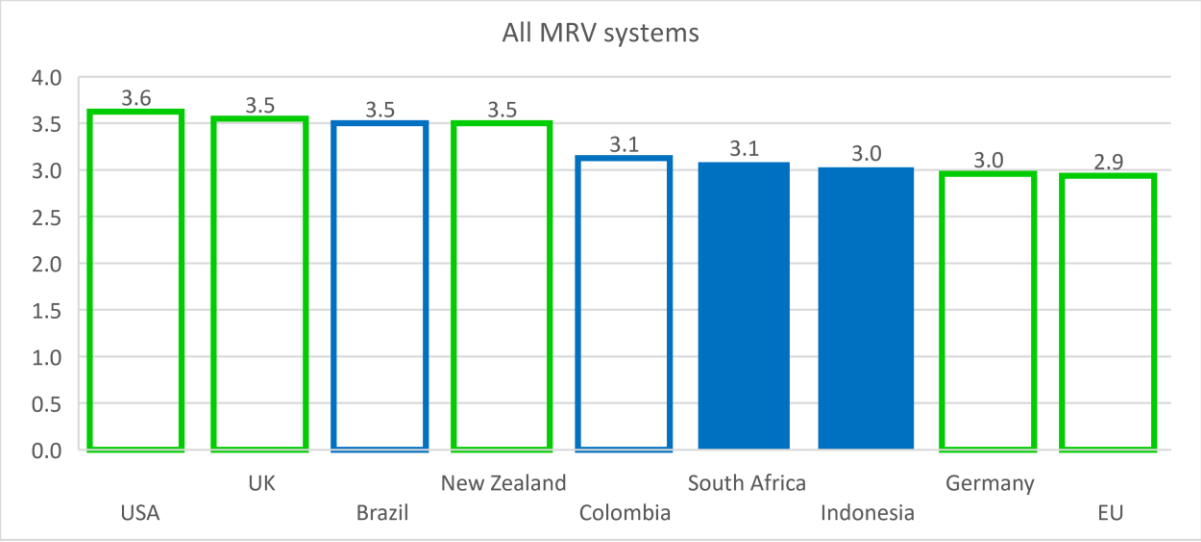
a. Proper implementation of these systems, as well as improving their adherence to TACCCT principles, require resources, which developed countries have more of compared to developing countries.
b. Developed countries have annual reporting obligations linked to both types of systems – of GHG inventories under the UNFCCC and of climate support given to developing countries to the OECD

DAC – while developing countries' reporting obligations linked with their GHG inventory and MoI MRV systems are only biennial. This means that developed countries have more opportunities for learning and improvement of their systems than developing countries.

c. Also, for developed countries, the outputs of both types of systems undergo comprehensive technical expert reviews under the UNFCCCC (for GHG inventories) and under the OECD DAC (for climate support rendered to developing countries). These reviews assist the countries to identify TACCCT shortfalls within their systems and they also help the countries to identify ways to address those gaps. This is not the case for developing countries because their BURs only undergo assessments that mostly check their adherence to UNFCCC guidelines.

In section 6.3.2 of this thesis an assessment of the extent to which results-based planning through logical modelling has been used by each country in establishing their domestic MRV systems was made, and the countries were categorized into three groups: 1) those that followed all the five steps of results-based planning approach; 2) those that followed only the first four steps of results-based planning; and 3) those that did not follow results-based planning. Furthermore, in section 7.3, where correlation of the relevance of the systems with the approach used to design them was made, the countries were recategorized into two, combining groups 1 and 2 above because the fifth step does not affect relevance of domestic MRV systems. Because quality relates only to the fifth step of results-based planning, including the resulting inputs, activities and outputs of the MRV system, as indicated in Figure 7 in Chapter 3 of this thesis, following only the first four steps of results based planning does not have an impact on the quality of the domestic MRV system, just like not employing results-based planning. As such, in this section, the second group that followed results-based planning only up to step 4 and those that did not utilize results-based planning are grouped together.

Figure 60 below compares and ranks the countries in terms of the average quality scores of their domestic MRV systems, covering all thematic components of the MRV systems that were evaluated for quality. In this Figure, countries which have employed results-based planning to a limited extent have been grouped together with those that have not used results-based planning at all.



**Colours distinguishing developed and developing countries the same as in Figure 59*

Key:		
	■	Filled cells = All 5 steps of results-based planning followed
	□	Empty cells = results-based planning not followed or followed for first 4 steps only

Figure 60: Ranking of country domestic MRV systems in terms of quality (all evaluated sub-systems)

It is worth noting that the comparison in Figure 60 is not a like-for-like comparison because the countries do not have the same number of components of their MRV system meeting eligibility requirements (as was reported in Section 9.1).

Figure 60 shows that inclusion of the quality scores of the systems within the adaptation and mitigation MRV themes in the country comparisons has resulted in the overall EU and German systems' quality scores being reduced from 3.6 and 3.5 respectively to 2.9 and 3.0, moving both those countries to the bottom of the rankings, below all developing countries. This is because of the particularly poor performance of the two countries' mitigation MRV systems which have average quality scores below two or just above.

Figure 60 Further shows that when all evaluated systems are considered, the USA's overall system comes out tops at the same average value of 3.6 as in Figure 59, followed by those of the UK, Brazil and NZ tied with the same score of 3.5. The Colombian, South African and Indonesian systems are then ranked fifth, sixth and seventh with respective scores of 3.1, 3.1 and 3.0. The general trend here is that the scores of all the countries which have other systems in addition to the GHG and MoI MRV systems have reduced compared to the previous ranking, because all other systems, except for emission projection systems, perform poorer than the GHG inventory and MoI MRV systems in terms of quality. This makes the countries with only the GHG inventory and MoI MRV systems look like they perform better than they did in the previous ranking, while in fact they've simply retained their quality scores while others have reduced scores.

In terms of the correlation between results-based planning and quality of domestic MRV systems, Figure 60 shows that the two countries that have utilized all the five steps of results-based planning to establish their domestic MRV systems – South Africa and Indonesia – are neither the best performers nor the worst in terms of overall quality of their systems. This is despite having TACCCT principles included in the design documents of some of the countries that have employed results-based planning.

The following conclusions can thus be drawn in relation to results-based planning and the quality of domestic MRV systems:

1. On their own the five-steps of results-based planning do not have a direct impact on the quality of the domestic MRV system.
2. Instead, the quality of a domestic MRV system depends heavily on the implementation of the system, the resources available for implementation, output frequency of the system, frequency of reviewing, monitoring and evaluating the system, as well as availability of guidance on how to adhere and improve the quality of the system.
3. Linked with the second point above, particularly on M&E, the results show that there is a need to go beyond results-based planning to results-based management, as defined in Section 3.1 of this thesis, to improve the quality of domestic MRV systems. This means that at the planning phase, the mention of TACCCT principles that the MRV system needs to adhere to on its own during the planning process is insufficient, rather this needs to be translated into a comprehensive monitoring and evaluation framework for the system.

9.5 Chapter Conclusions

In this chapter, the domestic MRV systems of the countries included in this study have been assessed for quality using the TACCCT principles and the relationship between the level of quality of the different domestic MRV systems and results-based planning has been investigated.

The key findings from this chapter can be summarized as follows:

- GHG inventory systems were found to achieve the highest quality levels among all thematic MRV systems, while mitigation MRV systems – both undertaking ex-post and ex-ante assessments – achieved the lowest quality levels.
- GHG inventories and means of implementation MRV systems of developed countries were found to be of better quality than those of developing countries.
- Completeness was found to be the most adhered to quality principle by domestic MRV systems, while accuracy is the least adhered to.
- While the selected criteria underlying the different quality principles are sufficient for understanding of the quality of different systems, there remains an opportunity to improve on those criteria to capture some of the nuanced issues on quality, like completeness within sectors or completeness in terms of the types of funding covered by the system.
- Following the five-steps of results-based planning in designing a domestic MRV system on its own does not have a direct impact the quality of the system.
- Instead, the quality of a domestic MRV system depends heavily on the implementation of the system, the resources available for implementation, output frequency of the system, frequency of reviewing, monitoring and evaluating the system, as well as availability of guidance on how to adhere and improve the quality of the system. Thus, there is a need to go beyond results-based planning to results-based management to improve the quality of MRV systems. As such, the second part of the hypothesis, that asserts that utilizing results-based planning improves the quality of the domestic MRV systems has been refuted.

This point marks the end of the results chapters of this thesis. The next chapter is the concluding chapter of the thesis. It focuses on consolidating all the findings and conclusions made in this thesis and demonstrates how the thesis has contributed to knowledge in climate change research and practice.

10 Conclusions

This concluding chapter presents a summary of the key research findings in relation to the research objective, the key research questions and the hypothesis, and it discusses the value and contribution of the thesis to knowledge. In addition, the chapter identifies and proposes opportunities for future research.

10.1 Objectives and hypothesis

MRV, which has been defined in this thesis as **"a monitoring and evaluation process involving information and data related to climate change and the response to it",** is essential in climate change response to build mutual trust and confidence among stakeholders and to promote effective implementation. As such the UNFCCC has established an MRV framework for climate information that has been evolving over the years, requiring countries to report specific information at given frequencies.

The Paris Agreement, which represents the latest global, multi-lateral approach to long-term climate action, has built on the UNFCCC MRV framework, establishing an enhanced transparency framework that has brought about additional requirements for reporting by all countries. Also, as part of implementing the UNFCCC and its Paris Agreement, countries have been establishing climate change policies, strategies, laws and plans at domestic and regional levels, and many of these have come with their own reporting requirements as well.

To enable themselves to effectively respond to these different MRV needs, countries have been setting up domestic MRV systems, defined in this thesis as "**sets of domestic arrangements, including institutional, legal and procedural arrangements, established for the purposes of or to support MRV"**. However, ensuring full relevance of these systems to all their reporting requirements as well as maintaining high quality of their outputs has been a challenge for most countries, and this, in turn, has jeopardized the ability of those MRV systems to effectively support global climate action.

This thesis firstly set out to investigate the factors that affect the relevance and quality of domestic MRV systems, and this included understanding the drivers for developing domestic MRV systems in the different countries and how the countries have established their MRV systems. Secondly, it set out to propose a framework which countries can use to establish fully relevant and high-quality systems. In responding to the second part of the objective, it was hypothesised that **"Results-based planning through logical modelling ensures maximum relevance of domestic MRV systems and improves their quality",** and this hypothesis was investigated and tested throughout the thesis.

10.2 What is Results-based planning for domestic MRV systems?

From the theory of programme planning, it was determined that domestic MRV systems can be classified as programmes, which are defined in literature as "means-to-end chains or sets of resources and activities directed towards bringing about specified changes or achieving one or more common goals". Programme planning theory is therefore applicable to the establishment of domestic MRV systems.

The thesis further found that results-based planning through logic modelling, is the most common and preferred approach to programme planning because it ensures that evaluation is integrated into every step of the programme cycle. Application of this planning approach to domestic MRV systems involves five steps as follows: 1) Assessing MRV needs, 2) defining and analysing the problem, 3) selecting the MRV interventions required, 4) describing goals and objectives of the MRV system and 5) designing the system. The fifth step entails logical sequencing of the elements of the domestic MRV system, showing the cause-and-effect linkages of its inputs, activities, outputs and outcomes. This is illustrated in the Figure below.

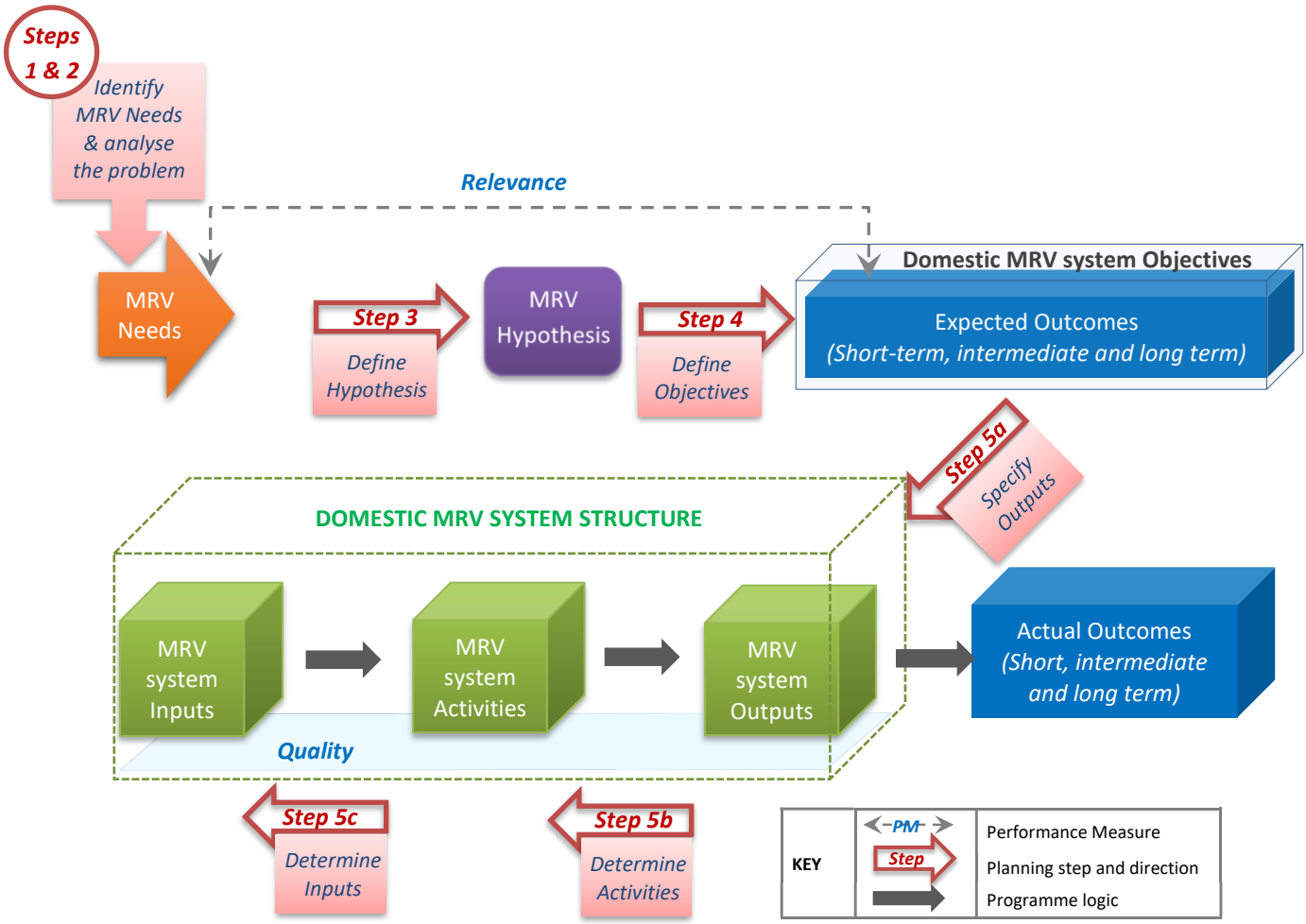


Figure 61: Theoretical framework for results-based planning of domestic MRV systems

This application of results-based planning to domestic MRV systems, described in more detail in Chapter 3, formed the theoretical framework upon which the rest of this thesis was based. It is the basis upon which the definitions of relevance and quality of domestic MRV systems were based, as well as the basis upon which sequencing of the thesis and interpretation of the results were based. Moreover, it is this planning approach which has been hypothesized to ensure maximum relevance of domestic MRV systems and to improve their quality.

Findings of the thesis in relation to the objectives, the hypothesis, and the key research questions are presented in the sections that follow.

10.3 Why and how have countries established domestic MRV systems?

It was determined in Chapter 5 that MRV needs that countries' domestic MRV systems need to respond to can be classified into international, regional and domestic MRV needs. International needs were found to arise from the annual or biennial monitoring and reporting requirements under the UNFCCC, the Paris Agreement's enhanced transparency framework and the OECD's Development Assistance Committee, while only the EU and its member states have regional domestic MRV needs from the reporting requirements of the EU regulation on Mechanism for Monitoring and Reporting Mechanism as well as the Governance regulation.

Domestic MRV needs, on the other hand, are the climate change reporting and information needs expressed by the countries through various means, including verbally, in their climate related legislation, policies, strategies, executive orders or other published government. On domestic MRV needs, the Lesotho Case study, in Chapter 8, revealed that published climate related national documents are sufficient for determining all the key domestic MRV needs expressed by a country, and there is generally no need to further collect verbally expressed domestic needs from stakeholders because these have already been covered by the published documents.

Still in Chapter 5, from the assessment of the countries' domestic MRV needs, it was observed that while most of those needs are the same as the MRV needs under the UNFCCC, there are several unique MRV needs that some countries have expressed domestically, which do not appear under the UNFCCC MRV framework. These are these are the need for monitoring and tracking climate change, the need for monitoring the effectiveness of climate finance as well as the need for tracking domestic climate finance.

From studying the domestic MRV systems of 11 countries, several key findings on how countries have established their systems in response to their respective international, regional and domestic MRV needs were made in Chapter 6 as follows:

General approach used: It was found that countries can be categorized into three groups, in terms of the approaches they have used in designing their domestic MRV systems: 1) those countries which fully employed results-based approach using logical modelling, following all the five steps of the approach; 2) those which employed results-based approach to a limited extent, only going as far as step four (defining objectives and envisaged outcomes), but not outlining the logic models and structures of their systems; and 3) those that have not employed result-based planning and have not specified the approach followed. Among these three groups of approaches, the second – of following results-based planning to a limited extent – was found to be most prevalent, with 42% of the countries studied (including the case study country) falling in that group, while 33% and 25% of the countries fell in the first and third group respectively.

MRV of emissions: it was observed that all countries have national GHG inventory systems as part of their domestic MRV systems. For all the developed countries, the primary motivation for this was found to be the need to meet UNFCCC reporting requirements, while for developing countries a range of primary reasons was found, with the most common being the need to respond to national MRV requirements and objectives.

MRV of mitigation: It was found that there is lower uptake and appetite of establishing mitigation MRV systems by developed countries compared to developing countries.

MRV of adaptation: It was determined that most countries are keen to establish MRV systems that focus on both adaptation MRV as well as MRV of climate risks, impacts and vulnerabilities, but these systems are much less mature compared to MRV systems in other themes. Furthermore, it was observed that countries are struggling to successfully establish adaptation MRV systems that are able to assess the extent to which adaptation measures reduce vulnerability or improve the country's adaptive capacity.

MRV of means of implementation (MoI): After the GHG inventory systems, MoI MRV systems are the most common systems that countries have established, and it was observed that developing countries tend to prioritize MRV of climate finance over that of capacity building and technology transfer. It was also observed that countries tend to couple MRV of technical transfer and capacity building with that of climate finance, with developed countries leveraging off their existing international ODA monitoring systems to track the climate-related support they give to developing countries.

Periodic Reviews: Finally, it was observed that periodic reviews of the domestic MRV systems play a critical role in the improvement of those systems over time. This was one of the main and critical findings of this thesis, affecting both the relevance and quality of domestic MRV systems as shown in the two sections that follow.

10.4 How can relevance of domestic MRV systems be maximized?

The thesis found that relevance of domestic MRV systems can be defined as the extent to which the objectives and expected outcomes of the systems are consistent with or respond to the respective countries' MRV needs. This means that relevance can be fully achieved at the planning stage, even before the system is implemented, by ensuring the system's objectives and envisaged outcomes respond to all the MRV needs of the respective country.

The following are the four main findings of this thesis in relation to relevance of domestic MRV systems from Chapter 7:

Firstly, while relevance is historically assessed qualitatively, it was found that a quantitative relevance index, defined as "***the percentage of a country's MRV needs that the objectives and expected outcomes of its domestic MRV system respond to"*** can be successfully used to objectively evaluate, monitor and compare the relevance of domestic MRV systems.

Secondly, it was found that continuous evolution of the UNFCCC MRV framework as well as changes in domestic and regional MRV needs generally affect the relevance of existing domestic MRV systems negatively, reducing their relevance index by as much as 26% if no enhancements are made to those systems to respond to the new MRV needs.

Thirdly, it was observed that it is possible for countries to establish domestic MRV systems that are relevant to 100% of their MRV needs, hence achieving maximum relevance. In particular, utilizing results-based planning through logic modelling to establish domestic MRV systems can result in maximum relevance for those systems, provided the planning process is undertaken correctly, by competent personnel and is ideally coupled with periodic review, monitoring and evaluation of the

systems. This requires that a comprehensive assessment of all international, regional and domestic MRV needs be undertaken, and all the country's MRV needs be equally responded to in the design of the domestic MRV system by ensuring that the envisaged outcomes and objectives address all the identified needs. This finding was also confirmed by the case study in Chapter 8.

Lastly, it was found that developing countries should be able to maximise the relevance of their systems as much as developed countries because ensuring relevance of domestic MRV systems is much less dependent on the capacity, financial muscle or technology that the countries have, compared to ensuring quality.

The above findings can be synthesized into the following conclusions that directly address the objectives, key questions and hypothesis of this thesis in relation to relevance of domestic MRV systems:

- Results-based planning through logical modelling, if done correctly, comprehensively, and by an adequately skilled and experienced team, can ensure maximum relevance of the domestic MRV system.
- This means that the first part of the hypothesis, stating that results-based planning through logical planning ensures maximum relevance of domestic MRV systems, is supported by findings of this thesis.
- Periodic review, monitoring and evaluation of the domestic MRV system play important roles in maximizing the relevance of existing domestic MRV systems.

10.5 How can high quality domestic MRV systems be established?

In addition to relevance, this thesis also focused on quality, where it set out to determine factors that affect the success and failure of establishing domestic MRV systems of high quality and to test the second part of the hypothesis stating that results-based planning through logical modelling improves the quality of domestic MRV systems.

The thesis showed that quality has various dimensions, and that transparency, adequacy, completeness, comparability, consistency and timelines (aka TACCCT) are appropriate quality principles for domestic MRV systems, from which more detailed sets of quality criteria can be specified. This signifies an addition of the timeliness principle to the typical TACCC quality principles for GHG inventories and those specified in the decisions that established the Paris Agreement. Furthermore, it was found that, unlike relevance assessment, quality assessment of domestic MRV systems using the TACCCT principles requires the systems to have been operational long enough for its outputs and outcomes to have been realized, which is a minimum of two reporting cycles.

For each of the TACCCT principles, a list of underlying quality criteria was defined for each principle to assess the quality of domestic MRV systems at input, activity and output levels as applicable. Then a semi-quantitative five-level rating scale was adopted for the assessment, ranging from the lowest score of 0 (No adherence to the criterion) to a maximum score of 4 (Full adherence to the criterion). The rest of the quality assessment in this thesis was then based on this rating approach.

Based on the underlying quality criteria defined for each of the TACCCT principles as well as a semi-quantitative rating scale for adherence to each criterion, the following key findings and conclusions on the quality of domestic MRV systems were drawn in Chapter 0 of this thesis.

Firstly, it was observed that GHG inventories have the highest average adherence to the TACCCT principles compared to other types of MRV systems. This domination by GHG inventory systems was found to be the result of having five of the TACCCT principles being explicitly required for GHG inventories under the UNFCCC, as well as the availability of guidance on how to improve them for GHG inventories in the form of the IPCC guidelines for national GHG inventories, while there is no comparable guidance for other thematic MRV systems.

Secondly, comparing across the different quality principles, it was found that completeness is the most adhered to of all the quality principles, while accuracy was found to be the least adhered to. On the other hand, comparing across MRV themes, revealed that ex-post and ex-ante mitigation MRV systems have the lowest average adherence to the quality principles among all thematic systems.

Lastly, it was found that following the five steps of results-based planning alone in designing a domestic MRV system does not have a direct impact on the quality of the system. Instead, there is a need for results-based management, which goes beyond the planning phase and includes implementation, monitoring and evaluation of the system. This is because the quality of a domestic MRV system depends heavily on how the system is implemented, the resources available for implementation, output frequency of the system, frequency of reviewing, monitoring and evaluating the system, as well as availability of guidance on how to adhere to and to improve the quality of the system. In particular, availability of resources, high output frequency and frequent technical expert reviews we found to have significant impact on improving the quality of domestic MRV systems. At the planning phase, this means that specifying the TACCCT principles that the domestic MRV system needs to adhere to on its own during the planning process is insufficient to improve quality, rather this needs to be translated into a comprehensive monitoring and evaluation framework for the system. The latter is specified in Chapter 0 as a necessary and critical to follow immediate after the five steps of result-based planning.

The above findings can be synthesized into the following conclusions that directly respond to the objectives, key questions and hypothesis of this thesis in relation to quality of domestic MRV systems:

- Transparency, accuracy, completeness, comparability, consistency and timeliness (TACCCT) adequately capture the quality of domestic MRV systems.
- Following the five steps of results-based planning on its own does not improve the quality of domestic MRV systems, instead there is a need to go further to implement results-based management.
- This is because the quality of domestic MRV systems is heavily dependent on the implementation, monitoring and evaluation of the system.
- This means that the second part of the hypothesis, asserting that the use of results-based planning through logical modelling improves the quality of domestic MRV systems, is not supported by findings of this thesis.
- Availability of resources and frequency of outputs also play significant roles in the improvement of the quality of domestic MRV systems.

- Finally, there is need for comprehensive guidance, similar to the IPCC guidelines for national GHG inventories, to give guidance on how the TACCCT quality principles for domestic MRV systems in other themes can best be assessed, monitored and improved.

10.6 Limitations and opportunities for future studies

While the thesis has answered all the key questions that it set out to answer, some limitations were noted as well as new questions and further opportunities that could be subjects of future studies. These have been outlined below.

Limitations to studying other performance measures: In addition to relevance and quality, there are other performance measures for which domestic MRV systems may evaluated, which may also be affected by the constant evolution of the UNFCCC MRV Framework, and these include adequacy, effectiveness, cost-effectiveness, and efficiency. However, this thesis has only focused on relevance and quality because of two reasons: 1) limited or non-availability of data required to objectively and comprehensively assess the other performance measurements, particularly information on achieved outcomes, which is central to all the other performance measures; 2) Limitation on the size of a PhD thesis to no more than 80,000 words has also meant that no more than two performance measures could be studied in detail, without leading to an excessively long thesis..

Limitations related to MRV systems of EU countries: The thesis was able to determine that countries generally prioritize their domestic MRV needs over their international MRV needs when establishing their domestic MRV systems. In terms of the regional EU MRV needs, it was found that the German and UK domestic MRV systems have the least relevance to their regional EU MRV needs, compared to their domestic and international MRV needs, which may suggest that EU countries are prioritizing domestic and international MRV needs over their EU MRV needs when establishing their systems. However, with only two EU countries having been included in this study, one of which is no longer an EU member, it was not possible to extend this finding to the entire EU member states because of the small sample size of two countries out of 27.

Limited by the number of evaluable MRV systems: Other than for GHG inventory systems and MRV systems of means of implementation, only one or two of the other thematic MRV systems met the minimum requirements for quality evaluation (i.e. ex-post and ex-ante mitigation MRV systems, systems in the adaptation MRV theme and emission projection systems), and this restricted the comparisons and trend analyses that could be made for those systems, as well as making findings that could confidently be applied to all countries.

General opportunity: While the selected quality criteria for the TACCCT principles are adequate for most purposes, including for completing this thesis, they are in no way exhaustive. There exists an opportunity to build on and to enhance them through additional criteria or redefining the existing ones. One area of improvement was identified in relation to New Zealand, where it was found that the country has since improved its MRV system for means of implementation to better capture information on capacity building, improving on the OECD DAC Rio markers by adding an additional marker. Seeing that this is an enhancement or improvement on the country's domestic MRV system, it is expected to lead to improved quality of the country's MoI MRV system, but none of the quality criteria defined in this study was able to capture effects of this improvement on the quality of the country's system. It is recommended that a future study be undertaken to explore and investigate

additional quality criteria or refinements of the current quality criteria that can be made to further improve the assessment of quality of domestic MRV systems.

Opportunity to improve assessment of completeness: The two criteria that were selected for completeness of domestic MRV systems relate to completeness in terms of sectorial and geographical coverage. It was, however, found that there were other dimensions of completeness that could not be captured through those two criteria. For instance, in mitigation MRV, many systems include mitigation actions in all sectors of the country's economy as well as mitigation actions in all geographical areas of the country, hence deemed to fully adhere to the completeness principle, but in most cases those systems don't actually include all mitigation actions in all sectors or all mitigation actions in the country. Similarly, the selected completeness criteria were unable to capture the fact that an MoI MRV system does not cover all types of climate finance, e.g private climate finance which is hardly ever covered in MoI MRV systems of many countries.

Thus, as an area of further study, it is recommended that for future studies the underlying criteria of completeness be broadened and enhanced to be able to distinguish between two systems that both have complete geographical and sectorial coverage, but the quality of one is better in terms of 1) inclusion of all relevant mitigation measures implemented in the country, 2) coverage of relevant emissions sources (for GHG inventory systems), and/or 3) coverage in terms of the types of climate finance assessed, including private climate finance.

Opportunity to improve assessment of accuracy: for the three accuracy criteria used in this study – uncertainty analysis, 3rd party or public review and use of latest methods and protocols – domestic MRV systems were scored based on the extent to which these criteria are adhered to. What this kind of scoring was not able to capture was the quality or depth of such a 3rd party review or the uncertainty analysis or how well the latest methods and protocols were employed. This meant that two domestic MRV systems wherein uncertainty analysis is always done and documented for all the data will always achieve the same accuracy score even if one may be undertaking the uncertainly analysis well and the other does it poorly. Hence there remains an opportunity for future studies to explore how the quality of these three activities that related to the accuracy quality criteria can be incorporated into the score.

Opportunity for a case study focused on quality: The Lesotho case study allowed for the process of designing a country's domestic MRV system to be studied closely as it unfolded, allowing for an in-depth analysis and understanding of the process followed in developing the system and the rationale on how it was designed in a particular way. It also allowed for interaction with the key stakeholders. However, because the system was only in the design phase during the research period of this thesis and had not been operational yet, it meant that this case study could only focus on relevance. Therefore, there remains an opportunity for a similar case-study which will focus on quality. Such a case study could follow a country as it implements its system over two or three reporting cycle, interrogating reasons and drivers for choices in adopting specific quality criteria and monitoring changes in the quality of the system over time.

10.7 Contributions of the thesis

The contributions that this thesis makes to knowledge will not only be useful to climate change practice, policymaking and research, but they can also be useful in other fields outside climate change, particularly the fields of results-based planning, monitoring and evaluation. This section presents the three main contributions of this thesis, as well as a list of several minor, but noteworthy, contributions.

The thesis has presented a novel and comprehensive domestic MRV planning framework by applying results-based planning to MRV of climate action. This first major contribution of the thesis has been achieved by combining the theoretical concepts from the fields of results-based planning, monitoring and evaluation, with empirical evidence from the climate change space into a new planning framework that can assist countries to establish domestic MRV systems that achieve maximum relevance and high quality. This contribution is particularly timely and important now as the deadline of the 31st of December 2024 for all countries to have transitioned to the more demanding enhanced transparency framework of the Paris Agreement gets closer, and countries are looking for guidance on how to establish domestic systems that will assist them to properly respond to those reporting requirements of the ETF. As revealed by the review of relevant literature, the existing guidelines and toolkits, aimed at supporting establishment of domestic MRV systems, focus on ensuring sustainability of the systems instead of relevance or quality of the systems. This thesis, on the other hand, has demonstrated that planning for results through logical modelling ensures maximum relevance of domestic MRV systems, provided it is carried out correctly, by appropriately skilled and experienced personnel.

Furthermore, the review of literature revealed that the existing body of literature has simultaneously studied and compared MRV results of at most three thematic MRV systems. A second main contribution of this thesis is that it has studied and presented a more comprehensive analysis that covers and compares results of all the thematic MRV systems, including their respective sub-themes.

In addition to the two contributions above, this study has also contributed to the body of knowledge on monitoring and evaluation. Most of the literature in that field focuses on typical developmental programmes, but this study brings a new perspective and found that monitoring and evaluation systems, especially those that analyse climate-related information (a.k.a. MRV systems), can be categorized as programmes which can also benefit from being monitored and evaluated. The categorisation of M&E systems developed in this thesis contributes a key operational element to implementing domestic MRV systems, as well as other types of M&E systems, thus making a significant contribution to the M&E literature.

Additionally, the thesis has made the following specific contributions to the body of knowledge:

- The thesis has applied and tested the definition of relevance in relation to domestic MRV systems, contributing to the understanding of the application of how performance measures can be applied to MRV systems.
- Also, while relevance is generally assessed qualitatively, the thesis has defined and tested a new quantitative relevance index that can be used to objectively assess, monitor, evaluate and compare the relevance of different domestic MRV systems.
- Finally, the thesis has identified and tested a set of quality principles that can be used for assessing, monitoring, evaluating and comparing the quality of domestic MRV systems. To the

well-known TACCC principles, the thesis has added the principle of timeliness to make up a new set of quality principles for domestic MRV systems, abbreviated TACCCT.

This is the end of the thesis.

Appendix A: Data-collection

A.1. Data-collection Questionnaires

Two types of questionnaires were used: 1) General questionnaire for all countries (except Case Study country) and 2) Lesotho Case Study Questionnaire. Preceding the questionnaires, each respondent was given a project information sheet summarizing the details of the project as well as the respondents' rights and expectations. The Information Sheet and the questionnaires are presented below.

A.1.1. Project Information Sheet

PROJECT INFORMATION SHEET

PhD Project Title: Establishing relevant and high-quality domestic MRV systems for long-term climate Action

My name is **Thapelo Letete** and I am PhD student at the University of Cape Town's (UCT) Energy Research Centre. My doctoral research project focuses on domestic measurement, reporting and verification (MRV) or transparency-related systems for climate change in different countries, and I would like to invite you to assist with relevant research data by answering a few questions presented in the form of a questionnaire (attached hereto).

RESEARCH BACKGROUND

In 2015, the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) adopted the Paris Agreement with the objective of keeping average global temperature rise below 2 degrees and as far as possible below 1.5 degrees. The Paris Agreement requires ambitious and systematic response to climate change by all Parties, supported by an enhanced transparency framework. Thus, Parties need to establish, at domestic level, MRV Systems that are relevant and of high quality to address all their long-term climate action needs, including the reporting needs of the Paris Agreement and the Convention. Most Parties, however, have not been developing systems that meet these criteria. Thus, there is a need for a globally adaptable tool to inform and support Parties to develop, improve and implement their MRV systems such that they are relevant and of high quality.

RESEARCH OBJECTIVES

The objective of this research is to develop a globally adaptable framework that countries can use to establish relevant and high quality national MRV systems, based on experiences of various countries around the world as well as relevant theories.

PRINCIPLES GUIDING THE QUESTIONNAIRES

1. **Voluntary nature of Participation** – Please understand that you are under no obligation to participate in this research, i.e., your participation is voluntary. The choice to participate is yours alone. If you choose not to participate, there will be no negative consequences. If you choose to participate, but wish to withdraw at any time, you are free to do so without negative consequences. However, I would be grateful if you would assist me by completing the questionnaire or interview.

2. **What is expected from the participants** – Participation in this research only entails responding to the questionnaire questions.

3. **Use of data** – With the exception of your contact information, the data and information collected through the questionnaire will be used in the analysis, conclusions and recommendations of the research. If there is any information that you do not want used in the research, provision is made at the end of the questionnaire or interview for you to specify this.

4. **Acknowledgements, anonymity and confidentiality –** Your participation in this project will be explicitly acknowledged and referenced in the research outputs. However, if you wish to remain anonymous and wish that confidentiality be applied to your inputs and identity, this will be ensured.

5. This research shall adhere to the UCT ethics policies for research which can be accessed via the following link: https://www.uct.ac.za/about/policies/ .

I wish to thank you in advance for your willingness to assist with this PhD research.

Thapelo Letete.

A.1.2. General Questionnaire:

PhD Research Questionnaire

Research Title: Establishing relevant and high quality domestic MRV systems for long-term climate action

By

Thapelo Clifford Mohale Letete

Student No: LTTTHA001

SUPERVISORS: Professor Harald Winkler & Dr Brian Mantlana

INSTITUTION & FIELD OF RESEARCH:

Energy Research Centre, Department of Mechanical Engineering, University of Cape Town

Energy and Climate Change

QUESTIONNAIRE STRUCTURE:

I. Country & Respondent Details
II. General Information about the domestic MRV/M&E system(s)
III. Methods and Processes
IV. Key principles of the system(s)
V. Other information
VI. Confidentiality

I. Country & respondent details

Name of the country:			
Details of main respondent • Name • Designation • Name of Institution • Email address • Telephone number	• • • • •		
Physical address of main respondent			
Details of other contributors to questionnaire response	Name 1. 2. 3	Designation 1. 2. 3	Name of Institution 1 2 3

II. General information about domestic MRV / M&E System(s) specific to climate change information

1. Does the country have domestic MRV / M&E system(s)?

☐ None ☐ Yes, one integrated system ☐ Yes, multiple systems

(*Please click on the boxes to check or un-check*)

2. Give the name(s) and status of the MRV/M&E system(s):

Name of MRV / M&E system	Status *(in design phase, operational, etc.)*	1st year of operation / design completion *(year)*

3. Summary of the system(s): *(please check the appropriate answers below)*

4. Geographical coverage of the MRV/M&E system(s)

☐ Economy-wide ☐ certain economic sectors only ☐ Regional

a. *What is the scope and frequency of reporting & analysis for the MRV/M&E system(s)?*

(Please answer by checking boxes as appropriate)

MRV Scope *(Please check where applicable)*	The frequency of data-collection, reporting & analysis				
	More frequent than annually	Annually	Biennially	Every 4 years	Ad-hoc basis
☐ GHG inventories	☐	☐	☐	☐	☐
☐ Mitigation actions / measures	☐	☐	☐	☐	☐
☐ Emission projections	☐	☐	☐	☐	☐
☐ Climate impacts, risks & vulnerabilities	☐	☐	☐	☐	☐
☐ Adaptation actions	☐	☐	☐	☐	☐
☐ Climate finance	☐	☐	☐	☐	☐
☐ Technology transfer	☐	☐	☐	☐	☐
☐ Capacity-building	☐	☐	☐	☐	☐
☐ Information on market use	☐	☐	☐	☐	☐
☐ Other (specify below): _____	☐	☐	☐	☐	☒

b. *Website or address of the online database(s) / platform(s) of the system(s)*

www…

www…

5. Background

- What motivated the country to develop the system(s)? – *mention all reasons if more than one*
- What are the national laws, decrees, policies or strategies that **enable** or **support** the establishment and/or implementation of the MRV/M&E system(s) in the country?

- MOTIVATION / REASONS FOR ESTABLISHING THE SYSTEM(S):
- ENABLING LAWS, POLICIES, DECREES AND STRATEGIES:

Law, policy, strategy, decree, etc. *(Please check where applicable)*	Enabled / supported / legislated MRV area *(tick where applicable)*							
	GHG inventory	Mitigation action MRV	Emission Projections	Climate risks & impacts	Adaptation M&E	Climate Finance MRV	Capacity building MRV	Technology Transfer / dev. MRV
1.	☐	☐	☐	☐	☐	☐	☐	☐
2.	☐	☐	☐	☐	☐	☐	☐	☐
3.	☐	☐	☐	☐	☐	☐	☐	☐
Add rows if necessary	☐	☐	☐	☐	☐	☐	☐	☐

6. Overall Objectives and Intended outcomes • What are the objectives of the system(s)? • What are the intended outcomes of the system(s)?	OBJECTIVES: • • INTENDED OUTCOMES: • •
7. General description of the MRV/M&E system(s) Please give a schematic (diagram) description of the MRV/M&E system(s), including: • Inputs, processes and outputs • components and information flows of the system(s) • Institutional arrangements • The IT platforms used to report and share information • Indicators	*Both words and diagrams may be used…*
8. Overall Design and Set-up *[Questions below should be answered only when applicable]* a) Was logical framework or logical modelling approach used design and establish the system(s)?	☐ Yes, logical framework was used to design the FULL system(s) ☐ Yes, logical framework was used to establish PART of the system(s) ☐ No, another approach was used (specify):_____ ☐ Multiple approaches were used as follows: • • •
b) Summarize the overall process followed to develop or establish the overall MRV/M&E system?	OVERALL PROCESS SUMMARY:

c) How were the resources or inputs of the system(s) determined? *Including:* *- number of people* *- financial requirements* *- IT tools / platforms* *- guidelines / regulations* *- Memoranda of Understanding, etc.*	Process used to determine resources needed:

III. Methods, Processes and achieved outcomes / objectives

1. GHG inventory system

[Questions below to be answered only when applicable]

a. Which GHG inventories have been compiled through the GHG inventory system?

GHG INVENTORY SYSTEM ESTABLISHMENT YEAR:

(Tick all that apply)	Specify Inventory years	Specify Publication years
☐ Annual inventories	From:	From:
☐ Inventories for specific years	Years:	Years:
☐ None		

b. Please summarize the GHG inventory system including:

- The processes and institutional arrangements of the GHG inventory system.
- How data is collected, verified or quality-assured at each stage
- Methods and guidelines used
- Tools and web-platforms used for data-gathering and estimations
- data-archiving processes

SUMMARY OF THE GHG INVENTORY SYSTEM: *(In a diagram and/or words)*

2. MRV of Mitigation policies, actions and measures (PAMs)

[Questions below to be answered only when applicable]

i. What are the objectives and **intended** outcomes of Mitigation MRV?

Year of establishment of the MRV system for PAMS:

INTENDED OUTCOMES AND OBJECTIVES OF THE MRV OF MITIGATION PAMs:

-
-
-
-

ii. Which Sectors and Mitigation PAMS are **intended** to be covered?

(Tick as appropriate)	Specify Sectors	Specify PAMs
☐ Specific PAMs in specific sectors		
☐ All sectors + All relevant PAMs		

iii. Please summarize the MRV system for Mitigation PAMs including:

- The processes and institutional arrangements of the system.
- How data is collected, verified or quality-assured at each stage
- Methods and guidelines used
- Tools and web-platforms used for data-gathering and estimations
- data-archiving processes
- co-benefits / co-costs of mitigation actions estimated

SUMMARY OF THE MITIGATION PAMs MRV SYSTEM: *(In a diagram and/or words)*

3. Projections of GHG emissions and removals

[Questions below to be answered only when applicable]

a) What are the intended objectives and outcomes of GHG emission projections?

b) Which Sectors and Mitigation PAMS are **intended** to be covered?

FIRST YEAR OF SYSTEMATIC EMISSION PROJECTIONS:

INTENDED OUTCOMES AND OBJECTIVES OF PROJECTIONS:

-
-
-
-

(Tick as appropriate)	Specify Sectors	Specify PAMs
☐ Specific PAMs in specific sectors		
☐ All sectors + All relevant PAMs		

c) Please summarize the process of projecting emissions and removals including:

- The processes and institutional arrangements.
- Models, methods and guidelines used
- How data is collected, verified or quality-assured at each stage

SUMMARY OF THE GHG PROJECTION PROCESS: *(In a diagram and/or words)*

- data-archiving processes
- Scenario development
- Identification and screening of mitigation options

4. Climate impacts and vulnerability M&E

[Questions below to be answered only when applicable]

A. What are the **intended** objectives and outcomes of climate impacts and vulnerability M&E?

B. Which Sectors are **intended** to be covered?

FIRST YEAR OF CLIMATE IMPACTS AND VULNERABILITY M&E IMPLEMENTATION:

A. INTENDED OUTCOMES AND OBJECTIVES:

-
-
-

(Tick as appropriate)	Sectors to be covered	Assessment frequency
☐ Observed climate trends		
☐ Current and projected climate risks and vulnerabilities		
☐ Observed and potential climate impacts		

C. Please summarize the climate impacts and vulnerability M&E System including:

- The indicators used for M&E of climate impacts and vulnerability
- The processes, tools and institutional arrangements
- How information/data is collected, reported and assured at each stage of the M&E chain
- methods used to link the observed impacts to climate change
- Guidelines used or followed

SUMMARY OF THE CLIMATE IMPACTS & VULNERABILITY M&E SYSTEM: *(In a diagram and/or words)*

5. Adaptation M&E

[Questions below should be answered only when applicable]

FIRST YEAR OF ADAPTATION M&E:

INTENDED OUTCOMES AND OBJECTIVES:

-
-
-

i. What are the **intended** objectives and outcomes of climate impacts and vulnerability M&E? ii. Which areas of M&E are **intended** to be covered by the system?	*(Tick as appropriate)*	Intended assessment frequency
	☐ Adaptation priorities and barriers	
	☐ List and description of adaptation PAMs	
	☐ Progress in implementation of adaptation PAMs	
	☐ Impact and effectiveness of adaptation PAMs	
	☐ Management of loss and damage	
iii. Please summarize the Adaptation M&E System including: • The indicators used for M&E of adaptation • The processes, tools and institutional arrangements • How information/data is collected, reported and assured at each stage of the M&E chain • Guidelines used or followed	Process and indicators for identifying adaptation priorities and barriers: Process and indicators for M&E of adaptation PAMs: Process for managing loss and damage:	

SUPPORT MRV	**6. Climate Finance MRV**	**7. Capacity-Building (CB) MRV**	**8. Technology Transfer & Development MRV**
a) First year of assessment:			
b) What are the **intended** objectives and outcomes of each of the support MRV systems?	• • • •	• • • •	• • • •
c) What is the **intended** coverage for each MRV system? *(tick where applicable)*	☐ International finance received ☐ Finance needed ☐ Finance provided to developing countries ☐ Domestic finance received	☐ CB received ☐ CB needed ☐ CB provided to developing countries	☐ Technology received ☐ Technology needed ☐ Technology transferred to developing countries ☐ Technology developed locally
d) Locally-adopted definition of finance, capacity-building and technology transfer / development (IF ANY):	Finance definition:	Capacity-building definition:	Technology transfer / development definition:
e) Indicators	• • • •	• • • •	• • • •

f) Please summarize each system including:
- The processes, tools and institutional arrangements
- How information/data is collected, reported and assured at each stage of the M&E chain
- Guidelines used or followed

g) Support MRV results since the systems were established:

Finance RECEIVED (international & domestic):

Publication year	Assessment period

Capacity building RECEIVED:

Publication year	Assessment period

Technology RECEIVED / developed locally:

Publication year	Assessment period

Finance NEEDED:

Publication year	Assessment period

Capacity building NEEDED:

Publication year	Assessment period

Technology NEEDED:

Publication year	Assessment period

Finance PROVIDED to developing countries:

Publication year	Assessment period

Capacity building PROVIDED to developing countries:

Publication year	Assessment period

Technology TRANSFERRED to developing countries:

Publication year	Assessment period

IV. Key Principles

In this section, information about the extent to which the following principles have been integrated into the M&E/MRV system(s) is requested:

A. **Transparency**: The process is open, accessible and comprehensible to relevant audiences, and the system's data, methodologies and results are available to be tested and scrutinized by the public and other stakeholders.
B. **Accuracy**: the system, methodologies and data are well-vetted and independently reviewed
C. **Consistency**: Consistency in how data are calculated and presented over time.
D. **Completeness**: The system covers all data required for domestic policymaking and climate action, and for international requirements.
E. **Comparability**: information is comparable across time, institutions, and different levels of government and other countries' data or reports
F. **Timeliness**: The system delivers information in a timely manner.

A. **Transparency** *(Please answer by checking the relevant boxes)*

MRV area	To what extent are these being done or adhered to?	1. Underlying data made publicly available?	2. Processes and methods used publicly made available?	3. Systematic record keeping of key decisions, documents and data?
GHG inventory system	**NOT** Done	☐	☐	☐
	RARELY done	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐
	MOSTLY done	☐	☐	☐
	ALWAYS done	☐	☐	☐
Mitigation actions MRV/M&E	**NOT** Done	☐	☐	☐
	RARELY done	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐
	MOSTLY done	☐	☐	☐
	ALWAYS done	☐	☐	☐
Climate impacts M&E/MRV	**NOT** Done	☐	☐	☐
	RARELY done	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐
	MOSTLY done	☐	☐	☐
	ALWAYS done	☐	☐	☐
Adaptation actions M&E	**NOT** Done	☐	☐	☐
	RARELY done	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐
	MOSTLY done	☐	☐	☐
	ALWAYS done	☐	☐	☐
Climate finance MRV / M&E	**NOT** Done	☐	☐	☐
	RARELY done	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐
	MOSTLY done	☐	☐	☐
	ALWAYS done	☐	☐	☐
Technology transfer or development M&E / MRV	**NOT** Done	☐	☐	☐
	RARELY done	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐
	MOSTLY done	☐	☐	☐
	ALWAYS done	☐	☐	☐
Capacity-building MRV / M&E	**NOT** Done	☐	☐	☐
	RARELY done	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐
	MOSTLY done	☐	☐	☐
	ALWAYS done	☐	☐	☐
Emission Projections	**NOT** Done	☐	☐	☐
	RARELY done	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐
	MOSTLY done	☐	☐	☐
	ALWAYS done	☐	☐	☐

B. Accuracy *(Please answer by checking the relevant boxes)*

MRV area	To what extent are these being done or adhered to? →	1. Data and methods subjected to 3rd-party or public review?	2. Process for identifying and measuring uncertainty documented?	3. The most up-to-date methods and protocols used?	4. Competency of the personnel and institutions ensured?
GHG inventory system	**NOT** Done	☐	☐	☐	☐
	RARELY done	☐	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐	☐
	MOSTLY done	☐	☐	☐	☐
	ALWAYS done	☐	☐	☐	☐
Mitigation action	**NOT** Done	☐	☐	☐	☐
	RARELY done	☐	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐	☐
	MOSTLY done	☐	☐	☐	☐
	ALWAYS done	☐	☐	☐	☐
Climate impacts M&E/MRV	**NOT** Done	☐	☐	☐	☐
	RARELY done	☐	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐	☐
	MOSTLY done	☐	☐	☐	☐
	ALWAYS done	☐	☐	☐	☐
Adaptation actions M&E	**NOT** Done	☐	☐	☐	☐
	RARELY done	☐	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐	☐
	MOSTLY done	☐	☐	☐	☐
	ALWAYS done	☐	☐	☐	☐
Climate finance MRV	**NOT** Done	☐	☐	☐	☐
	RARELY done	☐	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐	☐
	MOSTLY done	☐	☐	☐	☐
	ALWAYS done	☐	☐	☐	☐
MRV of Technology transfer or development	**NOT** Done	☐	☐	☐	☐
	RARELY done	☐	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐	☐
	MOSTLY done	☐	☐	☐	☐
	ALWAYS done	☐	☐	☐	☐
Capacity-building MRV	**NOT** Done	☐	☐	☐	☐
	RARELY done	☐	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐	☐
	MOSTLY done	☐	☐	☐	☐
	ALWAYS done	☐	☐	☐	☐
Emission Projections	**NOT** Done	☐	☐	☐	☐
	RARELY done	☐	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐	☐
	MOSTLY done	☐	☐	☐	☐
	ALWAYS done	☐	☐	☐	☐

C. Consistency *(Please answer by checking the relevant boxes)*

MRV area	To what extent are these being done or adhered to?	1. Consistent calculation and reporting methods used over time?	2. Methodological changes documented and applied to all previous years' data?
GHG inventory system	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Mitigation actions MRV/M&E	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Climate impacts M&E/MRV	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Adaptation actions M&E	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Climate finance MRV / M&E	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Technology transfer or development M&E / MRV	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Capacity-building MRV / M&E	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Emission Projections	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐

D. Comparability *(Please answer by checking the relevant boxes)*

MRV area	To what extent are these being done or adhered to?	Are comparable calculation methods used across institutions that make calculations?	Are comparable calculation methods used across sectors?	Does the system use internationally accepted protocols, methods and units?
GHG inventory system	**NOT** Done	☐	☐	☐
	RARELY done	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐
	MOSTLY done	☐	☐	☐
	ALWAYS done	☐	☐	☐
Mitigation actions MRV/M&E	**NOT** Done	☐	☐	☐
	RARELY done	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐
	MOSTLY done	☐	☐	☐
	ALWAYS done	☐	☐	☐
Climate impacts M&E/MRV	**NOT** Done	☐	☐	☐
	RARELY done	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐
	MOSTLY done	☐	☐	☐
	ALWAYS done	☐	☐	☐
Adaptation actions M&E	**NOT** Done	☐	☐	☐
	RARELY done	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐
	MOSTLY done	☐	☐	☐
	ALWAYS done	☐	☐	☐
Climate finance MRV / M&E	**NOT** Done	☐	☐	☐
	RARELY done	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐
	MOSTLY done	☐	☐	☐
	ALWAYS done	☐	☐	☐
Technology transfer or development M&E / MRV	**NOT** Done	☐	☐	☐
	RARELY done	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐
	MOSTLY done	☐	☐	☐
	ALWAYS done	☐	☐	☐
Capacity-building MRV / M&E	**NOT** Done	☐	☐	☐
	RARELY done	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐
	MOSTLY done	☐	☐	☐
	ALWAYS done	☐	☐	☐
Emission Projections	**NOT** Done	☐	☐	☐
	RARELY done	☐	☐	☐
	Done about **HALF** the time	☐	☐	☐
	MOSTLY done	☐	☐	☐
	ALWAYS done	☐	☐	☐

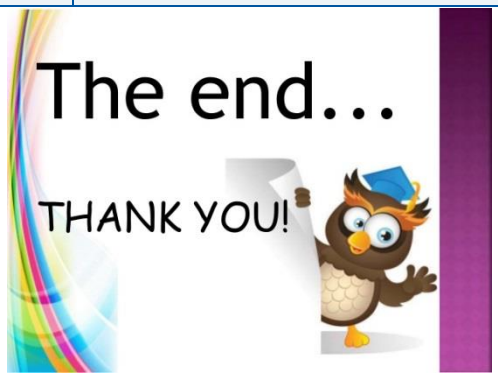
E. Comparability *(Please answer by checking the relevant boxes)*

MRV area	To what extent are these being done or adhered to? →	All sectors covered in the assessments?	Complete geographical coverage?
GHG inventory system	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Mitigation actions MRV/M&E	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Climate impacts M&E/MRV	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Adaptation actions M&E	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Climate finance MRV / M&E	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Technology transfer or development M&E / MRV	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Capacity-building MRV / M&E	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Emission Projections	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐

F. Timeliness *(Please answer by checking the relevant boxes)*

MRV area	To what extent are these being done or adhered to? →	1. Results delivered at the time and frequency required by domestic law and/or policies?	2. Results published at the frequency required for UNFCCC reporting?
GHG inventory system	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Mitigation actions MRV/M&E	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Climate impacts M&E/MRV	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Adaptation actions M&E	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Climate finance MRV / M&E	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Technology transfer or development M&E / MRV	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Capacity-building MRV / M&E	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐
Emission Projections	**NOT** Done	☐	☐
	RARELY done	☐	☐
	Done about **HALF** the time	☐	☐
	MOSTLY done	☐	☐
	ALWAYS done	☐	☐

V. Other relevant information about the domestic MRV system(s)	
Please give any other relevant information about the country's domestic MRV/M&E system(s) that has not be covered in the previous sections	
VI. Confidentiality	
Of the information that you have shared in this questionnaire, please specify any information that you consider confidential, which you do not wish for it to be explicitly linked with your country in the outcomes of this research.	



A.1.3. Case Study Questionnaire:

PhD Research Questionnaire – Case Study

Research Title: Establishing relevant and high quality domestic MRV systems for long-term climate action

By

Thapelo Clifford Mohale Letete

Student No: LTTTHA001

SUPERVISORS: Professor Harald Winkler & Dr Brian Mantlana

INSTITUTION & FIELD OF RESEARCH:

Energy Research Centre, University of Cape Town

Energy and Climate Change

CASE STUDY QUESTIONNAIRE

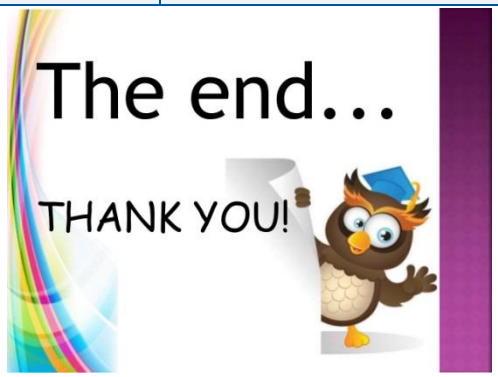
I. Your details	
• Name • Designation • Name of Institution • Email address • Telephone number	• • • • •
II. About the project to Develop Lesotho's MRV Framework	
a. What do you understand to be the objectives of this project?	
b. Please specify the results, deliverables and outputs that you expect to see from this project?	
c. What do you understand as the gaps that this project is aimed at addressing? (or reasons for existence of this project?)	
d. What do you understand to be the benefits of this project for the country?	

e. Do you see this project and its outcomes benefiting your institution in any way?	
f. Are the other issues that you feel this project should also address but are not included in the current project scope?	
g. What do you understand to be the objectives of the Stakeholder Engagement Workshop of the 6th June 2019?	
h. Do you think the workshop achieved its objectives? How?	
III. About MRV Systems	
i. What is your understanding of an MRV system?	
j. What is your understanding of an MRV framework?	

k. What kind of information do you feel should be covered by an MRV system?

MRV Scope or information *(e.g., GHG inventories, mitigation, etc.)*	**Description of the scope term**	**Motivation for inclusion in MRV system?**
1.		
2.		
3. *Add more rows if necessary…*		

IV. Confidentiality	
Of the information that you have shared in this questionnaire, please specify any information that you consider confidential, which you do not wish for it to be explicitly linked with you in the outcomes of this research.	



A.2. List of Respondents to the Questionnaires

Table 30: All Questionnaire Respondents

Country	Respondent Name	Position	Institution	Questionnaire / Interview completion date
1. South Africa	T'sepang Makholela	Director – Adaptation Monitoring and Evaluation	Department of Forestry, Fisheries and the Environment	3rd April 2019 and 8th June 2022
	Jongikhaya Witi	Chief Director – Climate Change Monitoring and Evaluation	Department of Forestry, Fisheries and the Environment	6th December 2021
2. Kenya	Stephen King'uyu	Deputy Director – Climate Change Mitigation	Climate Change Directorate – Ministry of Environment & Natural Resources	23rd September 2018
	David Adegu	Snr. Ass. Director/Coordinator National GHG Inventory System	Climate Change Directorate – Ministry of Environment & Natural Resources	23rd September 2019
	Fredrick Ouma	Deputy programmes officer	Transparency international Kenya	19th July 2019
3. Colombia	Paula Arbelaez	Climate Change Coordinator	Institute of Hydrology, Meteorology and Environmental Studies (IDEAM)	08th September 2017 and 06th September 2019
	Diana Barba Patino	Mitigation and transparency advisor	independent Association of Latin America and the Caribbean	08th September 2017
	Camila Rodriguez Vargas	Mitigation group coordinator	Ministry of Environment and Sustainable Development	6th September 2019
4. Indonesia	Prof Rizaldi Boer	Executive Director	Centre for Climate Risk and Opportunity Management in Southeast Asia Pacific	12th Sept 2019
5. Germany	Anke Herold	Executive Director	Oeko-Institut	5th August 2019
6. New Zealand	Helen Plume	Principal Analyst – Climate Change	Ministry for the Environment	16th July 2019
7. United Kingdom	Sina Wartmann	Principal Consultant – Monitoring, Reporting and Verification	Ricardo-AEA	3rd Sept 2019
8. United States of America	Randy Caruso	Foreign Affairs Officer – climate change	US Department of State	9th August 2019
	Christine Dragisic	Foreign Affairs Officer – climate change	Bureau of Oceans and International Environmental and Scientific Affairs, US Department of State	5th August 2019
9. Lesotho (case-study)	1. Malehloa Jockey	Project Coordinator – climate change	Lesotho Meteorological Services	8th July 2019
	2. Mookho Monnapula	Climate Change Officer	Lesotho Meteorological Services	5th July 2019
	3. Mota T'sehisi	Principal Transport Officer	Ministry of Public Works and Transport	6th August 2019

Country	Respondent Name	Position	Institution	Questionnaire / Interview completion date
	4. Mokitimi Thekiso	Pollution Control Programme Officer	Ministry of Health – Environmental Health	6th August 2019
	5. T'soarelo Nzemene	Senior Statistician	Bureau of Statistics	23rd August 2019
	6. Bernard Motlomelo	Senior Economic Planner	Ministry of Energy and Meteorology	9th September 2019
	7. Moleboheng Petlane	Environment Officer – Pollution Control	Ministry of Tourism, Environment and Culture – Environmental Pollution	10th September 2019
	8. Lekhooa Fokothi	Principal Forestry Officer	Department of Forestry	6th August 2019
	9. Tebello Mot'soane	Assistant Economic Planner	Ministry of Development Planning - Department of Project Cycle Management	4th September 2019
	10. Makhamisa Senekane	Lecturer	National University of Lesotho	23rd August 2019
	11. Thabiso Mohobane	Hydrologist	Ministry of Water	22nd August 2019

Appendix B: Full Relevance Assessments for each country

I. Brazil

Table 31: Relevance assessment of Brazil's Domestic MRV System

MRV THEME	MRV Details	Needs			Brazil's domestic MRV system(s)			Assessment	
		UNFCCC needs		Domestic needs	SMMARE	SIRENE	NAP M&E System	Pre-Paris	Paris-era
		BUR	ETF						
1. GHG emissions and mitigation	1.1 National GHG inventory and mitigation target	Yes	Yes	A		Yes	-		
	1.2. Mitigation policies, actions, measures and plans	Yes	Yes	B	Yes	-	-		
	1.3. Projections of GHG emissions & removals		Yes		-	-	-	N/A	
2. Climate change, impacts, risks, vulnerabilities and adaptation	2.3. Climate impacts, risks and vulnerabilities		Yes	D	-	-	-		
	2.4. Adaptation priorities and barriers		Yes		-	-	-	N/A	
	2.5. Adaptation strategies, policies, plans & actions		Yes		-	-	Yes	N/A	
	2.6. Progress on implementation of adaptation		Yes		-	-	Yes	N/A	
	2.7. M&E of adaptation actions & processes		Yes	I	-	-	Yes		
	2.8. Management of loss and damage		Yes		-	-	-	N/A	
3. Support needed	5.4. Financial support	Yes	Yes		-	-	-		
	5.5. Capacity-building support	Yes	Yes		-	-	-		
	5.6. Technology development and transfer	Yes	Yes		-	-	-		
4. Support received	6.1. Financial support	Yes	Yes		-	-	-		
	6.2. Capacity-building support	Yes	Yes		-	-	-		
	6.3. Technology development and transfer	Yes	Yes		-	-	-		
5. Other Means of implementation	6.4. Domestic climate finance			F	-	-	-		

II. China

Table 32: Relevance assessment of China's Domestic MRV System

MRV THEME	MRV Details	Needs			China's domestic MRV system(s)		Assessment	
		UNFCCC needs		Domestic needs	Statistical Indicator System	GHG Inventory System	Pre-Paris	Paris-era
		BUR	ETF					
1. GHG emissions and mitigation	1.1 National GHG inventory and mitigation target	Yes	Yes	A	Yes	Yes		
	1.4. Mitigation policies, actions, measures and plans	Yes	Yes	B	Yes	-		
	1.5. Projections of GHG emissions & removals		Yes		-	-	N/A	
2. Climate change, impacts, risks, vulnerabilities and adaptation	2.9. Climate impacts, risks and vulnerabilities		Yes	D	Yes	-		
	2.10. Adaptation priorities and barriers		Yes		-	-	N/A	
	2.11. Adaptation strategies, policies, plans & actions		Yes		Yes	-	N/A	
	2.12. Progress on implementation of adaptation		Yes		Yes	-	N/A	
	2.13. M&E of adaptation actions & processes		Yes	E	Yes	-		
	2.14. Management of loss and damage		Yes		-	-	N/A	
	2.15. Climate change indicators			F	Yes	-		
3. Support needed	5.7. Financial support	Yes	Yes		-	-		
	5.8. Capacity-building support	Yes	Yes		-	-		
	5.9. Technology development and transfer	Yes	Yes		-	-		
4. Support received	6.5. Financial support	Yes	Yes		Yes	-		
	6.6. Capacity-building support	Yes	Yes		Yes	-		
	6.7. Technology development and transfer	Yes	Yes		Yes	-		
5. Other Means of implementation	6.8. Domestic climate finance			I	Yes	-		

III. Colombia

Table 33: Relevance assessment of Colombia's Domestic MRV System

MRV THEME	MRV Details	Needs			Colombia's domestic MRV system(s)		Assessment	
		UNFCCC needs		Domestic needs	Colombian MRV System	Adaptation M&E System	Pre-Paris	Paris-era
		BUR	ETF					
1. GHG emissions and mitigation	1.1 National GHG inventory and mitigation target	Yes	Yes	A	Yes	-		
	1.6. Mitigation policies, actions, measures and plans	Yes	Yes	B	Yes	-		
	1.7. Projections of GHG emissions & removals		Yes		-	-	N/A	
2. Climate change, impacts, risks, vulnerabilities and adaptation	2.16. Climate impacts, risks and vulnerabilities		Yes	D	-	Yes		
	2.17. Adaptation priorities and barriers		Yes		-	-	N/A	
	2.18. Adaptation strategies, policies, plans & actions		Yes		-	Yes	N/A	
	2.19. Progress on implementation of adaptation		Yes		-	Yes	N/A	
	2.20. M&E of adaptation actions & processes		Yes	E	-	Yes		
	2.21. Management of loss and damage		Yes		-	-	N/A	
3. Support needed	5.10. Financial support	Yes	Yes		-	-		
	5.11. Capacity-building support	Yes	Yes		-	-		
	5.12. Technology development and transfer	Yes	Yes		-	-		
4. Support received	6.9. Financial support	Yes	Yes	J	Yes	Yes		
	6.10. Capacity-building support	Yes	Yes	K	-	-		
	6.11. Technology development and transfer	Yes	Yes	K	-	-		
5. Other Means of implementation	6.12. Domestic climate finance			I	Yes	Yes		

IV. Indonesia

Table 34: Relevance assessment of Indonesia's Domestic MRV System

MRV THEME	MRV Details	Needs			Indonesia's domestic MRV system(s)				Assessment	
		UNFCCC needs		Domestic needs	NRS – CC	SIGN-SMART	SIDIK	Climate Info System	Pre-Paris	Paris-era
		BUR	ETF							
1. GHG emissions and mitigation	1.1 National GHG inventory and mitigation target	Yes	Yes	A	-	Yes	-	-		
	1.8. Mitigation policies, actions, measures and plans	Yes	Yes	B	Yes	-	-	-		
	1.9. Projections of GHG emissions & removals		Yes		-	-	-	-	N/A	
2. Climate change, impacts, risks, vulnerabilities and adaptation	2.22. Climate impacts, risks and vulnerabilities		Yes	D	-	-	Yes	-		
	2.23. Adaptation priorities and barriers		Yes		-	-	-	-	N/A	
	2.24. Adaptation strategies, policies, plans & actions		Yes		Yes	-	-	-	N/A	
	2.25. Progress on implementation of adaptation		Yes		Yes	-	-	-	N/A	
	2.26. M&E of adaptation actions & processes		Yes	E	Yes	-	-	-		
	2.27. Management of loss and damage		Yes		-	-	-	-	N/A	
	2.28. Climate change indicators			F	-	-	-	Yes		
3. Support needed	5.13. Financial support	Yes	Yes		Yes	-	-	-		
	5.14. Capacity-building support	Yes	Yes		Yes	-	-	-		
	5.15. Technology development and transfer	Yes	Yes		Yes	-	-	-		
4. Support received	6.13. Financial support	Yes	Yes		Yes	-	-	-		
	6.14. Capacity-building support	Yes	Yes		Yes	-	-	-		
	6.15. Technology development and transfer	Yes	Yes		Yes	-	-	-		
5. Other Means of implementation	6.16. Domestic climate finance			I	Yes	-	-	-		

V. Kenya

Table 35: Relevance assessment of Kenya's Domestic MRV System

MRV THEME	MRV Details	Needs			Kenya's domestic MRV system(s)		Assessment	
		UNFCCC needs		Domestic needs	MRV+ System	Budget & Climate Finance tool	Pre-Paris	Paris-era
		BUR	ETF					
1. GHG emissions and mitigation	1.1 National GHG inventory and mitigation target	Yes	Yes	A	Yes	-		
	1.10. Mitigation policies, actions, measures and plans	Yes	Yes	B	Yes	-		
	1.11. Projections of GHG emissions & removals		Yes		-	-	N/A	
2. Climate change, impacts, risks, vulnerabilities and adaptation	2.29. Climate impacts, risks and vulnerabilities		Yes	D	-	-		
	2.30. Adaptation priorities and barriers		Yes		-	-	N/A	
	2.31. Adaptation strategies, policies, plans & actions		Yes		Yes	-	N/A	
	2.32. Progress on implementation of adaptation		Yes		Yes	-	N/A	
	2.33. M&E of adaptation actions & processes		Yes	E	Yes	-		
	2.34. Management of loss and damage		Yes		-	-	N/A	
3. Support needed	5.16. Financial support	Yes	Yes		-	-		
	5.17. Capacity-building support	Yes	Yes		-	-		
	5.18. Technology development and transfer	Yes	Yes		-	-		
4. Support received	6.17. Financial support	Yes	Yes	J	-	Yes		
	6.18. Capacity-building support	Yes	Yes	K	-	Yes		
	6.19. Technology development and transfer	Yes	Yes	K	-	Yes		
5. Other Means of implementation	6.20. Domestic climate finance			I	-	Yes		
	6.21. Impact and effectiveness of climate finance			H	Yes	Yes		

VI. South Africa

Table 36: Relevance assessment of South Africa's Domestic MRV System

MRV THEME	MRV Details	Needs			South Africa's domestic MRV system(s)		Assessment	
		UNFCCC needs		Domestic needs	M&E System	GHG System	Pre-Paris	Paris-era
		BUR	ETF					
1. GHG emissions and mitigation	1.1 National GHG inventory and mitigation target	Yes	Yes	A	Yes	Yes		
	1.12. Mitigation policies, actions, measures and plans	Yes	Yes	B	Yes	-		
	1.13. Projections of GHG emissions & removals		Yes		-	-	N/A	
2. Climate change, impacts, risks, vulnerabilities and adaptation	6.22. Climate impacts, risks and vulnerabilities		Yes	D	Yes	-		
	6.23. Adaptation priorities and barriers		Yes		-	-	N/A	
	6.24. Adaptation strategies, policies, plans & actions		Yes		Yes	-	N/A	
	6.25. Progress on implementation of adaptation		Yes		Yes	-	N/A	
	6.26. M&E of adaptation actions & processes		Yes	E	Yes	-		
	6.27. Management of loss and damage		Yes		-	-	N/A	
	6.28. Climate change indicators		Yes	F	Yes	-		
3. Support needed	5.19. Financial support	Yes	Yes		Yes	-		
	5.20. Capacity-building support	Yes	Yes		-	-		
	5.21. Technology development and transfer	Yes	Yes		-	-		
4. Support received	6.29. Financial support	Yes	Yes	J	Yes	-		
	6.30. Capacity-building support	Yes	Yes		-	-		
	6.31. Technology development and transfer	Yes	Yes		Yes	-		
5. Other Means of implementation	6.32. Domestic climate finance			I	Yes	-		
	6.33. Impact and effectiveness of climate finance			H	Yes	-		

VII. European Union

Table 37: Relevance assessment of European Union's Domestic MRV System

MRV THEME	MRV Details	Needs					European Union's domestic MRV system(s)		Assessment	
		UNFCCC Needs			EU-level needs		MMR	Governance	Pre-Paris	Paris-era
		BR	GHG	ETF	Pre	Paris				
1. GHG emissions and mitigation	1.1 National GHG inventory and mitigation target	Yes	Yes	Yes	A	5	Yes	Yes		
	1.14. Mitigation policies, actions, measures and plans	Yes		Yes	B		Yes	Yes		
	1.15. Projections of GHG emissions & removals	Yes		Yes	C		Yes	Yes		
2. Climate change, impacts, risks, vulnerabilities and adaptation	6.34. Climate impacts, risks and vulnerabilities			Yes				Yes	N/A	
	6.35. Adaptation priorities and barriers			Yes				-	N/A	
	6.36. Adaptation strategies, policies, plans & actions			Yes				Yes	N/A	
	6.37. Progress on implementation of adaptation			Yes				Yes	N/A	
	6.38. M&E of adaptation actions & processes			Yes				Yes	N/A	
	6.39. Management of loss and damage			Yes				-	N/A	
3. Support provided	5.22. Financial support	Yes		Yes			Yes	Yes		
	5.23. Capacity-building support	Yes		Yes			Yes	Yes		
	5.24. Technology development and transfer	Yes		Yes			Yes	Yes		

VIII. Germany

Table 38: Relevance assessment of Germany's Domestic MRV System

MRV THEME	MRV Details	Needs							Germany's domestic MRV system(s)					Assessment	
		UNFCCC needs			OECD	EU Level		Domestic needs	NaSE	Climate Action M&E	DAS monitoring	Finance MRV	EKF system	Pre-Paris	Paris-era
		BR	ETF	GHG		Pre	Paris								
1. GHG emissions and mitigation	1.1 National GHG inventory and mitigation target	Yes	Yes	Yes		A	5	A	Yes	-	-	-	-		
	1.16. Mitigation policies, actions, measures and plans	Yes	Yes			B	1(iii)	B	-	Yes	-	-	-		
	1.17. Projections of GHG emissions & removals	Yes	Yes			C	1(iv)	C *(Paris era only)*	-	-	-	-	-		
	1.18. Progress towards objectives & targets of the E&CC plan						1(i)		-	Yes	-	-	-		
	1.19. Progress in financing and implementing policies and measures towards E&CC objectives						1(ii)		-	Yes	-	-	-		
2. Climate change, impacts, risks, vulnerabilities and adaptation	6.40. Climate impacts, risks and vulnerabilities		Yes				2(b)	D	-	-	Yes	-	-		
	6.41. Adaptation priorities and barriers		Yes						-	-	-	-	-	N/A	
	6.42. Adaptation strategies, policies, plans & actions		Yes				2(a)		-	-	Yes	-	-	N/A	
	6.43. Progress on implementation of adaptation		Yes				2(d)		-	-	Yes	-	-	N/A	
	6.44. M&E of adaptation actions & processes		Yes					E	-	-	Yes	-	-		
	6.45. Management of loss and damage		Yes						-	-	-	-	-	N/A	
	6.46. Adaptive capacity						2(c)		-	-	-	-	-	N/A	
	6.47. Climate change indicators							F	-	-	Yes	-	-		
3. Support provided	5.25. Financial support	Yes	Yes		Yes	F1	4(i)		-	-	-	Yes	-		
	5.26. Capacity-building support	Yes	Yes		Yes	F2	4(ii)		-	-	-	Yes	-		
	5.27. Technology development and transfer	Yes	Yes		Yes	F3	4(iii)		-	-	-	Yes	-		
4. Other means of implementation	5.28. Use of EU ETS auctioning revenue and credits					G	3		-	-	-	-	Yes		

IX. New Zealand

Table 39: Relevance assessment of New Zealand's Domestic MRV System

MRV THEME	MRV Details	Needs						NZ's domestic MRV system(s)		Assessment	
		UNFCCC needs			OECD	EU Level		Inventory System	AID Monitoring	Pre-Paris	Paris-era
		BR	ETF	GHG		Pre	Paris				
1. GHG emissions and mitigation	1.1 National GHG inventory and mitigation target	Yes	Yes	Yes		A	A	Yes	-		
	1.20. Mitigation policies, actions, measures and plans	Yes	Yes			B	B	-	-		
	1.21. Projections of GHG emissions & removals	Yes	Yes				C	-	-		
2. Climate change, impacts, risks, vulnerabilities and adaptation	6.48. Climate impacts, risks and vulnerabilities		Yes					-	-	N/A	
	6.49. Adaptation priorities and barriers		Yes					-	-	N/A	
	6.50. Adaptation strategies, policies, plans & actions		Yes					-	-	N/A	
	6.51. Progress on implementation of adaptation		Yes					-	-	N/A	
	6.52. M&E of adaptation actions & processes		Yes				E	-	-	N/A	
	6.53. Management of loss and damage		Yes					-	-	N/A	
3. Support provided	5.29. Financial support	Yes	Yes		Yes	G	G	-	Yes		
	5.30. Capacity-building support	Yes	Yes		Yes	G	G	-	Yes		
	5.31. Technology development and transfer	Yes	Yes		Yes	G	G	-	Yes		
4. Other Means of Implementation	5.32. Impact and effectiveness of climate finance					H	H	-	Yes		

X. United Kingdom

Table 40: Relevance assessment of United Kingdom's Domestic MRV System

MRV THEME	MRV Details	Needs						United Kingdom's domestic MRV system(s)				Assessment	
		UNFCCC			OECD	EU level	Domestic needs	GHG system	BEIS projections	CCC Adaptation Monitoring	ICF M&E System	Pre-Paris	Paris-era
		BR	ETF	GHG		Pre-Paris							
1. GHG emissions and mitigation	1.1. National GHG inventory and mitigation target	Yes	Yes	Yes		A	A	Yes	-	-	-		
	1.2. Mitigation policies, actions, measures and plans	Yes	Yes			B	B	-	-	-	-		
	1.3. Projections of GHG emissions & removals	Yes	Yes			C		-	Yes	-	-		
2. Climate change, impacts, risks, vulnerabilities and adaptation	2.1. Climate impacts, risks and vulnerabilities		Yes					-	-	Yes	-	N/A	
	2.2. Adaptation priorities and barriers		Yes					-	-	Yes	-	N/A	
	2.3. Adaptation strategies, policies, plans & actions		Yes					-	-	Yes	-	N/A	
	2.4. Progress on implementation of adaptation		Yes					-	-	Yes	-	N/A	
	2.5. M&E of adaptation actions & processes		Yes				E	-	-	Yes	-		
	2.6. Management of loss and damage		Yes					-	-	-	-	N/A	
3. Support provided	2.7. Financial support	Yes	Yes		Yes	F1	G	-	-	-	Yes		
	2.8. Capacity-building support	Yes	Yes		Yes	F2	G	-	-	-	Yes		
	2.9. Technology development and transfer	Yes	Yes		Yes	F3	G	-	-	-	Yes		
4. Other MoI	.10. Impact and effectiveness of climate finance						H	-	-	-	Yes		
	.11. Use of EU ETS auctioning revenue and credits					G		-	-	-	-		N/A

XI. United States of America

Table 41: Relevance assessment of United States of America's Domestic MRV System

MRV THEME	MRV Details	Needs					USA's domestic MRV system(s)			Assessment	
		UNFCCC needs			OECD	Domestic needs	GHG inventory	Foreign assistance tracking	USGCRP indicators	Pre-Paris	Paris-era
		Pre	Paris	GHG							
1. GHG emissions and mitigation	1.1 National GHG inventory and mitigation target	Yes	Yes	Yes		A	Yes	-			
	2.12. Mitigation policies, actions, measures and plans	Yes	Yes			B	-	-			
	2.13. Projections of GHG emissions & removals	Yes	Yes				-	-			
2. Climate change, impacts, risks, vulnerabilities and adaptation	6.54. Climate impacts, risks and vulnerabilities		Yes			D	-	-	Yes		
	6.55. Adaptation priorities and barriers		Yes				-	-	-	N/A	
	6.56. Adaptation strategies, policies, plans & actions		Yes				-	-	-	N/A	
	6.57. Progress on implementation of adaptation		Yes				-	-	-	N/A	
	6.58. M&E of adaptation actions & processes		Yes			E	-	-	-		
	6.59. Management of loss and damage		Yes				-	-	-	N/A	
	6.60. Climate change indicators					F	-	-	Yes		
3. Support provided	3.8. Financial support	Yes	Yes		Yes	G	-	Yes	-		
	3.9. Capacity-building support	Yes	Yes		Yes	G	-	Yes	-		
	3.10. Technology development and transfer	Yes	Yes		Yes	G	-	Yes	-		
4. Other Means of implementation	6.61. Domestic finance					I	-	-	-		
	6.62. Impact and effectiveness of climate finance					H	-	Yes	-		

Appendix C: Quality Evaluability Assessment Results

Table 42: Results of the quality evaluability assessments for domestic MRV systems of all countries included in the study

Key		
		System does not meet minimum evaluability requirements
		System meets minimum evaluability requirements
		Some components of the system meet the evaluability requirements

Country	System	Evaluability assessment	
Brazil	1. Modular System for Monitoring Actions and GHG Emission Reductions (SMMARE)	• Brazil's design of the SMMARE system started in 2013, but was later halted, awaiting conclusion of ETF under the Paris Agreement. • New version of SMMARE was launched in 2018 and is currently in pilot phase - providing some preliminary data on the reporting of emissions reductions in the 4th BUR (Federative Republic of Brazil, 2020). • Therefore, it does not meet the minimum evaluability requirements since it has not been operational for more than one reporting cycle.	
	2. Brazil's National GHG inventory System (SIRENE)	• SIRENE was launched in 2016, and has been operational since 2017, providing GHG inventories annually • Hence this system meets the evaluability requirements.	
	3. NAP M&E System	• Brazil's NAP M&E system was piloted in 2017 with the publication of the first NAP M&E report. The system was meant to have annual reporting cycle, but no other NAP M&E report had been published as of December 2021 (Camarinha, 2018) • Hence this system does not meet the evaluability requirement of operating for more than one reporting cycle.	
China	1. GHG Emission Accounting and Reporting system	• China has not completed institutionalization of its national GHG inventory; the work on the preparation of National GHG Inventories is currently being conducted on a project basis (People's Republic of China, 2018). • Hence the system does not meet the minimum evaluability requirements	
	2. Climate Change Statistical Indicators and Basic Statistical System	• This system was established in 2014, and has been in piloting phase since then (People's Republic of China, 2018) (China, 2016) • Therefore, the system does not meet the minimum evaluability requirement of operating for more than one reporting cycle.	
Colombia	1. Colombian GHG Inventory System - SINGEI	• Colombia's GHG inventory system has been operationalized since 2016 during the compilation of the 1990 – 2012 GHG inventories (Arbelaez, 2017)	

Country	System	Evaluability assessment	
		• Since then, the GHG inventories of 2013 – 2014, contained in 2nd BUR, as well as those of 2010 – 2018, contained in the 3rd BUR, have been compiled through the system (IDEAM, Fundación Natura, PNUD, MADS, DNP, CANCILLERÍA, 2021) • This means that the system meets all evaluability requirements.	
	2. Colombian MRV System - RENARE	• RENARE is Colombia's system for managing information on GHG mitigation actions at the national level • It began operation in 2020, and has only had one reporting cycle informing the 3rd BUR (IDEAM, Fundación Natura, PNUD, MADS, DNP, CANCILLERÍA, 2021) • This means that the system does not meet the minimum evaluability requirement for systems to operate for at least two reporting cycles.	
	3. Climate Finance MRV system	• The climate finance MRV system was developed before the Paris Agreement came to be, and has been operating for many reporting cycles ever since (Rodriguez, 2019) • As such, the system meets all the evaluability requirements	
	4. Adaptation M&E System	• The Colombian Adaptation M&E system has been in development for many years, and but is yet to be implemented (Vallejo, 2018) • Therefore, it does not meet the minimum evaluability requirement for it to operate for at least two reporting cycles.	
Indonesia	a. National Registry System for Climate Change (NRS - CC)	• The implementation of this system is regulated and supported by two regulations of the Ministry of Environment and Forestry (Republic of Indonesia, 2018) • The system has been operational since 2016, with ex-post MRV of mitigation actions fully functional (Ministry of Environment and Forestry of the Republic of Indonesia, 2018). • For adaptation actions, the system only captures basic information but not progress tracking nor impact assessment (ibid). • Hence, the ex-post mitigation component of the system meets the minimum evaluability requirements, while the adaptation component does not.	
	b. National GHG Inventory System (SIGN-SMART)	• Indonesia's SIGN-SMART was established in 2015, and has been used to manage the country's national GHG inventories since then • This means that the system meets all the evaluability requirements	
	c. Vulnerability Index Data and Information System (SIDIK)	• SIDIK was first implemented in 2021, and the information therein has since been updated every 3 years or so (Boer, 2019). • As such the system meets all evaluability requirements	

Country	System	Evaluability assessment	
	d. Climate Information System	It has not been working since its development.	
Kenya	Kenya's MRV+ System	• The design for Kenya's MRV+ system was completed in 2012, and since then various elements have been set up (Ouma, 2019) • By the end of 2021 the implementation of the system had not been completed and no outputs from the system had been published • As such the system does not meet the minimum evaluability requirement for the system to have operated for two or more reporting cycles.	
	Climate change budget coding and tracking tool for climate finance	• Since 2018 Government of Kenya has been re-calibrating the existing finance information and management system to serve as the climate change budget coding and tracking tool for climate finance (Ouma, 2019) • As of 31st December 2021, the system had not been operational • This means that it does not meet the minimum requirement for system to operate for two or more reporting cycles to be eligible for evaluation	
South Africa	National GHG Inventory Management System	• The system was set up in 2017 during compilation of the 2015 GHG inventory, where it was partly utilized (DEA, 2019) • It was then implemented fully during compilation of the 2017 GHG inventory (DFFE, 2021) • It sufficiently contributed to the outputs of both the 2015 and 2017 GHG inventories that it can be assessed for all the TACCCT criteria used in this study • As such, this system meets all the evaluability requirements	
	National Climate Change Response Monitoring and Evaluation System / Climate Change Information System	• This system is meant to cover mitigation MRV, adaptation MRV and means of implementation MRV • The ex-post mitigation MRV component was completed and used for the first time in the compilation of the 4th BUR; hence it has operated for one reporting cycle (Witi, 2021) • While the IT platform of the climate finance component has not been set up, the system has been operational without the desired automation for the compilation of the 3rd and 4th BUR, as well as the TNC (ibid) • As of 31st December 2021, technology transfer module of the system was not operational (ibid) • The adaptation component was implemented for two years between 2019 and 2020 but the team has now gone back to the drawing board to improve the system, including aligning indicators with the recently published National Climate Change Adaptation Strategy and improving the approach (Makholela, 2022) • As such, the climate finance MRV component of the system meets all the minimum evaluability requirements • The adaptation MRV component can also be deemed to meet the minimum evaluability requirements	

Country	System	Evaluability assessment	
European Union	Mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change (MMR)	• The MMR came into force from 8th of July 2013 and operated with biennial reporting cycles until the 31st of December 2020 when it was repealed and replaced by the Governance system. (European Union, 2018) • As such, the system fully meets the minimum evaluability requirements.	
	Governance of the Energy Union and Climate Action	• This system repealed and replaced the MMR • It came into operation on the 1st of January 2021 and has since operated for one reporting cycle (European Union, 2018) • While it has inherited most of the characteristics of its predecessor, as a new system it has not operated long enough to meet the minimum evaluability requirements.	
Germany	National System of Emissions	• The German National System of Emissions has been in operation from 2007, and has been used to compile the country's GHG inventories annual (Roeser, 2014) • Therefore, the system meets all evaluability requirements	
	Monitoring system of the German Adaptation Strategy (DAS monitoring)	• Published through the system, the first DAS monitoring report was published and adopted by the German government in 2015 (Die Bundesregierung, 2020) • In 2020 the second DAS monitoring report was then completed (ibid) • 2nd DAS monitoring report states that institutional arrangements for the systematic DAS monitoring to fulfil Governance requirements are yet to be established (see page 50 of 2nd report) • As such, this system does not meet the minimum evaluability requirements used in this study	
	Climate Action Monitoring System	• The Federal German Government intend to prepare Climate Action Reports every year, with the aim of regularly reviewing implementation and progress towards achieving its greenhouse gas reduction target • Annual reports were published for 2015 – 18, but none have been published since 2019 • As such, the system meets all evaluability requirements	
	Climate finance MRV	• Germany has been using OECD climate markers since the 2011 reporting year and since 2013 the country has published its total public climate finance, including mobilised climate finance (Germany, 2020), • Through the system annual climate ODA climate finance data is generated and submitted to the OECD DAC. • This means that the system meets all the requirements for systems to be evaluated	
	Climate and energy fund monitoring (EKF system)		

Country	System	Evaluability assessment	
New Zealand	National Inventory System	• The New Zealand National Inventory System was enabled by the Climate Change Response Act 2002 (Ministry for the Environment, 2017) • Since then, national GHG inventories have been prepared and published through this system on annual basis • Therefore, the system meets all the minimum evaluability requirements	
	Aid Programme Management System (AID system)	• Annually the Ministry for Foreign Affairs and trade must monitor and report on the country' foreign aid programme, including on international support provided, pursuant to Section 44(1) of the Public Finance Act of 1989 (Ministry of Foreign Affairs and Trade, 2019) • The Aid Programme Management System has been established to achieve this • Over time climate change markers and policies have been included to this system to effectively monitor climate-related aid • As such, the system meets all the requirements for evaluability of domestic MRV systems.	
United Kingdom	UK National Inventory System	• The UK's national system for preparing GHG inventories was established under the UK Climate Change Act of 2008 (UK Government, 2008) • On annual basis, national GHG inventories of the UK are prepared and published through this system • Therefore, the system meets all the minimum evaluability requirements	
	Annual projections reporting system by Department of Business, Energy & Industrial Strategy	• This system was established in the 1990s, and through it, government has been modelling and publishing the country's projected energy consumption as well as national GHG emissions and removals annually (Department for Business, Energy & Industrial Strategy, 2019). • Therefore, the system meets all the minimum evaluability requirements	
	Climate Change Committee Adaptation Progress Reporting system to Parliament (CCC Progress reporting)	• The first output of this system was published in June 2015 (Committee on Climate Change, 2019) • Since then, national adaptation programme progress reports have been published every two years, with the latest one having been published in June 2021 (Climate Change Committee, 2021a) • This means that this system meets all the evaluability requirements fully.	
	International Climate Finance Monitoring and Evaluation System	• On monthly basis, Official Development Assistance (ODA) data is collated by Department for International Development (DFID) through the system, and reported to the OECD DAC on biannual basis using the Rio Markers (HM Treasury, 2018) • This reporting has been happening for many years, which means that this system meets all the evaluability requirements	

Country	System	Evaluability assessment	
United States of America	GHG Inventory System	• The USA has been compiling annual inventories of GHG emissions and sinks since the early 1990s under the coordination of the Environmental Protection Agency (EPA) as the national inventory entity (US EPA, 2020). • Therefore, this system meets all the evaluability requirements used in this study	
	Standardized Foreign Assistance Tracking system	• The USA foreign assistance tracking programme has been in place for many years, with annual presentation of the results to congress (Caruso, 2019) • The latest consolidated version, that fully encapsulates climate change reporting was first conceptualized in 2006 and implemented in 2017 using a set of more than 200 indicators (ibid) • Since then, data has been reported to both congress and the OECD annually, which means that the system meets all the evaluability requirements used in this study	
	Change to National Climate Change Assessment System	• The USA published the First National Climate Assessment report in 2000 (USGCRP, 2019) • During the compilation of the 1st, 2nd and 3rd National Climate Assessment reports, there was no system in place. • It is only during the compilation of the 4th National Climate Assessment report that as sustained and systematic process was put in place (USGCRP, 2020). • The development of the 5th is currently underway, with a view to publish it in 2023 (USGCRP, 2019) • This means that this system has not been implemented over enough reporting cycles to meet the minimum requirements for evaluability.	

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