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Measurement, Reporting and Verification (MRV) for low carbon development:
Learning from experience in Asia

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Foreword

To keep the global temperature rise due to climate change below 2 degrees, GHG emissions into the atmosphere must peak before 2020. This means that, emissions should be reduced to half the current level by 2050. This requires far more significant levels of cooperation between developed and developing countries, so that developing countries can develop a basic infrastructure and social system to promote appropriate mitigation measures, drawing upon enhanced finance opportunities. Low-carbon technology is also an important issue in this regard. Only through enhanced collaboration can the international climate change regime be substantially changed to one where not only developed but developing countries are actively taking mitigation actions together.

In the Bali Action Plan of 2007, "the Nationally Appropriate Mitigation Actions in each country" (NAMAs) were proposed, and the subsequent Cancun Agreement in 2009 stimulated assessment and development of policy frameworks for low-carbon development and green economy in many Asian countries. Developing an inventory of the current GHG emissions together with an effective MRV system will be an essential first step to identify important mitigation actions.

This report intends to provide lessons and experiences so far obtained in Asia, through a variety of case studies, for the design and implementation of effective MRV systems. Development of an effective MRV system will require establishment of a regulatory framework, development of tools and methodologies, and enhancement of capacity of major stakeholders concerned, as set out in this report.

It is vital to develop practical and yet science-based MRV systems backed by an appropriate institutional framework, taking into account different socio-economic circumstances of individual countries. This MRV report is the first small effort by IGES to achieve this, and further refinements and development are envisaged in the future.

This report is the result of an IGES-wide effort, involving different research groups with diverse backgrounds, including Climate Change, Natural Resource Management, Sustainable Consumption and Production, Economy and Environment, Governance and Capacity, Business, as well as the Kitakyushu Urban Centre. I would like to thank Professor Hidefumi Imura of Yokohama City University, for his valuable inputs and advice. I also very much appreciate the substantial coordination efforts made by Mr. Kazuhisa Koakutsu, Deputy Director of the Market Mechanism Group of IGES, throughout the process. I hope that the report will provide useful inputs toward the discussion on MRV and, ultimately, contribute to the development of low-carbon policy and NAMAs in the region.

Hideyuki MORI,

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Abbreviations and Acronyms

3Rs	Reduce, Reuse and Recycle
ACM	Approved Consolidated Methodologies
AM	Approved Methodology
AMS	Approved Methodology for Small-scales
ASEAN	Association of South-East Asian Nations
AWG-LCA	The Ad Hoc Working Group on Long-term Cooperative Action under the Convention
BAP	Bali Action Plan
BAU	Business As Usual
BEE	Bureau of Energy Efficiency, India
BEMS	Building Energy Management System
BOCM	Bilateral Offset Credit Mechanism
BRT	Bus Rapid Transit
CCA	Community Carbon Accounting
CDM	Clean Development Mechanism
CEMS	Central Energy Management System
CER	Certified Emission Reduction
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
CNG	Compressed Natural Gas
COD	Chemical Oxygen Demand
CPC	Communist Party of China
CSPOC	Closure of Small Plants and Outdated Capacity
CTF	Clean Technology Fund
DC	Designated Consumer
DNA	Designated National Authority
DOE	Designated Operational Entity
DRC	Development and Reform Commissions, China
EB	Executive Board
EE	Energy Efficiency
EI	Emissions Intensity
ER	Emission Reduction
ETC	Economic and Trade Commissions, China
EU-ETS	European Union Emission Trading Scheme
FOD	First Order Decay
FYP	Five Year Plan
GCF	Green Climate Fund
GEF	Global Environment Facility
GHG	Greenhouse Gas
HDI	Human Development Index
HEMS	Home Energy Management System
HFC	Hydrofluorocarbon
IEA	International Energy Agency
IGCC	Integrated coal Gasification Combined Cycle
IGES	Institute for Global Environmental Strategies
IPCC	Intergovernmental Panel on Climate Change
ISAP	International Forum for Sustainable Asia and the Pacific
ISO	International Organization for Standardization
J-VETS	Japanese Voluntary Emission Trading Scheme
JICA	Japan International Cooperation Agency
LCA	Life Cycle Assessment
LDC	Least Developed Country
LRT	Light Rail Transit
LULUCF	Land Use and Land Use Change and Forestry
MDG	Millennium Development Goals
MOEJ	Ministry of the Environment, Japan
MRV	Measurement/Monitoring, Reporting, and Verification
MSW	Municipal Solid Wastes
NAMA	Nationally Appropriate Mitigation Actions
NAO	National Audit Office, China
NAPCC	National Action Plan on Climate Change
NDRC	National Development and Reform Commission, China
NPC	National People's Congress, China
PAT	Perform Achieve and Trade
PDD	Project Design Document
PP	Project Participants
RAD-GRK	Local Action Plan for Green House Gas Emission Reduction, Indonesia
RAN-GRK	National Action Plan for Green House Gas Emission Reduction, Indonesia
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SWM	Solid Waste Management
TGO	Thailand Greenhouse Gas Organization
TIAM	TIMES Integrated Assessment Model
TRS	Target Responsibility System
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNFCCC	United Nations Framework Convention for Climate Change
WBE	Wastewater-Biogas-Energy

Executive Summary

MRV – Measurement/Monitoring, Reporting and Verification - is commonly understood as a series of processes to quantify GHG emission and their change over time. It is a key instrument to understand the level of emissions and the impact of actions aimed at changing emission levels. For this reason, MRV became a keyword as many developed and developing countries introduce measures to account greenhouse gas emissions and related support.

However, little work has been done on clarifying what exactly MRV means and systematically documenting the implemented cases of MRV. In addition, there is a common trade-off between the simplicity and stringency of MRV.

This report contributes to the further development of MRV modalities and methodologies by providing conceptual clarification of MRV and outlining 16 case studies of MRV schemes being implemented on the ground. Based on these case studies, the report identified eight key messages.

1. The concept of MRV entails multiple types, which need to be distinguished to avoid conceptual confusion.
MRV consists of four different levels: organisational, project, national and policies. These four types of MRV should be distinguished because they are different in their purpose and nature, and methodologies and experience at one level may not be immediately applicable to another level. For example, a MRV methodology at the project level is not applicable at the policy level in which baseline setting is technically more difficult.

- *Chapter 1 Introduction to MRV and this report*

2. There is a trade-off between simplicity and stringency of MRV.
An MRV scheme that aims for accurate measurement and monitoring of emission levels require a range of data, calculations and equipment, which can be burdensome and costly. One could take into account the dynamic baseline, rebound effects by energy savings and local development co-benefits for more accurate and comprehensive MRV. But it certainly adds more complexity, which should be weighed against the benefits of accuracy. For example, large-scale firms may be able to implement complex MRV, but such MRV may be too costly for small and medium enterprises. MRV needs to strike the right balance between simplicity and stringency depending on the context and objectives of the scheme.

- *Chapter 1 Introduction to MRV and this Report*
- *Chapter 10 Energy Efficiency (Industry): Innovative Schemes from Japan and India*
- *Chapter 12 Buildings: A Comparative Analysis of MRV Methodologies*
- *Chapter 14 Wastewater: MRV Proposal Based on the Lessons from Waste-to-energy Projects in Thailand*

3. Varying quality of domestic MRV schemes in Asian developing countries.
Many Asian developing countries, notably China, India and Indonesia, are implementing policies to control GHG emissions. In Southeast Asia, many programmes and policies are put forward as NAMAs to seek international support, but some countries such as China and India are implementing policies to control their GHG emissions and energy consumptions through domestic policy and measures. Nevertheless, the quality of MRV processes attached to such policies is sometimes questionable in terms of data quality and practicality. For example, issues of data availability were raised both in Chinese and Indian cases, partly because these schemes started their operation only recently. However, from a long-term perspective, the quality of MRV could be an issue when it aims to link with domestic GHG schemes in other countries or international offset mechanisms.

- *Chapter 4 China: MRV in Target Responsibility System (TRS)*
- *Chapter 5 India: MRV and the Way towards Meeting the Pledges*
- *Chapter 6 India: Perform Achieve and Trade and MRV Mechanism*

- *Chapter 7 Indonesia: Current Status and Future Challenges of Promoting Mitigation Actions*

4. There is a continued need for capacity building for MRV in developing countries.

MRV requires not only technical capacities, but also coordinating capacity and research capacity to understand best practices. The capacity gap is particularly wide at local governments, which are required by central governments to conduct MRV on their emissions (e.g. India and Indonesia). In response, Indonesian government implemented a series of capacity building exercises for local governments to implement RAD-GRK, an Indonesian action plan to GHG reduction at the local level. Capacity building activities in Vietnam, Thailand and Indonesia also pointed out the continued need for capacity building by local governments.

- *Chapter 3 Southeast Asia: Status of NAMAs*
- *Chapter 6 India: Perform Achieve and Trade and MRV Mechanism*
- *Chapter 7 Indonesia: Current Status and Future Challenges of Promoting Mitigation Actions*
- *Chapter 8 Cities: Cases from Indonesia, Vietnam, Thailand and Japan*

5. Improving the availability of basic data, such as default values, is critical to simplify MRV processes.

Some attempts are made to simplify MRV methodologies and modalities. A standardised baseline, which allows users to establish one baseline emission for a specific project, can potentially be a powerful tool to simplify MRV of projects that aim for credit issuance such as CDM. Such tools are particularly useful in least developed countries where MRV capacity is limited. However, such countries also tend to have a shortage of necessary data to develop standardised baselines. The same applies for default values, which are pre-defined parameters that allow users to simplify monitoring process and are often provided by the IPCC for the purpose of inventory development. Improving data availability in developing counties is an essential step to further develop such simplified methods.

- *Chapter 9 Renewable Energy: A Case of Rice Husk Biomass in Cambodia*
- *Chapter 11 Energy Efficiency (Appliances): A Case from Indonesia*
- *Chapter 13 Transport: A Comparative Analysis of MRV Methodologies and Possible Default Values*

6. MRV in cities should be an integral part of urban policies.

Introducing MRV processes in cities can result in a multitude of benefits: 1) cities can contribute to the national emissions target, 2) the cities' data management capacity is improved not only in climate change issues but also in other social and economic issues, and 3) the MRV can be expanded to other cities as the disclosure of impacts of policy measures draws the attention of local authorities. However, these may not provide sufficient incentives for the city governments to implement robust city-level MRV and GHG emissions reduction.

In this regard, city-level MRV system should be developed with sufficient consideration to the potential co-benefits of MRV implementation. In short, MRV should be an integral part of the city's priority issues such as water resource management and solid waste management or the city's urban development vision such as "Smart Community" and "Compact City". In addition, national government should set enabling conditions for local governments to enhance MRV-able GHG-reducing policies at sub-national levels. This supportive mechanism at the national level can include 1) incentive provision and ownership development, 2) effective monitoring and evaluation of policies, 3) adaptation to and appreciation of diverse local conditions and contexts, and 4) support for policy diffusion and mutual learning among sub-national governments.

- *Chapter 2 NAMAs: Institutional Framework and Linkage between National and Sub-national Levels*
- *Chapter 8 Cities: Cases from Indonesia, Vietnam, Thailand and Japan*

7. Communities can play important roles for MRV at the local level

Community-based monitoring has the potential to simplify monitoring processes and thereby promote local MRV system development while ensuring economic, social and environmental benefits for local people. It can be an alternative to the conventional MRV processes that primarily rely on a few people or entities for implementation. If procedures and required accuracy are set appropriately in line with local contexts and capacity, community involvement in MRV process can reduce transaction costs, time and administrative procedures as well as ensuring the ownership of programmes by the community. In particular, local ownership is a significant factor to make environmental projects such as REDD+ and composting socially accepted.

To enhance community- based MRV, local governments should develop supportive policies and benchmarks, including financial/technical assistance, and project partners must work closely with communities to develop local capacity for data development and collection in compliance with required criteria.

- *Chapter 15 Composting: Community-based Composting as an Alternative Route to Enhancing MRV*
- *Chapter 18 Forestry: Importance of Local Participation in MRV of REDD+*

8. Life- Cycle Assessment (LCA) can play an important role for MRV in waste and building sector.

Life Cycle Assessment (LCA) is a useful technique for GHG accounting and identifying the possible mitigation options throughout a product's lifespan. As LCA is a method for environmental assessment considering all the phases of the life cycle of products, it can account for both direct emission and indirect emissions.

- *Chapter 10 Energy Efficiency (Industry): Innovative Schemes from Japan and India*
- *Chapter 12 Buildings: A Comparative Analysis of MRV Methodologies*
- *Chapter 16 Solid Waste Management 1: A Case of First Order Decay Model*
- *Chapter 17 Solid Waste Management 2: Life Cycle Assessment (LCA) Perspective*

Part I

Introduction

Chapter 1 Introduction to MRV and this Report

1.1 MRV in a nutshell

MRV stands for Measurement/Monitoring[1], Reporting and Verification. This term is used in diverse contexts, but most frequently in the context of greenhouse gas (GHG) emissions and their reduction. In essence, MRV is a series of processes to quantify GHG emission and their change overtime. Quantified values that have passed through robust MRV processes can represent accurate levels of GHG emission. On the other hand, if the MRV processes are inadequate, the quantified value may not represent the real amount of emissions. Therefore, MRV with adequate processes is a key instrument to understand the level of emissions and the impact of actions aimed at changing emission levels.

However, there is no universally accepted definition of MRV. This term became popularly used in the international discussion after the Bali Action Plan in 2007 introduced the idea of "measurable, reportable and verifiable". But its definition was made deliberately ambiguous to capture a wide range of actions and methodologies in a hope that appropriate methodologies would become more definitive through action-based learning. Although a range of MRV methodologies did become available after Bali, there is a lack of consistency and conceptual confusion around the idea of MRV.

This chapter aims at clarifying the concept of MRV by using the typology of MRV proposed by Ninomiya (2012), and then identify the challenges that this report is going to address.

1.2 Why does MRV matter?

MRV matters because quantifying GHG emissions and their changing level is a key for policy-makers to manage GHG emissions. For example, most of developed countries quantify their national GHG emission levels to understand their trend and see whether the country complies with national or international targets. Many firms quantify their own GHG emissions in response to regulatory requirements, or as a part of their corporate social responsibilities.

For developing countries, MRV is often the basis of tradable credit issuance and access to international support for financing and technology assistance. With the Clean Development Mechanism (CDM) under the United Nations Framework Convention for Climate Change (UNFCCC), for example, all projects must comply with a pre-approved set of MRV methodologies and procedures to be eligible for credit issuance.

1.3 MRV and NAMAs

MRV is also important in the context of Nationally Appropriate Mitigation Actions (NAMAs) which are a set of mitigation actions that are put forward by developing countries for external support. In the Bali Action Plan, NAMAs are referred to as "nationally appropriate mitigation actions by developing country Parties in the context of sustainable development, supported and enabled by technologies, financing and capacity building, in a measurable, reportable and verifiable manner (UNFCCC 2007)". As the text indicates, NAMAs are expected to serve as the basis for international support for mitigation actions by developing countries. However, it should be noted that MRV methodologies for NAMAs are not developed compared with MRV methodologies at organisation or project levels, as discussed below.

1.4 Four distinct levels of MRV

As MRV is a complex concept that embraces diverse ideas, there is conceptual confusion about it. MRV has four

[1] For editorial convenience, following chapters in this report assume that M represents Measurement. However, the actual concept of MRV often includes Monitoring.

distinct levels: organisational, project, national and policy levels (Ninomiya 2012). These four types of MRV should be distinguished because they are different in their purposes and nature, and methodologies and experience at one level may not be immediately applicable to another level.

Type 1: Organisational level:

Organisational level MRV aims to determine the amount of GHG emission from designated entities under GHG emission trading and reporting schemes such as European Union Emission Trading Scheme (EU-ETS), Japanese Voluntary Emission Trading Scheme (J-VETS), Climate Registry and Tokyo Metropolitan Government ETS. The MRV at this level is characterised by a high level of stringency due to its direct linkage with financial incentives.

Type 2: Project level:

Project level MRV aims to quantify GHG reductions associated with a project for the purpose of crediting, most commonly through the implementation of the Clean Development Mechanisms (CDM) but also through other crediting schemes such as Verified Carbon Scheme (VCS). As at the organisational level, it requires a high level of accuracy. Although its methodologies are already well developed, there is a continued challenge to accurately estimate “baseline emission”, which enables the comparison between scenarios within and outside the project.

Type 3: National level

National level MRV aims at determining the GHG emission in each country. Its methodologies are well established through guidelines by the Intergovernmental Panel on Climate Change (IPCC). As the methodologies primarily rely on national statistics, its accuracy requirement is not as strict as organisational and project levels. Although most of developed countries established their national MRV schemes through their GHG inventories, many developing countries have yet to institutionalise such systems. Furthermore, national level MRV could potentially be applied to regional and local levels, but the methodologies and applications at subnational levels are limited at the moment.

Type 4: Policy level:

Policy level MRV aims at quantifying the impact of specific policies or actions, including NAMAs, with respect to GHG emissions. As the methodologies and guidelines available at this level are very limited, they need to be further developed based on experiences at other levels. In particular, MRV of NAMAs is extremely important as a precondition for facilitating external support to NAMAs.

Table 1-1: MRV of GHG emissions/reductions

		Type I: MRV of GHG emissions at organisation level	Type II: MRV of GHG reductions at project level for crediting	Type III: MRV of GHG emissions at national level	Type IV: MRV of GHG reductions by policy/ action
Object		GHG emissions at organisation level under GHG scheme	GHG reductions realized by individual project	GHG emissions at national/sub-national level	GHG reductions by policy/action at national/ sub-national level
Aim		Determination of GHG emissions at covered organisation under GHG scheme	Crediting and certification of amount of GHG reductions by individual project under GHG scheme	Determination of GHG emissions at national level and compliance assessment for developed countries under Kyoto Protocol	Unavailable
Methodology	**M • R**	Monitoring and Reporting Guidelines under GHG scheme	Monitoring/ Baseline/Calculation methodologies under GHG scheme	IPCC Guidelines and UNFCCC COP/CMP Decisions	Unavailable
	V	Verification Guideline under GHG scheme	Verification Guideline under GHG scheme	UNFCCC COP/CMP Decisions and Kyoto Protocol Art. 8 with related documents for review	Unknown (probably, government that is implementing the policy/action)
Implementation body	**M • R**	Covered organisation under GHG scheme	Project participant of individual project	National government/ sub-national government	Unknown
	V	Third-party verification body	Their-party verification body	Expert Review Team under UNFCCC/ Kyoto Protocol Art. 8	• Undeveloped MRV • Required level of accuracy unknown, but possibly less than medium • Important MRV regarding effectiveness of international climate regime
Characteristics		• Very high required level of accuracy • Technically well matured and sophisticated MRV • Sufficient knowledge and experiences accumulated in developed countries • Relatively simple	• Very high required level of accuracy • Technically well matured and sophisticated MRV • Globally operated via CDM all over the world • Technical difficulties inherited in baseline setting, additionality demonstration	• Medium required level of accuracy (not as much as Type I and II) • Technically matured and widely operated in developed countries/ Not well established in developing countries • Relatively simple	
Examples operated		• EU-ETS • Climate Registry • California Climate Action Registry (US) • Tokyo Metropolitan Government ETS • JVETS (Japan)	• CDM • VCS • J-VER (Japan) • BOCM (Japan: under developing)	Submission and review of National GHG Inventory	Unavailable
International standards/ Guidelines		• ISO14064-1 • ISO14064-3 • ISO14065 • ISO14066	• ISO14064-2 • ISO14064-3 • ISO14065 • ISO14066	• IPCC Guidelines (M/R) • UNFCCC COP/CMP Decisions (R/V)	Unavailable

Source: Ninomiya 2012

This report will focus on activities to reduce GHG emissions – which should go through MRV processes of Type 1, 2 or 4. Type 3, which is essentially related to the development of national inventories, is not covered in this report as it does not directly link to GHG-reducing activities.

1.5 Addressing the trade-off

There is a trade-off between simplicity and stringency of MRV. An MRV scheme that aims for accurate measurement and monitoring of emissions levels require a range of data, calculations and equipment, accompanying heavy burden and cost. For example, MRV requirements of CDM are sometimes seen as too stringent and costly to promote CDM in least developed countries. On the other hand, overly simple MRV schemes may not deliver reliable values. In general, developing countries and the private sector prefer simple and easily compliable MRV schemes, while developed country governments prefer strict MRV schemes to ensure real GHG reduction. Hence, MRV requires the right balance between simplicity and stringency.

Two approaches are available to address this trade-off. One is to strengthen capacity building activities for responsible entities. Such capacity building activities are implemented by national governments, international organisations, donor agencies and research institutes including IGES. However, there is a long way to go; many developing countries still do not have GHG inventories, and many local entities, even in developed countries, have limited experience in quantifying their emissions levels. Moreover, lack of MRV expertise in the private sector is one of the barriers to promoting CDM in least developed countries.

The other approach to address this trade-off is to develop new modalities and methodologies that are easier to implement while maintaining its accuracy. Such attempts are made by a range of stakeholders – notably by the CDM Executive Board by encouraging the development of standardised baselines and default values –which do not require monitoring during project implementation and hence are easier to implement for developing countries.

Capacity building and development of simplified methods are two sides of the MRV coin, and therefore equally important. They are also synergetic, as capacity building activities can provide lessons for developing simpler modalities and methodologies, and application of simpler methodologies and modalities will reduce the capacity gap. However, this synergy is often put in disarray due to the shortage of information, including on-the-ground case studies and lessons learned.

This report aims to accelerate both capacity building and development of simplified methods by compiling case studies and lessons learned from IGES activities on both strands.

1.6 Structure of this report

Following this chapter, Part 2 provides MRV case studies at the national level especially in relation to NAMAs. In the above typology, they belong to Type 4- policy level, whose MRV schemes are least developed among the four types. These chapters will assess existing policies to control GHG emissions in Asian developing countries, and identify missing links from the MRV perspective at the policy level.

Part 3 documents a stock of knowledge and lessons from IGES's MRV capacity building activities in Asia. It consists of case studies at subnational levels, including energy, waste and forestry sectors as well as cities. Chapters on the energy sector primarily focus on analysis and comparison of different MRV methodologies from CDM, Global Environmental Facilities and Global Technology Fund. In the waste and forestry sector, the analysis is not only on MRV methodologies but also approaches to leverage the effect of local participation and co-benefits by implementing MRV schemes. Such approaches may pave the way for MRV in places where GHG reduction incentive and administrative capacity of authorities are limited. Chapter 8 covers multiple sectors and countries with a perspective from cities and urban management.

Part 2: MRV and NAMA case studies at national Level		
Institutional framework of NAMAs (Ch.2) Southeast Asia (Ch.3) China (Ch.4) India (Ch.5 and 6) Indonesia (Ch.7)		
Part 3: MRV case studies at subnational level		
Energy demand/supply	**Waste**	**Forestry**
Biomass (Ch.9) Industry (Ch.10) Appliances (Ch.11) Buildings (Ch.12) Transport (Ch.13)	Wastewater (Ch.14) Composting (Ch.15) Solid waste (Ch.16 and 17)	REDD+ (Ch.18)
Cities (Ch.8)		

Figure 1-1: Structure of this report

Part II

MRV and NAMA Case Studies at National Level

Chapter 2 NAMAs: Institutional Framework and Linkage between the National and Sub-national Levels

Hidenori Nakamura

Key Messages

Possible national-level institutional mechanisms, including those categorised as NAMA, to enhance low carbon development at the sub-national level include mechanisms of 1) incentive provision and ownership development, 2) effective monitoring and evaluation of policies, 3) adaptation to and appreciation of diverse local conditions and contexts, and 4) support of policy diffusion and mutual learning among sub-national governments.

2.1 So far, most of the responsibilities to manage climate change are rest with national government, while sub-national governments are responsible to follow national policies and influence their own local stakeholders

According to many of the national communications submitted to the UNFCCC (five from Annex I countries and five from non-Annex I countries), main responsibilities to manage climate change are rest with national government while sub-national government are responsible to follow national policies and influence their own local stakeholders. In terms of the GHG inventory, only large sub-national governments in some developed countries are mandated but most of the sub-national governments are not mandated, and only some sub-national governments have voluntarily developed their own GHG inventory. GHG emissions reporting mechanisms from emitters to government do not exist at the sub-national level in five developing countries. Regarding the legislations and policies, some sub-national governments in developed countries have formulated local ordinance and implemented policies, in addition to legislative formulation at the national level. Climate change mitigation legislation, if any, exists only at the national level in Annex I countries. In the sectors of transport, commercial and residential buildings, and waste, the low carbon policies and measures have been identified in advanced provincial/state or city/municipal governments in five Asian developing countries (Nakamura 2012).

2.2 Providing incentives for policy implementation among sub-national governments and then nurturing ownership of such actions

One core institutional mechanism for promoting local low carbon policies and measures is for national governments to provide incentives for policy implementation among sub-national governments and then nurturing ownership of such actions. Such mechanism was designed and implemented by the secretariat of international intercity network programmes to promote sustainably development as demonstrated by CITYNET and ICLEI Southeast Asia (Nakamura 2011). The secretariat of an international network improves the results by properly understanding the particular needs of participating cities; providing them with useful opportunities; and nurturing ownership and commitment through calls for proposals, requests for action planning, and monitoring during the network activities. Likewise, national government could provide opportunities such as funding with sub-national governments while soliciting political commitment and consecutive performance demonstration from them.

2.3 Effective monitoring and evaluation of policies is the key

To enhance the effective implementation of any low carbon development policies and measures at the sub-national level, it is needed to strengthen the general monitoring and evaluation mechanism at the administration/organisation level. Concretely, introduction of performance indicators for each division or project, and feedback for planning next fiscal year/budget securing process are essential elements to embed such monitoring mechanisms. Moreover when national government extend nationally supporting programmes to sub-national governments, plan-do-check-act

(PDCA) cycle of such programmes shall be linked with national level low carbon development action plan. Another important, and yet challenging aspect of policy assessment is to embed the practices of ex-entre/ex-post evaluation of policy alternatives to achieve shared goals, i.e., evaluation of "relevance" by means of comparing different policy options, in addition to the monitoring and evaluation of policy outcomes, i.e., the expected/actual difference before and after execution of the policy. Capacity development and social learning process is also needed towards low carbon development in particular because climate policy deals with the difference between business-as-usual and possible execution of policies.

2.4 Adapt to and appreciate diverse local conditions and contexts

When the above incentive and ownership development mechanisms as well as monitoring and evaluation mechanisms are to be introduced, diverse local conditions and contexts are need to be fully taken into account. It basically adopts three phases, initiating from readiness support, then goes on to demonstration/test case support, to final stage of nation-wide adoption of policy or programme. Case study of a Japanese advanced city government, i.e., Hiroshima city, on low carbon policy development and implementation, also suggests the significance of coherence among low carbon development policies, local issues to be solved and initiatives taken in the past (Hosei University 2012). Political leadership shown by Mayor/Governor/chief executive promotes justification and relevance of new low carbon development policy by drawing different reasons in various contexts in the city. Developmental co-benefits provide justification with initiation and promotion of climate change mitigation policies.

2.5 Support policy diffusion and mutual learning among sub-national governments

Sub-national governments are not only developing and implementing their own policies and measures but also mutually learning and contributing to policy diffusion and innovation as a whole according to the study of Japanese sub-national government policy processes (Itoh 2006). The comprehensive study revealed the several key promoting factors of such sub-national level policy diffusion, which could be useful suggestion for low carbon development promotion at the sub-national level: a) Sub-national governments that are proactive in information and experience disclosure and searching on the Internet are innovative at policy development; b) Organisational and individual networking activities are conspicuous at innovative sub-national governments; and c) Promoting agency that supports knowledge production and dissemination can facilitate policy diffusion among sub-national governments. Therefore national government can support such mutual learning process in association with nation-wide incentive-provision and/or ownership-nurturing programmes for low carbon development at the sub-national level.

Chapter 3 Southeast Asia: Status of NAMAs

Koji Fukuda, Kentaro Tamura

Key Messages

- Despite conceptual ambiguity and diverse contents, Nationally Appropriate Mitigation Actions (NAMAs) offer a practical opportunity to set countries on a pathway towards sustainable, low-carbon development. The scope of activities could be expanded over time.
- Technical, mainstreaming and institutional dimensions of NAMAs formulation provide a systematic framework to assess the preparedness for NAMAs in developing countries. Selected ASEAN countries demonstrate tangible progresses over these dimensions.
- Stakeholders could further facilitate NAMAs formulation process in the region by
    1) Allocating more resources to expand in-house technical capacity, and sensitizing domestic stakeholders of the benefits that NAMAs could deliver, and strengthening coordination among domestic agencies involved in the process by developing country policy makers
    2) Supporting in-house capacity development, facilitating mutual learning and promoting South-South-North collaboration, and streamlining NAMA-related support among donors by international donors

3.1 Understanding Benefits for Engagement: NAMAs as a Practical Vehicle for Steering Country towards More Sustainable, Low Carbon Development Pathway

Despite its conceptual ambiguity, diverse range of scopes, and political implications attached to NAMAs, it is clear that NAMAs provides a practical opportunity for developing countries to transform themselves into low carbon development pathway. In order to seize such opportunity for meeting national low carbon objective in the context of broader sustainable development, developing country governments should strategically harness NAMAs as a practical vehicle to tap on associated benefits and incentives, including attracting international finance, low carbon technologies and capacity building for meeting wide range of domestic mitigation needs.

With this practical opportunities in mind, this section explores NAMA formulation process in selected five Southeast Asian countries (Cambodia, Indonesia, Lao PDR, Thailand, Viet Nam), and to assess where these countries currently stand in terms of NAMAs development in order to bring national low carbon agenda into reality.

3.2 Assessment Framework for NAMAs Formulation: Exploring Technical, Mainstreaming and Institutional Dimensions

In order for NAMAs to serve as a tipping point for steering a country towards low carbon development path, it is essential to focus on three dimensions of NAMA formulation; technical, mainstreaming and institutional dimensions. These three dimensions can lay foundation for national consensus for NAMA formulation.

Technical Dimension:

Regardless of the different scope of NAMAs that may be envisaged by developing countries, the common aspect of NAMAs which needs to be shared by all developing countries is that NAMAs need to be based on a good understanding of the current and future GHG emissions trends, possible lists of mitigation options and individual measures with mitigation potential, and their cost implications. These possible lists of mitigation options and individual measures also need to be prioritized, while reflecting national and sectoral developmental needs. Estimation of overall emission trends and mitigation potential for individual measures requires systematic data calibration, collection, archiving and storing practices along with data assessment capacity, and this dimension altogether serves as an essential basis for enabling future MRV for envisaged NAMAs.

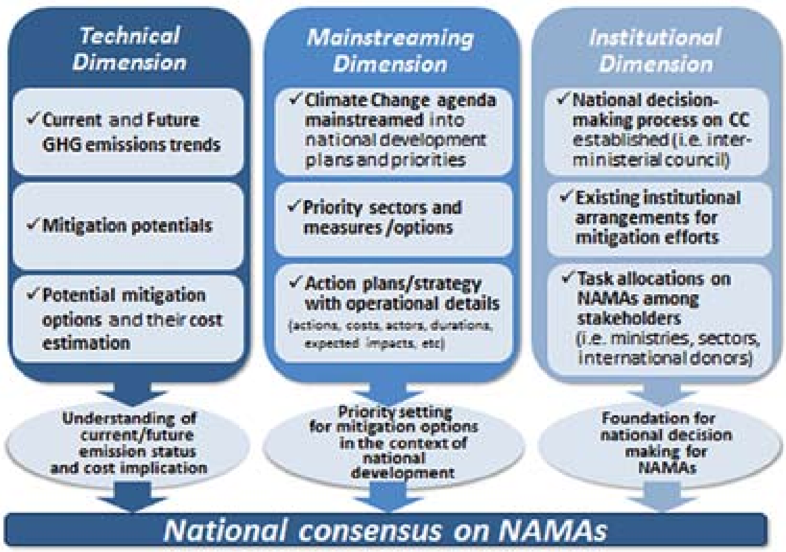
Mainstreaming Dimension:

This dimension enables to assess to what extent envisaged NAMAs is adequately embedded in overall national priorities. Mainstreaming perspective includes inclusion of climate change mitigation agenda in national development plans and priorities, the identification of priority sectors and policies and measures; and the development of mitigation action plans with operational details, among others.

Institutional Dimension:

In order to fully implement envisaged NAMAs, it is crucial that NAMAs to be domestically recognized by all stakeholders. To do so, NAMAs need to be formulated through a cross-ministerial decision-making process which can coordinate and reconcile diverse domestic interests. These aspects of NAMAs formulation is captured by an institutional dimension, which includes the establishment of national, cross-ministerial decision-making process on climate change mitigation; the coordination in institutional arrangements for mitigation efforts; and task allocation of NAMAs formulation and implementation among ministries and stakeholders.

These three dimensions altogether constitute a comprehensive analytical framework by which we can assess the status of NAMA formulation in each of the selected country.



Source: Fukuda and Tamura 2012

Figure 3-1: Essential elements of formulating a NAMA: Three dimensions

Table 3-1 summarizes the current status of each of 3 dimensions for NAMA formulation process for selected Southeast Asian countries.

Table 3-1: Summary of NAMAs formulation status for selected ASEAN countries

Progress Indicator		Laos	Cambodia	Vietnam	Indonesia	Thailand
Submission Status of NAMAs (INF document)		Not Yet Submitted	Submitted	Not Yet Submitted	Submitted	Not Yet Submitted
Technical Dimension	Identification of Mitigation Potential	• **INC:** identified priority mitigation areas and measures without mitigation potential amount. • International supports for forestry accounting	• **INC:** mitigation potential calculated • **SNC** (under development)**:** mitigation potential calculated for major sectors (energy, transport, LUCF) • **GHG mitigation technology assessment report:** mitigation potential estimated for non-energy sector	• **SNC:** identified 28 GHG mitigation measures/ options over mitigation sectors (Energy, LUCF, Agriculture)	• **SNC:** mitigation potential analyzed for 6 sectors (Energy, Industry, Forestry, Peatland, Agriculture, Waste) • **National Action Plan for Reducing. Greenhouse Gas Emissions (RAN-GRK):** mitigation potential by sectors estimated • **Local Action Plan for Reducing Greenhouse Gas Emissions (RAD-GRK):** in progress	• **SNC:** Analysis of GHG reduction potential and cost of existing policies • **Renewable Energy Development Plan (REDP) 2008-2022** and **Energy Efficiency Plan (EEP) 2010-2030:** Analysis of mitigation options and cost
	Future Projection and BAU for domestic GHG Emission	• **INC:** no description for future projection and BAU	• **INC:** GHG emission projection up to 2020 estimated • **SNC** (under development)**:** GHG emission projection up to 2050 estimated, along with BAU estimation	• **SNC:** BAU estimation for each GHG mitigation option • **Vietnam Green Growth Strategy (VGGS):** BAU estimates for 2020 and 2030	• **SNC:** GHG emission projection up to 2020 estimated	• **SNC:** No future projection of GHG emissions
	Understanding of Costs for Mitigation Measures	• No observed descriptions in existing policy documents	• **National Development Strategic Plan Update (NDSP Update, 2009-13):** overall budget for environmental conservation area identified, but no specifics figures for individual measure.	• **SNC:** BAU estimation for each GHG mitigation option	• **RAN-GRK:** estimated costs for identified lists of measures	• **SNC:** Analysis of GHG reduction potential and cost of existing policies • **REDP 2008-2022 and EEP 2010-2030:** Analysis of mitigation options and cost

Mainstreaming Dimension	Climate Change Mainstreaming	• **Seventh National Economic Social Development Plan (NESDP7, 2011-15):** inclusion of domestic climate change measures • **National Strategy for Climate Change (NSCC, 2010):** Priority sectors and measures identified • **Sector specific climate change mainstreaming:** Renewable Energy Development Strategy (2011), Agricultural Development Strategy (2011-20)	• **Rectangular Strategy II (RSII):** Environmental Sustainability as a Pillar • **National Development Strategic Plan Update (NDSP Update, 2009-13):** Inclusion of climate change measures • **Green Growth Roadmap (2011-):** formulation of sectoral policies and actions in the context of low carbon growth	• **National Target Program for Climate Change (NTPRCC)** and **National Climate Change Strategy (NCCS):** Clarification of schedule and lead agency for mainstreaming	• **Mid-term National Development Plan (RPJM 2010-14):** described climate change as cross-cutting measures • **ICCSR:** identified measures for major mitigation sectors • Sector-specific climate change mainstreaming: REFF-BURN, Vision 25/25, REDD+ Strategy	• **Draft National Master Plan on Climate Change (NMPCC) 2011-2050:** Long-term vision for being a low-carbon society in next 40 years • **11th National Economic and Social Development Plan (NESDP: 2012-2016):** Low carbon economy as a national development strategy
	Identification of Priority Sectors	• **National Strategy for Climate Change (NSCC, 2010):** Priority sectors and measures identified	• **NSDP Update 2009-13:** identified priority sectors and measures	• **NCCS:** Identification of prioritized sectors and measures with 2020 and 2030 targets	• **RAN-GRK:** Listed mitigation sectors for achieving reduction target • **ICCSR:** major mitigation sectors prioritized (primary sector, secondary sector)	• **NESDP** and **draft NMPCC 2011-2050:** Identification and description of prioritized sectors and policies for mitigation
	Development of Climate Specific Strategy and/or Action Plans	• **National Action Plan for Climate Change (NAPCC):** under development	• **Cambodian Climate Change Strategy and Plans (CCCSP):** under development	• **NTPRCC:** line ministries, sectors and local governments are requested to develop action plans	• **RAN-GRK:** placing the reduction target under the presidential regulation	• **REDP2008-2022** and EEP**2010-2030:** Specific targets
Institutional Dimension	Securing a forum for cross-ministerial decision making	• **National Steering Committee for Climate Change (NSCCC)** established (2006) • **REDD+ Task Force (2008):** preparing for establishing REDD+ Office	• **NCCC** established (2006) • **Cambodian REDD+ Task Force (2010):** transitioning to formal setup	• **National Climate Change Committee (NCCP) established (2011)** • National REDD+ Steering Committee (2011)	• **DNPI** established (2008) • **REDD+ Task Force (2010):** preparing for establishing a REDD+ agency	• **National Climate Change Committee (NCCC), under the Office of Natural Resources and Environmental Policy and Planning (ONEP)** of the Ministry of Natural Resources and Environment established (2006)
	Grasping Existing Implementation Framework	• **NSCC** established (2020)	• **NSDP Update 2009-13** established	• **NCCS:** Coordination by the Ministry of Planning and Investment • **VGGS:** Coordinated by MPI	• **SNC:** description of existing measures	• **NESDP** and **draft NMPCC 2011-2050**
	Task Demarcation among Stakeholders for NAMAs Implementation	• Depends on the scope of envisaged NAMAs: Currently MONRE considers transport NAMAs	• Depends on the scope of envisaged NAMAs: Currently MOE-CCD considers energy NAMAs	• Depends on the scope of envisaged NAMAs • **Various international supports for designing NAMAs and REDD +** • **MONRE:** Coordination of NAMA formulation	• **RAN-GRK:** Identified roles and responsibilities among ministries, sectoral allocation for GHG emission reduction amount • **RAD-GRK:** currently under development	• Depends on the scope of envisaged NAMAs • **Thai GHG Management Organization** (TGO) is taking the lead in considering NAMAs

3.3 Summary of Cross-Country Assessment of NAMAs formulation

Assessing Technical Dimension:

Different level of technical capacity is evident among selected countries reflecting different stages of development; while Thailand, Indonesia and Vietnam demonstrate relatively greater technical capacity for NAMA formulation process accompanied by effective utilization of domestic pool of technical expertise, LDCs including Cambodia and Lao PDR still lack sufficient domestic expertise to fulfill technical dimension of NAMAs. Yet on the other hand, it is also evident that each selected country has rooms for further improving technical capacity to capture GHG emission trends with BAU estimations with better accuracy, mitigation potentials of individual actions, and their associated costs.

All of the five countries also face a common challenge for ensuring data collection and data sharing across different activities under different ministries. In this regard, several national efforts are observed to provide better institutional arrangements to address the issue: establishment of legal basis for national GHG inventories with permanent team dedicated to inventory activities in Indonesia, as well as for process of establishing institutional arrangements to support inventories in Vietnam.

Domestically, Indonesia and Thailand are also currently considering establishing national voluntary emission reduction schemes (VER). Such voluntary schemes would provide robust accounting rules and systems along with methodological developments, altogether contributes to strengthen technical foundation and experiences for domestic MRV in respective country.

Assessing Mainstreaming Dimension:

In terms of the progress made over mainstreaming dimension of NAMA formulation, all of five selected countries demonstrate the mainstreaming of climate change agenda into national developmental plan and strategies one way or the other. However, differences are observed in terms of leading governmental ministry for domestic climate change agenda; While developmental and planning ministries are assigned to play a leading role in NAMA formulation in both Indonesia and Vietnam, environmental ministries play a leading role for Lao PDR and Cambodia. In this regard, further analysis is required to assess the extent to which such differences in leading ministries has implications over implementation of mainstreaming process under different national circumstances.

It is generally observed that developmental and planning ministries usually have strengths over cross-ministerial coordination due to years of coordination experiences in conventional developmental assistance, but the general awareness level over climate change agenda with sense of national priority may not be as high as environmental ministries. On the other hand, because climate change division of the environmental ministries, as observed in Cambodia and Lao PDR, have only gone institutional upgrading fairly recently, coordinating capacity and adequacy of staff may need to be further strengthened in the due course.

Assessing Institutional Dimension:

For the institutional setup for NAMA formulation, all the selected countries demonstrate the cross-ministerial decision-making body domestically for climate change agenda put in place, along with attempts to define roles and responsibilities of different stakeholders for NAMAs implementation. Indonesia, for instance, provides potential lists of activities and responsible ministries for priority mitigation sectors under the National Action Plan for Reducing GHG Emissions (RAN-GRK), along with development of local version of such action plans (RAD-GRK). Other countries, such as Vietnam, Cambodia and Lao PDR, who start consideration of NAMAs from a specific mitigation sector, invites relevant ministries and domestic stakeholders to engage in formulation processes.

One of the broader challenges facing each of selected countries over NAMA formulation is institutional and conceptual congestion; the former stands for that because climate change is cross-cutting in nature entailing different needs and interests, domestic stakeholders are generally large in volume. Political leadership may be required to reconcile such different interests to address possible domestic institutional power struggle, and to navigate a soft-landing to reach a common ground over NAMAs. The latter represents complex climate change landscape over the presence of different yet potentially overlapping initiatives with NAMAs, including green growth agenda and low emission development strategies. Better communication, coordination, and streamlining among different initiatives may be required to avoid possible scenario of dissipating resources. In this regard, national ownership should play an important role in prioritizing and streamlining these initiatives to bring resources together to push NAMAs agenda forward.

3.4 Ways Forward: Recognizing the Possible Roles by Developing Country Governments and International Donors for NAMAs

The cross-country assessment of NAMAs over the selected Southeast Asian countries revealed the substantive progresses have been made over NAMA formulation processes. While various challenges are observed in technical, mainstreaming and institutional dimensions in the process, it is clear that NAMA could serve as an essential vehicle to transform resource-intensive growth pattern to more efficient, low carbon path way, therefore is compatible with sustainable development. From MRV perspective, it is also made clear that all technical elements considered and developed under the technical dimension of NAMAs could contribute to lay stronger foundation for future MRV of actions to be taken under NAMAs.

It is therefore inferred that recognition of, and capturing of the benefits attached to NAMAs by the developing country governments are crucial to further accelerate the NAMA formulation process. Strategic thinking is needed in how to efficiently and effectively harness NAMAs agenda to attract more international finance, low-carbon technologies and transfer, and capacity building to support domestic technical capacity to enable implementation of the envisaged NAMAs.

International donors should also be present to provide sufficient support for NAMAs readiness activities including expansion of in-house technical capacity and human resources, strengthening and streamlining institutional arrangements for NAMAs, along with provision of a space for facilitating mutual learning opportunities among neighboring developing countries. Moreover, because NAMA formulation is not a one-off event, but is a continuous process through which developing countries are encouraged to expand the scope of mitigation activities over time to strengthen linkages with overall sustainable development, continuous technical support to expand sectors in NAMAs may also be helpful.

Chapter 4 China: MRV in Target Responsibility System (TRS)[1]

Zhen Jin

Key Messages

- China announced to decrease CO_2 emission intensity per GDP by 17% by 2015 compared to the 2010 levels in its 12th Five Year Plan (FYP12: 2011-2015).
- To ensure the implementation of the target, the Chinese government applied the Target Responsibility System (TRS) to the FYP12 energy intensity target.
- TRS played a crucial role in achieving energy intensity targets in the FYP11 period, but there were a number of issues observed, such as the unreasonable allocation of targets to some provinces, illegal forced power cuts by local governments as last-minute methods to achieving their targets, and uncertainty over the credibility of targets achievement results.
- Based on some problematic issues observed, China's government introduced various measures such as more reasonable (perhaps scientifically based) target allocation process, Energy Forecast and Early-Warning System and Fixed Asset Conservation Measures.
- For achieving 12th FYP's energy-saving and CO_2 target to contribute mid-term target, how to establish proper MRV is the common challenge in China. To overcome this challenge, it is needed to improve not only the infrastructure for measuring various data of enterprises, but also to enhance the data quality and information disclosure.

4.1 Introduction

China is the largest CO_2 emitter in the world today, accounting for 6.88 $GtCO_2$ in 2010 (Blue Book, 2012). Since 1978, China has experienced spectacular economic growth due to its open-door policy, and its economic growth is expected to continue for several decades with increasing energy consumption. By 2035, China`s primary energy consumption will increase nearly 70% from the 2010 (IEA, 2011). China`s economy growth has been heavily dependent on coal consumption, and the projected increasing core consumption will rising its pressure to reduce GHG emission and to overcome serious problem of environmental pollution such as acid rain.

At the COP16 of the UNFCCC in Cancun, Mexico, China made the pledge to reduce its CO_2 emission intensity per unit GDP by 40–45% by 2020 compared to the 2005 levels. To achieve the Cancun target, China has set a target to decrease CO_2 emissions intensity by 17% by 2015 compared to the 2010 levels in its 12th Five Year Plan (FYP). To achieve the CO_2 intensity target, the State Council announced in December 2012 its Document (State Council, 2012) to provide concrete measures by 2015. In particular, State Council Document No.41 positioned the energy intensity target (16% reduction of energy intensity per unit GDP between 2010 and 2015, established by the State Council Document No.26 in 2011) as one of the key measures to achieve the CO_2 target.

To ensure the implementation of the CO_2 intensity target, FYP12 introduced the Target Responsibility System (TRS) which was adopted in the State Council Document No.29. Under the TRS, national targets are fragmented to local governments and enterprises as mandatory targets with awarding and punitive measures for the personnel in charge (limited to public-private enterprises). A similar scheme to TRS has already been adopted as an energy-saving policy in

[1] This section is based on Jin,Z., Kuramochi,T., Asuka,J. "Energy- and CO_2-intensity reduction policies in China: Targets and Implementation" ,accepted for publication in Global Environmental Research.

the FYP11 and has been carried over into the FYP12.

Therefore, careful design and implementation of energy-saving policies as well as monitoring, reporting and verification (MRV) of the policy impacts will be crucial for achieving the target. With regard to the design of energy-saving policies, the allocation of CO_2 and energy intensity targets to provinces and lower levels of local governments through the TRS will become important.

The objective of this section is to review the implementation of the TRS and its MRV framework in the FYP11 for the allocation of energy intensity reduction targets in order to obtain insights into policy recommendations for the FYP12 and the future FYP13 (2016-2020) for effective achievement of the 2020 CO_2 emissions reduction target.

This section is structured as follows. Section 4.2 analyses the implementation challenges regarding energy and climate policies in China by investigating how the national energy intensity target in the FYP11 was achieved. Section 4.3 describes the planned measures to improve in the implementation of TRS in the FYP12, and conclusions and recommendations are drawn in Section 4.4.

4.2 The framework of TRS and its implementation challenges in the FYP11

What is the TRS?

The TRS was established through the State Council Document No. 29 in 2006 to allocate nine mandatory national targets set in the legally binding FYP11 to all local governments. The national targets are first translated into provincial targets, then further subdivided and redistributed by provincial governments to their respective lower branches. The central government places particular emphasis on energy-saving and reducing emissions of major pollutants, and both of these policies were combined into a single policy that was adopted starting in 2007 with a State Council Document No. 15 issued on 23 May 2007. Achievement of the energy-saving and emissions reductions targets, in particular, not only affects personnel evaluation of the local government officials in charge but failure to achieve mandated targets can also result in punitive measures.

There are three main reasons for adopting the TRS method to ensure policy implementation: (1) the strong command and supervisory authority of the central government over provincial governments, (2) strong binding force of national FYP, (3) Overall Control of Personnel Affairs by the Communist Party of China (CPC).

Target setting process

Further subdivision of the mandatory energy intensity targets

The decision-making process to determine energy intensity targets at local government level can be explained as follows. Based on the State Council Document No. 29 granting the state the authority to set targets for local governments, the National Development and Reform Commission (NDRC) draws up reduction plans for the various provincial governments. As shown in Table 4-1, the energy-saving targets are differentiated among local governments; for example, there is a more than 2.5-fold difference between the lowest and the highest targets.

The target figures can be roughly divided into those self-reported by provincial governments and those calculated by the central government's policy-making departments. If the targets declared by provincial governments are higher than nationwide averages, they are allowed to stand as regional targets. If, on the other hand, the targets declared are lower than nationwide averages, or no targets have been declared to begin with, targets are worked out in consultation with the local governments based on regional development levels, industrial structure, total energy consumption, per capita energy consumption, energy self-sufficiency and so forth and decided upon after the NDRC obtains the approval of the State Council.

However, there is some flexibility in target setting, taking into consideration the wishes of local governments, economic conditions, and other factors.

Responsibility of provincial governments for achieving the energy intensity target

Provincial governments are responsible for the implementation of energy policies and further distribution of the targets to lower branches of local government (e.g. city or prefectural government or administrative region), and energy-consuming enterprises within their jurisdictions (State Council, 2011).

To clarify the responsibility on energy saving activities for enterprises, energy-consuming enterprises are required to submit a pledge to provincial governments. In case of state-run enterprises that are included in the "Top-1000 energy-consuming enterprises program" (hereafter the Top-1000 program), they do not submit the pledges to provincial governments, but to the NDRC. Management and supervision of these enterprises are carried out by the provincial governments based on authorisation from the State Council.

The Top-1000 program aimed to achieve energy-saving of 100 million tce, and targeted the 998 largest energy-consuming enterprises across nine sectors with annual energy consumption of larger than 180,000 tce. The 998 enterprises together accounted for one-third of China's total energy use and almost half of industrial energy use in 2006 and thus, the Top-1000 program was considered to be a key measure to achieve the national energy intensity target in the FYP11 (for details, see, e.g., Taylor et al., 2009 and Price et al., 2011).

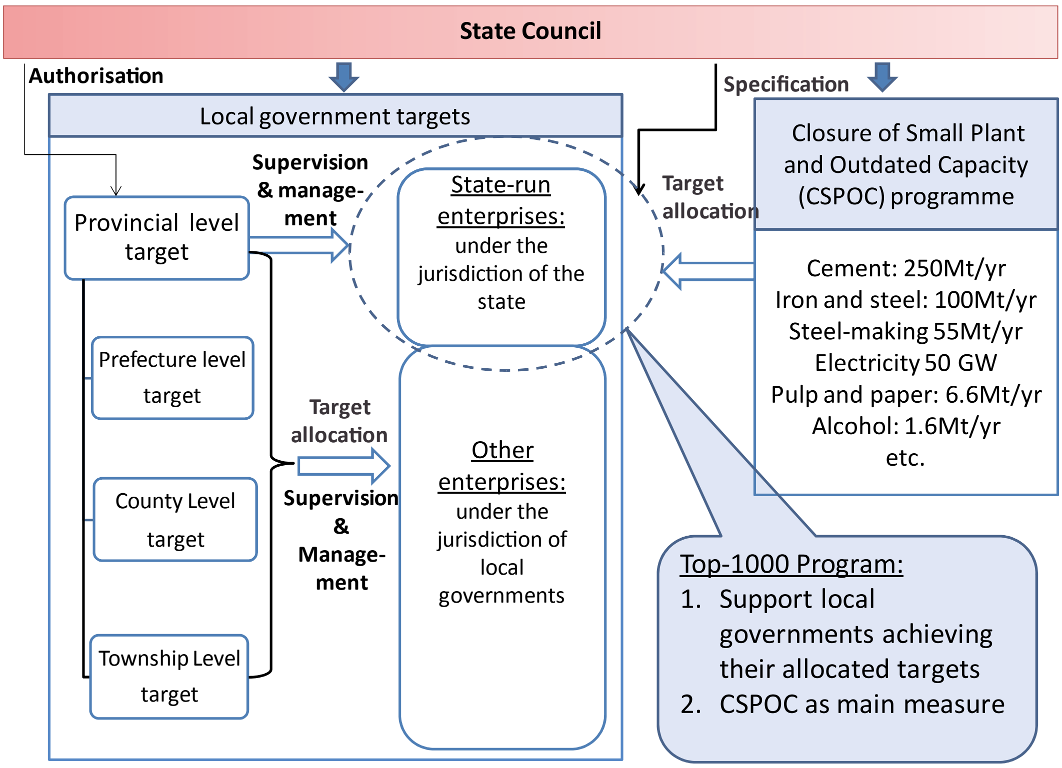


Figure 4-1: Schematic of target allocation process and TRS for the Top-1000 programme with the Closure of Small Plants and Outdated Capacity (CSPOC) programme.

Many enterprises in the Top-1000 program are required to achieve the allocated targets not only from provincial government in which they are located, but also from the central government under the Closure of Small Plants and Outdated Capacity programme (hereafter, the CSPOC programme - also known as the “adjusting industrial organizations policy” in China) that included 14 high energy-consumption industries such as electric power, and iron and steelmaking. It is estimated that the closures will save 118 million tce (State Council, 2007). Also, management and supervision of the CSPOC programme is carried out by provincial governments.

Provincial governments are also responsible for establishing a statistical system to track progress of energy saving efforts in their jurisdictions and reporting the statistics regularly to the central government (State Council, 2006a). Technical standards for developing a statistical system and evaluation rules of target achievement are detailed in a State Council document No.36 promulgated in 2007.

Measures for ensuring effective policy implementation

For an effective implementation of energy-saving policy, provincial governments are responsible for creating a personnel evaluation system that links the status of target achievement with both award and punitive measures which have already been introduced in central and provincial governments.

The officials in charge of energy policy implementation in either the government (this includes chiefs and vice-chiefs of provinces, cities, prefectures, districts and counties) or governing agencies (e.g. local development councils and environment bureaus) can lose their eligibility status for promotion, such as year-end awards or group or personal honorary titles, if they fail to meet their energy-saving targets, notwithstanding their high overall evaluation scores (the so-called One-Vote Veto System). This also applies to the heads of state-run enterprises and local government companies in the Top-1000 program. In addition, false reporting of statistics may lead to dismissal of the responsible personnel from their offices.

In addition, local governments with a poor record will be penalised by being restricted on investment projects or regional infrastructural support projects. Applications for approval of business plans may be refused (in the case of applications where the central government holds approval authority) for investment projects in the area under jurisdiction or applications for environmental assessments (Article 16 of the Environmental Assessment Act). Furthermore, central government support for regional infrastructure projects may be cut back (State Council, 2006a). China has a system for evaluating whether investment projects (including foreign investment) match the country’s industrial policy. This permit approval system based on a State Council Document No.29 and the “Interim Procedures for the Examination and Approval of Enterprise Investment Projects” order of the NDRC, not a system under the law, which reviews items to be adjudicated, from the viewpoint of securing the right of corporations to make decisions, and redistribution of adjudication authority between the central and local governments. Such penalties will affect regional economic growth considerably and therefore have strong impact on the political career prospects of local government leaders.

Provincial energy intensity results at the end of the FYP11

Table 4-1 presents the provincial energy intensity targets and the results for the FYP11 period. National statistics show that the national energy intensity declined by 19.1 % (NBS, 2011) slightly short of the target, with all regions except for Xinjiang meeting their targets. The announcement from the NBS about the top ten provinces that surpassed the allocated targets indicates that the Chinese government places importance on how much the provinces exceeded their respective targets. At the time, many other provinces barely achieved their respective target; 10 out of 41 provinces and cities exceeded their targets by less than 0.1%-points.

A number of important factors affected the national energy intensity reduction result. It is indicated that most provinces and cities achieved the energy intensity target mainly because the economic growth under the 11th FYP was far higher than expected (Teng, 2012); energy consumption did not increase as fast as economic growth, thus leading to lower-than-expected energy intensity. On the other hand, the revision of the GDP and energy consumption data for the base year, i.e., 2005, led to the country as a whole falling short of the national target, although almost all provinces achieved their respective targets (Teng, 2012). Moreover, it is also indicated that the economic stimulus plan that took place in 2008-2009 following the global economic crisis have slowed down the energy saving efforts (Ma, 2011).

Table 4-1: Energy intensity targets in the 11th and 12th Five Year Plan and the results for the 11th Five Year Plan. Numbers in bold present provincial targets higher than the national target values.

Province/region	11th FYP (2006-2010)			12th FYP (2011-2015)	
	2005 Intensity (tce/ 104RMB)	Target (%)	Actual reduction (%)	2015 Target (%)	Reduction vs. 2005 (%)
National target	1.22	-20	-19.1	-16	-32
Beijing	0.8	-20	-26.59	**-17**	-39.1
Tianjin	1.11	-20	-21	**-18**	-35.2
Hebei	1.96	-20	-20.11	**-17**	-33.7
Shanxi	2.95	**-22 (originally -25)**	-22.66	-16	-35
Neimenggu	2.48	**-22 (originally -25)**	-22.62	-15	-34.2
Liaoning	1.83	**-20**	-20.01	**-17**	-33.6
Jilin	1.65	**-22 (originally -30)**	-22.04	-16	-34.5
Heilongjiang	1.46	-20	-20.79	-16	-33.5
Shanghai	0.88	-20	-20	**-18**	-34.4
Jiangsu	0.92	-20	-20.45	**-18**	-34.8
Zhejiang	0.9	-20	-20.01	**-18**	-34.4
Anhui	1.21	-20	-20.36	-16	-33.1
Fujian	0.94	-16	-16.45	-16	-29.8
Jiangxi	1.06	-20	-20.04	-16	-32.8
Shandong	1.28	**-22**	-22.09	**-17**	-35.3
Henan	1.38	-20	-20.12	-16	-32.9
Hubei	1.51	-20	-21.67	-16	-34.2
Hunan	1.4	-20	-20.43	-16	-33.2
Guangdong	0.79	-16	-16.42	**-18**	-31.5
Guangxi	1.22	-15	-15.22	-15	-27.9
Hainan	0.92	-12	-12.14	-10	-20.9
Chongqing	1.42	-20	-20.95	-16	-33.6
Sichuan	1.53	-20	-20.31	-16	-33.1
Guizhou	3.25	-20	-20.16	-15	-32.1
Yunnan	1.73	-17	-17.41	-15	-29.8
Xizang	1.45	-12	-12	-10	-20.8
Shanxi	1.48	-20	-20.25	-16	-33
Gansu	2.26	-20	-20.26	-15	-32.2
Qinghai	3.07	-17	-17.04	-10	-25.3
Ningxia	4.14	-20	-20.09	-15	-32.1
Xinjiang	2.11	-20	-8.91	-10	-18

Source: State Council 2006a, NBS 2011 and State Council 2011

With regard to the Top-1000 program, it exceeded its target by saving 165.49 Mtce; 866 enterprises achieved their allocated targets while there were 15 failures. The CSPOC program succeeded in closing 76.828 GW of small electricity plants, was also exceeding the target of 50GW. Other industries also achieved energy consumption reduction beyond their targets: for example, iron and steel industry reached 120Mt (up from a starting target of 100Mt in 2006), and cement industry reached 370Mt (up from 250Mt).

Up until 2010, there were many cases reported that business plans for investment projects had been rejected and officials in charge had lost their eligibility status for promotion in provincial government due to their poor record of achieving regional targets (National Government Website, 2008).

Issues on the local energy intensity target allocation and the TRS in the FYP11

Although the Chinese government claims that the implementation of energy intensity reduction policy measures was successful, there are three major issues on TRS in the FYP11 according to the authors' view. The first issue relates to the provincial target allocation. The provincial targets were more or less based on the equal-numbers principle, which failed to reflect disparities among provinces such as their levels of economic and social development, economic structure and technological performance (Teng, 2012). In addition, because neither NDRC nor provinces realized the potential impacts of such targets the NDRC did not object to extremely ambitious targets proposed by the provinces at the start of the FYP11 (Feng and Yuan, 2011). As seen in Table 4-1, there are three provinces (Shanxi, Neimenggu and Jilin) that readjusted the initial targets during the 11th FYP. For these provinces, it was found in mid-period evaluations in 2008 that the original targets were too ambitious to achieve, but the adjusted targets were still higher than 20% (Feng and Yuan, 2011). The unreasonable target allocation described above may have put some local governments with unfeasible targets under extreme pressure under the TRS. Xie Zhenhua, the deputy director-general of NDRC admitted that the individual targets assigned to provincial governments in the 11th Five-Year Plan may not have weighted relevant local conditions adequately on September 2010 (China Net, 2011). In other words, it is necessary to improve the target allocation process which can prevent too (or inordinately) ambitious targets (Feng and Yuan, 2011).

The second issue is about the last-minute measures taken by some provinces to achieve their energy intensity targets. According to domestic news reports, in 2010, the final year of the FYP11, there were many cases of local authorities taking illegal last-minute methods such as cutting off power to meet energy saving targets (Power.IN-EN.com, 2012). Such incidents are a result of the unreasonable target allocation and the increase in energy consumption due to the economic stimulus plan of 2008-2009. These last-minute measures caused a major social problem; the CPC's internet newspaper People's Daily has also set up a site inviting readers to report such incidents; up to the end of 2010, more than 1,000 messages related to this matter had been received (People's Daily Online, 2010). To resolve the problem, the State Council issued an emergency decision forbidding illegal and unwarranted power interruptions for the purpose of meeting the energy policy targets. This demonstrates that local government leaders are under strong pressure to meet their targets. Responding to public anger over the measures, Zhang Ping, the chair of the NDRC made a public apology on March 6 in 2011, admitting that the institution had made errors due to a lack of experience (Feng and Yuan, 2011).

The third issue is about the credibility of targets achievement. The National Audit Office (NAO) conducted audit investigations on the reporting of energy conservation and emissions reduction between 2007 and 2009 for power, steel and cement companies in 20 provinces. The finding showed that, as of the end of 2009, 8 power generation companies (total 492.5 megawatt capacity), 121 steel companies (total 23.479 million tonnes iron per year capacity), and 54 cement companies (total 9.1555 million tonnes cement per year capacity) made overstatements on the shutdown of small and inefficient facilities under the CSPOC programme (NAO, 2011). Considering that the audit investigations were conducted in only 20 provinces, there are many more companies that violated the reporting regulations across the country. Not only that the uncertainties about the credibility of the target achievement remain, these audit results also indicate that the TRS may not be functioning as it is expected to be.

Although TRS played a crucial important role in meeting the energy intensity target of the FYP11, there are some shortcomings within the implementation of TRS during the FPY11. In order to make the implementation of TRS more efficient and smooth, it is important to make it more predictable in the beginning stages and have an effective monitoring mechanism.

In addition, the TRS is a top-down regulatory mechanism and exclusively focused on the most energy intensive and traditional sectors. As some are argued, the same policy framework to reduce energy intensity, what was adopted in the virtually all the provinces such as the CSPOC programme, did not fully take into account the differences between provinces, they may not always have been cost-effective (Teng, 2012). Therefore, it seems that a more flexible mechanism needs to be introduced to complement the TRS, such as creating a market for energy-saving target certificates among local governments.

4.3 Framework for executing energy and CO_2 intensity targets in the 12th Five Year Plan

Target setting process

Compared to the FYP11, there are some improvements in the implementation of TRS in the FYP12. Firstly, looking at the allocating target process of TRS during the term of each FYP, a three-stage process was used to allocate provincial-level targets (Feng and Yuan, 2011). Initially, provincial governments submitted their proposed target to the central government and the NDRC responded with an adjusted target. This adjustment routine was then repeated. Finally, the provinces submitted a third figure, which was examined and approved by the National People's Congress (NPC) before being announced as part of official provincial tasks. This process was improved for the FYP12 so that there was increased coordination between central and local government, and there was also intervention of NPC on the allocating target process compared with process of the TRS in the FYP11 (Figure 4-2).

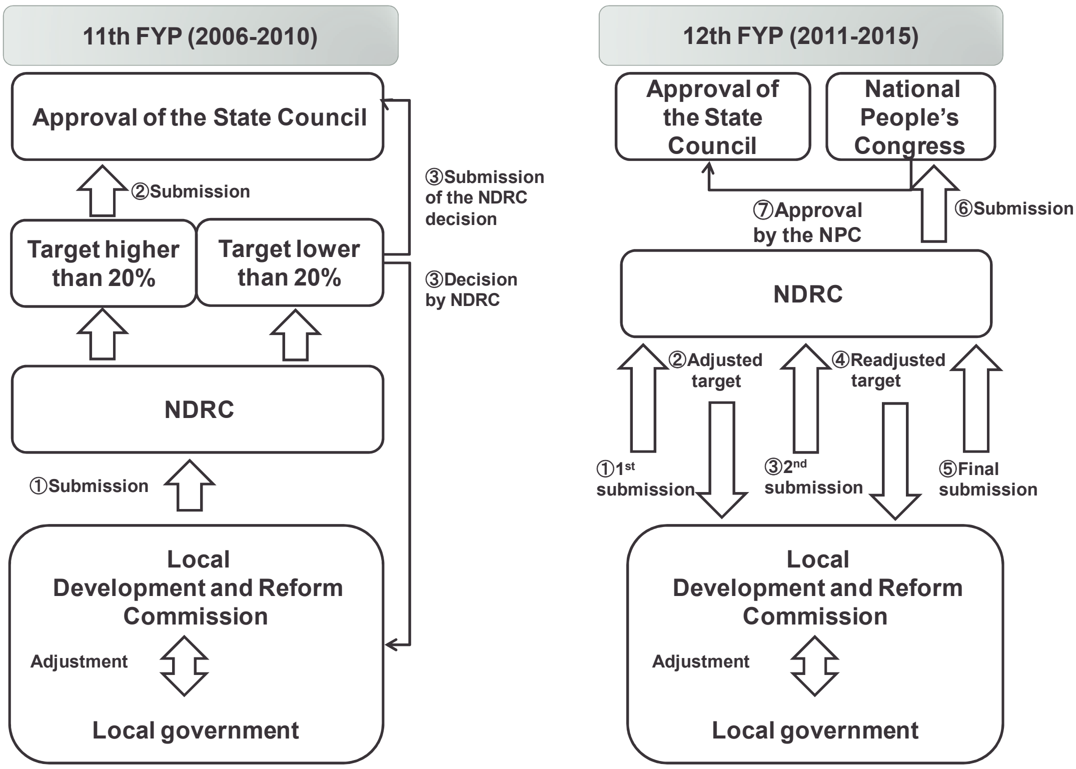


Figure 4-2: Changes in the provincial target setting process between the 11th and 12th Five Year Plans.

Another improvement is about the methods of target setting. The Chinese government is trying to use a more scientific methodology to achieve an equitable distribution of targets. In recent years, many groups have evaluated experience from the past 11th FYP and conducted analyses for more reasonable allocation of provincial targets in the 12th FYP. At the provincial level, local Development and Reform Commissions (DRCs) and Economic and Trade Commissions (ETCs) have been working with local universities to recommend specific targets and their own methodology and criteria (Ohshita et al., 2011). The US Lawrence Berkeley National Laboratory (LBNL) also developed in cooperation with China's Energy Research Institute (ERI) a sector-based target allocation methodology, which takes into account provincial circumstances (e.g., GDP, population, economic structure, and industrial energy intensity).

Table 4-1 shows the provincial energy intensity targets in the FYP12. While an overall goal to cut energy-intensity (energy consumed per unit of GDP) by 16% was set for the nation, provincial targets adjusted up or down to suit local conditions. It is indicated that provinces were classified into four groups for target differentiation: coastal developed, developed, central or western (Feng, 2012), while there are five different target values observed (Table 4-1).

A LBNL study (Ohshita and Price, 2011) compared the draft provincial targets of the Chinese government with the allocation results of three scenarios that they investigated in (Ohshita et al., 2011). The results indicate that the draft official targets are a mix of three scenarios. It is also mentioned that draft official targets have a tighter range of targets than the three scenarios. These results suggest that the draft official targets are a compromise of political negotiations and the consideration of differences in energy and economic circumstances among provinces.

It should, however, be noted that the Chinese government has not disclosed the energy intensity reduction at the national level when the provincial targets are added up. A recent study (Guan et al., 2012) shows that there is a 1.4 gigatonne-CO_2 emission gap between the emissions data from the NBS and the sum of emissions data from the statistical departments at provincial and county levels. Such a large uncertainty in official energy and emissions data raises major concerns whether the achievement of provincial targets would lead to the achievement of national targets.

Measures for Ensuring System Implementation

The second improvement under the FYP12 is that the TRS will be strengthened to meet the energy and CO_2 intensity targets. There will be several differences compared to the TRS in the FYP11. The new TRS for the control of total energy consumption will be implemented in such a way that there will be whole-process monitoring. The energy control TRS has been expected to play an important role providing the predictability of energy-saving TRS administration.

The expected role will be enabled through the Energy Forecast and Early-Warning System (hereafter, Early-Warning System) and Provisional Measures on the Assessment and Examination of Energy Conservation of Fixed Asset Investment Projects (hereafter, Fixed Asset Conservation Measures). The Early-Warning System aims to grasp every region's energy consumption in a timely manner and then demand that each local government takes prompt action because of over-consumption (State Council, 2011). The Fixed Asset Conservation Measures issued in September 2010 (Administrative Rule of NDRC, 2010) requires entities considering an investment in fixed assets to perform an energy conservation assessment prior to applying for project approval (Grobowski et al., 2010). The stringency of the energy conservation assessment is allowed to be made stricter in provinces and other lower branch governments where energy conservation is projected by the Early-Warning System to be more difficult.

The third improvement is that the "Top 10,000 energy-consuming enterprises program" (hereafter the Top-10,000 program) has started from 2012, which aims to promote an effect framework for achieving the 2015 energy intensity targets. The Top-10,000 program maintains the similar framework of the preceding Top-1000 program as mentioned above, but there are some differences. Firstly, the target entities were expanded to more than 15,950, covering a wide range of sectors such as manufacturing industry, transportation as well as service and commercial sectors (hotels, restaurants, department stores, universities). Secondly, the project has established an energy-saving target of 250 million tonne of coal equivalent (tce), 2.5 times larger than that in the Top-1000 program. Moreover, most cheap and quick energy-saving measures such as the CSPOC programme have been exhausted over the last five years, and there is now less potential for shutting down out-dated facilities (Feng and Yuan, 2011), so enterprises need to further improve their energy-saving technologies and energy management skill etc. This is expected to promote an energy efficient market. In fact, the Chinese government has been considering the introduction of a national carbon credit market or national energy-saving credit market to provide incentives to various stakeholders (State Council, 2012).

The final improvement that was noted is that China's government has been considering introducing the Total Energy Consumption Control Program that was planned in State Council Document No. 26 in 2011. This was mentioned by Prime Minister Wen Jiabao in the government work report for 11th 5 session of national People's Congress on 15 March 2012. In this programme, an energy consumption cap of about 4.1 billion tce has been introduced with TRS. If it were to be established, it will mean that China will establish an energy-saving certificate market with the new TRS system.

4.4 Conclusions and recommendations

As mentioned, China's distinctive legal and political system enables TRS to be introduced to local governments. To ensure effective implementation, TRS makes it clear which bodies and individuals are responsible for taking measures, and linking the status of target achievement with a personnel evaluation system, and taking punitive measures if targets are not reached are designed to ensure that the system is implemented. The reasons for adopting these methods to ensure policy implementation are due to the central government's strong command and supervisory authority over provincial governments; the strong binding force of the national FYP; and the party's overall control of personnel affairs.

TRS played a crucial role in achieving energy intensity targets in the FYP11 period, but there were a number of issues observed, such as the unreasonable allocation of targets to some provinces, illegal forced power cuts by local governments as last-minute methods to achieving their targets, and uncertainty over the credibility of targets achievement results.

Based on some issues observed on the overly regulatory TRS, the Chinese government has introduced a more reasonable target-setting process and method with the Early-Warning System and the Fixed Asset Conservation Measures. In addition, for improving TRS, the Chinese government is considering to introduce a national carbon credit market or a national energy-saving certificate market to provide incentives to various stakeholders.

For achieving 12th FYP's energy-saving and CO_2 target to contribute mid-term target, how to establish proper MRV is the common challenge in China. To overcome this challenge, it is needed to improve not only the infrastructure for measuring various data of enterprises, but also to enhance the data quality and information disclosure. There is a basically problem that the local government cannot to get energy statistical data from large state enterprises because they are not under local government control (Wang, 2012). As a way for solving this problem, the establishment of a unified nationwide unified statistical system and the improvement of local government's legal status are necessary.

Chapter 5 India: MRV and the Way towards Meeting the Pledges

Anindya Bhattacharya

Key Messages

- It is important to have common and benchmarked objectives of all the mitigation actions running in the country for easy comparison and deciding the priority of NAMAs.
- MRV mechanism should be developed on a case by case basis depending upon the specific mitigation actions' characteristics like funding sources, institutional responsibility etc.
- Energy sector's mitigation action related MRV mechanism should be based on an integrated energy system analysis rather than just following a top down technology/program identification processes.
- Designing of national MRV mechanism can be a two-step process. The first step is to develop the enabling environment for running a successful MRV regime in the country and the second step could be developing the actual case-by-case MRV framework.
- India needs to ensure availability of reliable data in a transparent manner. Increasing NATCOMM reporting frequency to the UNFCCC could be a positive step ahead in this context.
- It is essential to implement the existing programs successfully rather than having new programs on mitigation actions.

5.1 Introduction

Paragraph 1(b) (ii) of the Bali Action Plan (BAP) seeks enhanced action on emissions reduction by developing countries through Nationally Appropriate Mitigation Actions (NAMAs). Such NAMAs by developing country Parties are proposed in the context of sustainable development supported and enabled by technology, financing, and capacity building, in a measurable, reportable, and verifiable (MRV) manner. Thus, the BAP proposes developing country mitigation actions subject to compliance with the provisions enunciated under paragraphs 4.3, 4.5, and 4.7 of the United Nations Framework Convention on Climate Change.

Since Bali, negotiations under the AWG-LCA track have focused on detailing what exactly constitutes NAMAs? There are many proposals and ideas. However, these proposals remain conceptual in nature and are open to multiple interpretations. Nevertheless, the basic components of NAMAs include the nature and scope of NAMAs, the governing principles for NAMAs, operationalization of NAMAs and finally measurement, reporting and verification of the enabling support provided and the outcomes realized. This study focuses on the MRV issue which is considered to be contentious but inevitable in the context of achieving the voluntary national pledges made by India.

At Copenhagen, India made a voluntary pledge to reduce its emissions intensity of GDP in 2020 to a level that is 20% to 25% below the corresponding 2005 level. Discussion in this study seeks to analyze this pledge in the context of the historic and current performance of the economy and the Prime Minister's National Action Plan on Climate Change (NAPCC).

5.2 What NAMA means in India?

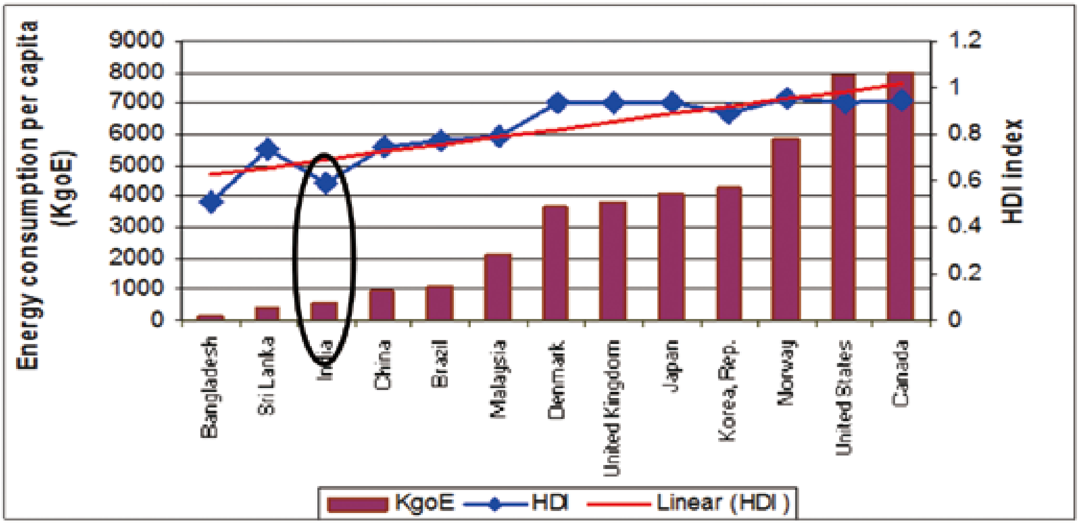
Indian Government has been taking several domestic initiatives under its National Five Year Plans and specially designated action plans to mitigate climate effect (NAPCC) ever since the Copenhagen summit. However, India's basic understanding regarding NAMA and its related monitoring activities (so called MRV) is as long as the activities are externally funded, the Indian Government is committed to comply to its successful completion, allowing international monitoring and disclosure of information. Except that, India is not willing to comply with any international reporting protocol. As a matter of fact, currently, almost all climate mitigation activities are domestically funded by the tax payers' money and purely voluntary in nature. Developing such project is so far completely under the GoI's discretion. However, in future international funding might play a potential role as some of the mission plans such as solar mission indicated the potential usage of the international funds for the implementation of the solar energy targets. While voluntary measures towards mitigation actions within India have been gaining momentum significantly over the past few years, there is a visible reluctance from the government in making any major commitments at the international platform which can adversely affect country's much needed economic development at a relatively lower cost. India being a developing country needs to have a significant level of economic growth to meet the long term economic targets towards raising the living standards of its people and poverty alleviation. Nevertheless, giving the priority to the economic development, India still came up with an international commitment to reduce its *emissions intensity to GDP to the level of 20-25% compared to the level of year 2005*. While these mitigation actions are more or less in place it is important to note that the monitoring and evaluation of these actions are largely fragmented. Irrespective of international commitments, India needs to work out on long term emissions reduction policies for her own benefits. Fall out of reckless economic development will not be very good for India especially while the country is still developing and its majority of the population still lives under $2/day threshold. There is a need for a well-structured intuitional as well as policy mechanism to ensure that these actions are measurable, reportable and verifiable. Thus, NAMA in India is basically nothing but a self-determined target to guide the future planning processes of the Government which can meet the India's development objectives like poverty alleviation and sustained economic growth. It is, therefore, important to investigate and scrutinize all major sectors' long term contribution towards gross national emissions which can give better information to the policy makers for planning.

5.3 India's National Action Plan for Climate Change

Considering the importance of addressing issues related to climate change, in 2008, India took its plan for domestic actions towards climate change mitigation considering its need for sustainable development, under the high level government council headed by the Prime Minister. The council prepared the National Action Plan for Climate Change which has been considered as one of the key pillars of the climate change agenda in the country. The council proposed actions in eight areas such as solar energy, energy efficiency, sustainable habitat, water, Himalayan ecosystem, green India, sustainable agriculture, strategic knowledge for climate change, running through the year 2017 with an aim to support country's actions towards climate change mitigation, while also keeping in view the long term economic development. The most important aspect of the NAPCC council is that the actions have been proposed to be in a mission mode with tangible targets.

Setting the context of emissions reduction for India

In the context of developing a MRV framework for activities that are designed to support India's pledge, it is necessary to take stock of India's economic situation and its development path. Given its growth trajectory over the past two decades, India is clearly seen as one of the major emerging economies in the world. However, despite this growth, India remains the world's poorest country and/or region with most of its socio economic parameters at or below the median level of Sub-Saharan Africa. A look at India's Socio Economic parameters, her low level of energy consumption and her massive developmental challenges makes one wonder what India can truly contribute to the global mitigation effort. This is not an attempt to undermine the need for collective action aimed at reducing global GHG emissions but it merely a realistic assessment of India's capability to deliver within the common but differentiated responsibility (CBDR) principal established under the UNFCCC.



Source: Sethi 2011. (estimated based on IEA World Energy Outlook 2007 and HDI published by UNDP 2010.)

Figure 5-1: Energy consumption and HDI comparison

Figure 5-1 above shows India's position in the global context on Human Development Index and per capita energy consumption (in KgOE). This corroborates the fact that though India is one of the fastest growing economies in the world, she is at the very early stages of economic development and faces enormous developmental challenges linked to poverty and absence of lifeline levels of access to energy, clean drinking water, health services, education and sustainable livelihoods that nurture inclusive growth. The Oxford Poverty and Human Development Initiative (OPHI)[2] puts India's situation in its stark perspective through its Multidimensional Poverty Index that incorporates more that the three dimensions of poverty (income, health and education) captured by HDI. Before setting the emissions (intensity) reduction targets for India, it is important to take a stock of economic, environmental and social issues which would be affected directly and/or indirectly by the process. If one looks at some relevant indicators of India's growth trajectory in the pre and post liberalisation period, one observes significant differences in India's growth pattern in these two periods.

Table 5-1: India's pre and post economic liberalization situation (in % form)

Period	GDP growth rate	Growth in Primary Energy use	Energy intensity of GDP	CO_2 emissions	CO_2 intensity of energy	CO_2 intensity of GDP
1970-1990	4.4	5.47	0.63	5.88	0.39	1.42
1991-2005	6.4	4.09	-3.52	3.87	-0.21	-2.37

Source: Compiled from CSO and MoEF, India 2010 database

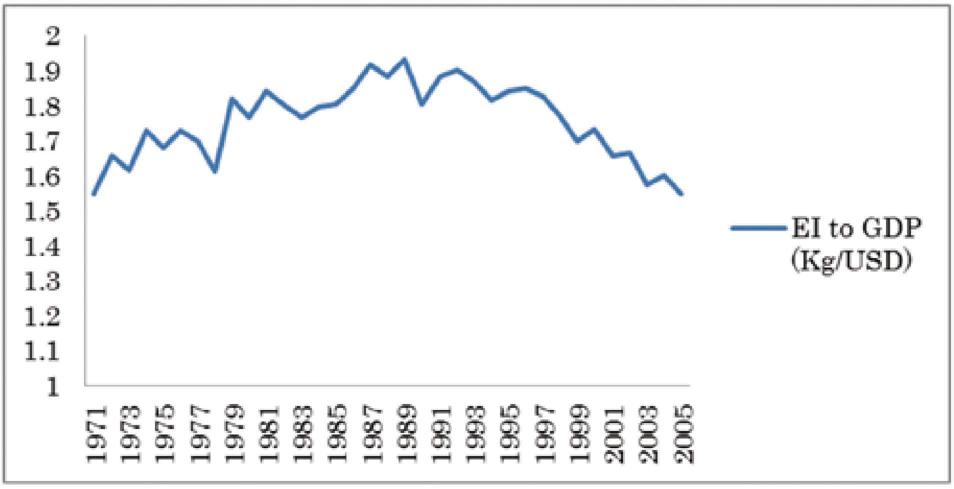
Clearly, Table 5-1 demonstrates that India is on a low carbon growth trajectory and its emissions intensity has been falling since 1991. Thus, India can be said to be pursuing sustainable development. However as seen from Table 5-1 above India still faces huge development challenges and cannot be expected to contribute much more than a sustainable growth trajectory as its legitimate contribution to the global effort on mitigation. Clearly, high GDP growth alone is a poor measure of either the level of development of a country or its capability in delivering unrealistic levels of mitigation through NAMAs. In several areas, India faces challenges that qualitatively mirror the challenges faced by Sub-Saharan Africa and often exceed those of Sub-Saharan Africa in their quantitative magnitude. One cannot allow

2 Source: OPHI's findings and its comparison of India with Sub-Saharan Africa can be accessed at: http://www.ophi.org.uk/policy/multidimensional-poverty-index/

global mitigation objectives to override the development aspirations of millions of Indians striving to improve their social and economic conditions to an acceptable human level.

Reviewing India's pledge/commitment

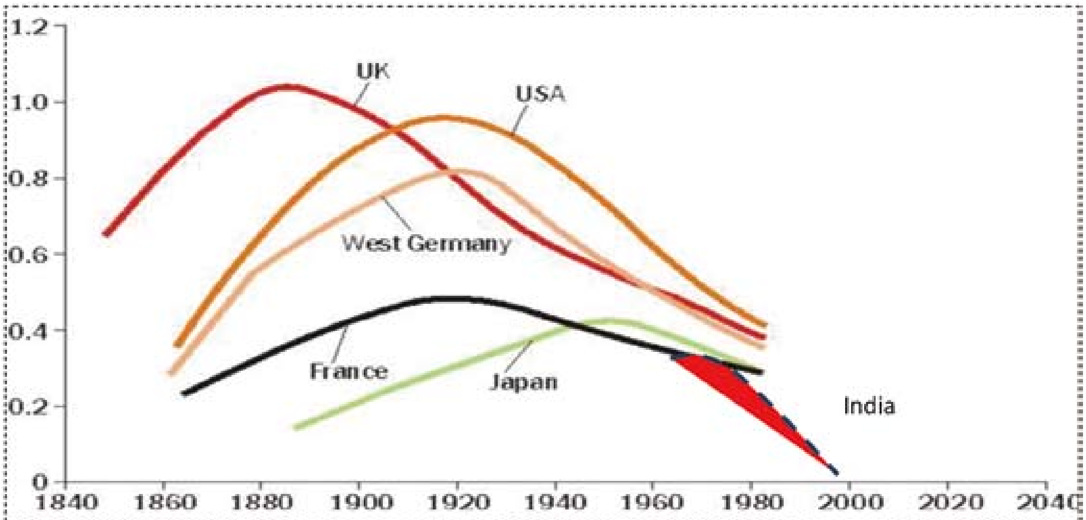
India's voluntary pledge to reduce her CO_2 emissions intensity of GDP by 20-25% compared to 2005 by 2020 would be the governing obligation under any future global climate mitigation and MRV regime. India has, over the preceding two decades, demonstrated steady progress in reducing her emissions intensities per unit of energy consumed as well as per unit of PPP GDP.



Source: Estimated using data provided in the TIAM Model data base on national GDP and CO_2 emissions

Figure 5-2: Historic emissions intensity of GDP in India

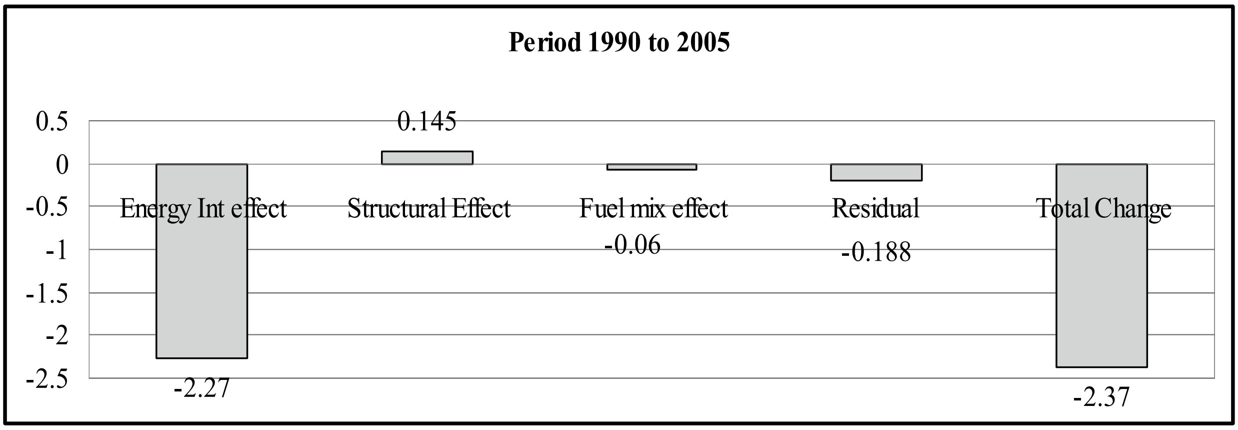
India continues to grow at a robust rate of 7-9% and must maintain this level of growth if it is to meet its developmental challenges of eradicating poverty and meeting the millennium development goals. However, once again, as Figure 5-3 shows India's growth trajectory has not been as "fuelish" as that of other developed countries. India's point of inflexion was achieved at a much lower level of per capita energy consumption as well as a much lower level of per capita income. As stated above, this again underscores India's sustainable development trajectory.



Source: Estimated based on IEA data and World Energy Outlook 2010.

Figure 5-3: India's historic emissions intensity compared to other developed countries

In the context of analysing India's decreasing emissions intensity characteristics, it has been observed that energy sector has the maximum impact on overall intensity reduction (Sengupta, 2011). Decomposition of various factors contributing to the overall GHG emissions shows that energy sector is the single largest source of GHG emissions in the country and, therefore, achieving a higher level of energy efficiency contributes significantly to a reduction in the emissions intensity. Figure 5-4 below shows the decomposition of total emissions intensity reduction by various factors. The energy sector itself is responsible for more than 95% of reduction.



Source: Sengupta 2011

Figure 5-4: Decomposition of India's emissions intensity among various sectors

Importance of energy sector in emissions reduction in India

Indian energy sector is one of the fastest growing sectors in the country with an average growth rate of 7% per annum until 2030. Moreover, majority of the future energy supply in India is expected to come from coal and other fossil fuels which are highly polluting in nature and highly carbon intensive. Thus it has been projected that the electricity sector (among other energy sub sectors) will have the highest growth rate of GHG emissions until 2030 which is around 5.6% per annum. As a matter of fact, energy sector is the most polluting in nature in India and in the context of emissions reduction in the country; this is the single most important sector indeed. So far, GoI has taken two major steps to mitigate GHG emissions from the electricity sector which are National Solar Mission and National Mission on Enhanced Energy Efficiency under its National Action Plan for Climate Change. The table below shows the key features of these two missions which are considered the most import pillars for sustainable development India as well.

Table 5-2: Highlights of energy sector's mitigation action plans

National Solar Mission (NSM)	National Mission for Enhanced Energy Efficiency (NMEEE)
• The National Solar Mission aims at generating 20,000 MW of solar power by 2022. • The Mission also has other targets: 2000 MW of off-grid solar plants, and 20 million sq meters of solar collectors to be installed. • 20 million solar lighting systems will be created/ distributed in rural areas, saving about 1 billion liters of kerosene every year	• Estimated to help reduce CO_2 emissions by 25 million tons per year by 2014-15 • 762 designated consumers in 9 sectors (including the 7 most energy intensive industrial sectors and power stations) in India would be mandated to reduce their energy consumption by a specified percentage • Trading of Energy Savings Certificates (ESCerts) for the savings which are in excess of their mandated target. These Certificates can be used by other facilities for compliance if they find it expensive to meet their own reduction target. • Energy efficiency ratings have been made mandatory for 4 key appliances – refrigerators, air conditioners, tube lights and transformers from January 7, 2010 • more appliances planned to be brought into the ambit in due course of time

5.4 Objective and methodology

India's official climate change mitigation plan comprises of 8 missions. The energy efficiency improvement and promotion of solar energy are the two most important missions and are directly linked to the reduction in the energy sector's emissions intensity. As we have observed that the energy sector itself contributes the maximum to the national emissions intensity reduction target, the objective of this paper is therefore, to evaluate the impacts of the 20GW of solar installation by 2022 under the Solar Mission and the National Mission on Enhanced Energy Efficiency in the context of national emissions intensity reduction.

Selection of Model

This is essential to understand that the energy intensity to GDP of a country not only depends upon the performance of the energy sector per say but also on the economic performance as well. Moreover, energy is also input to all most all economic activities in the economy. Therefore, economic performance, energy consumption and GHG emissions are all interlinked under the market system. It is therefore, prudent to use a system wide assessment model which can take care of such inter linkages while identifying the net reduction in emissions intensity under certain policy intervention. Therefore, we used the TIMES Integrated Assessment Model (TIAM) to investigate the implication of India's solar mission and energy efficiency improvement measures along with use of advanced power generating technologies on national emissions intensity reduction target.

The TIMES Integrated Assessment Model (TIAM-WORLD) is used in this study to project energy mix, energy costs and CO_2 emissions. Detailed description on TIAM-WORLD can be found in, e.g. (Loulou, 2007; Loulou and Labriet, 2007; KanORS, 2012). TIAM-WORLD is developed, maintained and used in various EU and other international projects, and served as the starting point for the global energy system model used by the Energy Technology Program (ETP) at the IEA (KanORS, 2012). TIMES is a technology-rich model that integrates the entire energy/emission system of the World, divided in 16 regions (one of which is Japan), including the extraction, transformation, trade, and consumption of a large number of energy forms. The economic paradigm of TIMES is the computation of an inter-temporal partial equilibrium on energy and emission markets based on the maximization of total surplus, defined as the sum of suppliers and consumers surpluses. The objective function of TIMES is the minimization of the discounted total energy system cost for the entire modelling period. The total energy system cost includes capital cost, variable and fixed operation and maintenance (O&M) costs on both the demand and the supply sides. The detailed technological representation of the energy system of TIAM-WORLD allows the computation of energy flows, prices, technology uses, net GHG emissions and concentrations (Loulou, 2007; Loulou and Labriet, 2007; KanORS, 2012).

Energy service demands are calculated based on the quantified activity drivers and elasticities of demands to their respective drivers. Elasticity represents how strongly the demand follows the changes of the driver. Energy technologies convert primary energy sources to energy services; TIMES contains technical and economic descriptions of more than 1500 technologies and several hundreds of commodities in each region. Primary energy resources are disaggregated by type and multi-stepped supply curves are generated for each primary energy form, with each step representing the potential of the resource available at a particular cost. Lastly, regarding policy scenarios, TIAM-WORLD enables to incorporate various policy scenarios including renewable energy installation capacity targets and CO_2 emission caps (Loulou and Labriet, 2007).

Scenario development

Based on the national polices for emissions reduction in the energy sector, we have identified three main activities of India like energy efficiency improvement in high energy intensive industries, installation of solar power units and gradual shifting to more advanced thermal power generating technologies which are further converted to three different policy scenarios for this study.

PAT is an important scheme under the National Mission for Enhanced EE. The PAT program is expected to enhance energy efficiency at the national level in the selected industry (as measured by specific energy consumption per unit of output). Improvements are to be measured based on being benchmarked to the best performer within the specific industry group. In this study, we analysed such industrial efficiency improvement in sectors like iron & steel, non-ferrous metal and the chemical sector mainly.

The power sector in India is dominated by sub-critical and super critical coal fired plants fired by the low grade domestic coal. Hence, advancement of power sector technology is an important option for India to lower her emissions intensity. As part of the NAPCC, India proposes to aggressively pursue the deployment of IGCC technologies for coal fired power generation within next decade. Thus in this study a scenario has been introduced which analyses the impacts of early and rapid deployment of IGCC technologies starting from 2010 and rising ton20GW of installed capacity by 2020.

Similarly to evaluate the national solar mission, we considered an energy scenario with the planned 20GW of solar installation by 2020. These two policy scenarios are compared to the reference scenario of India under the most likely base case scenario until 2030. The modelling exercise demonstrates the impact on India's energy intensity as a result of the two policy scenarios. Table 5-3 below provides the scenario descriptions. Based on the projected impacts we investigated a probable MRV system for India which can ensure the achievement of the emissions intensity reduction target of India and keep India on a sustainable growth track.

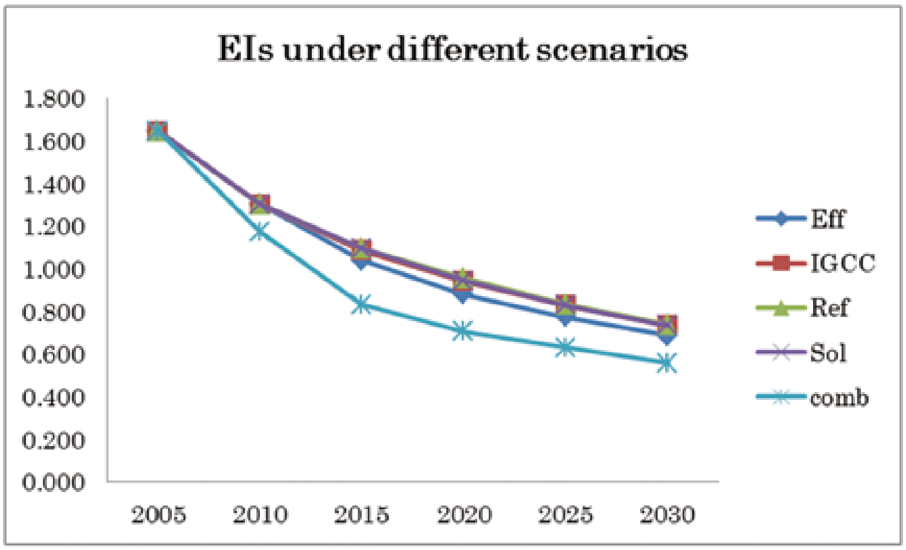
Table 5-3: Scenario description

Scenario Name	Description	Remarks
Industrial EE	5-15% of energy efficiency improvement	Iron & Steel industry is given 5% target compared to 15% for the Chemical industry
Advanced Power Technology	IGCC based power supply of 20GW equivalent by 2020	IGCC made available in the market by 2015 which is otherwise delayed until 2025.
Solar Energy	20GW of solar installation by 2020 .	It is assumed all types of solar technologies like solar PV, CSP etc are equally available in the market.
Combined policy	1-15% energy efficiency improvement in industrial sector plus advanced power generation technology and solar energy of 20GW each by 2020.	It is assumed that all the policies are put together in the market simultaneously.

5.5 Research findings

This study shows that the voluntary reduction target set by India for lowering the emissions intensity of India's GDP can be met even under a business as usual scenario. Further, the research shows that it is possible for India to deliver a 55% reduction in the emissions intensity of its GDP compared to the 2005 level. While underscoring India's low-carbon growth trajectory the research confirms that India will not only easily meet her voluntary pledge for reduction in emissions intensity but would exceed that in all probability. The research, however does not answer the likely implications that this trajectory might have on issues of access and the daunting development imperatives to improve India's poor socio economic parameters.

While comparing the impact of the scenarios considered for reducing India's emissions intensity; it is observed that the efficiency improvement mission including PAT and advanced technology use in power sector deliver a much better impact to achieving emissions intensity reduction by 2020 and beyond. However, as one would expect, combining all the measures considered delivers the largest impact on lowering emissions intensity. Figure 5-5 below shows the impact on emissions intensity under three different scenarios compared to the reference case.



Source: Estimated based on model result

Figure 5-5: Emissions intensity comparison under different scenarios

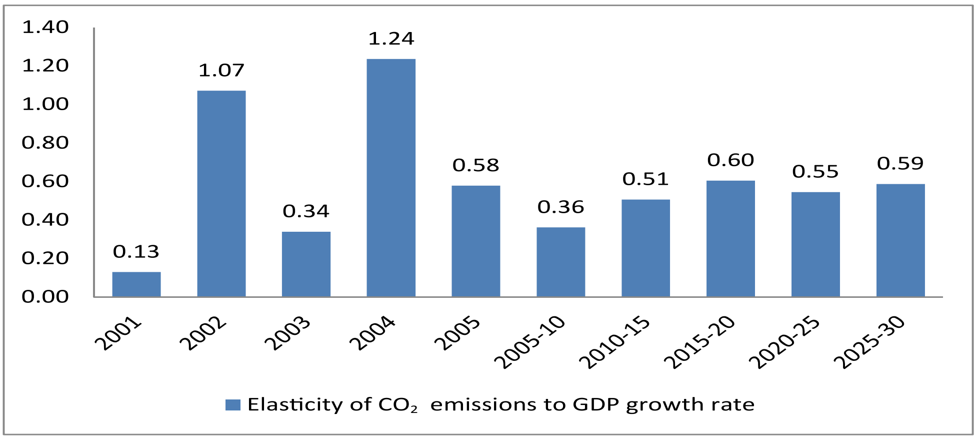
Table 5-4 below shows percentage reduction in emissions intensity compared to the year 2005 under different scenarios

Table 5-4: Reduction in emissions intensity compared to 2005 under different scenarios

Scenarios	2010	2015	2020	2025	2030
REF	-21%	-33%	-42%	-49%	-55%
Efficiency Imp	-21%	-37%	-47%	-53%	-58%
Adv. Power Tech (IGCC)	-21%	-34%	-43%	-50%	-55%
Solar Energy	-21%	-33%	-43%	-50%	-55%
Combined Policy	-29%	-49%	-57%	-62%	-66%

Source: Author estimated

The data appears to indicate that India's CO_2 emissions are inelastic to GDP growth. Figure 5-6 below shows the GDP elasticity of CO_2 emissions for different years. It shows that barring 2002 and 2004, India's CO_2 emissions are inelastic to GDP growth.



Source: Estimated based on model result

Figure 5-6: GDP elasticity of India's CO_2 emissions

India is achieving her lower emissions intensity of GDP due to the difference between GDP growth rate and corresponding CO_2 emissions growth rate. CO_2 emissions growth rate is much slower than economic growth rate. One wonders if such inelasticity is truly sustainable over the long run.

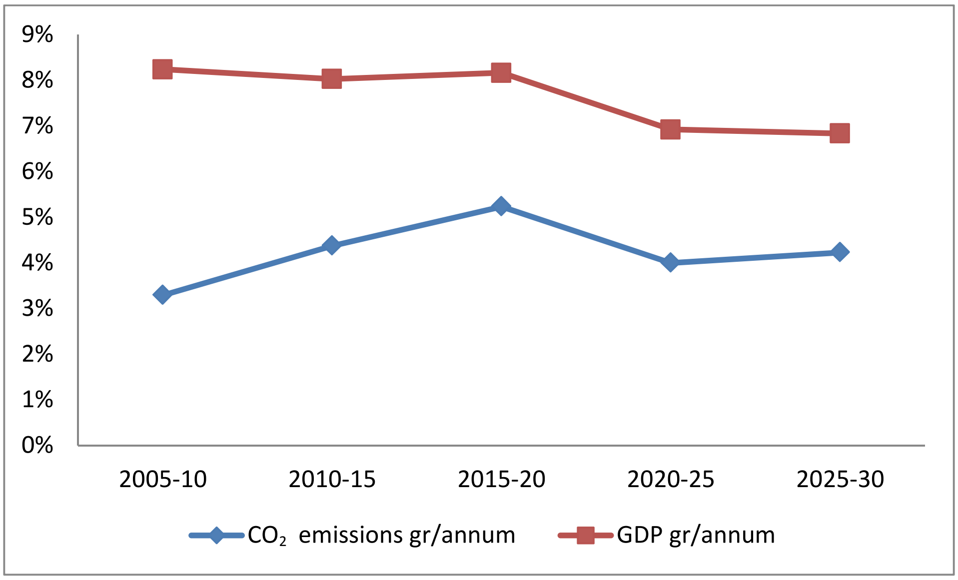
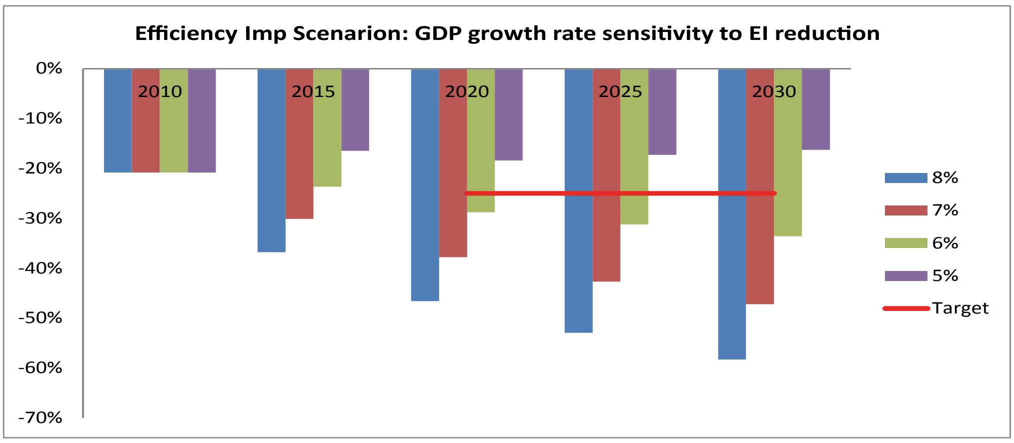
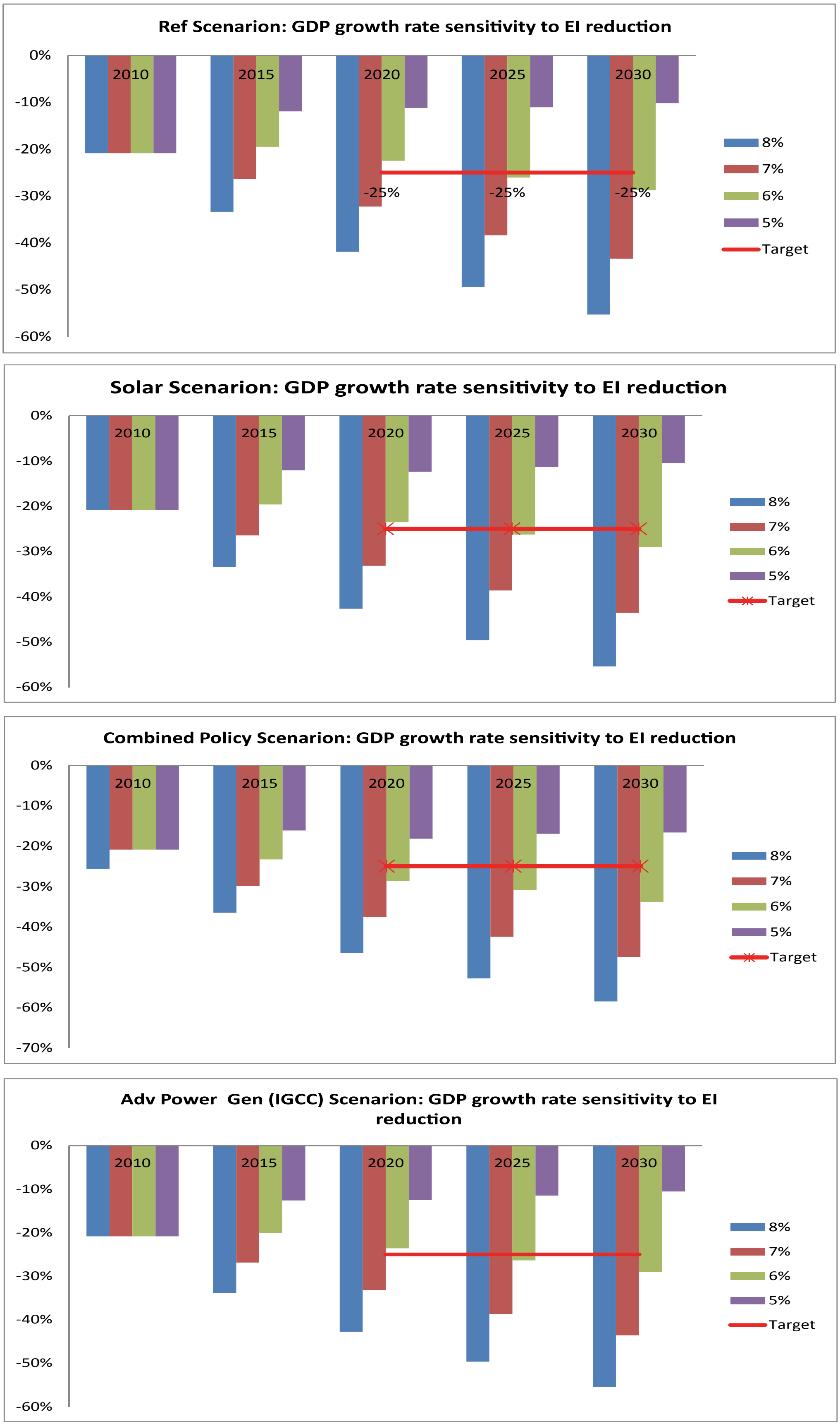


Figure 5-7: CO_2 emission and GDP growth rate projection for India

Sensitivity Analysis

Given the inelasticity of CO_2 emissions to GDP growth, it is noted that India will far exceed its voluntary pledge of a 25% reduction in emissions intensity of her GDP if it delivers the trend of an 8% GDP growth with CO_2 emissions growth remaining at or below 4%. However, India's ability to maintain an 8% GDP growth rate over the given time span under the given global economic recession and slowdown remains uncertain. We have conducted sensitivity analysis of different GDP growth rates on emissions intensity reduction. The sensitivity analysis further demonstrates the importance of various mitigation measures like efficiency improvement in industrial sector by using PAT program, use of advanced technologies in power generation (use of IGCC technology) and the national solar mission. These measures can finally work as risk hedging measures for meeting the national commitment. The following figures shows the variation in emissions intensity reduction compared to 2005 level under 7%, 6% and 5% per annum GDP growth scenario for India. Here CO_2 emissions are also adjusted with GDP growth rate using their corresponding elasticities. However, CO_2 emissions changes slightly compared to the GDP under all cases as CO_2 emissions are inelastic to GDP growth in India. The sensitivity analysis shows that as long as India maintains a GDP growth of 6% or higher, it should have no difficulty in meeting or exceeding its voluntary pledge to lower emissions intensity by 25% below the 2005 level by 2020-2025.





Source: Estimated based on model result

Figure 5-8: Sensitivity analysis of EIs to GDP growth rate and corresponding CO_2 emissions

5.6 Conclusions

A MRV regime for climate change mitigation actions is still in its formative stage and needs extensive elaboration especially in terms of its scope, methodologies, institutional requirements and its operation. There is no easy way to have a blanket MRV mechanism that can satisfy all mitigation actions while addressing the legitimate concerns of those funding such mitigation activity and those delivering the mitigation. However, it is understood that MRV is an intrinsic process of any project or activity that is taking place on the ground and each specific case would have a regime that satisfies all the stakeholders involved in the specific project/program.

In the context of India, a legitimate MRV regime faces another complex hurdle. Based on World Development Indicators as also the Multi-Poverty-Index there is significant evidence that not only has India failed to deliver inclusive growth; its human development indicators have actually slipped not just in comparison to a large neighbour such as China but also in comparison to smaller neighbours within South Asia. Given this fact, one must consider if it is legitimate for the developed world to demand and, indeed, India to agree to any pledge/commitment for reduction in emission or even emissions intensity. Given the widespread poverty and human suffering in India, as also the fact that the absolute number of the poor and disempowered is rising, should it not be a priority for India and the rest of the World to address access to merit goods and services (absence of which lies at the base of such depravation) based on the available least cost options.

It is stressed that the foregoing argument is not in conflict with a commitment to aggressive measures for reducing energy intensity and/or pursuing sustainable growth for every section of the society, especially those living below the 2$ per day threshold. India's energy options remain fairly limited in the absence of financial and technological support that addresses the incremental costs of choices such as Solar or clean coal technologies. Any pledge that India makes or the World demands from her on emissions intensity must carefully weigh the un-sustainability of a billion people being left below the 2 dollar/day threshold in India. And the MRV regime that monitors such a pledge or commitment must recognize this reality.

The above argument should not be seen as excusing India from her common but differentiated responsibilities to stabilize the global temperature rise. Any trajectory that negates such a differentiated responsibility would undermine the inclusive growth that is in India's interest to achieve. Thus the MRV regime governing climate change mitigation actions in India must provide for meeting India's climate change commitments without undermining the imperative of sustainable and inclusive growth. Such a regime cannot ignore that India has achieved low energy intensity at a much lower level of GDP compared to other countries and India's point of inflexion (point of decline in energy intensity) occurred at much lower level of energy consumption compared to other countries. This track of sustainable growth needs to be made inclusive while meeting India's common but differentiated responsibilities towards any global compact on climate and MRV.

India is already on a trajectory that minimizes her carbon footprint through a falling energy and emission intensity while maintaining above average economic growth. The National Action Plans for Climate Change propagates 8 different missions—all aimed at achieving India's mitigation objectives. India's pledge on emissions intensity reduction under the Copenhagen Accord is achievable. However, the impact of meeting that pledge on delivering sustainable and inclusive growth, without global support of finance and technology, has not been studied/estimated.

The 8 Missions outlined in the National Action Plan for Climate Change can all play an important role and positively catalyze reduction in emissions and emissions intensity. The Solar mission and the energy efficiency mission are already being implemented aggressively. This study analyses three potential scenarios for India in the context of emissions intensity reduction which are considered critical: These include the energy efficiency improvement scenario, advanced power generation technology scenario and the solar energy scenario following the respective national missions.

This study further identifies that the National Mission for Energy Efficiency can realize higher benefit in terms of emissions reduction compared to the National Solar Mission (20 GW by 2020) which is indeed good for reducing India's energy imports. In fact, advanced technologies in coal fired power generation like IGCC, can realize a relatively better impact in terms of emissions reduction compared to the solar power generation. Having said the foregoing, it is stressed that it is hard to justify any of the three scenarios unless they are all benchmarked against a common achievement target. Thus far, there is no effort in India to evaluate these nationally appropriate mitigation actions (NAMAs) under a common metric.

5.7 Recommendations

Finally, our findings in the context of designing a MRV regime in India following GoI's existing action plans are summarized below:

1. It is important to have common and benchmarked objectives of all the mitigation actions running in the country for easy comparison and deciding the priority of NAMAs. This is essential to evaluating alternate programs and measuring their effectiveness. It appears that emissions intensity target is an overly simple metric to evaluate the performance of different mitigation programs.

2. MRV mechanism should be developed on a case by case basis depending upon the characteristics of the specific mitigation action under consideration. Such characteristics would typically include technology and issues such as the objective, the target, direct and indirect costs, funding sources, institutional responsibility and co-benefits if any.

3. Mainstreaming of MRV in the national planning process is important. This is not just to comply with the international requirement but also for improving the performance of domestic actions addressing climate change.

4. The MRV mechanism for the energy sector's mitigation actions should be based on an integrated energy system analysis rather than just following a top down technology/program identification processes. The study demonstrates that the ultimate impact on curbing GHG emissions vary between alternate mitigation actions and their corresponding technologies.

5. Designing of a national MRV mechanism can be a two-step process. The first step is to develop the enabling environment for running a successful MRV regime in the country and the second step could be developing the actual case-by-case MRV regimes.

6. For the first set of actions, India needs to ensure availability of relevant data in a transparent manner and with reasonable reliability. India can use the existing platform of NATCOMM to do this. In this context, increasing NATCOMM reporting frequency to the UNFCCC could be a positive step ahead.

7. It is also important to implement a stringent data Q&A for the GHG accounting system. This will be the basis for a full-fledged MRV regime in future. Erroneous data can easily defeat the objective of the proposed MRV regime.

8. It is essential to implement the existing programs successfully rather than having new programs on mitigation actions. MRV of existing programs like PAT Program can be domestically pilot-tested. International funding support can be sought for such pilot projects.

Chapter 6 India: Perform Achieve and Trade and MRV Mechanism

Nanda Kumar Janardhanan, Manish Shrivastava

Key Messages

- PAT scheme can play a significant role in energy efficiency targets India envisioned under the climate mitigation agenda
- The sustainability of PAT scheme depends on the efficacy of institutional and legal measures adopted
- Methodology for estimating carbon offset and the lack of stringent MRV measures would potentially challenge any efforts for linking PAT to international carbon offset mechanisms

6.1 Introduction

Industry is one of the major energy consuming sectors in many economies. With regard to India, lion's share of the total primary consumption is due to the demand from industrial sector. Hence any action for addressing issues on energy related emission needs to give adequate policy attention to this sector. Notably, majority of the consumption within industrial sector is accounted by a smaller percentage of industrial units, which made India develop specific programs addressing the energy efficiency issues among these selected units. The *Perform Achieve and Trade* (PAT) program in India have specifically targeted the top consumers and designed measures that would address the larger concern of energy related emission, a critical step for addressing climate related challenges.

The PAT program is developed as a policy tool under the National Mission on Enhanced Energy Efficiency (NMEEE), one of the mission plans for addressing climate mitigation in India. As the mission targets to reduce a total of 98.5 million tons of CO_2 per year, significant attention has been given to industrial sector where PAT would play an important role. The PAT has gained attention from industries as well as policy makers alike, for its capacity to bring down the energy related carbon emission and also for its potential to be a future platform for international carbon trading.

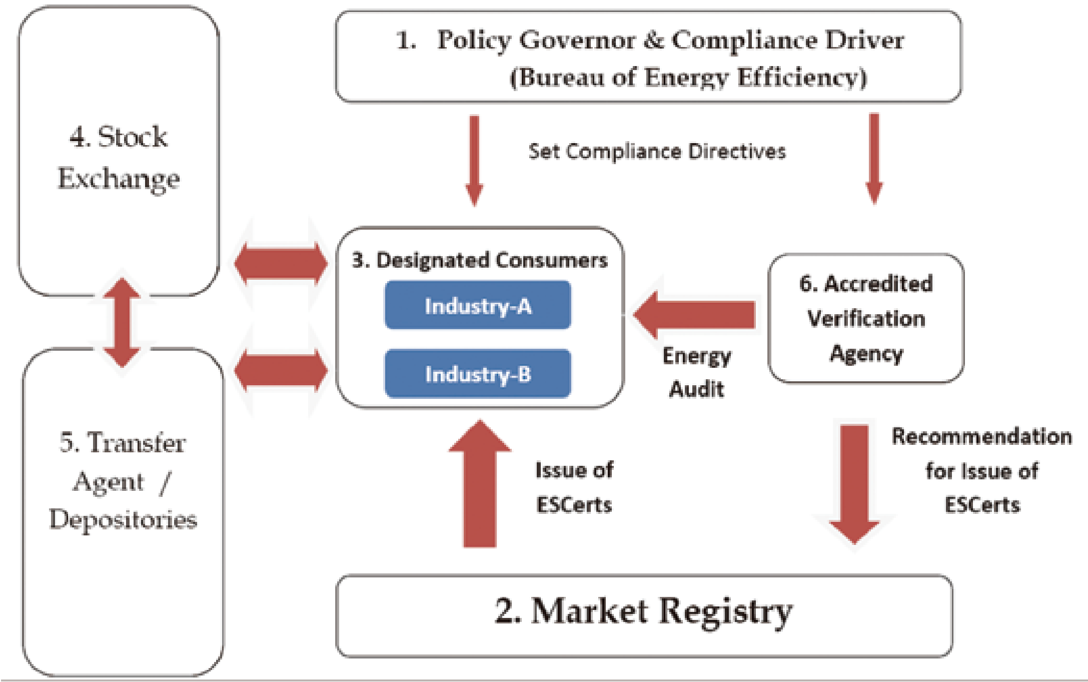
Three important issues are being explored in this paper: First, the institutional structure and operational trajectory of PAT, second, challenges encountered by its stakeholder in the implementation of the mechanism and developing MRV tools, and third, possible synergies or potential to be linked with international carbon offset mechanisms. The paper highlights that while the PAT scheme has the potential to improve industrial energy efficiency in the country, its MRV implementation mechanism need to be strengthened in order to be meet its energy efficiency targets and to link with any possible international carbon offset mechanisms.

6.2 PAT: Institutional Framework

As a national scheme success of the PAT scheme is critically dependent on the linkages between various agencies involved in its implementation. The governance structure in terms of hierarchy between various agencies and institutions can broadly be understood in four different institutional structures. The overarching structure is provided by the specific functions that the Bureau of Energy Efficiency (BEE) has to perform under the Energy Conservation Act of 2001 and the guidance provided by the National Mission on Enhance Energy Efficiency under the National Action Plan on Climate Change[1]. The overall scope for BEE to intervene and regulate, and hence that of the PAT scheme,

[1] The report on 'National Action Plan on Climate Change' was released by Prime Minister's Council on Climate Change on June 30th 2008.

is defined and limited by the Act. At the second level are the agencies that have the responsibility and authority to demand information from various energy consumers, termed as Designated Consumers (DC) in the industrial sectors. These include the State Designated Agencies (SDAs) and Accredited or Designated Energy Auditors (DEAs). At the third level are the designated energy consumers (DC) and a range of solution providers with regard to ways to improve energy efficiency. These are the actors that would important role in the success of the scheme, and hence the choices that these actors make that are going to define whether the targets set by the BEE under the PAT scheme are achieved, or the SDAs and DEAs are able to perform their assessments with adequate certainty. The fourth level is parallel to these three which is that of the energy exchanges where the energy saving certificates are to be traded. Apparently, they are likely to operate independent of the BEE interventions.



Source: TERI Report submitted to IGES titled "Study of Climate Mitigation Actions and the Development of MRV Framework in India", March 2012

Figure 6-1: Operational mechanisms of PAT

In its simplest form, the BEE is responsible to lay down rules, guidelines and procedures to achieve the targets of the NMEEE, in accordance with the Act. The SDAs and DEAs draw their responsibilities and authority from these rules, guidelines and procedures. The designated consumers are legally bound to take action and provide necessary information as stipulated by the BEE, particularly in terms of format and frequency of reporting and meeting the target. Solution providers (e.g. energy and technology consultants) help the DCs to meet these requirements keeping in mind the business preferences of DCs. Together, the flow of actions and information among these three institutional structures will generate a commodity in the energy saving certificates. The ESCerts can be traded through energy exchanges such as Power Exchange India Limited (PXIL), which will function as independent commodity markets.

Operational Trajectory of PAT and its Sustainability

Whether the PAT scheme is able to deliver its energy efficiency objectives, would also depend, in addition to the efficacy of the governance and MRV mechanisms, on the ability of the DCs to meet their targets and continuity of the scheme over a long period of time. With respect to continuity of the scheme there is a sense of confidence among different stakeholders. This optimism is grounded in the belief that the random threshold energy consumption at plant level, which is the basis to identify a DC, can be modified. In addition, new sectors are likely to be added to the scheme. Together, these two steps are expected to expand the scope of the scheme vertically as well as horizontally over time.

On the operational feasibility of the scheme, however, stakeholders follow a wait and watch approach. Operationalization of the scheme implies that there is actual reduction in the SEC of a plant. The scheme relies on the combination of incentives and penalties. While the possibility that some may not achieve their targets provides a strong incentive for those who are in a position to overachieve (in addition to the benefits of energy savings), the cost implications in case of failing to meet the targets in the form of paying penalties (at the current price of underachieved oil equivalent energy consumption plus Rs. 10 Lakh) is even a stronger incentive to perform. It is expected that those who fail to meet their targets would use a mix of trading and paying penalties. But for trade to occur at least some DCs must over-achieve their targets. In this context, some are of the view that the 'trade' part of the PAT scheme (Perform, Achieve and Trade) is only accidental and there is no guarantee that trade would necessarily happen. Those involved in the designing of the scheme, however, are confident that some, particularly those who are already performing better, are not likely to be able to achieve their targets even though small. Hence, trade is bound to occur. Further, to safeguard against a situation of general overproduction of ESCerts, the BEE has also provided for government buying those ESCerts.

In the first instance, due to a two year gap between the baseline year and beginning of the first cycle of the scheme, it is generally believed that the actual targets for many DCs have become relatively lenient and hence most of them are likely to meet their targets. There are concerns regarding access and awareness of technological options, availability of finance and positive reaction by industry, although for the first cycle these concerns are rather mild. More so, because the BEE has already developed a technology compendium to facilitate DCs choose action along with the provision of a Risk Guarantee Fund combined with technical assessment of actions to build confidence among the financial institutions to support energy efficiency projects. The real concerns begin with the second cycle, which begins immediately after the first cycle gets over in 2014. For those who have achieved a higher level of efficiency in the first cycle, the achievement of second cycle targets would require huge investment in technologies. Realization of that may take longer time. In that case DCs are likely to falter in meeting their targets.

To avoid such situations, the option of banking energy savings from the first cycle has been allowed. This implies that early movers will have advantage. However, some stakeholders are of the view that the necessary legal guarantee to support such 'early movement' is not there yet. There is a lack of clarity on the nature of targets in the second cycle for those who have been given targets in the first cycle. While there is a general expectation that there would be a second cycle and more targets would be given to DCs, a stronger indication is needed to give enough incentives for early investments.

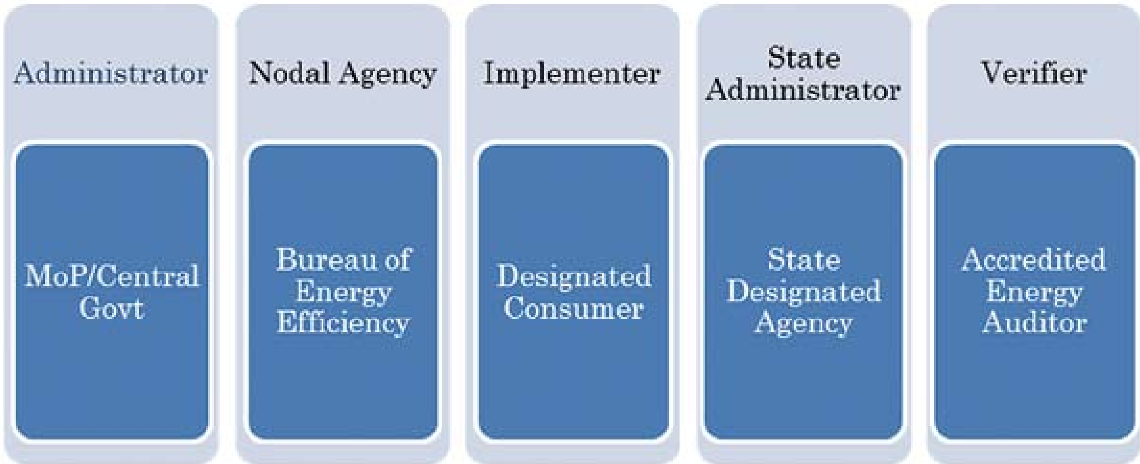
6.3 MRV Framework and stakeholder Challenges

The credibility of PAT scheme, and its contribution to the achievement of goals set in the Energy Conservation Act 2001 and the National Mission on Enhanced Energy Efficiency, depends on the reliability of the MRV framework. So far the BEE has developed the framework for measurement and reporting. The structure for verification is in the process of conception.

The whole purpose of the MRV mechanism under the scheme is to ascertain the changes in the value of a single variable i.e. the specific energy consumption (SEC) of a plant. SEC is measured according to the Gate-to-Gate concept, which defines SEC as the ratio of net fossil fuel based energy input to the total output from a plant. The reporting framework consists of the electronic filing (E-filing network) of the details of energy consumption and quantity of output for each DC through prescribed formats. The E-filing network is an internet based platform where all designated consumers are to submit their energy consumption data in prescribed formats.

Stakeholder Challenges

Various levels of stakeholders view different types of challenges that are critical to the effective implementation and success of the scheme.



Source: Bureau of Energy Efficiency 2012

Figure 6-2: Stakeholders of PAT

Implementation Challenges: Designated Consumers

Capacity needs: The most critical challenge faced by the DCs in adhering to the PAT scheme is the lack of adequate in-house capacity in terms of estimating, managing and implementing energy efficient practices within the premises of industrial units. Though the PAT scheme stipulates that every industrial unit needs to have an energy manager who would be responsible for the activities related to energy efficiency improvement, often this has not been adequately followed. The industrial units also require capacity in terms of understanding the best practices in energy saving. Factors such as lack of product uniformity or diversity under a single category of industrial units[2] also put burden on the DCs in meeting the MRV processes.

Policy-level Challenges: Administrator, Nodal Agency and State Designated Agency

Identifying designated consumers: One of the critical challenges faced by PAT in its initial stage was to identify the actual major energy consumers that need to be brought under the scheme. Though the initially planned designated consumers were more than seven hundred, a number of final consumers shrunk to about four hundred. This was primarily due to the changes in the numbers estimated by the State Designated Agencies which was the nodal point for collecting and sharing information about the specific industrial units listed under each state.

Centre-State Administrative Dilemma: Often the impact of centre-state relations is seen as a critical factor in deciding the effectiveness of any national level policies that are to be implemented in the states. The differences in jurisdiction of the state government and the central government over specific industrial units will be a critical factor in determining the efficacy of MRV processed that is being developed under the PAT scheme.

[2] According to Avijit Choudhury ([Accredited Energy Auditor], ENFRAGY Solutions Pvt. Limited, New Delhi) various industrial units under a single category DCs undertake different industrial activities which has different specific energy consumption. For e.g.: in Textile industry, different industrial products are involved but are often put under same category of units as per PAT classification.

Challenges to Monitoring and Reporting: Accredited Energy Auditors

From interviews with industry consultants and energy auditors who verified the data towards determining baseline SEC, against which the individual targets are decided, it is evinced that there are considerable level of concerns related to measurement and reporting exist due to management practices and capacities of personnel at the DCs. Many respondents have found a range of inadequacies at the staff level which is responsible for maintaining necessary data in appropriate formats. These inadequacies primarily relate to:

(a) *Lack of information about the procedures and requirements*: even though the top management might be aware of these requirements through various consultation processes, the lower level staffs are not adequately well informed about what information to keep and in what format. Although, from the minutes of the four stakeholder consultations that the BEE had with industry, it appears that on many procedural issues the BEE officials did not provide a clear satisfactory answer.

(b) *Understaffed energy management units*: It is a legal requirement for the DCs to have an energy manager who has been certified by the BEE through examination. Although, all DCs have informed the BEE to have appointed these energy managers, the SEC baseline auditors have faced a problem of the energy management cell at plant level being understaffed, and hence, unorganized, making the reporting and verification process cumbersome.

A similar problem has already been identified by the BEE with regard to technical capability of the SDAs in order to assess and evaluate provided data. This, however, has been taken care of by the capacity building exercises by the BEE.

A second type of problem that has been reported relates to the methodological challenges in calculating SEC under different scenarios. This is particularly complex in case of multiple by-products from a plant. Since the SEC is to be measured for the plant and not different products, SECs for all by products are required to be converted and aggregated into the SEC of the main product that the plant produces. The variety of products within same sector plants, which in some cases such as textile can be in 100s, makes it difficult to apply any universal method for measurement.

From the discussion above, capability enhancement for DCs and DEAs emerges as the key challenge and need from the MRV perspective. In addition, initial lack of cooperation from the DCs with DEAs has also been pointed out by the stakeholders are critical challenge in operationalizing the program.

Although the verification structure is still emerging, the process followed during the determination of baseline SEC is generally believed to be adequate. The mutually agreed methodology by the DCs and DEAs to calculate SEC and its two level approvals by the EESL and the BEE ensures that sufficient checks and balances are there in the process. In addition the provision of stringent penalty to be paid by the DEAs (termination of license and full payment of calculated loss) in case of wrong information favouring any DC ensures that DEAs remain disciplined and alert in their work. To carry out the verification work, the BEE is in the process of identifying/training/examining energy auditors (individuals as well as institutions) to be awarded the status of 'accredited energy auditors'.

6.4 PAT and Potential Synergies with International Carbon Offset Mechanisms

Currently PAT mechanism is designed as a national scheme for improving industrial energy efficiency. The energy efficiency targets under the PAT scheme neither create any international obligations nor has any linkage to international financial instrument for emission reductions. According to the Energy Efficiency Services Limited (a Joint Venture Company of 4 Central Public Sector Undertakings of Ministry of Power, Government of India) 'PAT has no relationship with CDM or any such international scheme to incentivize emission reduction. Specific Energy Consumption (SEC) reduction targets under the PAT mechanism do not create any international obligations. These targets also do not intend to put any overall cap on energy consumption, consistent with the Indian stand in the on-going climate change negotiations'.[3]

However, there have been various thoughts from industry experts about exploring options to tap the international finance options. The two[4] prominent methods discussed by experts for making the international finance available to PAT scheme are: first, international finance can be directly utilized for the trading the ESCerts and second, the use of carbon offset fund can help the Indian government to create a domestic fund which can help finance the energy efficiency projects through providing soft loans. The bilateral offset credit mechanism (BOCM) proposed by Japan also is a potential platform where PAT may find synergies. However such synergies will largely depend on the success of PAT in the first operational phase which is currently underway, its institutional structure, the legal mechanisms and the process of monitoring and evaluation.

Certain points are critical while examining the compatibility of PAT with any international offset mechanism such as CDM, as mentioned below:

- Compatibility in terms of synergising with international carbon offset is reflected in two ways.
    - First, the institutional arrangement, procedural requirements for data collection and reporting are already established or in the process.[5]
    - Second, the Scheme is expected to avoid CO_2 emission of 98 million tons per year which could possibly be utilized in the carbon offset markets.

However such compatibility will largely depend on the policy willingness within India to link this program with any existing international mechanism. Various methodological challenges in linking PAT with international mechanisms also need to be addressed before seeing the compatibility.

The main challenges are in in terms of

- Definition of "additionally": The emission avoidances are a result of regulatory and legal requirement, does not count as 'additional emission reduction' under the CDM requirements,
- Data Collection: The data towards MRV of PAT is not collected on all parameters that are necessary to calculate emission avoidance in international carbon offset mechanisms. However could be easily included as the processes of MRV already exist.
- Information access: Currently the data towards PAT MRV is available to DCs, DEAs, SDAs, EAs only though login facilities, whereas the CDM requires public access to PDD and data along with calculations for public scrutiny. This, again, is not a big issue, (D), the DEAs would do the verification which are recognized by the BEE through exams, whereas DOEs for CDM are to be recognized by the CDM-EB through a different process. These two need to be coordinated.

The BOCM and PAT may find synergies among them. However, two types of challenges would be prominent as one looks at PAT-BOCM compatibility, namely methodological challenges and policy challenges. In brief, methodological challenges that may rise concern would be about 'developing appropriate methodologies to calculate emission

3 PAT Scheme, Accessed, 2 Nov 2010, http://www.eesl.co.in/website/PAT.aspx

4 Keith Regan, Potential benefits of Indian Industry by the PAT Scheme, http://cii.in/WebCMS/Upload/Keith%20Regan%20-%20Camco%2018th%20presentation.pdf, Accessed Nov, 2010

5 Interviews and PAT booklet (requirement to submit Form# 1, Form A, B and D), e-filing

reductions without compromising the logic and functioning of the PAT scheme', while the policy challenges would be more about garnering political willingness to accept BOCM. Since BOCM is proposed as a mechanism that bypasses the existing offset mechanisms like CDM always raises questions and often makes way for debates about the credibility.

6.5 Conclusion

PAT in its present design is primarily aimed at incentivising the energy efficiency improvement efforts among the industrial sector in India. However, the program is yet to develop significant implementation mechanisms based on strong legal framework in order to bring accountability of the energy consumers. The stakeholder survey indicated that the challenges faced by the programme are manifold, which are primarily related to the implementation and the process of MRV. From the climate mitigation perspective, PAT would be an important program that would contribute to lowering the emission intensity especially due to the technology integration in the industrial sector. However, the observations in this research indicate that PAT in its current form does not offer any significant opportunity in terms linking with other existing carbon offset mechanisms. Especially, the institutional arrangement, operating mechanisms, legal structure, and the MRV mechanisms in its current form do not offer any immediate opportunity. Nevertheless, the research agrees that after the initial operational cycle, the program may undergo noticeable restructuring and would find potential synergies with the market mechanisms that contribute to climate mitigation efforts.

Chapter 7 Indonesia: Current Status and Future Challenges of Promoting Mitigation Actions

Jun Ichihara, Aya Watarai, Muchamad Muchtar

Key Messages

- **Coordination among relevant governmental ministries and agencies** is crucial for mitigation action plans.
- Preparation of national mitigation action plan in Indonesia is achieved through **utilizing existing development planning system** as well as **mainstreaming climate change into government planning**. Opportunities to develop local mitigation action plans have promoted further mainstreaming climate change issues at the local level.
- **High political commitment and support** are keys to successful preparation of mitigation action plans.

7.1 Introduction: Overview of Climate Policies in Indonesia

Indonesia is recognised as one of the largest GHG-emitting countries in the world when emissions from Land Use Change and Forestry (LUCF) sector are included. The total amount of GHG emissions is 1.38 $GtCO_{2e}$ in 2000 and is expected to reach 2.95$GtCO_{2e}$ by 2020 (SNC, 2010). Major GHG emissions come from LUCF and peat fire with 0.821 $GtCO_{2e}$ in 2000 while the amount of GHG emission in energy sector has increasing trend from 2000 to 2005 (SNC, 2010). In order to address climate change issues, the Government of the Republic of Indonesia (GOI) has actively addressed climate change issues and has prepared climate change related policies and institutions, i.e. preparation of National Action Plan Addressing Climate Change (RAN-PI) in 2007; hosting the 13th Conference of Parties (COP13) of the United Nations Framework Conventions for Climate Change at Bali, in 2007; issuance of Yellow Book (National Development Planning: Indonesia Responses to Climate Change) in 2008; establishing the National Council on Climate Change (NCCC), the inter-agency council for coordinating climate policies, in 2008; launching the Indonesian Climate Change Trust Fund (ICCTF) in 2009; declaring the target to reduce GHG emissions by 26% from BAU by 2020 by the President in 2009; submission of Indonesia voluntary mitigation actions with the above voluntary target to UNFCCC after Copenhagen Accord in 2010; and preparation of Indonesia Climate Change Sectoral Roadmap (ICCSR) in 2010. Year 2011 was a milestone in climate change mitigation policy, in which two presidential regulations concerning the National Action Plan for Green House Gas Emission Reduction (RAN-GRK) and the National Green House Gas Inventory System respectively were issued. Both regulations provide bases for NAMAs and MRV development respectively.

In this chapter, we review RAN-GRK and Local Action Plan for Green House Gas Emission Reduction (RAD-GRK) and argue what kind of factors are keys to promoting mitigation actions. As the conclusion of this chapter, we summarise and discuss lessons learnt from preparation and implementation of mitigation action plans at national level and local level in Indonesia toward other developing countries.

7.2 RAN-GRK /RAD-GRK and Way of their Preparation

What is RAN-GRK and RAD-GRK?

The National Action Plan for Green House Gas Emission Reduction (RAN-GRK) provides policy framework to relevant stakeholders to reduce GHGs emission by 26% from BAU scenario unilaterally and up to 41% with international support by the year of 2020. The RAN-GRK was issued as a Presidential Regulation No. 61 Year 2011. It set Indonesia's mitigation actions in five priority sectors (Forestry and Peatland, Agriculture, Energy and Transportation, Industry and Waste) according to the National Long-term Development Plan (RPJPN 2005-2025) and the National Medium-term Development Plan (RPJMN). The Action Plan covers 50 main activities and 73 supporting activities to be implemented by 20 government ministries and agencies.

The target of emission reduction from BAU and major actions in those sectors are shown in Table 7-1. BAU figures in the Second National Communication report is referred in RAN-GRK. Around 88 % of total GHG emission reduction will be conducted by Forestry and Peatland sector in the case of 26 % emission reduction from BAU. RAN-GRK stipulates RAN-GRK reviews: the BAU calculation, (sectoral) target level for GHG emission reduction and GHG emission reduction activities may be reviewed in the event that better methodologies, data and information are available in the future.

Table 7-1: GHG emission reduction targets and major action plan

Sector	Emission Reduction (Giga tons Co_{2e})		Action Plan	Implementing Ministry/Agency
	(26%)	**(41%)**		
Forestry and Peatland	0.672	1.039	Forest and land fire control, network system management and water management, Forestry and land rehabilitation, HTI (Industrial Plantation Forest), HR (Community Forest). Illegal logging eradication, Deforestation prevention, Community empowerment	Ministry of Forestry (MOF), Ministry of Environment (MOE), Ministry of Public Works (PU), Ministry of Agriculture (MOA)
Agriculture	0.008	0.011	Introduction of low-emission paddy varieties, irrigation water efficiency, organic fertilizer use	MOA, MOE, PU
Energy and Transportation	0.038	0.056	Bio-fuel use, engines with higher fuel efficiency standard, improvement in TDM (Transportation Demand Management), quality of public transport and roads, demand side management energy efficiency, renewable energy development	Ministry of Transportation (MOT), Ministry of Energy and Mineral Resources (MEMR), PU, MOE
Industry	0.001	0.005	Energy efficiency, use of renewable energy, etc	Ministry of Industry (MOI), MOE
Waste	0.048	0.078	Use of Final Landfill, waste management by 3R and urban integrated waste water management	PU, MOE
	0.767	**1.189**		

Source: Bappenas 2011, Guideline for Implementing Green House Gas Emission Reduction Action Plan

RAN-GRK mandates development of RAD-GRK for the achievement of GHG emission reduction targets across Indonesia to encourage further participation of local governments and relevant stakeholders. RAD-GRK documents set programs and activities by sector integrated with closely Provincial sectoral offices' Strategic Plan (RENSTRA), Local Long-term Development Plan (RPJPD) and Local Medium-term Development Plan (RPJMD).

RAN/RAD-GRK and "Mainstreaming" of and high level political support for Climate Change Issues

Preparation of national mitigation action plan in Indonesia is achieved through mainstreaming climate change into government planning and high level political commitment and support.

After hosting the 2007 UNFCCC Conference in Bali, GOI has made further efforts to mainstream climate change issues. GOI has prepared and contributed to various documents and policies such as RAN-PI, 'Yellow book' containing list of activities related to climate change; Indonesia Climate Change Trust Fund; Indonesia Climate Change Sectoral Roadmap; and Indonesian Second National Communication. The National Medium-term Development Plan (RPJMN

2010-14; enacted in 2010) puts climate change issue as a part of national priorities. Under the environment and disaster management priority, GOI sets adaptation and mitigation strategies. It includes mitigation efforts involving sectors of forestry and peatland, agriculture, energy and transportation, industry, and waste. Preparation of RAN-GRK was achieved based on mainstreaming efforts in Indonesia, more concretely on RPJMN 2010-2014 and National Long-term Development Plan (RPJPN) 2005-2025.

Those mainstreaming efforts have been supported and facilitated by the leadership of the President. The GOI has been implementing its climate policies with high level political commitment. In September 2009, at the G20 Summit, President Susilo Bambang Yudhoyono declared the GOI's target of 26 % GHG emission reduction from BAU by 2020 and reiterated it at Copenhagen COP meeting in December 2009. It facilitated processes of formulation for national mitigation action plans including policies, programs and actions to achieve the target. President office instructed to the government to follow up the declaration of President Yudhoyono at the G20 Summit. GOI started preparation for national mitigation action plan or RAN-GRK to specify actions to be taken in various sectors to attain the GHG emission reduction target. In the early stage of preparation of RAN-GRK, 7 key mitigation actions and 26% emission reduction target by 2020 were submitted as Indonesia Voluntary Mitigation Actions to UNFCCC as for a mechanism of the Copenhagen Accord in January 2010. High political commitment and support are crucial for preparation of domestic mitigation action plans and mainstreaming climate change issues into the government.

RAN/RAD-GRK and Development Planning System

RAN-GRK reflects RPJMN and RPJPN in term of sustainable development framework to mitigate the climate change impacts. Most of the programmes and activities until 2014 are derived from those on the existing RPJMN 2010-14. By incorporating the programmes and activities in RPJMN, the implementation of RAN-GRK can be secured in development plan policy framework and budget.

National Development Planning System covers socio-economic development strategy and policy goals. National Long-term Development Plan (RPJPN 2005-2025, enacted in 2007) has the aim for long-term sustainable development, and is divided into each RPJMN. The latter concerns indicative programmes and activities and their budgets, which becomes reference for government and sectoral ministries and agencies to develop their annual working plans (RKP). As for national budgeting, each ministry develops budget proposal for the next fiscal year based on RKP. Any programmes to be implemented by state budget should be integrated with the above plans.

With regard to the RAN-GRK preparation, interplays within related line ministries and agencies are requisite. To follow up President's commitment before the G20 and the UNFCCC's Copenhagen COP in 2009, BAPPENAS was assigned to coordinate with sectoral ministries, which was agreed during a meeting held by Coordinating Ministry of Economic affairs in December 2009. It was the instruction of the President to develop RAN-GRK in three months from December 2009 to March 2010 (interview with a state official, 2012). Intensive meetings and consultations involving related sectoral ministries were taken place.

In November 2010, it was reported that BAPPENAS concluded a draft of a presidential regulation on RAN-GRK and sent it to Cabinet Secretary (Anonymous, 2010), although LOI with Norway (Letter of Intent between the Government of Norway and the Government of the Republic of Indonesia on "Cooperation in reducing greenhouse gas emissions from deforestation and forest degradation," agreed May 2010) came in the way causing postpone on the discussion of RAN-GRK, which required further clarification of relation between RAN-GRK and REDD+.

Preparation of RAD-GRK: further mainstreaming with facilitation mechanism

In Indonesia, since the decentralisation era applied, both province and district/city levels have local authorities. In this regards, provincial governments should prepare Provincial GHG emission reduction action plans, as mandated by RAN-GRK, which refers to RAN-GRK and local development priorities. The plan should be in line with Local Development Plan (RPJPD/RPJMD), Provincial/District-City Regional Spatial Management Plan (RTRWP/K), and RENSTRA of local government units.

For formulating RAD-GRK, institutional arrangement and interplay between central and provincial government are visible. Local governments need to conduct technical preparation that includes five elements: (1) Sources, potential and characteristics of GHG emissions, (2) BAU baseline of GHG emissions, (3) Proposed mitigation action plan, (4) Priority scale of proposed mitigation actions, and (5) Institutional affairs and funding (Bappenas, 2011a). To support the preparation and implementation of RAD-GRK, the province establishes 1) Coordination Team, which is headed by the Province Secretary and under responsibility of Governor; and 2) Working Group, which consist of sectoral implementing unit of provincial government relevant to climate change. Upon the completion of RAD-GRKs, they are legalised as Governor Regulations.

The central government, under the coordination of BAPPENAS, deploys technical assistance to build local government capacity by establishing a national secretariat for RAN/RAD-GRK development and implementation, preparing guidelines of RAD-GRK preparation and implementation and conducting relevant trainings and workshops. The national secretariat was established to facilitate processes and provide technical supports for preparation of RAD-GRK while the guidelines were prepared as the common tools for RAD-GRK development. A series of trainings and workshops were held by the national secretariat along with the climate change coordination team.

During the preparation of RAD-GRK, Ministry of Home Affair, which is responsible for the relation of central and local government, plays facilitation roles. Several donors including JICA, GIZ and AusAID involving experts from local universities provided supports for several provinces for their preparation of the RAD-GRKs. Finally, as of December 2012, 27 provinces issued governor regulations on the RAD-GRKs while 5 provinces finalized RAD-GRKs with preparing governor regulations and only province was still in the finalising process of RAD-GRK.

7.3 Key Findings from this study

Preparation of RAN/RAD-GRK is achieved by mainstreaming efforts (including RPJMN) and high level political support and through utilizing coordination and facilitation mechanism on development planning in Indonesia. First, GOI developed RAN-GRK based on their efforts to mainstream climate change issues into development strategies and plans such as ICCSR and RPJMN. Climate change issues are given the priorities in RPJMN and RENSTRA. RAN-GRK is integrated part of national planning documents, and many activities of RAN-GRK until 2014 are derived from current RPJMN. Second, high political commitment and support are key drivers to successful preparation of mitigation action plans. Through the leadership and direction of the President, coordination among relevant ministries and agencies has run smoothly. Third, the preparation of mitigation actions through existing coordination and facilitation mechanism with line ministries under development planning system could avoid confusion in coordination among relevant ministries and agencies for preparing climate mitigation action plans. This coordination and facilitation mechanism also applies during the RAD-GRK development processes among central and local governments.

Preparation of RAN-GRK and RAD-GRK has several advantages in Indonesia. Firstly, RAN-GRK and RAD-GRK further promote mainstreaming climate change issues into government agenda at national and local levels. They must be used as references for preparation of next medium-term development plans. While local governments faced some difficulties such as tight schedule and limited budget during the development processes of RAD-GRK, they are expected to deal with climate change issues as their own routine programs, as well as other tasks from the central government such as achieving the Millennium Development Goals and preparing local action plans for food and nutrition, corruption eradication and reduction of disaster risk (Nugroho, 2012). Secondly, the way to prepare RAN-GRK secures governmental budget for implementation of climate policies, programs and actions. It was prepared mainly based on RPJMN and RENSTRA and in the preparation of those planning documents, provisional budget for implementing them was also argued and agreed. In this way, line ministries and local governments would feel the RAN-GRK provides additional 'guarantee' that their programs could be supported by the State Budget, although it should be further examined whether expected amount of state budget for climate change programmes and actions is enough for full implementation of RAN-GRK. Thirdly, GOI effectively utilized supports from experts from universities and donor agencies during the preparation of RAD-GRK.

The followings would be remaining challenges and recommendations for further developing and implementing mitigation actions in Indonesia. First, further preparation of plans with operational details for implementation of RAN-GRK and RAD-GRK is necessary. In this process, it would be expected to further clarification on key conceptual issues including relation between RAN/RAD-GRK and carbon markets including credits from REDD+. Further clarification and elaboration on technical issues such as refinement of BAU is also expected. Second, as stipulated in RAN-GRK, monitoring, evaluation, and reporting mechanism shall be developed and implemented. Third, further coordination mechanism among stakeholders (with wider participation if necessary) is expected to be developed toward overall climate policy development and some of key issues such as peatland management as well as implementation of monitoring, evaluation and reporting mechanism of RAN/RAD-GRK. Further participation of private sectors could be further argued. Forth, knowledge and capacity of local governments over climate change issues are still limited. Further involvement of experts from universities and donor agencies in the implementation processes, is expected.

Part III

MRV Case Studies at Subnational Level

Chapter 8 Cities: Cases from Indonesia, Vietnam, Thailand and Japan[1]

Ikuyo Kikusawa, Jian Huang

Key Messages

- After the adoption of the Bali Action Plan of the COP 13 in 2007, Asian countries including Indonesia, Viet Nam and Thailand have established their GHG reduction target or started preparing a national policy on climate change mitigation. However, such national policies have not mandated a specific CO_2 reduction target for cities.
- Some leading cities have voluntarily set their emission reduction goal and started developing a climate change mitigation master plan. Also, local governments have been undertaking their priority environmental policies. Although many of those contribute to not only environmental protection but also low carbon, the impacts of GHG emission reduction are not well identified.
- By accounting the emission reduction of such existing policy actions, the following impacts can be expected; 1) cities can contribute to the national emission target, 2) cities' data management capacity is improved, and 3) the quantification of the GHG emission reduction effects of local policies and measures can be expanded to other cities.
- Therefore, capacity development in the field of emission accounting skills and data management needs to be enhanced. Capacity development should be further extended to policy planning and development. In this process, lessons can be learned from the experiences of Japanese cities in areas such as energy efficiency, public transport and water management.

8.1 Background

Developing countries have been urged to commit to the reduction of greenhouse gas (GHG) emissions in the form of Nationally Appropriate Mitigation Actions (NAMA) in a measurable, reportable, and verifiable (MRV) manner. Asian countries including China, India, Thailand and Indonesia have set their GHG emissions reduction targets, and such national action has encouraged the formulation of local action plan (Locally Appropriate Mitigation Action: LAMA). It is necessary to promote capacity development on low carbon policy measures and GHG accounting accordingly, Also, there is a growing trend of low carbon development at the local level in Japan. Lessons from the practices of Japanese cities will be of good reference to those who are going to develop associated policy measures in Asia.

8.2 Objectives

The study aims at identifying low carbon policies and activities at the local level, surveying whether local governments have mandates, requests or incentives to develop low carbon policies, identifying how to promote low carbon policies or actions at a local level and finally building the capacity of local government officials in Asia in MRV to assess the impacts of policy action. It eventually contributes to the formulation of policies and urban planning for low carbon and sustainable cities.

8.3 Methodologies

Targeting three cities from developing Asian countries, namely Surabaya City, Indonesia; Ho Chi Minh City, Viet Nam; and Nonthaburi City, Thailand, this study conducts surveys on low carbon policies in five sectors, namely waste

[1] This section is based on the MRV Capacity Development Project conducted by IGES Kitakyushu Urban Centre (The authors and Maeda, T., Higashi, S., and Kagawa, H.).

management, water management, transport, energy and greenery (Table 8-1). Numerical data required for GHG accounting are collected in cooperation with the target cities. With a reference to existing GHG accounting tools, GHG emission reduction impacts of major policies of each city are identified.

Table 8-1: Targeted sectors of low carbon policies and measures at a local level

Sector	Policy	Programme / Project
Waste management	Community-based 3R	Source separation, garbage bags charging system, waste cooking oil collection, composting
	Resource recycling	Recycling of by-products in eco industrial park
	Controlling waste generation	Industrial waste disposal tax
Water management	Wastewater and drinking water management	Sludge reuse, micro hydro power generation, prevention of water leakage
Transport	Public transport and mobility management	Introduction of LRT, community bus system, park & ride
	Control of automobiles	Road pricing, low emission vehicle
	Compact city	Bicycle promotion, access to public centres, improved connection
Energy	Regional energy management system	Central Energy Management System (CEMS)
	Energy efficiency in the commercial and industrial sectors	Energy saving labelling, CASBEE, PHV/EV, LED street lighting, building energy management system (BEMS)
	Renewable energy, unharnessed energy	Subsidy for PV, PV rent-a-roof system, waste heat recovery in plants, waste-to-energy
Greenery	Greening urban areas	Park improvement, reverse mortgage for green space, etc.
	Natural resource conservation	Cooperation between urban and rural areas, eco tour, bank protection, water quality conservation

In addition to the policy analysis, capacity development activities are also conducted. The Capacity Development for NAMA/MRV training is organised on 18-26 September, 2012 in Kitakyushu, Japan. This is attended by five delegates from the target cities. As a follow-up activity, capacity development workshops are conducted in each city (Table 8-2).

Table 8-2: Workshop and training schedule

Month	Action
July	• Preliminary survey on low carbon policies in target cities • Workshops in Surabaya, HCMC and Nonthaburi: Information sharing on the direction of international climate change negotiations, national mitigation action development (NAMA), and the implication for local governments • ISAP session
Aug.	• Development and drafting of training modules for the NAMA/MRV training
Sept.	• NAMA/MRV Training in Kitakyushu: Showing low-carbon activities at the local level in Japan in expectation of replication in the countries / cities of the trainees
Nov.	• Workshop in Surabaya: Discussion on measurement of low-carbon policies and activities
Jan.	• Workshops in HCMC and Nonthaburi: Discussion on measurement of low-carbon policies and activities
Mar.	• Final MRV workshop

Hearing surveys as well as case studies are also conducted in Japanese cities, which have been undertaking advanced low carbon policy measures. Those include Toyama City and Yokohama City for transport, Kitakyushu City, Kashiwa City and Yokohama City for energy management, Kitakyushu City for waste management, water resource management and greenery.

8.4 Findings

After the adoption of the Bali Action Plan of the COP 13 in 2007, Asian countries including Indonesia, Viet Nam and Thailand established their GHG reduction target or started preparing a national policy on climate change mitigation. In 2009, Indonesia publicly announced a GHG emission reduction target of 26 % by 2020 from the business as usual (BAU) level with its own efforts and 41 % with international support. The country also launched a national action plan and a guideline for local governments. In Viet Nam, the National Target Program to Respond to Climate Change (2008) and the National Climate Change Strategy (2011) were launched. Thailand also set the National Strategic Plan on Climate Change for 2008 - 2012. While the policy framework at the national level has been developed, such decisions have not sufficiently influenced local governments. More specifically, cities have no mandatory target for CO_2 emission reduction or incentives to collect necessary data. One exception is Indonesia, which mandates provincial governments (not municipal governments) to develop local action plan on GHG reduction.

Some far-sighted cities have already started developing master plans voluntarily. Also, cities have already taken a number of low-carbon practices such as waste reduction, decentralised treatment of wastewater, tree planting, mitigation of traffic congestion, and the introduction of renewable energy and LED bulbs. However, many of those are not necessarily meant for GHG emission reduction, therefore data management is still insufficient to evaluate the GHG reduction impacts of those activities.

It has been also pointed out that by accounting the emission reduction of such existing policy action, the following impacts can be expected; 1) cities can contribute to the national emission target, 2) cities' data management capacity is improved, and 3) the quantification of the GHG emission reduction effects of local policies and measures can be expanded to other cities.

There is also a potential to enhance the capacity of local government officers in policy designing and implementation by improving data management capacity. In this process, lessons can be learned from Japanese cities especially in the area of energy efficiency, public transport and water management.

However, GHG reduction is not a top priority for local governments. There are many other imminent issues such as solid waste management, wastewater treatment, transportation management, energy supply, health, education, welfare, and so on. GHG reduction alone cannot be the main action. In line with that, there is a chance to mainstream GHG accounting as a necessary additional option since other environmental, social, economic impacts are not well evaluated either.

8.5 City level Low Carbon Policy in Asia

Low carbon policies and actions of Surabaya city, Ho Chi Minh city and Nonthaburi city are identified and categorised into the sectors of waste management, water management, transport, energy and greenery. The comparative table below shows the extracts of low carbon policy measures in the three cities. It also gives some leading practices in Japanese cities as reference (Table 8-3).

Table 8-3: List of priority policies

Sector	Policy	Surabaya	Ho Chi Minh	Nonthaburi	Reference
Waste management	Community-based 3R	• Implement 3R policies • Environment cadre recruitment	• Implement 3R policies	• Reuse campaign through my cup project	[Kitakyushu] • 3R promotion by citizens • Separate collection of waste; charge for garbage bag
	Resource recycling	• Surabaya Green and Clean and Free From Garbage competitions • Waste Bank • Composting Center • ***Composting in communities***	• Use of municipal waste for compost making materials (Vietstar company) • The land fill gas to energy projects in 3 disposal sites	• Reduce landfilled waste by maximising recycling	[Kitakyushu] • Promotion of resource recycling • Recycling of by-products in the Eco-Town
	Controlling waste generation	• Waste reduction at Benowo Landfill • Waste reduction activities at community	• Enhance a waste collection system • Construct incineration plant for MSW	• Reduce the landfilled waste • Enhance a waste collection system	[Kitakyushu] • Reducing the generation of waste • Securing funding by taxation • Utilization of tax revenue
Water management	Wastewater management	• Sewage treatment plant • Communal wastewater treatment plant	• Utilise sludge from wastewater • Recycle wastewater	• Reduce water use through awareness raising	[Kitakyushu] • ***Reuse sludge***
	Drinking water management		• Groundwater management • ***Water leakage prevention*** • Rainwater harvest	• Reduce water use • Awareness raising	[Kitakyushu] • Improvement of water supply and sewerage • Decrease in the rate of leakage
Transport	Public transport and mobility management	• Monorail track development (planned) • Shift to environmentally friendly transportation modes • Bicycle lane (Jin Basuki Rahmat)	• ***Develop metro rail routes*** • Use of CNG as fuel for urban public transport • Build 4th ring road • Rapid Bus System • New sky highway system	• Promote mass transit use • Motivate people to use mass transit travelling to work	[Kitakyushu] • Public transport and mobility management • Community bus [Toyama] • ***Retrofitting existing trail lines***
	Control of automobile	• Intelligent transport system (ATCS) • Vehicle emission testing		• Increase bicycle travelling by supporting bicycle parks • ***Carpooling for school students***	
	Compact city	• Main road network plan • Integrate landuse and transportation planning	***Policy development suggested***		[Toyama] • Promoting migration to city central

Energy	Regional energy management system	• Introduction of low carbon technology at industrial estate • Develop smart community	***Policy development suggested***		[Kitakyushu, Yokohama, Kashiwa] • ***Introduction of CEMS, BEMS and HEMS***
	Energy efficiency	• Change to LED • Combined heat & power system	• Energy audit • Apply new technology in cement production plants	• Decrease electricity use in office • High efficiency equipment • ***Change electric bulbs***	[Kitakyushu] • Energy efficiency in the commercial and industrial sectors • CASBEE
	Renewable & unharnessed energy	• Solar cell in public street lighting • Biogas utlisation	• Green energy (energy saving, solar and wind power, LED street lights) • Solar water heating	• Find more renewable energy source (PV panels)	[Kitakyushu] • ***Promotion of renewable energy and unharnessed energy*** • Promotion of small hydropower plants • Waste power generation • Utilization of waste heat from plant [Toyama] • Promotion of small hydropower plants
Greenery	Greening urban areas	• ***Tree planting*** • Establish regulations to preserve spatial extent and designation open green area	• Increase the green areas of the city • Green roof	• Support the creation of green area in the community	[Kitakyushu] • Greening urban areas • Park improvement
	Natural resource conservation	• Conservation control at Pamurbaya Conservation Area	• Promote afforestation and reforestation in the designated forestry zone	• Avoid the use of chemical fertilizer and promote organic fertilizer	[Kitakyushu] • Nature conservation • Utilisation of tourism resources • Revetment maintenance; Water Purification

* Policy measures in ***italic*** are elaborated in the following sections.

Surabaya City, Indonesia

At the national level, the President Susilo Bambang Yudhoyono stated in his speech at the Pittsburgh G-20 Summit in the United States on September 25, 2009 that Indonesia is committed to reducing GHG emission by 26 % in 2020 from the BAU level with its own efforts and reaching 41% with international support. As a follow-up action, the National Action Plan for Green House Gas Reduction (RAN-GRK) was set for the year between 2010 and 2020. Serving as guidance on the investment related to coordinated GHG emission reduction at the national and regional levels, RAN-GRK covers the sectors in forestry and peatland, agriculture, energy, industry, transportation and waste management. At the same time, the Guideline for Developing Local Action Plan for Green House Gas Emission Reduction (RAD-GRK) was prepared in 2011. In order to enhance the local capacity, the National Development Planning Agency (BAPPENAS) together with other associated agencies held a workshop for developing RAD-GRK in May 2012. On the other hand, the Japan International Cooperation Agency (JICA) has supported Indonesia under the Indonesia Climate Change Program Loan (ICCPL) since 2008. The programme aims at mainstreaming climate change in the national development programme, developing financing schemes and policy coordination, and measuring GHG emissions and absorption.

Surabaya City has been well known for its efforts toward clean city promotion through community-based waste management. The city has also taken a step further towards a low carbon city, integrating various sectors including waste management, green space management, energy management and transportation management and bringing multiple actors such as community organizations, NGOs, the private sector and the community. The city's community-based waste management has established its unique operating mechanism, centred by the Surabaya city government which is backed by women's groups in collaboration with local media, NGOs and community groups. The city government and NGOs typified by Pusdakota have supported nurturing community leaders and environmental facilitators. This led to the creation of 28,744 of environment Cadres who educate community people in the use of composting baskets and the impacts of composting activities. The total number of houses that have installed a compost system has reached over 17,000. This, with other waste management activities such as waste bank, resulted in the reduction of waste dumped onto the Benowo landfill by 673 tons or 63 % in seven years from 2005 to 2011. Also, as part of green space management, a total of 5,267,000 trees including rain tree or trembesi in Indonesian language (*Samanea saman*) and Cassia (*Cassia sp*), which have a high carbon absorption rate, were planted. The number of trees by species and by diameter is yet to be available.

For example, the impacts of composting and tree planting activities are calculated with the following factors.

Table 8-4: GHG emission factors and formula of composting activities

Item	Value
The weight of organic waste at house	132.86 kg/year/house
Number of houses installing compost system	17,028 houses
Global warming potential (GWP) of CH_4 (data from IPCC)	23
Global warming potential (GWP) of N_2O (data from IPCC)	296
Emission factor for CH_4 from the composting process (data from IPCC)	0.004 tCH_4/t
Emission factor for N_2O from the composting process (data from IPCC)	0.0003 tN_2O/t
Methane emission factor for organic waste in Surabaya city	N/A tCH_4/ t
Formula	
Baseline emission (tCO_2/y) = weight of composting waste (t) * methane emission factor of organic waste (tCH_4/t) * global warming potential (GWP) of CH_4 Weight of composting waste (t) = {weight of organic waste at house (kg/y/house) * number of houses installing compost system (house)} / 10^3 **Project emission (tCO_2/y)** = N_2O emission from composting process (tCO_2/y) + CH_4 emission from composting process (tCO_2/y) N_2O emission from composting process (tCO_2/y) = weight of composting waste (t) * emission factor for N_2O emission from composting process (tN_2O/t) * global warming potential (GWP) of N_2O CH_4 emission from composting process (tCO_2/y) = weight of composting waste (t) * emission factor for CH_4 emission from composting process (tCH_4/t) * GWP of CH_4 **GHG reduction** = baseline emission - project emission = N/A due to lack of data	

Source: Surabaya City 2012

Table 8-5: GHG emission factors and formula of tree planting

Item	Value
Absorption coefficient of trees for each species	N/A $kgCO_2$ / tree
Number of trees for each species	N/A trees
Formula	
Project absorption (tCO_2/y) =∑absorption coefficient of trees (tCO_2/tree) * number of trees (m2/y) **GHG reduction** = project absorption = N/A due to lack of data	

Source: Surabaya City 2012

Ho Chi Minh City, Viet Nam

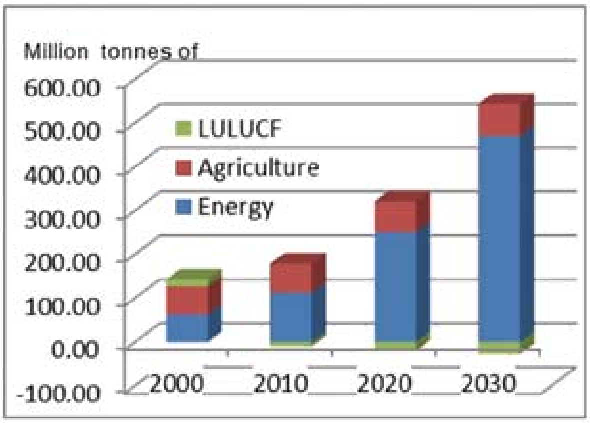
According to the Viet Nam's Second National Communication 2008, the GHG inventory by sector shows highest emissions coming from the agricultural sector (43.1 %) followed by energy (35 %) and land use and land use change and forestry (LULUCF) (10 %). However, looking at the projection for 2010, 2020 and 2030, the proportion as well as the absolute value of emissions in energy sector are expected to increase at an unprecedentedly rapid pace (Table 8-6 and Figure 8-1). In response to such a situation in the country, Viet Nam has been developing the national policy on climate change including the Kyoto Protocol implementation in 2005, PM Decision on some financial mechanism and policy for CDM projects (No.130/QĐ-TTg dated 02/8/2007), the National strategy reduction and prevention of calamity due to natural disasters by 2020 (No.172/2007/QĐ-TTg), the National Target Programme to Respond to Climate Change in 2008, and the National Climate Change Strategy in 2011. The National Climate Change Strategy is positioned as the core policy among others covering both mitigation and adaptation tasks. In relation to mitigation actions, Strategic Task 5 of the Strategy underscores the four priority sectors, namely the development of new and renewable energies, energy saving and efficiency, agriculture and solid waste management.[2] From the launch until 2012, focus

[2] Decision on Approval of the National Climate Change Strategy, 2011

is put on adaptation activities while special attention is drawn to GHG emissions reduction between 2013 and 2025. Finally, from 2026 to 2050, emission reduction activities are integrated into socio-economic activities as criteria, and the missions of the strategy are reviewed (Trương, 2012).

Table 8-6 and Figure 8-1: GHG emission projections for 2010, 2020 and 2030 in Viet Nam
(million tonnes of CO_2 equivalent)

Sector	2000	2010	2020	2030
Energy	62.77	113.10	251.00	470.80
Agriculture	65.09	65.80	69.50	72.90
LULUCF	15.10	-9.70	-20.10	-27.90
Total	142.97	169.20	300.40	515.80



Source: Ministry of Natural Resources and Environment, Vietnam 2010

Ho Chi Minh City's low carbon policies are categorised into eight sectors: urban planning, water management, energy, agriculture, waste management, propagation and capacity building, public health and national security and defence. Among those, the development of metro rail routes is set as one of the priority issues in the promotion of public transportation to avoid severe traffic congestion in the city. The first line of the whole network is currently under construction and scheduled to be completed in 2014. An expected amount of GHG emission reduction from the metro 1 development is calculated in Table 8. For more accurate figures, data collection needs to be improved in areas such as number of passengers who switched their travelling mode from one to another. Also, Compressed Natural Gas- (CNG) run public buses are introduced to reduce air pollution as well as GHG emissions. In energy management, energy audit, introduction of energy efficient technology in cement production plants and use of renewable energy are being implemented or planned. Waste management includes composting of municipal waste, application of 3R principles, and methane gas collection from the three landfill sites. For water management, low carbon polices are set in groundwater management, lowering of water leakage rates and utilisation of sludge generated in the process of wastewater treatment. The project demonstrates an expected GHG emission reduction of 39,804 tCO_2/y through the improvement of water leakage rate by 32 % from 38 % (Table 8-7). The improvement in the production of plantation yields and plantation of trees along the river embankment are in practice under the policy on the promotion of afforestation and reforestation on the designated forestry zone.

For example, the impacts of water leakage prevention and CNG bus introduction are calculated with the following factors.

Table 8-7: GHG emission factors and formula of water leakage prevention

Item	Value
Water demand quantity of HCM city in 2015	2.000.000 m3/d
Water leakage rate before the program	38 %
Energy consumption for water purification (data from Campuchia)	0.43 kWh/m3
Water leakage rate after the program	32 %
Grid emission factor	0.891 tCO_2/MWh =0.000891 tCO_2/kWh
Formula	
Baseline emission (tCO_2/y) = <u>water supply quantity (m3/d)</u> * power consumption (kWh/m3) * emission factor (tCO_2/kWh) <u>Water supply quantity (m3/y)</u> = {water demand quantity (m3/d) / (1-**0.38**)} * 365 **Project emission (tCO_2/y)** = <u>water supply quantity (m3/y)</u> * power consumption (kWh/m3) * emission factor (tCO_2/kWh) <u>Water supply quantity (m3/y)</u> = {water demand quantity (m3/d) / (1-**0.32**)} * 365 **GHG reduction** = baseline emission – project emission = 39,804 tCO_2/y	

Source: Climate Change Bureau, Ho Chi Minh City Government 2012

Table 8-8: GHG emission factors and formula of the introduction of CNG buses

Item	Value
Total extension	19,6km
Transport capacity	620.000 people/day (2020)
Total time for one departure	30 minutes
Working hours	20 hours/day
Waiting time between each departure	5-6 minutes
Number of daily Metro departures	22 times/day
Annual total distance of operation of the Metro route 1	157.388 km
Annual number of passengers using the Metro route 1	113.150.000 (assumption)
Electricity consumption factor (data from IPCC)	4.3 kWh/km
Emission factor of VN electricity grid (data from Surabaya City)	0,891 tCO_2/ MWh
Model share rate when Metro route 1 is not available (data from Surabaya City)	Cars: 22.4% (25.345.600 people) Motorbikes: 68.3% (77.281.450 people) Buses: 9.3% (10.522.950 people)
Mileage of each vehicle when Metro route 1 is not available	10 km (assumption)
Average number of passengers for each vehicle	Car: 1,5 people/unit Motorbike: 1 person/ unit Bus: 15 people/ unit
Emission factor of each vehicle (data from Bangkok)	Car: 166,2 gCO_2/km Motorbike: 54,5 gCO_2/km Bus:1125 gCO_2/km
Formula	
Baseline emission (tCO_2/y) = (<u>∑CO_2 emission coefficient per person</u> * number of passenger) / 10^6 <u>CO_2 emission coefficient per person</u> = (emission factor of each vehicle * mileage of each vehicle) / average passenger of each vehicle **Project emission (tCO_2/y)** = <u>total amount of electricity consumed by metro</u> * grid emission factor <u>Total amount of electricity consumed by metro</u> (MWh) = (electricity consumption coefficient * annual total distance of metro route 1) / 10^3 **GHG reduction** = baseline emission – project emission = 77,490 tCO_2/ y	

Source: Climate Change Bureau, Ho Chi Minh City Government 2012

Nonthaburi City, Thailand

In Thailand, 70 % of the CO_2 emissions in the country come from the energy sector; 42 % is from energy industries, 28 % from transport and 19 % from manufacturing and construction. Energy is highly dependent on fossil fuels (53 %), followed by natural gas (33 %), coal (12 %), hydroelectricity (2 %), and other renewables (1 %). Outside the energy sector, emissions from agriculture and livestock reach 22 %, 7 % from industry and 4 % from waste. Under the 11th National Economic and Social Development Plan set as the master plan of the country, the National Strategic Plan on Climate Change (2008-2012) were launched and the draft National Master Plan on Climate Change (2011-2050) has been prepared under the auspices of the Ministry of Natural Resources and Environment (MONRE). As an operating body, the National Committee on Climate Change has been established, centred in the Office of Natural Resources and Environmental Policy Planning (ONEP) under MONRE as the Secretariat and also the UNFCCC National Focal Point. Other relevant Ministries such as Energy, Industry, Transport, Interior etc. give guidance to sub committees. Additionally, Thailand Greenhouse Gas Management Organisation (TGO) supports the Committee in technical aspects. TGO also provides support to local governments in carbon accounting, the National Guideline Carbon Footprinting for Local Administration and capacity building for MRV. In addition, some private companies e.g. Toyota are actively supporting local governments as part of their CSR portfolio. The National Municipality League, Thailand Environment Institute (TEI) and European Union (EU) also function to support the development of low carbon municipalities.

On the other hand, Nonthaburi City has shown its gradual but stable improvement in 3R activities. After joining the Kitakyushu Initiative Network in 2001, the city has introduced a number of solid waste management policies from a small scale to city-wide by learning from other cities. The city started a pilot project in maximising recycling and minimising waste in communities in 2002. In the same year, the Nonthaburi Composting Plant with the capacity of producing 5 tons of organic fertilizer per month was established. In 2004, the separation of infectious waste management began and collected 405,510 kg of infectious waste per year. A GPS vehicle monitoring system was introduced in 2005 to control efficient waste collection. Hazardous waste including light bulb collection started in 2007, and polystyrene paper (PSP) and expanded polystyrene (EPS) foam separation began in 2010. On the top of those waste management policies, the city has introduced low carbon policies such as the promotion of bicycle travelling, carpooling for school students, and promotion of mass transit use in the transportation sector. In the carpooling campaign, 125 people joined, and 25 car owners are registered so far (Table 8-9). However, such figures are set based on the assumption of government officials and are not collected from surveys. For energy management, offices try to lower electricity use by changing electric bulbs to more efficient ones and setting an operating time for air conditioner. 500 sets of light bulbs are replaced with high efficiency T5 type bulbs (Table 8-10). Renewable energy is also promoted, and 232 photovoltaic (PV) panels have been installed. The creation of green areas has been promoted by distributing seedlings to the community people and increasing the green space in public parks and traffic islands. The city also encourages avoidance of chemical fertilizer use and promotes people to use Nakornnont Organic Fertilizer type I and II produced from vegetable and organic waste. Although activities focusing mainly on CO_2 reduction are relatively new, many cumulative local actions can be considered as low carbon activities by supplementing MRV components to the existing and planned policies.

For example, the impacts of carpooling campaign and changing bulb project are calculated with the following factors.

Table 8-9: GHG emission factors and formula of carpooling campaign

Item	Value
Number of cars driving to a high school before the project	125 cars
Number of cars driving to a high school after the project	25 cars
Average distance of cars to a high school (round trip)	15 km/day (assumption)
Emission factor of each vehicle (data from Bangkok)	166.2 gCO_2/km
Formula	
Baseline emission (tCO_2/y) = {number of cars driving to a high school before the project * average distance of cars to a high school (km/day) * emission factor of each vehicle (gCO_2/km)} / 10^6 * 365 **Project emission (tCO_2/y)** = {number of cars driving to a high school after the project * average distance of cars to a high school (km/day) * emission factor of each vehicle (gCO_2/km)} / 10^6 * 365 **GHG reduction** = baseline emission – project emission = 91 tCO_2/year	

Source: Nonthaburi City 2012

Table 8-10: GHG emission factors and formula of the introduction of changing bulb project

Item	Value
Number of Light Bulb replaced by the project	500 sets
Average lighting hour / day	5.5 hour / day
Energy consumption of T8 light bulbs set	72 W / sets
Energy consumption of T5 light bulbs set	36 W / sets
Grid emission factor [*1]	0.5113 kg/kWh
Formula	
Baseline emission (tCO_2/y) = {∑ amount of consumption for T8 light bulb (kWh/y) * grid emission factor (kg/kWh)} / 10^3 Amount of consumption for T8 light bulb (kWh/y) = number of T8 light bulb * energy consumption of T8 light bulb * average lighting hour/d * 365 **Project emission (tCO_2/y)** = {∑ amount of consumption for T5 light bulb (kWh/y) * grid emission factor (kg/kWh)} / 10^3 Amount of consumption for T5 light bulb (kWh/y) = number of T5 light bulb * energy consumption of T5 light bulb * average lighting hour/d * 365 **GHG reduction** = baseline emission – project emission = 18.47 tCO_2/y	

Source: Nonthaburi City 2012

8.6 City level Low Carbon Policy by Sector in Japan

Water resource management

Wastewater and drinking water management

The popularizing rate of the sewerage project in administrative district (area 18,743 ha) of Kitakyushu City (March 2006) has achieved 99.8 %. Kitakyushu now is promoting the reorganization and outfitting of personal sewers and disseminating purifying-tanks to achieve the target sewage treatment rate of 100 %. The rate of wastewater treatment in Kitakyushu was 99.2 % in fiscal year 2009, and it is expected to be 99.4 % in fiscal year 2020. From April 1, 1989 to March 31, 2011, by using subvention, 379 community wastewater treatment tanks were established. In cooperation with the city, a private cement company (Mitsubishi Materials Corporation) developed a method to use the sewage sludge to make raw material for cement. Currently Kitakyushu uses 4.5 tons of sewage sludge to make cement raw material each year; this amount is the largest in Japan. Sone Purification Center is utilizing the treated water. It sends approximately 10,000 m^3 treated water to the parks nearby each year.

Table 8-11: The situation of the reorganization and construction of sewers (2010/5)

Population penetration	99.8 %
The area of the treated part	16,164 ha
Washed rate	99.2 %
Anti-flood rate achieved (rainwater maintenance)	69.2 % (The area for rainwater maintenance: 13,858 ha)

Transport

Public transport and mobility management

Toyama city has conducted retrofitting of existing JR trail lines to light rail transit (LRT). On the north side of the main Toyama Station, conventional train cars were all replaced with low-floor cars. The number of stations was increased from 9 to 13. The frequency of train cars increased from every 30-60 minutes to 10-15 minutes, and the operation hours were extended from 5:00 to 21:00 to 5:00 to 23:00. Together, non-contact IC cards were introduced to not only LRT but also public buses in the city. Such a package of infrastructure investment and service improvement has resulted in an increase of passengers by 2.1 times on weekdays and 3.6 times on weekends. Among those, 12 % of passengers shifted from a private vehicle to LRT. On the south side of the station, existing tramway lines were extended to create a loop line in the city centre. In addition, a community bicycle sharing system was introduced with 16 bike stations at frequently used facilities such as the station, shopping mall and a city hall.

Compact city

The concept of city planning in Toyama City is described as meatballs and skewers. It promotes people to live and work in the areas within 500 m to a train station or 300 m to a bus stop. Such concentrated areas of major facilities and residential buildings are described as meatballs, and skewers mean for public transport routes which connect meatballs or populated areas. This is to mitigate urban sprawl and reduce automobile dependency. The city provides subsidies to those who build commercial facilities, apartments and houses in the designated areas near stations and to those who move into the city centre. Japan is facing issues of population decline and aging, and the city is no exception. In Toyama city, hospitals and nursing facilities are gathered near the central area. Also, the city set the restriction area for the construction of large-scale malls, movie theatres, music halls etc. at the outskirts of the city. As a country-wide tendency, large-scale shopping malls are often accessible only by vehicles.

Table 8-12: Development of compact city in Toyama City

		Present	Future (2025)
Vicinity of	train stations	1,481 ha	2,043 (increase of stations and extension of LRT)
	bus stops	1,446 ha	1,446 ha
Population density	along train lines	45.8 / ha	50 / ha
	along bus lines	34.4 / ha	40 / ha

Source: Kaneda 2012

Energy

Regional energy management system

A number of low carbon policy measures have been taken at the local level in recent years in Japan. The national government has also promoted local action through legislation and advocacy. Those include the Next-Generation Energy and Social System Demonstration Project by the Ministry of Economy, Trade and Industry in 2010, the Low Carbon City Development Guidance by the Ministry of Land, Infrastructure, Transport and Tourism in 2011, the Formulation of Low Carbon Society Model District (Pilot Programs of Inventing Cool City) by the Ministry of

Environment in 2008. Accordingly, pilot projects of smart community development have begun in leading cities such as the City of Kitakyushu, Yokohama City, Kashiwa City and the Tokyo Daimaruyu Area. The home and building energy management system (HEMS and BEMS) which are connected to the central energy management system (CEMS) were installed, and information networks were laid out in the pilot areas. Although the transmission and selling of electricity are yet largely restricted to electric power suppliers due to the Electricity Act, many attempts have been made to the deregulation of electric utilities, so that decentralized, independent energy supply systems can be established in the region. This is especially important to Japanese cities which suffered from the interruption of electricity supply after the Great East Japan Earthquake. Generally, three factors are found to be imperative. The first one is the institutional and legislative issues such as limited electricity sales by non-power companies. The second factor is the coordination of stakeholders, especially those who have authority to make rules and regulations such as national and local governments, those who are committed to the technology development and operation of newly established system, and finally those who use the system. The third one is the establishment of business model for the operation of regional energy management system, which remains a great challenge to all.

Renewable energy, unharnessed energy

The amount of electrical power generated by renewable energy in Kitakyushu city is increasing year by year (Table 8-13). These recycling resources include solar power, wind power, hydro power and waste power generation. In particular, the amounts of solar power systems have been growing significantly. From fiscal year 2007 to 2010, there are 1,869 cases about using national and city subsidies in the solar power system; and the total power output reaches 7,029.61 kW; meanwhile 2,853 tons CO_2 have been reduced. In addition, by using waste to energy, power can be generated with both recyclable and non-recyclable resources such as biomass and waste plastic. The total amount of electrical power generated by recycling resources at the end of fiscal 2010 is 119,491 kW.

Table 8-13: Capacity of renewable energy supply from 2007 to 2010

Kitakyushu renewable energy supply				
Kitakyushu's renewable energy supply capacity (kW) (from the resource acquisition)				
Year	2007	2008	2009	2010
solar power	9,254	10,266	14,197	20,953 (House: 17,350 kW)
Wind power	16,990	16,990	16,990	16,990
hydro power	1,708	1,708	1,708	1,708
Waste	79,840	79,840	79,840	79,840
Total	107,792	108,804	112,735	119,491

Source: City of Kitakyushu 2012

8.7 Recommendations

Indonesia, Viet Nam and Thailand have recently established their GHG reduction target or started preparing a national policy on climate change mitigation. However, cities have no mandatory target for CO_2 emission reduction. Without such mandates, responsibility or incentives, concrete action cannot be expected. There is a huge potential for GHG reduction had there be proper mandates and/or incentives, which should be given by the national government.

Some leading cities have voluntarily set their emission reduction goal and started developing a climate change mitigation master plan. It is recommended that these voluntary actions are supported and enhanced. Also, local governments have been undertaking their priority environmental policies such as waste reduction, decentralised treatment of wastewater, tree planting, mitigation of traffic congestion, and the introduction of renewable energy and

LED bulbs. Although many of those contribute to not only environmental protection but also low carbon, the impacts of GHG emission reduction are not well identified. The impacts of respective policy actions should be adequately recognized and documented by the local authority. It is necessary to develop the institutional as well as individual capacity of local governments in measuring, reporting and verifying existing and planned low carbon actions.

There are benefits to accounting GHG emissions of local actions for both national and local governments. Firstly, cities can contribute to the national emission target. Secondly, cities' data management capacity is improved. Thirdly, the quantification of the GHG emission reduction effects of local policies and measures can be expanded to other cities. Disclosing the impacts of policy measures with clear numerical data is appealing and attracting the attention of local authority. In this light, more support by national government is required to enhance MRV of low carbon action, involving provident cities. The support could be rewarding or awarding, demanding or mandating, or development of a carbon market. Development of a periodical reporting system such as inventory is also an option.

Accordingly, capacity development in the field of emission accounting skills and data management needs to be enhanced. Capacity development should be further extended to policy planning and development. In this process, lessons can be learned from Japanese cities' accumulated knowledge and experience. Particularly, in the area of energy management, energy efficiency, public transport and water management, high potential of transferring policy and technology can be suggested. While renewable energy and waste management policy have been practiced in the three cities, there is room for improvement when it comes to smart use of energy and compact city design. Moreover, the evaluation of policies is recommended to improve local governments' capacities in designing new policies including not only GHG related but also other issues.

As GHG emission reduction is not a priority for local governments, carbon reduction alone cannot be the main action. It needs to be linked to other priority issues. In line with that, there is a chance to mainstream GHG accounting as a necessary additional option since other environmental, social, economic impacts are not well evaluated either.

Chapter 9 Renewable Energy: A Case of Rice Husk Biomass in Cambodia

Akiko Fukui

Key Messages

- The measure for establishing CDM standardized baseline needs to consider data availability and sector specific situation in host countries.
- There is room to simplify measures of leakage emissions calculation and monitoring project activity, which are not applicable in CDM standardized baseline guideline.

9.1 Background

The aim of this study is to review the establishment of a simplified emission reductions calculation method for the rice mill sector in Cambodia and involves a comparison of existing methodologies, such as conventional CDM and CDM standardised baselines. A standardised baseline can be used to demonstrate additionality, identify the baseline and estimate baseline emissions, all of which are currently burdens for project developers in drafting PDDs and for the DOE in validation. A standardised baseline would also reduce transaction costs and facilitate access to CDM. A sampling survey was conducted in order to establish a standardised baseline for the rice mill sector in Cambodia.

Rice production contributes significantly to Cambodia's economy—the agriculture sector represented 36% of GDP in 2010 and a large percentage of the population engages in rice production. Rice is distributed in the consumer market after the milling process, and 78% of small and medium-sized entrepreneurs (SMEs) in Cambodia are rice millers (MIME, 2011). Cambodia's government adopted a strategy of promoting all sectors related to rice by enhancing infrastructure, services, land management, finance, marketing and allied institutions (Royal Government of Cambodia, 2010). As regards rice exports, paddy rice is occasionally exported to other countries un-milled and sold at a low price, thus promoting rice bound for export is expected to increase the amount of milled rice and raise quality.

At the time of writing there were about 30,000 rice millers registered at the Ministry of Industry, Mining and Energy of Cambodia (MIME) (MIME 2011), who together are responsible for a wide range in annual capacity of milled rice—from 1 to 48,000 t. Most rice millers operate rice mill machines (transporters, shakers, threshers, polishers and sewing machines for packing bags) powered by diesel engines. Rice husk, a by-product of the process, show promise as a source of clean energy for operating these machines, and a switch in fuels would achieve a low carbon society and avoid generating agricultural waste.

9.2 Comparing approaches for emission reductions calculation

Among the CDM-approved methodologies, that for emission reduction estimation and monitoring for renewable energy is relatively simple. In the electricity generation methodologies, baseline emissions are calculated from the quantity of electricity generated by project activities and multiplied by a CO_2 emission factor, which is the volume of CO_2 per MWh of electricity generation. The CO_2 emission factor depends on the type of electricity source the project activity replaces, and for projects connected to the national grid system, which applies methodology AMS-I.D. or ACM0002, a grid emission factor is used, which is based on the "Tool to calculate the emission factor for an electricity system". Default values for the emission factor for off-grid electricity generation systems, including isolated systems and mini-grid systems, are provided in approved methodologies (AMS-I.A., AMS-I.F. and AMS-I.L.). The CO_2 emission factor of each fuel type is provided by IPCC. Project emissions in most renewable energy projects are considered to be 0 t- CO_2.

In the case of a mechanical power generation project, which applies approved methodology AMS-I.B, baseline emissions are calculated using the quantity of diesel consumption saved under the same load, which gives the default emission factor for diesel engines.

The “guidelines for the establishment of sector-specific standardised baselines” (hereafter “the guidance”) compares the carbon intensity of each technology or fuel per output for each type of energy, such as electricity, heat and mechanical power. To establish a standardised baseline for the rice mill sector in Cambodia used in this study, four types of energy generation technology were identified: power-driven by a diesel engine (Technology 1), electricity supplied from rural electricity entrepreneurs (Technology 2), power-driven by a dual mode engine and rice husk gasification system (Technology 3) and electricity generated by a steam turbine using risk husk combustion (Technology 4). The baseline is the technology or fuel with the highest carbon emissions factor and produced in aggregate to the approved threshold of the output for the sector, and in this case is Technology 1, which applies to 90% of rice production in the sector. Additional technologies, identified by their share in the sector and cost comparison, are Technologies 3 and 4.

With the proposed standardised baseline, baseline emissions calculation requires only one parameter for project-specific data—the quantity of rice production—instead of the quantity of diesel consumption required in the methodology of AMS-I.A. or AMS-I.B. (Table 9-1). It is easier for rice mill owners and stakeholders to estimate emission reductions with rice production data than diesel consumption data. Providing default values contributes to projects using Technology 3 in particular, which is the most promising technology in the rice mill sector of Cambodia and does not completely replace diesel with rice husk as the fuel used; the replacement rate depends on the performance of the gasifier system. The diesel replacement rate for Technology 3 preferably refers to the specific performance of a product used in a project. If no figures are provided by the manufacture or the system provider of the gasifier system, 65%, which is the average diesel replacement rate of 25 rice mills based on the interview survey, can be used.

Table 9-1: Default values for parameters comprising baseline emissions calculation

	Parameter	Description	Data source	Judgment for replacement by a default value	
The proposed standardized baseline	MR_y	Quantity of milled rice production in year *y*(t)	Project specific data	×	Volume of activity
	$EF_{BL,y}$	Emission Factor of Baseline Technology in year *y* (t-CO_2/t-rice)	Calculated with data	○	Default value can be established when data (diesel consumption and rice production) for the composed parameter is available
AMS-I.A.	FC *j,y*	Amount of fuel consumption of fuel type j; mass or volume unit in year *y*	Project specific data	×	Volume of activity
	NCV j	Net calorific value of fuel type j; gigajoule per mass or volume unit	IPCC	○	Default value is provided
	$EF_{CO_2,j}$	CO_2emission factor of fuel type j; tCO_2/GJ	IPCC	○	Default value is provided
AMS-I.B.	-	Diesel fuel consumption per hour times hours (kg)	Project specific data	△	The diesel consumption depends on the diesel engine performance and size.
	-	Hours of operation per year	Project specific data	×	Volume of activity
	-	Emission factor for diesel (kg CO_2per kg of diesel fuel)	Provided	○	Default value is provided
Additional parameter for baseline emissions in the case	DR	Diesel replacement rate (%)	Calculated with data	△	Preferable figure is the facility specific performance provided from the manufacturer. Default value can be established from the sector average.

However, the guidance does not cover leakage; biomass projects need to consider the biomass usage effect of the project activity and leakage emissions. In accordance with “General guidance on leakage in biomass project activities”, if it is demonstrated at the beginning of each crediting period that the quantity of available biomass in the region (e.g., 50 km radius) is at least 25% larger than the quantity of biomass that is utilised in the project activity, then this source of leakage can be neglected. This case study revealed that the projects installing biomass gasification can ignore leakage emissions. Rice husk is an in-house by-product and does not generate transport-related emissions. Based on the mills in the interview survey, the total rice husk produced is on average 260% of the rice husk utilised as fuel in project activities, which exceeds the criteria. As shown by this study, the leakage emissions calculation may not be necessary in individual projects if the project activity 1) is limited to certain circumstances (i.e., country, technology and sector), 2) identifies leakage emission sources and 3) clearly demonstrates that the calculations represent common situations. Project participants only consider leakage emissions from project-specific situations in which energy generating equipment is transferred from another activity or the existing equipment is transferred to another activity.

9.3 Reducing the barriers to monitoring and verification

The method of monitoring and verification in a project with a standardised baseline approach is the same as for conventional CDM projects. Parameters in Table 9-2 are required to be monitored in this type of project activity. If the installed facility and its performance (output per unit of fuel consumption) are specified, it is possible to replace such with conservative default values, leaving only the monitored parameters for deciding the volume of activity. According to the Cambodia Research Centre for Development (2010), Salam, PA. et al. (2010) and SME renewable (2011), there are six biomass gasification system suppliers and 48 rice mills with biomass gasification systems installed in Cambodia. Facility performance could thus be identified by undertaking periodic research.

Table 9-2: Monitoring parameters required

Methodology	Data type	Data Variable	Measured, calculated or estimated	Recording frequency	Proportion of data to be monitored	Instrument used to record	Emissions calculation*	Replaced by default value
AMS.I.A.	Quantity	Electricity generation	Measured	Not specified	All or a sample	Meter	BE	×
	Quality	Operation of installed systems	Monitored	Annually	All or a sample	Evidence of continuing operation, such as on-going rental/lease payments could be a substitute	BE,LE	×
	Quantity	Biomass (rice husk) consumption	Measured	Not specified	Not specified	Not specified	BE,LE	△
	Quantity	Fuel (diesel) consumption	Measured	Not specified	Not specified	Not specified	BE	△
	Quantity	Specific fuel (diesel) consumption	Ex ante	-	-	-	BE	△
	Quantity	Specific fuel (rice husk) consumption	Ex ante	-	-	-	BE	△
AMS.I.B.	Quantity	Number of systems operating	Measured	Annually	All	Evidence of continuing operation, such as on-going rental/lease payments could be a substitute	BE,LE	×
	Quantity	Annual hours of operation for the equipment	Calculated	Not specified	All or a sample	Calculated from total output and output per hour	BE	×
	Quantity	Total output (milled rice)	Measured	Not specified	All or a sample	Not specified	BE,LE	×
	Quantity	Output (milled rice) per hour	Measured	Not specified	All or a sample	Not specified	BE	△
	Quantity	Biomass (rice husk) consumption	Measured	Not specified	Not specified	Not specified	BE,LE	△
	Quantity	Fuel (diesel) consumption	Measured	Not specified	Not specified	Not specified	BE	△
	Quantity	Specific fuel (diesel) consumption	Ex ante	-	-	-	BE	△
	Quantity	Specific fuel (rice husk) consumption	Ex ante	-	-	-	BE	△

*BE: Baseline emissions; LE: Leakage emissions

9.4 Issues regarding CDM standardised baseline guidance

This study found that the guidance on standardised baseline includes stringent conditions which are difficult to meet. First, it is difficult to collect data from the three most recent years as required by the board. In this case, as data of energy usage status, such as type of fuel and technology and amount of fuel consumption in rice mills was not available, sampling surveys were conducted. Further, most rice millers use paper-based daily records and do not store annual summaries. Data for this survey is thus comprised of extrapolated estimated averages from daily data and annual operating days (based on daily records and on-site interviews with rice millers).

Second, the guideline provides no clear instructions on how to compare the cost of technologies in Measure 2 (Switch of technology with or without change of energy sources (including energy efficiency improvement)). The requirement is to compare the cost per unit of output—however, the technologies used as a basis for the prior conditions differ. For example, most diesel engines used in rice mills in Cambodia are second-hand car engines, which cannot be estimated in terms of lifetime or annualised initial costs. Further, the applicability of scale of rice mills differs according to technology.

Third, it is problematic to decide baseline and additionality technology criteria using the percentage of output based on fuel or technology, as the annual rice mill capacity varies widely, from 1 to 48,000 t. The presence of only a few large companies with advanced technologies in a sampling survey raises the bars for performance of the baseline technology as well as additional technology.

9.5 Conclusion

Although a standardised baseline is expected to facilitate access to the CDM, it requires the setting of stringent requirements. Therefore, methodologies need to be established according to national contexts—such as data availability and sector status. One of the reasons for the popularity of renewable energy in CDM projects is due to the simplified methodology used, which suggests that a simple methodology would enhance participation in emission reductions projects.

Chapter 10 Energy Efficiency (Industry): Innovative Schemes from Japan and India

Abdessalem Rabhi

Key Messages

- There is a shortcoming of the CDM mechanism to promote energy efficiency (industry) projects in a larger scale. This can be related to the fact that industrial energy efficiency projects are of small size as well as to the fact that MRV process is burdensome under CDM.
- MRV process have been less burdensome under new market mechanisms, such as J-VER in Japan, PAT in India, BOCM between Japan and its partner country, which makes these new market mechanisms good complementary mechanisms to the CDM to promote industrial energy efficiency.
- While industrial energy efficiency for large size industries can be promoted through the new market mechanisms, there is a challenge to promote energy efficiency at small and medium size enterprises (SME) due to the limited credits that they may generate. Bundling them may be one option to overcome this issue.

10.1 Shortcoming of the CDM mechanism to promote industrial energy efficiency in a larger scale

Industrial energy efficiency has numerous methodologies and actual application examples in the CDM methodology. Examples of these methodologies are listed in table below.

Table 10-1: Examples of CDM methodologies related to industrial energy efficiency

Steam system	AM0017, AM0018	**Metal**	AM0038, AM0059 AM0066, AM0068, AMS-III.V.	**Waste gas/energy recovery**	AM0055, AM0058, AM006, AM0095, AM0098, ACM0012, AMS-II.I, AMS-III.P, AMS-III.Q
Water pumping	AM0020, AMS-II.C	**Boiler**	AMS-II.D, AM0044, AM0054, AM0056		
Other/various technologies	AM0088, AMS-II.C, AMS-II.D	**Chiller**	AM0060		

Source: Author, based on UNFCCC 2012

The small scale approved methodologies AMS-II-D ranked the highest among other methodologies related to industrial energy efficiency project under CDM (JICA 2011). Although the number of methodologies related to energy efficiency projects are large, compared to other sector, the share of energy efficiency projects implemented under the CDM mechanism in the total number of projects implemented under this scheme is small (Table 10-2). For instance, as of Aug.2010, only 29 projects related to energy efficiency have been implemented. Among them, only few are related to industrial energy efficiency. This result has questioned the effectiveness of the CDM mechanism to promote industrial energy efficiency in a larger scale.

The shortcoming of the CDM mechanism to promote industrial energy efficiency projects can be related to two mains facts. The first is that these projects are of small size. Hence, even if they are certified they generate only small number of CERs. The second is related to the MRV processes under CDM, which lead to a consumption of so many labor and time. For instance, regardless of their small size, the energy efficiency projects are required to apply same procedure of CDM and need strict MRV process. The eligibility demonstration under the CDM, which is based on the "additionality tool", may constrain project participants to prepare monitoring report, and delay designated operational entity (DOEs) to verify and certificate them. As shown in Table 10-2, the monitoring report period, the DOE verification period and the UNFCCC & CDM EB consideration period for energy efficiency projects is longer compared to other projects (Table 10-2). This may be due to the fact that energy efficiency projects are more reviewed than other projects, and to the complexity of their monitoring process. The volume of monitoring reports for energy efficiency projects is also larger compared to all other projects (except for methane recovery) (Table 10-2) which make MRV burdensome.

Table 10-2: Information about several CDM projects

CDM project type	Num. of CER issuance project	Vol. of monitoring report (av. pages)	Monitoring report making period (av. days)	DOE verification period (av. days)	UNFCCC & CDM EB consideration period (av. days)
Energy efficiency	29	19	76	219	84
Biomass	118	14	65	179	61
Wind power	159	10	43	136	77
Methane recovery	60	22	20	205	85
Hydro power	167	11	33	163	77

Source: Author, based on Mizuno 2012

Several new mechanisms have been designed creatively by paying attention to problematic points under the CDM. The J-VER in Japan, PAT in India, the BOCM between Japan and its partner countries, can be listed as examples.

10.2 Innovative crediting schemes

Japan Verified Emission Reduction (J-VER) scheme

In November 2008, the J-VER was established by the Ministry of the Environment, Japan (MOEJ) in order to facilitate domestic emission reduction/removal projects, which generates carbon credits with higher quality to be used for carbon offsetting and others. In order to meet international standards, J-VER scheme is designed and operated in accordance with ISO-14064-2, 14064-3 and 1406-5.

Key feature of J-VER, in comparison with the CDM, is that the former was designed creatively by paying attention to the eligibility demonstration which is based on the "additionality tool" under CDM. J-VER has introduced the concept of "positive list" of methodologies. J-VER has developed a positive list which identifies eligible project types as a government policy, rather than assessing the "additionality" of each project (Takuya Hiroshima. 2012).

As of September 2011, the positive list included 31 methodologies for the J-VER scheme. Examples of methodologies which are related to industrial energy efficiency are shown in Table 10-3.

Table 10-3: Example of J-VER methodologies which are related to industrial energy efficiency

E001	Fuel switch from fossil fuels to woody biomass fuels for a boiler	**E011**	Renewal of boilers	**E025**	Fuel switch from coals to unused biomass fuels for cement kilns
E002	Fuel switch from fossil fuels to woody pellet fuels for a boiler	**E017**	Renewal of fan and pump or introduction of inverter and controlling equipment	**E026**	Energy efficiency improvement of air conditioning facilities by installing a rooftop greenery
E006	Recovery and utilization of waste heat	**E019**	Introduction of heat pump		

Source: Author, based on Kato 2012

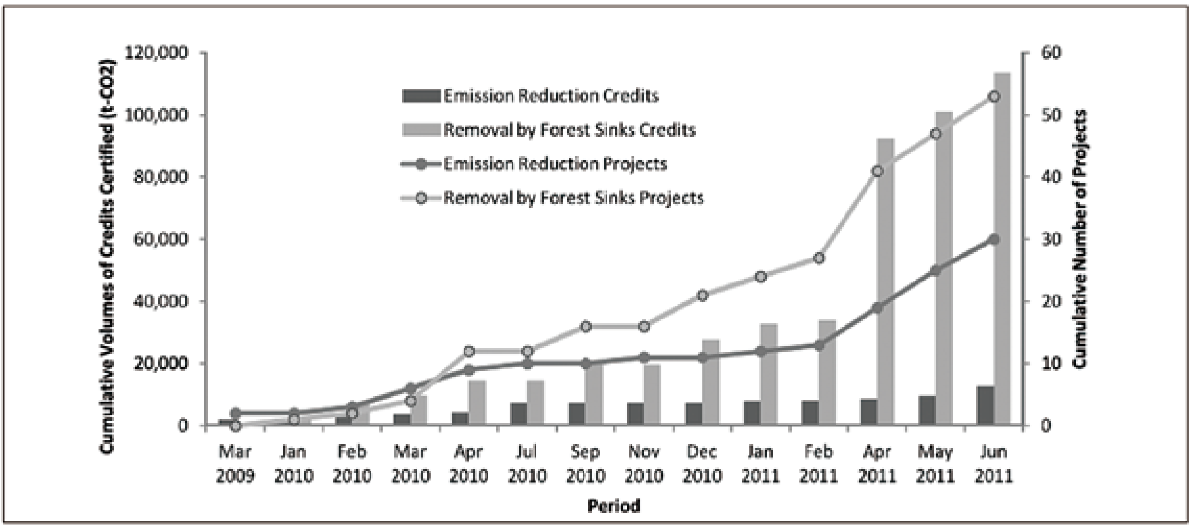
Together with the positive list, the J-VER has developed “eligibility criteria” to judge whether or not a proposed project satisfies conditions prescribed in the positive list. Project planners need to prove that their projects satisfy these criteria to demonstrate their project additionality (Figure 10-1).

Condition1: Heat pumps will be installed during heating equipment upgrades;
Condition2: Hot water, steam or cold water generated by the heat pump is for the personal consumption of the project operator Condition
Condition3: Energy source for both the baseline and the project is either fossil fuels or electricity Condition
Condition4: The heat pump does not have a heat recovery system Condition;
Condition5: Project profitability is non-existent or lower than any other alternatives

Figure 10-1: Eligibility criteria for J-VER methodology regarding introduction of heat pump (E0019)

Key features of the J-VER, in comparison with the CDM, can be seen also in the monitoring and verification processes. For instance, in order to reduce the monitoring requirements, the J-VER allows wide use of conservative default values as well as it has excluded low emission sources (those accounting for less than 0.1% of the estimated emission reduction). The verification process under J-VER are carried by ISO 14065 certified agencies, which should be the same agencies who carried the validation process. The design of J-VER has resulted in saving time and labor in demonstrating the additionality of individual projects, while ensuring the level of accuracy of the scheme.

By the end of June 2011, J-VER had certified a total of 83 projects with 126,390 t-CO_2 emission reduction. Given that J-VER is targeting domestic emission in Japan, where energy efficiency in industrial sector is high, only limited numbers of energy efficient projects are carried under this scheme. Most of the projects are related to removal by forest sinks rather than to energy emission reduction through energy efficiency (Figure 10-2).



Source: Hiroshima 2012

Figure 10-2: Trend of projects implemented under J-VER

J-VER scheme is a good example to overcome problematic points under CDM; however it is a unilateral scheme (implemented only in Japan). Diffusing and promoting experiences and know-how gained from the J-VER scheme to other countries can help advance international cooperation vis-à-vis climate change mitigation through market mechanisms. The J-VER, although has overcome the eligibility criteria under the CDM, it is still facing several criticisms regarding the cost in term of labor and time. This should be taken in consideration when designing other mechanisms.

India's Perform, Achieve and Trade (PAT) scheme

- The Perform, Achieve and Trade (PAT) is an Indian market based mechanism officially launched in July 2012. It aims to enhance cost effectiveness of improvements in energy efficiency in energy intensive large industries and facilities, through certification of energy saving that could be traded. Under PAT, the energy efficiency improvement targets are unit-specific and not sector specific, which means that each Designated Consumer (DC) would be required to reduce its Specific Energy Consumption (SEC) by a fixed percentage based on its current SEC (or baseline SEC) within the sectoral bandwidth. The SEC of an industry is calculated based on Gate -to- gate concept, which defines SEC as the ratio of net energy input into the DC's boundary to the total quantity of output exported from the DC's boundary. To approve the methodology of baseline estimation and target setting, sector specific expert committees were constituted from the nominees of respective ministries.

Key feature of the PAT in comparison with other scheme such as the CDM and J-VER. can be reported as follow:

1) Norm and standards

Under PAT the Central Government, in consultation with BEE, shall establish, amend or rescind the energy consumption norms and standards for designated consumers. The energy consumption norms and standards shall be specific for every DC.

2) Validation

PAT scheme is mandatory scheme and not voluntary, thus there is no validation process. Every DC is mandated to undertake measures to reduce energy consumptions and improve energy efficiency to comply with the specified energy consumption norms and standards. He should submit a performance assessment documents in form "A" to the State designated agency with a copy to the Bureau covering the performance.

3) Monitoring and verification

PAT has more in common with J-VER and is different from CDM in this regards. In consultation with the accredited energy auditor, DC shall put in place transparent, independent and credible monitoring and verification arrangements for energy consumption and production based on the Bureau of Energy Efficiency (Manner and Intervals of Time for Conduct of Energy Audit) Regulations, 2010 for compliance with the energy consumption norms and standard.

All the activities undertaken by the DC, under the specified rules, shall be scrutinized by an accredited energy auditor. Any firm registered under the Indian Partnership Act, 1932 (9 of 1932) or any company incorporated under the Companies Act, 1956 (1 of 1956) or any other legal entity competent to sue or to be sued or enter into contracts shall be entitled to undertake the verification (and check-verification) process. The accredited energy auditor in-charge of verification function shall report the results of his assessment in a verification report together with due certificate in Form 'B' to the Bureau and the concerned State Designated Agency.

The Bureau may on its own, or on receipt of a complaint regarding any error or inconsistency or misrepresentation, shall initiate check-verification action for review of compliance report. The accredited energy auditor in-charge of check-verification function shall submit the results of his assessment in a check-verification report with due certification in Form 'C' to the Bureau and the concerned State Designated Agency.

4) Certification

The Central Government, on the receipt of recommendation from the Bureau, shall issue energy savings certificates of required value to the concerned designated consumer.

The success of the PAT scheme would be ensured through a cohesive and transparent Monitoring & Verification (M&V) system. During the first cycle of PAT scheme -2012 - 2015- there would not be any M&V; however, each DC would be required to submit its annual energy consumption report, in the required format, to BEE. In addition, the Energy Conservation Act requires DCs to conduct energy audits by accredited energy auditors. These would form a basis of M&V system in the target year.

Designated Consumers (DCs) in the eight energy intensive industrial sectors (Thermal power plant, Iron & Steel, Cement, Fertilizer, Aluminum, Pulp & paper, textile, and Chlor-Alkali) will have mandatory participation in the 1st cycle of the PAT scheme. The energy saving targets of 8 sectors covered under PAT cycle-1 is 6.686 million tons of oil equivalents, distributed among 478 DCs.

10.3 BOCM between Japan and foreign country (e.g. India)

The BOCM is decentralized mechanism that aims to address climate change through promoting the transfer of advanced Japanese low carbon technologies, products and services to developing countries. The BOCM should be viewed as a complementary to CDM, because it is expected to realize the projects/activities which may not be eligible under the CDM or which are difficult to implement due to strict applicability conditions and/or impossibility to financial or other additionality demonstration. BOCM mechanism has several features in comparison with the CDM. For instance, under the former, the preparation of the PDD is less burdensome since the eligibility demonstration and validation has been simplified by making a wider use of positive lists[1], benchmarking[2], and other methods as necessary. In addition, the basic elements of methodologies applicable to the BOCM are identified by the joint committee and should be simplified, objective and practical, and take into account the national circumstances of host country. Furthermore, in order to reduce monitoring burden under BOCM, monitoring methodologies should be designed so that they are feasible and do not impose excessive burden on project participants, taking into account national circumstances in hot countries by establishing conservative default values, making use of manufacturer's specifications or statistics, which don't need to be measured, making use of estimation based on sampling and simulations, allowing the estimation of missing data at the verification or monitored data under certain conditions, etc. last but not least, The methodology format under the BOCM is designed in a way that proponents can use them easily, verifiers can verify the data easily, and calculation logic is disclosed transparently.

Using default values, simplified methodologies, swift procedures, simple format, etc. bring the cost of MRV under BOCM down, and make it easier to promote the transfer of advanced Japanese low carbon technologies, products and services to developing countries.

Although the FS/DS of this scheme have been carried only in 29 projects up to now, there is potential to use it more widely in the future.

BOCM may be a good scheme to promote industrial energy efficiency for large scale enterprises; however the question is whether this scheme can promote energy efficiency for small and medium enterprises. This question will not be addressed about BOCM, but about PAT as well. We think that energy efficiency for SME should be considered since the contribution of SME in GHG emission reduction is also high.

[1] The positive list identifies the low carbon technologies, product and service that should be deployed in host countries as its priority and the project meeting the positive list will be automatically deemed eligible.

[2] Benchmarks are determined in advance by project types based on energy efficiency or diffusion rate of equipments and measures, and the project overreaching the benchmark will be automatically deemed eligible.

10.4 Case studies

In order to promote energy efficiency projects in small and medium enterprises (SME) in India, IGES Kansai Research Centre is conducting a research project which includes pilot projects implementation regarding two promising Japanese low carbon technologies, namely Gas Heat Pump air conditioning system and Electric Heat Pump water conditioning system (EHP)[3].

Based on preliminary estimation done by relevant technology experts, the impact of implementing Gas Heat Pump (GHP) in selected investment casting sites and the impact of implementing EHP in selected dairy industries in India is given respectively in Table 10-4 and Table 10-5 below.

Table 10-4: Impact of implementing GHP in selected investment casting sites in India

	Investment casting (Company “D”)	Investment casting (Company “J”)
Primary energy saving	60%	60%
CO_2 emission reduction	61%	61%
Cost saving	31%	33%

Table 10-5: Impact of implementing EHP in selected dairy industries in India

	Company “V”	Company “A”
Primary energy saving	54%	47%
CO_2 emission reduction	47%	39%
Cost saving	77%	64%

As an attempt to facilitate the deployment and diffusion of GHP and EHP in India through BOCM, IGES KRC is elaborating MRV methodologies regarding these two technologies according to BOCM framework[4]. In this regards, several eligibility criteria have been fixed and several calculation methods have been elaborated. Necessary data for calculation have been identified and calculation charts for reference emission, project emission and emission reduction have been developed. The developed methodologies should be improved further based on data and functioning of pilot projects, before to be used as input in the BOCM scheme between Japan and India.

[3] The project is conducted under SATREPS scheme (Science and technology Research Partnership for Sustainable Development) and scheduled to end on March, 2014

[4] MRV project commissioned by Ministry of Environment-Japan (MOEJ).

Chapter 11 Energy Efficiency (Appliances): A Case from Indonesia

Hidefumi Katayama, Aya Watarai

Key Messages

- Indonesia enacts relative energy-saving laws/institutions, and awareness degree toward energy-saving is comparatively high. Establishment of information access and opportunities for obtaining relative information would promote further awareness-raising and actions toward energy efficiency and conservation.
- In Indonesia, where the penetration rate of home appliances will be rapidly growing, it would be desirable to disseminate low carbon technology-based home appliances and proper evaluation method.
- MRV methodology for low carbon technology-based home appliances and energy management system, is simplified to measure for households. Thus verification should be simplified, and as well as capacity building toward this is necessary.

11.1 Background

Indonesia has a plenty of natural resources. Indonesia has been relied on fossil fuel for producing energy. However, current situation has been changed - Indonesia has been encouraged to introduce renewable energy.

By 2025, Indonesia has aims for reducing 26%-41% of CO_2 emission by BAU, and that the rate of renewable energy in primary energy will be increased to 17%. However, the rate of electric demand is still low. It happens due to lack of access toward electricity, and shortage of electric supply. In this regards, it would be important to introduce renewable energy resource more. It will be contributed to increase the rate of electric supply, and as well as Nationally Appropriate Mitigation Actions (NAMAs) in Indonesia will be actively more.

In current energy consumption situation in Indonesia, energy consumption amount in industrial sector is the most. Also, the penetration rate of home appliances is gradually increasing. In current status of home appliances, TV reaches to approximately 90% penetration in households. On the other hand, less than 10%-30% of households own refrigerators and air conditioners. Both penetration rate will be increased when Indonesia's economy and the rate of electric supply will be growth. It is very important in Indonesia to reduce energy consumption amount and energy saving action both in industrial and residential sectors.

11.2 Issues and Purpose of this study

It is expected for economic growth in Indonesia, thus, it is necessary for achieving both economic growth and improvement/conservation of environmental situation. The purpose of this research will create MRV methodologies for promoting and disseminating Japanese low carbon technologies and items toward Indonesia. Therefore, in this research, it will identify historical background and current status of energy sector in Indonesia.

11.3 Methodologies

In order to understand current status which are related to energy sector in Indonesia (i.e. relative energy-saving laws, environmental awareness and environmental friendly actions of citizens, process of sales volume on home appliances (TV, air conditioner, and refrigerator), capacity building support for management of energy consumption amount in industrial sector), this research had been conducted literature review. Through literature research results, Focus Group Discussion FGD) among governments, private sectors, NGOs in Indonesia had been implemented in order to discuss on an appropriate method that will be supported and improved energy situation in Indonesia.

11.4 Main Research

Relative Energy-saving Laws and Institutions in Indonesia

Establishment of relative energy-saving laws/institutions in Indonesia goes back to 1999, "Institution of Energy-saving labeling." This institution was functioned on voluntary bases, but in 2003, this institution was amended. Newly institution showed energy-saving performance, and classification of energy efficiency for each item/product.

In Indonesia, since 2005, laws, implementation plans and countermeasures, have been enacted in gradually. In 2008, countermeasure of energy-saving was made obligatory. Awareness-raising actions toward citizens also have been implemented in Indonesia. Degree of energy-saving in Indonesia has been increased.

BEMS Methodology in Indonesia

In order to promote energy efficiency in industrial sector, capacity building support of BEMS methodology in Indonesia has been implemented in PROMEEC (Promotion of Energy and Conservation). This project has the aim for building and operating energy management system among ASEAN countries in order to promote building energy management and energy-saving measures.

Table 11-1: Programmes and tools on PROMEEC (energy management) for ASEAN energy management system

Programmes	Content
Award System of Energy Management Best Practices	• Collection and dissemination of best practices
Registration of ASEAN-Japan Experts	• Advisory services
Expansion of Network ASEAN Cooperator's network	• Cooperation to activities and information sources
Sub-systems and Tools	
Information system to disseminate (ACE/ ECCJ Website)	• Best practices in energy management • ASEAN Energy Management Handbook • In-house Database (Standardized Data Files) • Technical Directory
Handbooks	• ASEAN Energy Management Handbook • Thermal Energy Efficiency Improvement Handbook • Electrical Energy Efficiency Improvement Handbook
Online Energy Information System	• The information system for bridging implementing organizations and customers
Directories	• Directory of ESCOs • Directory of Suppliers (Equipment and Technologies)

Source: Abstract from ECCJ FY 2011 Report

In supportive project of methodology development, relative good practices are utilized for providing relative technologies and current status of actions/activities. Also "Energy management handbook" is utilized for analyzing and evaluating energy management of good practices. Based on results of analysis and evaluation, development plan that contributed to better operation is proposed.

Awareness and Actions of Citizens toward Environment

The rate of awareness toward energy-saving in Indonesia is comparatively high. Most of citizens are concerned with shortage of green space, air pollution, and affect toward human body. Also they have highly awareness toward purchase of energy-saving items. The awareness rate of energy-saving labeling is low (7.2%), but this situation can be changed through expansion of opportunities for getting relative information and information access.

Penetration Rate of Home Appliances in Indonesia

The process of sales volume of home appliances and its penetration rate are showed below (Table 11-2 and Table 11-3). Sale of volume of all home appliances is increasing. Especially, sales of volume of refrigerator and air conditioners are expected to grow. Penetration of home appliances will be increased, if power grids will be disseminated toward local areas. In this regard, dissemination of energy-saving home appliances is necessary in Indonesia.

Table 11-2: Process of sales of volume of home appliances in Indonesia (Unit: Number of sales)

Household appliance	2005	2006	2007	2008	2009
TV	3,396,183	3,268,034	3,982,791	4,679,366 (y/y:17.5%)	3,859,786 (y/y:17.5%)
Refrigerator	1,854,733	1,724,870	2,126,199	2,325,424 (y/y:9.4%)	2,486,431 (y/y:6.9%)
Air conditioner	799,544	691,791	932,892	1,059,715 (y/y:14.4%)	1,211,313 (y/y:14.3%)

Source: JODC 2009, 17
Number of Table: Domestic Consumption

Table 11-3: Penetration rate of home appliance in Indonesia (2009 data)

TV	Refrigerator	Air conditioner
6.7%	86.5%	25.1%

Source: Mitsubishi UFJ Research and Consulting 2012, 29

Since the penetration rate of home appliances is getting increasing, energy-saving from these appliances is important. National Standardization Agency of Indonesia (BSN) established for developing national standard in Indonesia, develops Indonesian National Standards (SNI). The standard is voluntary basis, but through technical regulation with SNI, environmental situation can be protected. The standard is based on minimum energy efficiency performance level. BSN had conducted investigation study in 2011 for checking whether home appliances (AC, fan, washing machine, refrigerator, and water pump) can comply with the standard level or not. Through the study, it was realized that there are various performances in one appliance, and each for suitable standard, like ISO and IEC (International Electrotechnical Commission) is different. Thus, the gap between the standard and the actual usage of home appliances were identified. In order to improve energy-saving and energy efficiency, it is very important to fill in the gap between the two.

11.5 Findings

Energy sector in Indonesia is now a stage for promotion both of energy security for stable energy supply and demand and energy saving. Policies, institutions, and regulations have been established, and also energy efficiency standard has been created. Energy saving infrastructure is getting growing. However in reality, the gap between the standard and the actual usage of energy consumption amount in home appliances is occurred. For further improvement of energy-saving actions in Indonesia, it is necessary to fill in the gap. Thus, it is important to develop MRV methodology for evaluation the gap. For developing MRV methodology, an approach how to acquire sampling for energy consumption amount of home appliances is necessary.

11.6 Recommendations

For filling the gap between the energy efficiency standard and the actual usage of energy consumption of home appliances, the mechanism for evaluating the gap is need. MRV methodology for evaluating the gap should be created. This methodology should be targeted in residential sector, thus, simplified methodology, like simplified HEMS

(Home Energy Management System), which each household can measure their own energy consumption amount by themselves, should be established.

Also strong participation and cooperation from residential sector is very important in order to collect data for energy consumption amount of home appliances. Thus, expansion of information access, opportunities and awareness-raising toward the public is also very necessary. Further research should be expected to identify the gap factors which are occurred in actual life in household related life-style and residences' characteristics, and to find the approach for evaluating whole market. In particular, this research would focus on development of rational approach for correcting catalogue value through identification of disturbance factor which high influences are affected in actual energy consumption amount.

Chapter 12 Buildings: A Comparative Analysis of MRV Methodologies

Eric Zusman

Key Messages

- This chapter compares how the Clean Development Mechanism (CDM), Global Environment Facility (GEF) and "Citywide NAMA" methodologies for measuring, reporting, and verifying (MRV) greenhouse gases (GHG) in the buildings sector perform across three dimensions: 1) systems boundaries; 2) baseline setting; and 3) data requirements.
- The chapter proposes a two-stage strategy (post-2012 and post-2020) for expanding the system boundaries of MRV methodologies while holding down transaction costs (from baseline setting and/or data requirements).
- In the post-2012 stage, the strategy will involve shifting gradually from CDM methodologies with a narrow scope, stringent baseline setting, and significant data requirements such as AMS-III.E to those with a wider scope and novel baseline setting (albeit considerable data requirements) such as AMS0091.
- In the post-2020 stage, lessons learned from the above CDM and soon-to-be-released GEF methodologies will provide the foundation for MRVing Citywide NAMAs. It will also help to draw upon lessons learned from other sectors in the report (appliances, transport, waste management, wastewater, etc).
- Incorporating dynamic baselines, rebound effects, co-benefits, and lifecycle emissions can improve the accuracy of MRV in the buildings sector. Determinations of which of these elements to include in MRV should be based on weighing the benefits of greater accuracy against the costs of increased data collection and analysis.

12.1 Introduction

The 100,000 urban residents Asia adds daily is fueling a rapid increase in residential and commercial buildings (World Bank, 2010). This high-speed growth presents both an opportunity and a challenge for low carbon development in Asia. The opportunity lies in new flows of carbon finance from a future climate regime to support nationally appropriate mitigation actions (NAMAs) in the buildings sector (see Table 12-1 for a listing of pledged NAMAs with buildings components). The challenge is that financing for NAMAs will rest in part on the measurement, reporting and verification (MRV) of greenhouse gases (GHGs). This chapter aims to make the MRV challenge more tractable by comparing how the Clean Development Mechanism (CDM), Global Environment Facility (GEF) and "Citywide NAMA" MRV methodologies perform across three dimensions: 1) systems boundaries; 2) baseline setting; and 3) data requirements.

The chapter proposes a two-stage strategy (post-2012 and post-2020) for expanding the system boundaries for MRV while holding down transaction costs (from baseline setting and data requirements). In the post-2012 stage, the strategy will involve shifting gradually from Clean Development Mechanism (CDM) methodologies with a narrow scope, stringent baseline setting, and significant data requirements such as AMS-III.E to those with a wider scope and novel baseline setting (albeit considerable data requirements) such as AMS0091. In the post-2020 stage, lessons learned from the CDM and soon-to-be-released GEF methodologies for buildings will provide the foundation for MRVing Citywide NAMAs. Incorporating dynamic baselines, rebound effects, co-benefits, and lifecycle emissions can improve the accuracy of MRV in the building sector. The determination of which elements to include should be based on weighing the benefits of greater accuracy against the costs of increased data collection and analysis.

Table 12-1: NAMAs in the buildings sector

Country	Subsector	Intervention
Algeria	Energy efficiency (residential)	Increase energy efficiency in new and existing residential buildings using mature technologies.
Ethiopia	Energy efficiency (residential) Alternative fuels	Scale up the usage of energy efficient fuelwood and alternative fuel stoves.
Libya	Energy efficiency (residential) Energy efficiency (public and commercial)	Reduce by half average specific emissions in the residential sector in 2023 by increasing energy efficiency of buildings and appliances and increasing the usage of solar water heaters.
Mexico	Energy efficiency (residential) Energy efficiency (public and commercial)	Supplement on-going initiatives for energy-efficient housing as laid out in the PECC and as currently operated by INFONAVIT by: 1. Extending penetration of basic efficiency standards to the entire new housing market in Mexico 2. Upgrading efficiency standards to more ambitious levels
Morocco	Energy efficiency (residential)	Incorporate several measures to incentivize the uptake of solar hot water systems, accelerate the adoption of compact fluorescent light bulbs (CFL), implement measures related to the thermal performance of buildings and incorporate energy efficiency labeling of appliances.
Mongolia	Energy efficient buildings	Building energy efficiency improvement
Peru	Energy efficiency Energy efficiency (residential) Energy efficiency (public and commercial)	Reduction of energy consumption through the implementation of more efficient lighting technologies in the residential, industrial and public services sectors
South Africa	Energy efficiency (residential) Alternative fuels	GHG emission reductions through solar water heaters and thermal efficiency in one million new low-income houses

Source: NAMAs Database 2012, and New Mechanisms Information Platform 2012.

12.2 Systems boundaries, baseline setting, and data requirements

As with any sector, the difficulty in MRVing GHG emissions from the buildings sector depends on what is being MRVed. Clearly MRVing GHGs from a single energy savings technology—an inefficient boiler, for instance—is relatively straightforward. The difficulties lie in that the greatest mitigation potential for buildings requires more than a single technology. Rather, maximizing energy savings often requires a "whole-building approach"—an approach that simultaneously considers relationships between building materials, building envelope, insulation, flooring, windows, heating/cooling systems as well as user behavior and lifestyles (Cheng et al, 2008). In fact, the greatest energy savings often involves expanding boundaries even more to include entire urban systems and the enabling environments in which decisions are made about different aspects of those systems (World Bank, 2010). Hence it would be best to gradually expand the system boundaries for MRVing emissions in the buildings sector.

A possible downside of expanding system boundaries will be a greater difficulty in two other essential components of the MRV process. The first is baseline setting. MRVing emissions will require establishing a credible business-as-usual (BAU) baseline against which GHG reductions can be compared. A second major challenge will be acquiring sufficient data to establish both reputable baselines and actual measurements of emissions reductions. The CDM can offer some useful lessons into how to expand the scope of reductions while minimizing transaction costs from generating baselines and data requirements. It also stands to be a useful starting point before more approaches are proposed.

12.3 CDM Methodologies

The CDM is a project-based offset mechanism that was created under the Kyoto protocol. The backbone of the CDM is methodologies specifying how to calculate and monitor GHG emissions as well as demonstrate additionality. Until recently, the main MRV methodology for residential buildings was “AMS-II.E energy efficiency and fuel switching measures for buildings” (see Table 12-2 for a listing of projects using AMS-II.E).[1] As a small scale methodology, it relies of technology specific baselines for various energy efficiency and fuel switching measures. It can apply to a number of technical interventions as well as more than one similar building; and is relevant to either to existing or new buildings. The approach is especially useful for one-off technological solutions like the aforementioned boilers.

At the same time, it is meant for one technology at a time, making it difficult to capture multiple interventions or indirect changes in lifestyles and user behavior. It also includes stringent baseline setting rules that require comparing project emissions to baselines for BAU technologies and measures. This will be exceedingly difficult for new buildings as it is challenging to demonstrate a counterfactual BAU without knowledge of preexisting technologies. Moreover, its requirements that data be gathered for each energy efficiency and fuel switching measure raise the costs of data gathering. Overall, its narrow scope, stringent baseline setting, and significant data requirements make it less applicable to the previously mentioned “whole building approach” (Cheng et al, 2008).

Table 12-2: CDM projects in Asia using AMS-II.E (energy efficiency and fuel switching measures for buildings)

Project Name	Status	Host Country	Annual Average CERs
Energy efficiency measures in "Technopolis".	Undergoing Registration	India	8,448
Energy Efficiency Improvement Measures in a commercial building facility	Undergoing Registration	India	7,053
Energy Efficient Green Building at New Delhi by ONGC Ltd	Completeness Check	India	6,181
Energy efficiency measures at Mindspace Airoli, building nos: 1, 2, 4 and 5&6 of Serene Properties Pvt.Ltd.at Navi Mumbai	Completeness Check	India	29,884
Energy efficiency measures in Office Building at Kalina of Ivory Property Trust	Validation	India	1,938
Green Building at Dehradun	Validation	India	788
Energy Efficiency Measures at MindSpace Building No 14 at Hyderabad	Validation	India	3,334
Energy Efficiency Measures at MindSpace Building No 11 at Hyderabad	Validation	India	7,926
Energy Efficiency Measures at MindSpace Building No 6 at Hyderabad	Validation	India	5,312
Energy Efficiency Measures at MindSpace Building No 9 at Hyderabad	Validation	India	16,285
Energy Efficient Green Building at Mumbai by ONGC Limited	Validation	India	5,115
Green Building at Kolkata	Validation	India	1,881
Energy efficiency measures in Ecospace, Kolkata, West Bengal	Validation	India	7,359
Energy efficiency improvement measures in FORTIS Hospital buildings at Shalimar Bagh, New Delhi, and Gurgaon, Haryana India	Validation	India	4,942
Energy efficiency measures at Terminal T3	Validation	India	16,455

Source: IGES 2012

NOTE: The only project using AMS-II.E that has received credits is in South Africa (CDM Lusaka Sustainable Energy Project 1)

In 2011, the CDM executive board approved a new large scale methodology for residential and commercial buildings that covers electrical and thermal energy savings: AMS0091 "Energy efficiency technologies and fuel switching in new

[1] The majority of buildings energy efficiency projects in Asia have used this methodology. There have also been a handful of other projects related to buildings. These include lighting and demand side energy projects that have used small scale methodologies such as (AMS.II.A, AMS.II.C, AMS.II.D, AMS.II.I and AMS.II.J) and large scale district heating and lighting methodologies (AMS0046 and AMS0058).

buildings."[2] The methodology applies to efficiency measures and/or fuel switching in new building units (residential, commercial, and/or institutional building units). The methodology is unique in that it can capture a range of different interventions as well as difficult-to-measure lifestyle changes. The reason it has this broader scope is a benchmarking (control group) approach to establishing additionality and constructing baselines. The methodology relies on a conservative benchmark based on buildings that are outside the project: the baseline is consistent with the top 20% of buildings not covered by the project in emissions per gross floor area ($tCO_2e/m2$) over the past five years (UNFCCC, 2011b). A benchmark for an entire building will help streamline MRV for entire buildings. It is nonetheless important to point out that it is contingent on gathering a significant amount of data for the per gross floor area data. This data is not always available in developing country setting, creating an obstacle to actual use. There are other methodologies being discussed that could potentially expand the scope without increasing the data requirements, including the GEF and Citywide NAMAs.

12.4 Other Methodologies

The Global Environment Facility (GEF) aims to catalyze transformational change for low carbon technologies. It does this by not only attracting co-financing, but investing in a package of measures and enabling environments that have an indirect effect on emissions. For example, this might include investing in a revolving fund for low carbon lighting across an entire city. The GEF has recently initiated work on methodologies for MRVing GHGs in the building sectors (paralleling a similar effort in the transport sector). This work is still in progress, however. Until a buildings specific manual is published, it is only possible to comment on methods for measuring GHG emissions from the catchall category of “energy efficiency” (GEF, 2008)

The GEF energy efficiency methodologies reflect the motivations of the GEF. That is, they attempt to capture three impacts: 1) direct impacts of the project; 2) post-project impacts; and 3) indirect impacts. The direct impacts are calculated with a standard approach that multiplies the energy saved from the project; then multiplies the energy savings by an appropriate emissions factor; and contrasts that figure against a reasonable baseline. The post-project impacts involve calculating emissions reductions beyond the project’s completion. This is often used for supporting funding mechanisms that have long lifetimes—such as how much turnover financing facilities will deliver after the project is complete. The indirect impacts are calculated by using a bottom-up approach to estimate how many times the project is likely to be replicated. The GEF methodology is flexible and intuitive. It also helps that it includes methods for evaluating impacts of entire policies. At least for now, however, it is better designed to support the development of markets for energy efficiency or renewable energy than for whole buildings. It could therefore have an impact on buildings but may be difficult to tailor to multiple varying policies and measures that are central to the whole buildings approach (GEF, 2008).[3]

There have also been discussions of methodologies that are less stringent but arguably more practical to MRV emissions reductions in the building sector. Many of these approaches are designed to accommodate broader changes to the built environment at the city level. In this respect, there scope is not limited to buildings but relate to other forms of infrastructure (roads, bridges and public areas) as well as emissions sources (transport, waste management, and urban forests). To highlight a salient example, the World Bank has proposed a two tiered set of methodologies for buildings and citywide NAMAs. The approach relies on a set of more rigorous methodologies to measure and monitor GHGs for similar buildings; it also applies a second set of more flexible “estimation” rules (as opposed

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2 The approach was developed by Perspectives for the Masdar project in Abu Dahbi, United Arab Emirates.

3 According to presentations at a February 2012 seminar, the proposed new methodologies will be specific to buildings; have options for ex ante and ex post calculations; offer a technology and investment approach; employ a simple spreadsheet based approach; provide improved baseline estimation methods; and offer improved emission factors for direct and indirect emission reductions. See UNEP, 2012a.

to measurement) to capture citywide reductions, using a set of energy intensity indicators that are well suited to "developing countries given their overall objective of improving and expanding urban services and amenities without limiting their GHG impact on the atmosphere (World Bank, 2010)."[4] This approach has considerable promise but will likely encounter difficulties in combining the more robust building-specific and flexible citywide methods. Clearly additional details will be needed to judge its usefulness; just as clearly there will be important lessons to take from the CDM and GEF methodologies.

12.5 Conclusions and the Way Forward

This chapter has examined the strengths and weaknesses of four different methodologies for MRVing emissions reductions in the building sector. It has demonstrated that current CDM methodologies, though offering limited support for energy efficient buildings, can shed useful light on how the sector's emissions can be MRVed. In particular, it demonstrated that one of the main difficulties will be capturing interactions between different kinds of measures, technologies and behavioral changes in whole buildings. Recent advances in benchmarking—using a control group of buildings to set a conservative baseline—has considerable promise to remove these obstacles, though sampling might be needed to establish benchmarks in AMS0091.

Outside of the CDM, the GEF offers a more intuitive and user-friendly approach to MRVing reductions from energy efficiency improvements. It also captures changes to the enabling environment (such as unique funding mechanisms) that extend beyond the project physical and temporal boundaries. However, the energy efficiency methodologies are similar to the previous CDM in that they focus on "one technology at a time" and are not specific to buildings. The GEF's development of building specific methodologies should be watched closely as they might prove both simple and scalable. Some international organizations have also advanced new ideas for MRVing emissions at the city level that would necessarily include buildings as part of larger NAMA. These approaches would rely at least partially on estimation, sampling, and top-down fuel use and electricity use data, but more details will be needed of how they operate in practice.

Table 12-3: Comparison of MRV methodologies in the building sector

Methodology	Scope	Baseline Setting/ Additionality	Data Requirements
CDM AMS-II.E Energy efficiency and fuel switching measures for buildings	Technology specific solutions	Rigorous	Significant, especially for new buildings
CDM AMS0091 Energy efficiency technologies and fuel switching in new buildings	Whole buildings	Innovative benchmarking	Significant, especially for benchmarks
GEF Energy Efficiency	Technologies and enabling environments (not specific to buildings)	Flexible	Flexible (includes indirect and post-project impacts)
Citywide NAMAs	Buildings and Other Infrastructure	Potentially Flexible	Flexible, though more detail needed on combination of buildings with other urban emissions

The comparison of the four methodologies in Table 12-3 also leads to some recommendations. It is clear that there will be transition from methodologies that focus on single technologies to those focusing on entire buildings to those

[4] UNEP also proposes an innovative approach to an urban CDM. See UNEP, 2012b.

focusing on entire cities. While the recent AM0091 for entire buildings projects offers some hope to facilitate this transition, more research will be needed on precisely what steps will guide cities from a technology to a building to a city. This will be especially important as more countries pledge that NAMAs move from projects to programmes to policies. A similar set of questions revolves around whether MRV should be more stringent for the three different types of NAMAs being discussed in climate negotiations: unilateral, supported, and credited NAMAs. It is possible that the rigor of the MRV might vary with the type of the NAMA.

There are also a final set of issues that will need to be factored into the MRV of emissions concerning a potentially expanded scope. The first involves the need for dynamic baselines to accommodate fast moving changes in technologies that could potentially save energy and should be factored into MRV. The failure to build these changes into baselines will lead to significant overestimates in emissions. A second issue is rebound effects. Rebounds occur when energy efficient improvements in technologies result in greater usage rate, effectively offsetting emission reductions. This is likely to accompany shifts to more consumer-oriented lifestyles. A third issue is co-benefits. Policymakers may be more interested in the local development benefits (cleaner air and improved public health) attributable to energy efficiency reforms than GHG reduction. A final cross cutting issue involves lifecycle emissions. It will be increasingly important for infrastructure investments to trace emissions from extraction of raw materials to the end of the lifetime of the building. Factoring each of these considerations—dynamic baselines, rebound effects, co-benefits, and lifecycle emissions—adds greater complexity to the MRV. As with many of the issues covered in this chapter, the costs of this complexity should be weighed against the benefits of accuracy.

Chapter 13 Transport: A Comparative Analysis of MRV Methodologies and Possible Default Values

Jane Romero

Key Messages

- The significant and growing greenhouse gas (GHG) emissions from the transport sector remain a challenge to mitigate climate change.
- Transport projects are not "low hanging fruits" under the Clean Development Mechanism (CDM); perched on "higher branches" requiring more data, financing and technical know-how to design and implement, thus, only less than 1% of total GHG reduction generated by CDM projects came from the transport sector.
- It is envisaged that post-2012 mechanisms will be able to mainstream sustainable transport projects, policies and programs. Easing the complexity and data intensiveness of calculating transport GHG emissions will be necessary to attract and roll out more sustainable transport project.
- This section explores ways to simplify transport MRV methodologies and data requirements by incorporating lessons learned from CDM and other existing methodologies. To illustrate, the proposed simplification by introducing default values and its implications are discussed by examining methodologies to calculate emission reductions from a Bus Rapid Transit (BRT) project.

Transport-sector CO_2 emissions have grown by 45% from 1990 to 2007, contributing about 23% (globally) of overall CO_2 emissions from fossil fuel combustion. The sector accounts for approximately 15% of overall greenhouse gas emissions (OECD/ITF, 2010). Most of the GHG emissions from the transport sector are from road based transport, which is estimated to grow at a rate of 2.8% annually up to 2030 with the increasing motorization in developing countries (Bongardt and Sakamoto, 2009).

Currently there are 44 NAMA submissions to the UNFCCC of which more than half, 28 out of 44 (64%), include activities in the transport sector. This indicates that transport measures are becoming a priority with countries proposing actions ranging from single stand-alone transport projects similar to CDM projects to sector-wide policies and programs. The diversity of proposed actions poses a challenge on how to design an encompassing transport MRV methodology. Most likely, a suite of methodologies will be developed depending on the specific transport project, policy or program.

13.1 To what extent is the required level of accuracy?

In preparing MRV methodologies for transport NAMAs or other new post-2012 mechanisms, it is pragmatic to look and learn from the experiences of the Clean Development Mechanism (CDM) and other existing methodologies such as the Global Environment Facility (GEF) *Manual for Calculating Greenhouse Gas Benefits of GEF Transportation Projects* prepared by ITDP and the Clean Technology Fund (CTF) *Guidelines for Calculating GHG Benefits of CTF Investments in Transport*.

One of the fundamental differences between CDM, GEF and CTF methodologies is the degree of accuracy required by each methodology. Under CDM, to ensure the environmental integrity of emission reduction, which are certified and traded, near accurate emission estimations are required while a larger degree of uncertainty are allowed under GEF and CTF methodologies. The level of accuracy is not yet settled nor lengthily discussed in the MRV process for NAMAs or other new mechanisms. But one thing is sure; it is envisioned to be simpler than CDM to have a wider coverage and attract participation by more countries and project proponents which could translate to more GHG emission reductions.

13.2 Comparison of methodologies and mechanisms

In this sub-section, the comparison of methodologies and mechanisms is structured as follows:

- scope
- project boundary
- baseline calculation
- data requirements
- requirements for monitoring

Scope

Under the CDM framework, there are 10 transport and 5 biofuel methodologies applicable to transport projects as shown in Table 13-1 categorized based on purpose following the Avoid-Shift-Improve[1] approach to reducing emissions in the transport sector. Note that there is no methodology for Avoid strategies, i.e. to avoid the need to travel. Note also the subtle differences among methodologies applicable to the same project category. For example, the coverage of AM0031 is wider as it includes operational improvements (e.g. new or larger buses) of an existing and operating bus system as well as the contribution of feeder lines in the Bus Rapid Transit (BRT) system while ACM0016 is limited to BRT systems based only on dedicated bus lanes.

Table 13-1: Approved CDM methodologies applicable to transport projects

Category	Methodology	Purpose
Bus systems	AM0031, ACM0016	Shifting travel to more sustainable modes
Mass rapid transit systems	ACM0016, AMS-III.U	Shifting travel to more sustainable modes
Energy efficiency	AMS-III.AA, AMS-III.AP, AMS-III.C, AMS-III.AT	Improve the efficiency of modes
Fuel switch (bio-CNG)	AMS-III.AP	Improve the efficiency of modes
Fuel switch through retrofit	AMS-III.S	Improve the efficiency of modes
Transportation of cargo	AM0090	Shifting travel to more sustainable modes
Biofuel for transport	AM0047, ACM0017, AM0089, AMS-III.AK, AMS-III.T	Improve the efficiency of modes

Basically, GEF is more flexible to accommodate and finance a wider range of transport project types. The GEF methodologies include a series of Excel-based templates called *Transportation Emissions Evaluation Model for Projects (TEEMP)* derived base from a combination of international experience and best practices. The GEF methodologies also advocate the Avoid-Shift-Improve strategies. Currently, TEEMP models are available for bike-sharing, bike-ways,

[1] The paradigm shift towards sustainable, low-carbon transport requires the a number of strategies grouped as follows – avoid to reduce the need to travel through integrated land-use planning, implementation of traffic demand management or other similar measures; shift to more efficient and low-carbon modes of transport such as taking public transport or non-motorised transport (NMT) instead of personal car use; and improve to advance fuel and vehicle efficiency as well as optimisation of transport infrastructure (Dalkmann and Brannigan, 2007).

bus rapid transit (BRT), expressways alternatives, mass rapid transit (MRT), pedestrian facility improvements, railway alternatives, as well as several different transport demand management (TDM) programs.

The CTF methodology has a wide applicability allowing for use in multiple project types as it is designed generally to calculate GHG benefits for all transport projects.

Project boundary

The project boundary of a CDM project encompass all anthropogenic emissions by sources of greenhouse gases under the control of the project participants that are significant and reasonably attributable to the CDM project activity (3/CMP.1, Annex, paragraph 52). This includes the power plants connected physically to the electric system that supply power to transport systems. For example, the project boundary of AM0031 encompasses the passenger trips on the BRT project in the respective city with the spatial extent determined by the outreach of the new BRT project and covers emissions of different modes taken by passengers before taking the BRT system. Leakage emissions due to change in load factors of taxis and conventional buses as well as congestion change are included in the project boundary.

In the CTF methodology, the project boundary is not fixed, it is determined by the scope of emissions. Similarly, in the GEF methodology, the exact project boundary varies according to each project and their related emissions.

Both the CTF and GEF BRT methodologies differentiate between direct project emissions, post-project direct emission reductions and indirect emission savings. Direct emission reductions are those achieved by investments that are directly part of the results of the projects. Direct post-project emission reductions are achieved through those investments that are supported by GEF-sponsored revolving financial mechanisms still active after the project's conclusion while a range of indirect impacts are achieved through market facilitation and development. No single formula can be applied unilaterally to calculate this divergent impact, that's why GEF methodology estimates direct and indirect impact figures separately, and applies numerical values for uncertainties that are appropriate to each scenario.

Baseline calculation

In the CDM methodology, baseline emissions and emission reductions are calculated ex-ante to project implementation and are verified through annual monitoring. Strict calculations of emission parameters are required. Different formulas with clearly defined parameters are used to calculate baseline and project emissions.

The GEF methodology only requires emissions to be estimated ex-ante, when financing is made available. The methodology recognizes the likely unavailability of data at the early planning stage so it allows more uncertainty in the data, making use of secondary data or international sources if local data is not available.

The CTF methodology also estimates emission savings before project implementation but it conducts detailed ex-post calculation of GHG benefits to monitor the market transformational impacts of CTF investments.

All the methodologies reviewed follow the ASIF[2] framework although it is not explicitly mentioned in CDM methodologies. In addition, CTF also relies on transport models to assess emission reductions.

[2] The ASIF framework (Schipper et al, 2000) shows the fundamental indicators used to quantify transport-related emissions wherein emissions are a product of (A) the total transport activity x (S) the modal structure x (I) the energy intensity of each mode X (F) the carbon content of the fuel used in each mode

Data requirements

Data requirements vary depending on the transport project. Most likely, the same data are required regardless of methodology used but the quality of data required depends on the methodology or more aptly, on the source of funding if it is under CDM, GEF or CTF.

To illustrate, for a proposed BRT project, data are needed for the following indicators: (i) transport modes used in the absence of the BRT project and their specific fuel consumption (including the former bus system, as well as other non-bus modes), (ii) the fuel types used by the different transport modes and their carbon emission factor, (iii) the occupancy rate of the vehicle by mode, (iv) the trip distance of each mode, and (v) the total number of passengers on the new system. These key parameters are tabulated in Table 13-2 vis-à-vis data sources per methodology based on a compilation by Eichhorst et al, 2010.

Table 13-2: Key parameters for BRT baseline establishment and data sources per methodology

Indicator	CDM/AM0031	CDM/ACM0016	GEF	CTF
The transport modes used in absence of the BRT project	Passenger survey	Passenger survey	Derived from passenger numbers on new system and overall modal split	No specifications
Fuel types of different modes	Local statistics	Local statistics	Local statistics or secondary sources	Official statistics or survey
Average speeds	Project data or local statistics	Project data or local statistics	Local observations or secondary sources	Local observations and/or transport modeling
Specific fuel consumption by mode and fuel type	Local statistics, national or international literature, or IPCC values multiplied by an annual technology improvement factor of 0.99 for buses, taxis and passenger cars, 0.997 for motorcycles	Local statistics, national or international literature, or IPCC values multiplied by an annual technology improvement factor of 0.99 for all vehicles	GEF default value, assuming 10% fuel efficiency improvement per decade	No specifications
Fuel emission factor	IPCC values	Fuel supplier statistics, sample measurements, regional or national or IPCC default values	GEF default factors or local data	IPCC values adjusted for the locally available fuel heating values and vehicle technology mix
Average occupancy rate of the vehicles by mode	Project statistics or official statistics	Project statistics or official statistics	Secondary materials or local observations	Survey and default values
Average trip distance for each mode	Project statistics or official statistics	Project statistics or official statistics	Local statistics or default value (for buses only)	No specifications
Total number of passengers on the new system	Recorded per entry station	Based on turnpike or electronic ticketing system	Based on operational plan plus a suitable traffic model or derived from use in current bus system using draft BRT model to estimate future ridership	No specifications

It is expected that CDM methodologies will yield the most accurate calculation of emission reductions. It also follows that it requires substantial data to monitor and could be costly. The challenge is to lessen the trade-off between accuracy and practicality.

Requirements for monitoring

To ensure the environmental integrity of emission reductions under CDM, strict monitoring is required. Monitoring refers to the measurement and analysis of greenhouse gas emissions from a project within its boundary to determine the volume of emission reductions that are attributable to the project under the CDM. It is implemented through the monitoring plan, which is included as part of the project design document (PDD) submitted for registration.

For GEF projects, the ex-ante estimation is used to facilitate financing approval with focus on long-term impacts of reducing emissions rather than on ensuring accuracy of emission reductions. Projects are encouraged to design tools for monitoring and evaluation, and systemic collection of data recognizing that more accurate data could make successful projects easier to replicate. Suggested data collection tools include traffic counts, household surveys, GPS vehicle and personal activity monitoring, local fuel and emissions testing, etc.

CTF monitors resource flows, project activities and achievement of results and enabling funding or activities to be adjusted as necessary. It follows a three-tiered approach to measure results by monitoring transformational impacts of the CTF investments, monitoring country outcomes indicators and monitoring the CTF's contributions to country outcomes. During the project's monitoring and evaluation, ex-post data is collected and applied.

Analysis and suggestions

The increased rigor of CDM methodologies make it pretty accurate compared to the other methodologies but their applicability is limited to only a few types of projects. In some cases, CDM methodologies have additional limiting factors, e.g. presence of existing transit else the methodology is not applicable.

In general, CDM and CTF methodologies require a huge amount of primary data while GEF methodologies contain large amount of default data which could be used in the absence of local data. The TEEMP spreadsheets can be used in lieu of transport modeling which is sometimes necessary if CTF and CDM methodologies are used.

As summarized in Romero (2012), the common challenges regardless of methodology used in calculating the GHG emissions of transport projects are the following:

- Lack of reliable transport data
- Numerous parameters to be monitored
- Monitoring methods are not practical and expensive to undertake

The importance of reliable transport data could not be discounted. An inventory should be done on existing transport data available and collected by government agencies vis-à-vis transport data needed to conduct MRV as exemplified by the parameters required in CDM, GEF or CTF. Capacity of local and/or national agencies in collecting and compiling of relevant transport data should be strengthened as their functions could be coordinated.

A delicate balance between accuracy and practicality is necessary in designing the MRV framework for transport NAMAs or other new mechanisms. Based from the reviewed methodologies, one possible option is to consider use of initial default values fitting to the region or country in lieu of conducting expensive surveys. Monitoring surveys can also be simplified by requiring only sample surveys.

13.3 Using default values initially to facilitate more implementation

Taking the case of proposing a new Bus Rapid Transit (BRT) line, numerous surveys are necessary based on the data requirements listed in Table 13-2 which could discourage project proponents to measure potential GHG reductions. The following traffic surveys should ideally be carried out:

- Traffic volume count
- Vehicle occupancy survey
- O-D (origin-destination) surveys
- Bus boarding and alighting counts

The intention of providing appropriate default values for certain parameters like average occupancy and average trip distance is primarily to lessen the burden of data gathering thereby reducing cost at the outset of the project preparation. Default values for specific fuel consumption of different transport modes and fuel types as well as fuel emission factors are already being used even in CDM for AM0031 and ACM0016.

Conservative values for average occupancy rate and average trip distance could be based on previous empirical research, expert opinion, and other sources such as the Global Environment Facility's (GEF) *Manual for Calculating Greenhouse Gas Benefits of GEF Transportation Projects* or based on PDDs of similar projects in the same region with near-like circumstances. To illustrate, if allowed, a potential BRT project in Cambodia or Lao PDR may utilize the parameters in Table 13-3.

Table 13-3: Key parameters for AM0031 baseline establishment and data sources

Indicator	AM0031	Proposed default values
The transport modes used in the absence of BRT project	Passenger survey	
Fuel types of different modes	Local statistics	
Average speeds	Project data of local statistics	
Specific fuel consumption by mode and fuel type	Local statistics, national or international literature, or IPCC values multiplied by an annual technology improvement factor of 0.99 for buses, taxis and passenger cars, 0.997 for motorcycles	
Fuel emission factor	IPCC values	
Average occupancy rate of the vehicles by mode[3]	Project statistics or official statistics	Bus: 39.33 Car: 1.86 Taxi: 1.86 3-wheeler: 4.25 2-wheeler: 1.48
Average trip distance for each mode[4]	Project statistics or official statistics	Bus: 3.753[5] Car: 6.25 Taxi: 6 3-wheeler: 5 2-wheeler: 7.5
Total number of passengers on the new system	Recorded per entry station	

[3] Based on PDD for Indore BRT

[4] Based on values derived in Vientiane from Onnavong and Nitta (2005) *"Identifying inequality of transportation mobility: developed country vs developing country"* (http://www.easts.info/on-line/proceedings_05/1065.pdf);

[5] The GEF's *"Manual for Calculating Greenhouse Gas Benefits of GEF Transportation Projects"* suggests 6 km as a conservative default value for average trip distance however the lower value derived from Onnavong and Nitta (2005) is deemed more appropriate especially for LDCs

The implications on actual emission reduction, either under or over estimation, could be corrected by necessary surveys to monitor and validate actual emission reduction. To ensure the environmental integrity of the carbon emission reductions, recognizing the potential under or over estimation based on using initial default values, the baseline values will be updated based on actual local values generated by conducting the abovementioned surveys to monitor and validate the project once it is implemented. This process of enhancing and updating the values is continuous.

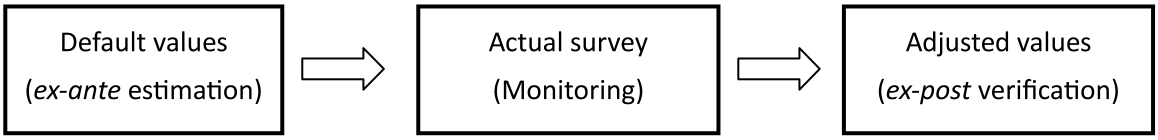


Figure 13-1: Actual steps for using default values

Chapter 14 Wastewater: MRV Proposal Based on the Lessons from Waste-to-energy Projects in Thailand[1]

Binaya Raj Shivakoti, Yatsuka Kataoka

Key Messages

- The wastewater sector—particularly wastewater-biogas-energy (WBE) system—presents an opportunity to reduce GHG emissions and tap into renewable energy. In Thailand, several WBE projects have been introduced through the Clean Development Mechanism (CDM) as well as by "unilateral" investments from the private sector in order to treat industrial wastewater, although CDM and unilateral investments have different goals.
- The primary objective of CDM WBE projects is to demonstrate GHG emission reduction (ER) through biogas (i.e., methane) capture and acquire certified emission reduction credits (CERs), while unilateral investment projects are mainly intended to harness renewable energy by burning the captured biogas. Both types of WBE system have the potential to procure positive outcomes such as minimising effluent pollution loads, controlling odour and reducing volumes of sludge.
- To demonstrate ER, MRV is integrated into CDM planning process.. However, carrying out MRV in CDM projects in Thailand is difficult due to the lengthy, inflexible nature of the process, lack of clarity regarding monitoring requirements and accuracy, as well as high cost of monitoring instruments and transactions. The chief impediments for unilateral investment projects in seeking CDM registration are cost and time.
- A simplified and flexible MRV should thus be developed as a timely intervention to encourage existing and future WBE projects and other sustainable wastewater management practices to undertake MRV and demonstrate their efficacy not only in terms of GHG ER but also other associated environmental and socio-economic benefits.
- Therefore, this paper proposes an integrated planning procedure for MRV, consisting of GHG ER, pollution control and resource recovery components, which as a whole would enable developing countries to identify potential actions and formulate supporting policies in favor of mitigation actions at different scales. MRV would thus act as an integrated tool for facilitating low carbon and sustainable wastewater management.

14.1 Background

The primary objectives of managing wastewater are environmental protection and public sanitation, which are achieved through adoption of appropriate methods of collection, transport, treatment and disposal, and GHG emission reduction (ER) and resource recovery have often been overlooked. For instance, wastewater management can pursue multiple benefits by controlling the release of methane (CH_4; a highly potent GHG) from the treatment process by avoiding its generation or by post-generation capture and burning. Under the capture-burn strategy, higher generation volumes of CH_4 are favored, under controlled conditions, as all CH_4 could be safely used as a source of renewable energy. Burning biogas avoids its escape into the atmosphere and enables carbon-intensive fuels such as coal, diesel oil, or grid electricity to be replaced. From this viewpoint, managing wastewater for biogas production could double the ER amount.

Wastewater-Biogas-Energy (WBE) (i.e., waste-to-energy) systems have been widely promoted as an option under the Clean Development Mechanism (CDM); to date over 600 small- and large-scale WBE CDM projects have been registered worldwide, realising over 27 million tCO_2e of ER every year (Table 14-1), thus their efficacy for treating

[1] Authors would like to thank Dr.Suwanna Kitpati Boontanon and Dr. Kanoksak Eam-o-pas from Mahidol University for supporting this study from Thailand. Authors also acknowledge stakeholders from various organizations and wastewater-biogas projects who provided valuable inputs during this study.

wastewater, controlling GHG emissions, and producing renewable energy in the form of biogas has been well demonstrated. The processes of measuring (or monitoring), reporting and verifying (and validation) ERs are CDM conditions needed to be fulfilled to obtain Certified Emission Reductions (CERs) (after approval by CDM Executive Board (EB)). On the other hand, a significant number of WBE projects have been installed unilaterally, i.e., without CDM registration, and such projects are mainly aimed at energy recovery and pollution abatement (preventing water pollution, reducing sludge volume and increased odour control) and do not embrace ER or MRV, specifically. Therefore, introducing MRV, which is similar to CDM, into such unilateral WBE projects will not be easy due to the lack of direct incentives such as CER, the obligation for reporting, the additional cost and time required for monitoring and the need to keep ER records.

Table 14-1: Status of WBE CDM projects in Thailand, Asia and the world

Project type		Scale	Status				Total	
			Under Validation		Registered			
			Number	Total Av. Annual ERs (tCO_2/y)	Number	Total Av. Annual ERs (tCO_2/y)	Number	Total Av. Annual ERs (tCO_2/y)
Wastewater (without animal waste)	Thailand	Small	27	1012405	31	1006692	58	2019098
		Large	12	1072946	9	785561	21	1858508
	Asia	Small	111	4532837	125	4679812	236	9212649
		Large	28	3002837	25	1975838	53	4978675
	World	Small	124	4880151	150	5364019	274	10244170
		Large	30	3167894	29	2985826	59	6153720
Animal (manure)	Thailand	Small	3	165556	4	102681	7	268237
		Large	0	0	0	0	0	0
	Asia	Small	23	861111	48	784292	71	1645404
		Large	5	385608	5	423472	10	809080
	World	Small	58	2205326	152	2567576	210	4772903
		Large	10	1869212	55	4090668	65	5959880

Source: IGES CDM Project Database (Updated up to 31 Jan 2012)

There is still a huge untapped potential for GHG ER from wastewater, and in Thailand, for example, there is still a huge ER potential from both domestic and agro-industrial wastewater (Table 14-2). Of the 14 million m^3 of wastewater and corresponding total loading of 2.4 million kgBOD generated daily by its 69 million inhabitants, only 3.2 million m^3—or about 4.8%—can be treated by existing or planned WWTPs. According to the IPCC Guideline, untreated wastewater is a potential source of GHG emission such as CH_4 or N_2O. Similarly, the estimated ER potential from selected agro-industrial wastewater is several times higher than the ER from existing CDM projects in Thailand. Since some potential mitigation projects might be incompatible with CDM, an alternative framework of simple and flexible MRV—which accounts for local management context (domestic, agro-industrial, animal farm), scale, treatment process and so on—could make it possible to demonstrate potential ER for such projects. An alternative MRV framework should therefore be introduced in order to implement various future mitigation actions, such as Nationally Appropriate Mitigation Actions (NAMAs), through modifying the MRV requirements.

Table 14-2: Overview of estimated maximum annual ER potential from domestic/municipal and agro-industrial wastewater effluents in Thailand

Sources	Population [in 1000] #1	Wastew ater generation Rate		Wastew ater generation Total Volume (Q) [1000 m^3/d]	COD or BOD loading		MCF #6	Bo #6	GWP_{CH4} #6	Max. emission potential #7 [1000 tCO_2e/y]
Domestic/Municipial #2										
Total	69519 [capita]	201.4	[l/capita/d]	14000	0.171	[kg BOD/m^3]	0.1	0.6	21	1103.8
Municipalities/cities				2500	0.171	[kg BOD/m^3]	0.1	0.6	21	197.1
Bangkok-Pattaya				2500	0.171	[kg BOD/m^3]	0.1	0.6	21	197.1
Sub-districts				9000	0.171	[kg BOD/m^3]	0.1	0.6	21	709.6
Treated effluent				3213	0.02	[kg BOD/m^3]	0.1	0.6	21	29.6
Untreated				10787	0.171	[kg BOD/m^3]	0.1	0.6	21	850.5
Agro-Indus trial	Production [in 1000]									
Pigs #3	8347 [heads]	28.1	[m^3/1000 heads/d]	234.5	2.63	[kg BOD/m^3]	0.8	0.6	21	2269.1
Starch #4	16938 [ton/y]	20	[m^3/t starch]	1129.2	20	[kg COD/m^3]	0.8	0.25	21	28455.8
Palm Oil #4	7728 [ton- FFB/y]	0.6	[m^3/t- FFB]	15.456	90	[kg COD/m^3]	0.8	0.25	21	1752.7
Ethanol #5	1012500 [l/y]	10.5	[liter/liter-ethanol]	35.4	120	[kg COD/m^3]	0.8	0.25	21	5358.9

#1 UNDESA/Population Division (2011). World Population Prospects: The 2010 Revision, Volume I. Comprehensive Tables

#2 Pollution Control Department, Annual Report Water Quality Management Bureau 2010; 0.02 kg BOD/m^3 is based on effluent standard of Thailand

#3 http://w qm.pcd.go.th/w ater/images/stories/agriculture/records/pig/loading53.pdf (accessed 25 Jan 2012)

#4 Department of Industrial Works (2006) Management Information System (MIS) Guides for Eco-efficiency (For tapioca and Palm oil); Daily production w as converted to yearly by assuming 16 hours/day and 300 days/ year operation of procession plants; 0.6 m^3/t- FFB (fresh fruit bunch) w as adopted from PDD of the CDM Project 4323 (Lam Soon Wastew ater Treatment for Energy Generation, Trang)

#5 List of Existing Ethanol Plants in Thailand (October 2011) Bureau of Biofuel Development (w w w .dede.go.th); 10.5 liter/liter-ethanol w as adopted from Nguyen and Gheew ala (2008). The Int. Journal of Life Cycle Assessment, 13(4):301-311

#6 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Methane Correction Factor (MCF): 0.1 for discharge of untreated w astew ater into sea, river or lake, 0.8 for deep open lagoon (>2 m); About Max. methane producing capacity (Bo): 0.6 $kgCH_4$/kgBOD and 0.25$kgCH_4$/kgCOD; GWP_{CH4} is global w arming potential of methane (i.e., 21tCO_2e/tCH_4)

#7 Max. emission potential (tCO_2e/y) =Q × BOD loadings × MCF × Bo × GWP_{CH4} × 365 days (for domestic and pig)
Max. emission potential (tCO_2e/y) =Q × COD loadings × MCF × Bo × GWP_{CH4} × 300 days (for Agro-industry, w ithout pig)

With the goal of introducing an appropriate procedure for MRV in Thailand's wastewater sector, which has seen a steady rise in WBE projects over the last decade, a study was undertaken to assess the options and challenges related thereto. Two types of WBM project—registered CDM and "unilateral" investments (i.e., not yet registered in the CDM)—covering existing major wastewater types (pig farms, starch factories, ethanol factories and palm oil processing mills) were investigated. The CDM-WBE projects were examined to reveal any issues in MRV implementation that might be relevant for other wastewater management actions, and Unilateral WBE projects were examined to ascertain the level of data availability for MRV in comparison to CDM and their readiness for MRV adoption. The study was also anticipated to assist in forming a MRV planning procedure for new and future mitigation actions, thus additional components related to sustainable wastewater management were examined with a view to potential integration with a modified form of MRV.

14.2 Experience from MRV process in WBE CDM projects

According to the latest information from Thailand Greenhouse Gas Organization (TGO)—the country's Designated National Authority (DNA) for the CDM—biogas projects represent over 68% of all registered CDM projects in Thailand (TGO, 2012) and in terms of number, WBE is considered as one of the most widely adopted type of CDM project in Thailand. Such projects treat wastewater effluents from ethanol processing factories, palm oil mills, starch factories and pig farms. Through the survey, we identified three common issues in MRV of the WBE CDM projects in Thailand—methodological, procedural, and operational.

The main differences in methodology in estimating ER were identified between wastewater sources from agro-industries and animal farms, which use different approaches[2] despite the fact that wastewater is often treated by similar systems, such as a Cover Lagoon, Upflow Anaerobic Sludge Blanket (UASB) digester. One of the critical parameters for estimating ER from agro-industries relies on the biodegradable organic load, which is derived by measuring COD (chemical oxygen demand) concentration and wastewater volume. However, in the case of animal farms, volatile solids in manure—estimated based on other parameters such as number, size and type of animal, feed composition and quantity and so on—is an important parameter to determine ER. But whereas keeping detailed records of animals and their feeds can be incorporated into daily farm management practices for large farms (> 5,000 pigs), such practice would become a burden for medium-sized (<5,000 pigs) and small farms (<500 pigs) rearing mixed sizes and using a local feed composition. Another variable is the context of the manure management system, which for Thailand differs in terms of climate, regulations, and methods, from those of the developed countries–used as a reference for CDM methodology. Such differences often add complexity to determining what constitutes appropriate monitoring, measuring and estimating procedures or in finding applicable values such as for higher tiers of IPCC Guidelines (IPCC, 2006). However, there are also some commonalities in the two methodologies in terms of ER estimation, especially those related to captured biogas and energy generation, which have to be monitored separately.

At the procedural level, CDM processes involve a series of steps from planning, implementation and ultimately issuance of CERs (IGES, 2012), which for the majority of Project Participants (PPs) represents a significant undertaking in terms of cost and time. For Thailand, despite the successful registration of about 49 WBE projects at CDM EB, only 10 projects have acquired CERs so far (TGO, 2012), mainly due to failure in demonstrating actual ER during verification. Among others, discrepancies between the monitoring plan as set out in the Project Design Document (PDD) and actual implementation process were identified as a key obstacle during the verification process. Although verification is conducted ex-post, the primary cause for uncertainty is at the initial stage of PDD preparation. Some of the interviewed PPs stated that although the CDM process is now better understood, a basic communication gap still exists between the PPs, who are mainly responsible for monitoring and reporting, and the externally hired experts who prepare PDDs. For instance, although PPs usually supply the necessary information related to wastewater management based on demands highlighted by the experts during PDD preparation, they are often unaware of why they collect such information, how it will be used and the implications thereof in verification. There is also a language barrier: the PDD is in English. Inappropriate design of the monitoring plan in the PDD and misunderstanding thereof by PPs usually have direct implications during implementation due to the mismatch in technical requirements for maintaining monitoring accuracy, financial constraints in installing the required monitoring equipment, and lack of skilled human resources to undertake monitoring/measurements, perform calibration and prepare reports. All such shortcomings encountered during the implementation processes could surface during the verification stage, which is performed by an independent third party.

Although the above problems might be addressed over time, the key issue at stake is how to deal with unavoidable changes occurring during project implementation. Despite the presence of a reporting structure within the CDM to take account of such changes, however, approval from CDM EB usually involves a protracted, intensive and expensive correspondence process. PPs are thus forever at the risk of losing CERs due to potential disapprovals, which limits the scope for improving system efficiency. Hence undertaking MRV in CDM projects has conventionally been closely linked with the overall success of project implementation, issuance of CERs and timely recovery of investments made in WBE projects.

[2] However it is recommended to use similar methodology as of wastewater from agro-industries, i.e., AMS III. H instead of AMS III.D, if final effluent is discharged to natural water bodies or only left-out manure after cleaning is send to a biogas digester.

Although certain methodological and procedural issues are inherent to CDM, their resultant impact can only be observed during the operation or implementation phase. As the CDM process aims to ensure a high level of accuracy in terms of ER achieved through evaluation of emissions at the baseline, within the project and through leakage, it often involves rigorous calculations to estimate baseline and project emissions, use of monitoring instruments complying with international standards, and installation of monitoring systems at multiple locations to avoid uncertainty, as well as regular calibrations to ensure quality control. In particular, the installation of monitoring instruments such as pumps, gas meters, sensors, flaring instruments, pressure gauges and real-time monitoring systems can easily consume the bulk of the overall investment. Skilled human resources are another prerequisite for operation and maintenance of such instruments, and sometimes incurs outsourcing. Since WBE systems are only a minor component of wastewater management for the business in question (such as pig farming or palm oil processing), this time and cost requirement in preparing and implementing CDM for the sake of CER can represent a large burden for PPs.

14.3 Lessons learned from WBE projects from unilateral investments

Unilateral investments in WBE projects involve cases where ERs are not explicitly monitored due to the lack of regulatory or institutional obligations for reporting or verification. Although the CDM is successful in demonstrating the utility and potential of WBE in Thailand, unilateral investments became attractive primarily due to their economic and environmental benefits rather than net ER contribution. For such WBE projects, CDM preparation could not be applied, and often was not even considered due to the lengthy and complex CDM process, which often requires external support at different stages of preparation and implementation. Involving the CDM also involved the additional risk of not obtaining CERs and future uncertainty over the carbon market. Among the surveyed WBE projects, none had installed monitoring systems, except those essential for the operation and maintenance of WBE systems; specifically, for the estimation of ER. In consideration of the above, the potential entry point for introducing MRV could be to use data from current WBE systems, such as quantity/quality of wastewater, number of animals, feed quantity, electricity or heat generation from biogas and equivalent cost saving from the use of energy. Additional validity parameters required to meet minimum requirements should be backed by proper incentives and institutional facilitation due to the additional cost and time burdens allied with such MRV practices. During the consultations, it was identified that unilateral WBE projects could be made financially attractive for small and medium-sized agro-industries and the large number of animal farms across the country. This can also be understood from Figure 14-1, which shows both CDM and unilateral projects. In addition to environmental benefits are the advantages of reduced operational and maintenance costs in managing and operating biogas, since biogas fully or partly fulfills the energy needs of the agro-industry or animal farms (left side of the figure). As projects incurring higher levels of investment capital would nullify up to several years of net benefits, i.e., have a longer payback period (right side of the figure), a simple, flexible MRV for small and medium-sized agro-industries or animal farms would enable self-assessment of ER, and MRV data resulting from such could be used to attract investment or technology-transfer support from domestic or international sources—such as government subsidies and loans for renewable energy production, domestic carbon markets, BOCM and the Green Climate Fund (GCF). Further, as regards uncertainty over international CER prices and financial markets, an MRV focused on domestic or supported action would make more sense since it could enhance developing country capacity to promote mitigation without (or with minimal) external support.

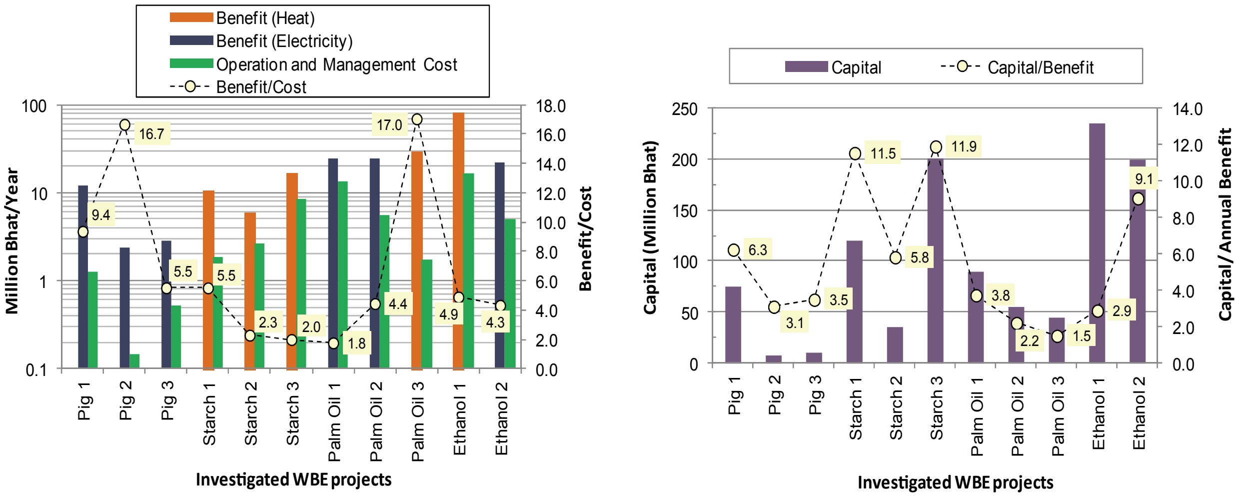


Figure 14-1: Comparison of surveyed WBE projects in Thailand for their 1) annual cost and benefit (left side); and 2) investment capital and annual benefit (right side)

14.4 Diversifying the scope of MRV

To date, MRV has been communicated mainly from the viewpoint of GHG mitigation. However, its scope could be expanded to encompass parameters related to sustainable benefits, such as efficacy in abating pollution, contributing to MDG sanitation targets, or for resources recovery. There is a general consensus that mitigation strategies, in order to be effective, should also generate sustainable benefits, and such are often highlighted as part of mitigation action—notably CDM or NAMA—but remain largely under-prioritised during planning and implementation. In particular, during identification and implementation of NAMA, it is debatable whether benefits related to sustainable development should be MRVed or not on a continual basis. Thus, expanding the scope of MRV could proportionately increase the time and resources required for implementation in the short term. On the other hand, it could also be viewed as setting the stage for a future boost in mitigation–with multiple socio-economic and environmental benefits resulting in the long term. Integrating sustainable benefits into MRV could thus eventually prove the net positive impacts of a mitigation project in sustainable wastewater management, which could be used to leverage national and international support favouring sustainable wastewater management practices, leading to its rapid uptake throughout developing countries in Asia.

In order to assess the potential scope for plugging in additional indicators of sustainable benefits into MRV, existing benefits of WBE projects were also examined in addition to ER. While biogas generation and pollution abatement (treatment of effluent, sludge reduction, and odour control) were direct incentives, partial or full reuse of treated wastewater and use of sludge as fertiliser were two additional benefits identified in existing WBE projects. Reuse of treated effluent was prevalent in almost all cases, such as for cleaning pig farms, washing in starch factories and irrigating palm oil plantations. Such practices have resulted in a net saving of water, which is usually scarce during dry season in Thailand, and also lower costs for pumping and purifying raw water. In addition to recycling and reusing water inside factories, nutrient-rich effluent was found to be in high demand in nearby farms, where it could contribute to irrigation during the dry season. Farmers also expressed high demand for sludge as an organic fertiliser. However, no practices to monitor or record such benefits on a regular basis exist due to their insignificant economic contribution to owners—such as by selling dried sludge to farmers or irrigating fields. Similarly, some benefits are qualitative, such as odour control for nearby communities, and are inherently difficult to measure or monitor. Thus, without easy monitoring methods and incentives, such benefits might not be realised by MRV due to resistance from PPs. In answer to this, these benefits could be included at the outset as voluntary components of MRV and be backed by appropriate incentives such as corporate social responsibility (CSR), government recognition, green certificates, tax subsidies, higher prices for domestic or international ER credits and so forth, which could assist in their acceptance.

14.5 Recommendations for a practical MRV in the wastewater sector

Despite differences in purpose, IPCC Guidelines and CDM methodologies together provide a comprehensive means for estimating potential GHG emission or ER from a given wastewater management practice. Both IPCC guidelines and CDM methodologies will be adequate to estimate ER from wastewater in most instances. Apart from the estimation methodology, the key issue, however, is the need for introducing a simple, flexible and more compatible MRV processes that can facilitate introduction of low carbon, resource-efficient and self-sustaining wastewater management practices in the future. Further, due to the disparity in types and management of wastewater within developing countries, proposing separate methodologies to suit specific contexts would constitute quite a challenge, i.e., setting baselines, installing new monitoring systems, enhancing human capacity, and added transaction costs for MRV, thus a more pragmatic approach would be to introduce a planning process to assist developing countries in formulating and implementing MRV by themselves (such as in setting baselines), to stipulate the use of only key parameters as required by regulations or to complement GHG inventory, and to help set their own emission targets. Such planning process could be designed and implemented to plug into existing or future wastewater management practices, at least in the initial stage, and be designed not to incur an additional burden. After implementation is made into a routine process, the scope of MRV could then be gradually enhanced or broadened and more uses or benefits could be identified.

Based on the above this study recommends a planning procedure for MRV that takes into account the relative contribution or effectiveness of the following three key components for sustainable wastewater management: pollution control, GHG ER and resource recovery. Pollution control the sole primary objective of wastewater management directly related to the environment—health and sustainable development. Introducing MRV could be advantageous in assessing the efficacy of wastewater management because developing countries are often constrained by a lack of appropriate check-and-fix procedures for management deficiency or failure. Although GHG ER and resource recovery are not the main priorities for the majority of wastewater management operations in developing countries—where pollution control tops the agenda—they are essential for promoting sustainable wastewater management. Along with the expected shift towards low-carbon and green growth pathways, there is a need to instill a mindset within developing countries that places value on cost- and resource-efficient, multipurpose, low-carbon, and zero-emission self-sustaining wastewater management systems. Similarly, under growing national and international pressure towards accelerating GHG mitigation, more willingness to prioritise emission footprints, set targets and possibly also impose regulations will be forthcoming in the future. Including such components into MRV could help developing countries plan and prioritise their investments and limited resources in sustainable wastewater management options.

Such planning procedure as mentioned above could take the form of three steps; assessing the scope, determining the process, and evaluating the utility, as shown in Figure 14-2. The main aim of introducing steps is to avoid redundancy and optimise the required efforts—in terms of cost and time—in undertaking MRV, while also exploring ways to capitalise on the body of MRV data collected.

Step I: Assessing the Scope

Assessing the scope of MRV, in the first place, is crucial to avoid inappropriate prioritisation, redundancy, and resultant complexity in terms of baseline-setting, parameter-selection, and quality control and accuracy. Wastewater often differs in its source (domestic, industry, agro-processing plant, animal farm) and scale of activities (volume). Such qualitative and quantitative characteristics are essential to assessing their potentials for causing pollution, GHG emissions and resource recovery (such as biogas, water reuse, or nutrients), while the methods of collection, treatment and disposal of wastewater at different locations determines efficacy in controlling pollution, GHG ER and harnessing resources. Therefore, prior consideration of these basic factors helps set the boundaries for MRV in accordance with the management context and relative potential for pollution control, GHG mitigation and resource recovery. It also helps in uncovering any shortfalls in management that impede attaining the full potential.

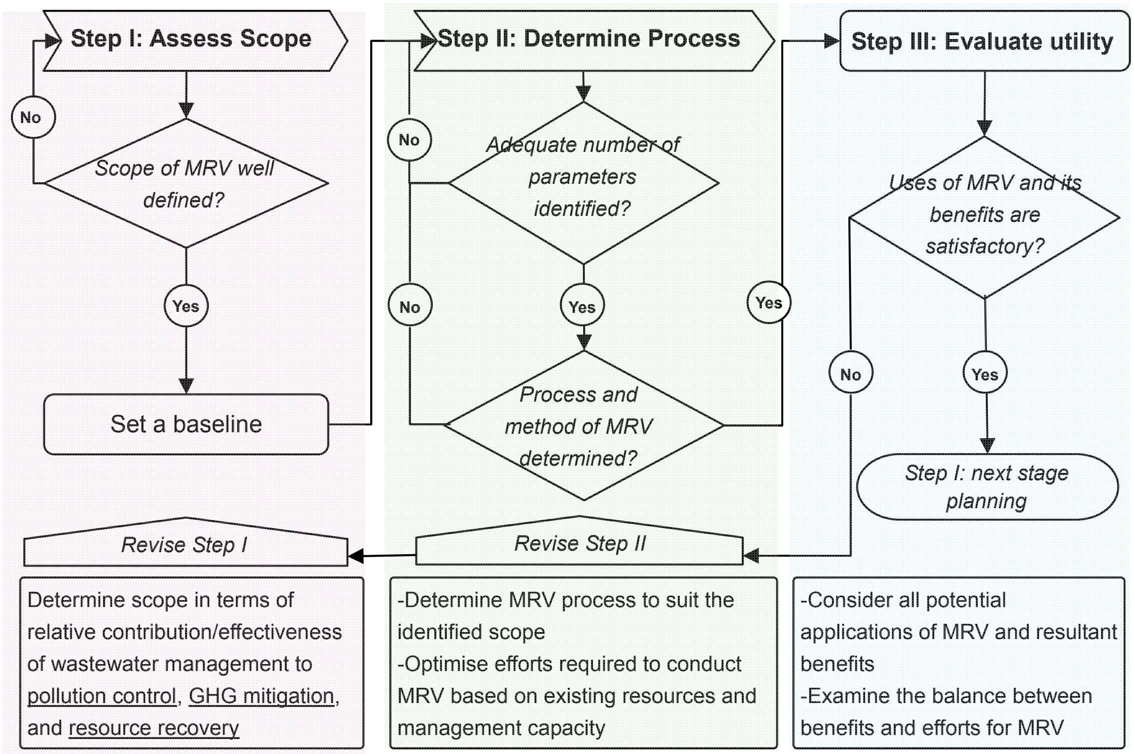


Figure 14-2: Conceptual outline of the planning procedure in introducing MRV to the wastewater sector

Step II: Determining the Process

The second step consists of two stages. The first is to identify the parameters (starting from basic to more specific) that could compose MRV, which could be further divided into water quantity/quality, operation and management, and performance parameters. The second determines the specifics of the M, R and V parameters in accordance with the degree of management efficacy required. For the M parameter, these could include approach (direct measurement, indirect estimation or using default value), method of monitoring (such as instruments, calibration) and frequency and number of monitoring locations. The factors influencing R it could include questions such as who will report, where to report, how to report, and at what frequency. Similarly, for V the questions concern who will, how to, and how often to verify. Once the parameters and processes are determined, the workload can be calculated. Cross-checking with current processes and additional implementation requirements also need to be undertaken—for example, one option for simplifying MRV is to only include monitoring of key parameters (such as wastewater volume, electricity generated from biogas) using available resources, which are institutionally enhanced through more effective reporting and verification.

Step III: Evaluating the Utility

Evaluating uses and resulting benefits is the last, but not least important step in ensuring MRV functionality. Diverging from the sole purpose of MRV as a tool to estimate GHG emission or ER, this step explores the scope of MRV utility, because unless MRV offers more than one benefit or incentive it may run out of steam; in other words, does the *end*, i.e., the benefits gained, justify the *means*—the effort required to carry it out?

To secure easy acceptance, use of MRV should be first examined internally as a wastewater management planning and management tool. It could also help consolidate efforts for data monitoring, storage and dissemination, so many synergies exist in terms of its uses. For example, monitoring COD (chemical oxygen demand), an indicator of organic matter contained in wastewater, or volume of wastewater could be used to assess the impact of discharged effluent on the environment or estimate GHG ER and biogas generation. But current reporting of such is often fragmented due to the myriad monitoring method and frequency requirements dictated by related institutions or parties. In the case of Thailand, bodies such as the Pollution Control Department, Department of Industrial Works and respective Municipalities often collect the same wastewater effluent information, but through different processes and reporting formats. Similarly, information on biogas production could be used for reporting in CDM projects or to the Energy Policy and Planning Office (EPPO), which is also supporting renewable energy. In addition to collecting valuable monitored data, other potential benefits from MRV are demonstration of performance of wastewater management operations, social recognition, availability of incentives or tax subsidies, government budgetary assistance for maintenance or renovations, domestic or international support and access to climate-related funds (BOCM, GCF, NAMA related supports, domestic carbon market. etc.).

It is assumed that introducing an MRV planning process for the wastewater sector would act as a metric to monitor and evaluate incremental progress towards achieving sustainable wastewater management. Eventually it could also facilitate in framing supporting policies to promote sustainable wastewater management solutions in all developing countries.

Chapter 15 Composting: Community-based Composting as an Alternative Route to Enhancing MRV

Premakumara Jagath Dickella Gamaralalage

Key Messages

- Since the municipal solid wastes (MSW) of most cities in low and middle income countries have very high proportions of organic materials, the bulk of other recyclables being separated at source, or taken out later, composting remains of great interest for reduction of waste to be landfilled.
- Community-based composting has great potential in reducing GHG emissions and achieving sustainable development at the local level.
- High costs and time-consuming monitoring, reporting procedures make community-based composting projects un-practicable in applying CDM mechanism.
- Community monitoring mechanism, which is a strong element of the successful community-based composting programmes, can be utilised as an alternative to simplify the application and monitoring procedures of the CDM for small-scale projects.
- The project partners must work closely with communities in develop their local capacity to enable data development and collection necessary for compliance with the standard, accuracy and its measurability.
- Local governments should be able to develop policy and benchmark to address GHG emissions occurring from activities undertaken within their own boundary integrating the community initiatives.

15.1 Introduction

Solid waste management (SWM) is considered to be one of the most serious environmental issues confronting urban areas in developing countries. Rapid urbanisation and economic growth in Asia have resulted in a rise in solid waste, the management of which is proving challenging for local governments (Scheinberg et al. 2010). Estimates from some cities in developing countries show that as much as 20 to 50% of their annual budget is devoted to SWM, despite uncollected waste rates of 30 to 60% and service coverage of less than 50% of the population (UNEP 2009).

The most common waste treatment method throughout the region is land-filling due to cost and simplicity (ADB, 2011). However, many landfills in developing countries are poorly designed and uncontrolled, effectively turning them into open, unsanitary dumpsites. Further, most existing dumpsites are already full and finding new sites is becoming increasingly difficult for municipal governments due to the scarcity of suitable land within their boundaries and rising costs and land values (Zurbrugg et al. 2005). This results in serious local, regional and global public and environmental health problems, including air pollution, soil and groundwater contamination and greenhouse gas emission (GHGs) (IGES 2008).

Many cities in developing countries are now focused on establishing an integrated solid waste management system based on the 3Rs (Reduce, Reuse and Recycle) in an attempt to reduce the amount of waste generated at source rather than later at end-of-cycle. Since the municipal solid wastes (MSW) of most cities in low- and middle-income countries feature high proportions of organic materials—usually 40 to 85% of the total waste generated in cities (World Bank 2012)—with the bulk of other recyclables being separated at source or removed later, composting remains of great interest in the context of MSW.

The Clean Development Mechanism (CDM) of the Kyoto Protocol aims to support developed countries in reaching their emission reduction targets through the mobilisation of more cost-efficient reduction options in developing countries, and at the same time to assist the latter in achieving sustainable development (UNFCCC 1997). The high transaction costs and monitoring requirements are, however, shown to be impractical for community-based composting projects. This paper therefore discusses the experiences of two different cities in Asia—Surabaya, Indonesia and Cebu, the Philippines—and identifies the potential of community-based composting in reducing the greenhouse gases (GHG) in landfills and also in achieving a high rate of sustainability with strong environmental, social and economic benefits. Based on an analysis of case studies, the paper proposes a community-based monitoring mechanism as an alternative institutional design, one that suppresses the high transaction costs and monitoring requirements for small and community-based composting projects.

15.2 Community-based Composting

Composting can be applied in various scales, from small, more community-based approaches to large, centralised facilities that can handle several hundred tonnes of waste per day. Community-based composting projects are located in the proximity of neighbourhoods and integrated with their waste collection service. They commonly feature small operational scales and high degree of community participation and have all been initiated as a response to crises in local hygiene and poor waste management systems, often in areas lacking or having only unreliable municipal collection services. Thus the framework of the scheme was formed via the needs and priorities of the residents. House to house collection is the core service activity of the initiative and residents are motivated to pay the related fees, which often guarantees financial viability and enables composting activities (Drescher et al. 2006).

A number of composting techniques exist, such as household bins, windrows or piles that are aerated with poles and turned with front-loaders or simple spades. Some composting plants rely on naturally occurring micro-organisms, while others add worms (vermin composting) or specialised microbes (Effective Microorganisms or Native Microorganisms) to speed up the process.

As shown in Table 15-1, community-based composting reduces transportation costs, utilises low-cost technologies based mainly on manual labour, and ensures waste is well sorted before being composted. This minimises many of the issues that led to failure of larger centralised composting plants and is best suited to meet the technical, financial and institutional capacities of Asian cities.

Table 15-1: Centralised vs. community-based composting (Grimm 2011)

Community-based Composting	Centralised Composting
Simple technology and labour intensive	Relies on highly mechanised technology
Low capital costs and locally available materials	Large investments for advanced machineries
Low maintenance costs and low-level skills required	High operation and maintenance costs and specialised skills required for operation and maintenance
Requires residents to separate domestic waste, reducing the volume of solid waste for disposal, increases the value of recyclables, and enhances environmental awareness of the community	Low interaction and involvement of the residents
Reduces transportation costs due to proximity of disposal facilities	High transportation costs as all waste is transported to disposal facilities often far from the city
Good quality compost resulting from efficient double separation of waste and minimal risk of contamination	Poor quality compost resulting from large quantity of unseparated waste and high risk of contamination

15.3 Potential of Community-based Composting in Achieving Sustainable Development

As the CDM aims to not only reduce emissions but also assist Non-Annex 1 Parties in achieving sustainable development (UNFCCC 1997, p.11), the experiences of Surabaya, Indonesia and Cebu, the Philippines show that community-based composting represents an enormous positive contribution to achieve these objectives.

Community-based Composting in Surabaya City, Indonesia

Table 15-2: Key facts on SWM in Surabaya City, 2010 (Surabaya City 2011)

Total population	3 million
Total land extent	33,000 ha
Administrative districts	31
Total waste generated in the city	1,240 tonnes per day
Waste composition	Organic 72%, paper 12%, plastic 8%, metal 1%, glass 1%, other 6%
Method of disposal	Landfill
Average cost for waste management	23 USD per tonne

Since 2005, Surabaya City—Indonesia's second-largest—has prioritised community-based solid waste management and composting for its 3 million inhabitants. Table 15-2 gives some key facts relating to the city's solid waste management. Its Mid-term Local Development Plan (2006-2010) entailed a waste management strategy involving reduction at source and the city supports the Rukun Warga (RW), a citizens organisation responsible for neighbourhood waste collection (*Kampung*) under the 1980 community primary collection (*Copricl*) law (Premakumara et al 2011). The city has also strengthened partnerships with other stakeholders, such as the Women's Network (PKK), local NGOs, waste pickers, academic institutions, private ventures and the media. Related activities included a series of awareness-raising campaigns covering all municipal districts, targeted at different sectors (Surabaya City 2011).

In the scheme, a system of community facilitators was established in each neighbourhood, involving recruiting a team of environmental cadres (one cadre for every ten houses) based on their popularity and leadership qualities among the households. In the new waste management system, environmental carders were trained to disseminate information

Photo 15-1: A training of the household composting

Photo 15-2: A community composting facility is in operation

within their neighbourhoods, a municipal budget was allocated to establish additional composting centres—specifically for land, construction costs, staff, required tools and the necessary training (Surabaya 2011)—and a Green and Clean Campaign was instigated in partnership with the private sector and the media to motivate and strengthen community participation towards improving neighbourhood environments.

This policy of enablement resulted in distributing 17,000 composting baskets at the household level and establishing at least 16 community-based composting centres in the city to process organic waste collected from neighbourhoods, markets, streets and parks (Surabaya City 2011). About 56 workers (mostly from the surrounding low-income families) were enrolled in these compost centres, which produces about 5,760 tonnes of compost per year, used mainly by the municipality to maintain city parks and for landscaping. Green spaces in the city have also increased by 10% over five years (Maeda 2009) and some neighbourhoods have gained popularity through growing plants.

Waste separation at the source ascribes higher value to recyclable materials, which are sold to junk collectors or processed by members of the PKK for handicraft production. In this regard, about 10 small or medium-sized recycling businesses have been established through private ventures for promoting handicrafts, which has created extra income opportunities for low-income families and waste pickers (Surabaya City 2011). Further, a 30% reduction in waste deposited at the landfill was achieved by 2010, saving the municipality solid waste management around 4 million USD annually. A reduction in greenhouse gases estimated at 2,800 tonnes CO_{2e} (based on Intergovernmental Panel on Climate Change (IPCC) guidelines) was generated by landfills as a result of composting in Surabaya City in 2011.

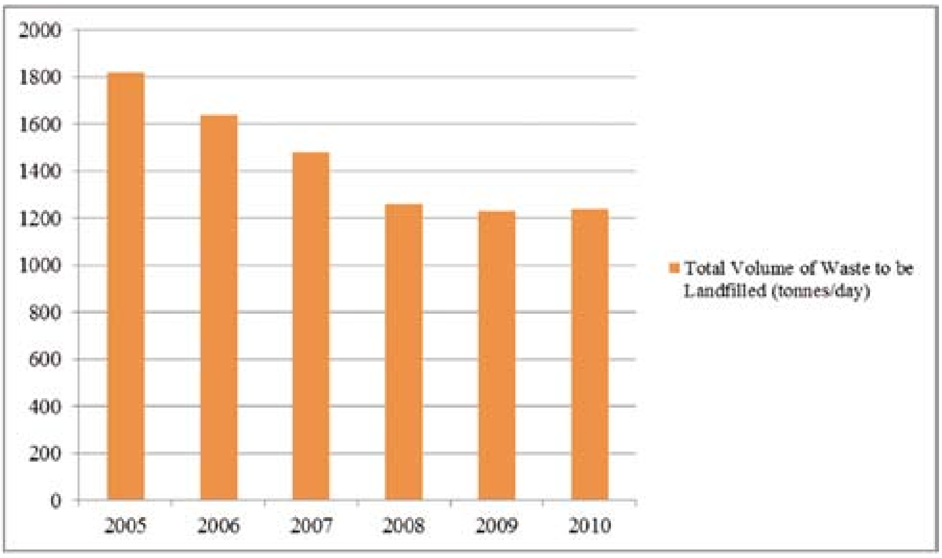


Figure 15-1: Reduction in waste of 30% during 2005–2010

Community-based Composting in Cebu city, Philippines

Table 15-3: Key facts on SWM in Cebu City, 2010 (Cebu City 2012)

Total population	1 million
Total land extent	31,500 ha
Administrative units (barangays)	80
Total waste generated in the city	470 tonnes per day
Waste composition	Organic 66%, paper15%, plastic 6%, metal 1%, glass 1%, others 11%
Method of disposal	Landfill
Average cost for waste management	20 USD per tonne

Since enactment of the Republic Act (RA) 9003 and the Ecological Solid Waste Management Act of 2000, Cebu City, the second-largest growth centre in the Philippines with a population of one million in 2010, has taken innovative efforts to manage waste based on the 3Rs concept. Action started in 2003 under the leadership of the city mayor with creation of the Solid Waste Management Board (SWMB), responsible for making policy, legal and institutional recommendations. This led to the drafting of a 10-year Plan for Solid Waste Reduction in 2005, with technical assistance from Fort Collins, Colorado, USA, under the Resource Cities Programme of the International City/County Management Association. Under the Kitakyushu Initiative Network for a Clean Environment (2000/2010), which was initiated by Kitakyushu City and IGES with assistance from the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), Cebu City set a target to reduce waste destined for land-filling by 50% by 2015. Table 15-3 gives key facts for solid waste management in Cebu City.

To achieve the above waste reduction target, Cebu City adopted a *No Segregation and No Collection Policy* in April 2011 and started educating citizens to separate waste at source into biodegradable, non-biodegradable, recyclables and residuals with a view to meeting the goals of RA 9003. The policy was strictly enforced, with fines or imprisonment for violators under City Ordinance Nos. 1361 and 2031. A system of Barangay Environmental Officers (BEOs) was established, which involved recruiting five staff for each barangay based on their experiences, leadership qualities and commitment to work with community members. The BEOs were trained to play effective roles as both community facilitator and information provider in their respective barangays and are also responsible for municipal policies, monitoring waste collection, assisting in establishing the Material Recovery Facility (MRF) and managing composting schemes. The Cebu Environmental Sanitation Enforcement Team (CESET) was established for the purpose of coordinating the activities of BEOs.

The city has taken efforts to allocate both financial and technical assistance for establishing MRF at the barangay level: an annual municipal budget (500 USD for each barangay) supports the efforts of barangays in establishing composting centres, which can be used to cover the construction costs and purchase of tools and equipment. Training for the barangay staff was also provided. To motivate and strengthen community participation, and encourage improvements to neighbourhood environments, competitions, including the best environmental barangay were also held in partnership with the private sector and the media. Cebu City also strengthened partnerships with other stakeholders, such as the Women's Network, home owners associations, local NGOs, waste pickers, academic institutions, private ventures and the media. In addition, a series of awareness-raising campaigns was organised with the above stakeholders covering all municipal districts.

The above enabling policy resulted in establishing a multi-scale community-based composting system, which encompasses household and neighbourhood barangay composting schemes, small-scale private sector composting

Photo 15-3: Training and distribution of household compost baskets

Photo 15-4: A community composting facility in operation

enterprises, and corporate and institutional initiatives involving on-site composting. To date, city officials have distributed about 2,350 baskets to households (Premakumara 2012) and established community-based composting centres in 58 barangays, covering 72% of the city area (Cebu City 2012).

The experiences of Cebu City reveal some of the advantages of community-based composting, such as the improved environmental conditions in residential areas through establishing appropriate waste collection and treatment at the neighbourhoods and also increasing environmental awareness among residents. According to a city estimate, about 60% of residents are involved in waste separation at source (Cebu City 2012).

Further, by treating solid waste near to its source, transportation costs and landfill waste can be reduced, landfill life can be extended and municipal costs for landfill management can be reduced. According to the Department of Public Services (DPS), a 30% reduction in waste deposited at landfills was achieved by 2012, saving the municipality tipping fees for landfills estimated at 0.9 million USD annually. Further, a reduction in greenhouse gases generated at landfills through composting in Cebu City equal to 12,000 tonnes CO_{2e} can be assumed for 2012.

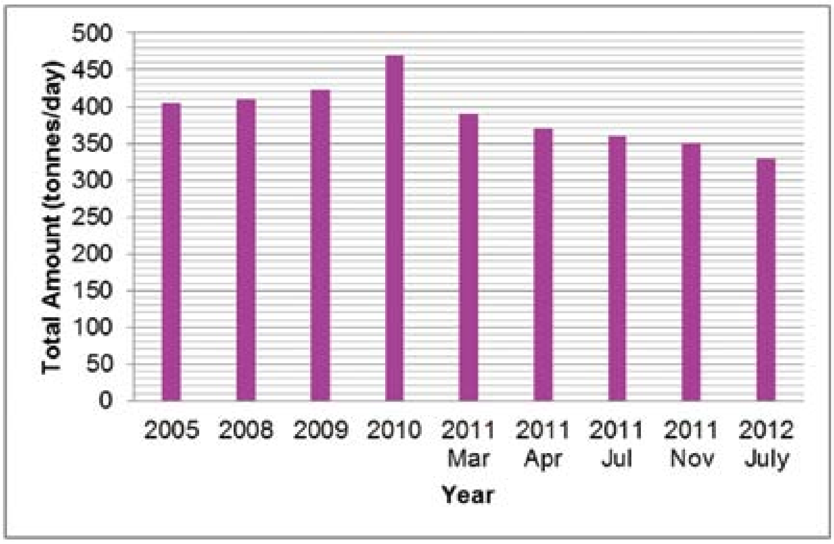


Figure 15-2: Waste reduction of 30% over 2010–2012

The experiences of Cebu City further highlight the potential for creating new jobs and extra income for the urban poor and waste pickers, as evidenced by barangay Luz, a successful model barangay in Cebu City, whose composting and recycling activities resulted in 338 new jobs for poor residents, providing them with an income equivalent to 13,000 USD per month (see Table 15-4). The experiences of barangay Luz further show that such approaches not only create economic opportunities within neighbourhoods but also facilitate spaces for community involvement, building partnerships and social capital for achieving sustainable development at the neighbourhood level.

Table 15-4: New job opportunities created by Banrangay Luz composting and material recovery facility (Premakumara 2012)

	No. of new job opportunities created	Average monthly income in USD	Total monthly income generated in USD
Direct job opportunities at composting facility and material recovery facility			
Waste separation, collection and transport to facility	15	150	2,250
Composting facility	6	150	900
Eco centre assistants	2	75	150
Indirect job opportunities created by programme			
Collection of recyclable materials	40	40	1,600
Production of handicrafts from recyclable materials	75	40	3,000
Household composting and worm production for sale	200	30	6,000
Total	338		13,900

15.4 CDM Approval and Monitoring Process

Both case studies identified the potential of community-based composting in reducing GHG emissions, making them potential candidates for application of the CDM and achieving sustainable development at the local level. Community-based composting often complements primary waste collection services and improves overall performance of the municipal service. Further, it significantly improves the level of hygiene within the service area. By diverting a major proportion of waste away from the municipal waste stream close to the source of generation, it minimises transportation costs, reduces the amount of wastes for landfills, prolongs the life of landfills and reduces municipal costs for landfill management. It also creates new job opportunities and extra income for neighbourhoods by applying labour-intensive technology adapted to the local socio-economic context. Further, community-based composting activities and the interaction between residents in issues of waste handling, hygiene, cleanliness and environment can significantly enhance environmental awareness within communities, assist in community voluntarily activities, help develop partnerships between service providers and receivers and increase community empowerment.

Although community-based composting plants show potential in covering operational costs through the sale of compost products, collection of user fees and sale of recyclable materials, challenges are faced in financing the establishment and scale-up of composting plants across the city (Premakumara 2012). In both cities the initial capital costs are covered by subsidies from local and national government, as well as international organisations. The use of carbon credits, in connection with crediting standards, would therefore prove beneficial in enabling additional funds to be tapped to scale-up such community-based composting projects city-wide, strengthen operations, monitoring and reporting practices and create a sense of project ownership among community members—the primary owners and equal partners in the project.

In order to obtain carbon credits, a project must pass the CDM project cycle, which is composed of the following key steps (Luthi 2005): identification of project idea, preparation of project design document (PDD), validation, registration, project implementation and monitoring, verification and issuance of CERs. Verification and issuance are repeated several times during the crediting period, which can be fixed (10-year duration) or renewable (up to three times in seven years, with baseline re-assessments after year seven and 14) according to preference. The frequency of verifications is defined by the project owner and most are conducted annually. As shown in Figure 15-3, the cost of the CDM project cycle is high and requires much time.

Bangladesh is one of the most populous countries in the world; about 135 million and growing at 2.06% annually. The urban population—25% of the total—generates about 14,000 tons of waste per day, which poses serious social, environmental and health problems, especially in the capital, where only 40% of the waste is collected and the remainde fills up streets and unmanaged landfill sites. This prompted Waste Concern, an NGO to develop a community-based model for waste recycling to transform solid waste into organic compost using a low-cost, low-tech and labour-intensive method.

In early 2004, Waste Concern collaborated with a Dutch company (World Wide Recycling) for investment in CDM-based composting projects. Its initial aim was to establish a 100–130 tonne per day compost plant at Bulta, Dhaka, and thereafter create small and medium-scale composting plants throughout Bangladesh with a final capacity of 700 tonnes of organic waste per day. The potential for compost production in the country is 50,000 tonnes per year, with an annual GHG emission CO_2 equivalency of 89,000 tonnes per year.

These experiences show that Waste Concern submitted the above composting project for CDM registration approval with their designated national authority in February 2004 and the project was approved in July 2006. Subsequently, a 15 year concession agreement was signed with Dhaka City Corporation (DCC) in May 2007. The delay in signing the public-private partnership was due to the lack of Government guidelines on such partnerships, which was subsequently issued in 2010. The project started actual operations in the fourth quarter of 2008, verification of CERs occurred in June 2011 and issuance of the first CERs from the UNFCCC took place in the third quarter of 2011 (ADB 2011).

As testified by the case history of Waste Concern, the costs of the CDM project cycle are high: equivalent to 70,000–110,00 USD. This cost can be broken down into up-front costs such as ER feasibility assessments (5,000-

20,000), PDD preparation (25,000–40,000), registration (10,000), validation (10,000–15,000) and other legal tasks (20,000–25,000). A further 3,000–15,000 USD is required annually for monitoring and verification (Maqsood Sinha 2012).

Figure 15-3: Experiences of waste concern in design, implementation and monitoring of waste sector CDM projects in Dhaka, Bangladesh

15.5 Community Monitoring as an Alternative Route to Enhancing MRV

The case studies of Surabaya and Cebu revealed the potential of a community monitoring mechanism as an alternative means to prepare the PDD and manage the project cycle without involvement of external consultants. This resulted in simplifying the approval procedures and monitoring and verification methodologies, and reducing the costs related thereto.

Table 15-5 shows the planning, implementation, monitoring and verification of the community-based composting programme in two case study cities carried out under two different scales. The first involved community or neighbourhood groups who designed, planned, implemented and monitored the composting project in their territories. The second involved the local government in partnership with other key stakeholders (non-governmental organizations (NGOs), the private sector, the media, and academic institutions), responsible for overall programme coordination, monitoring, reporting, as well as evaluation and awarding.

Table 15-5: Community-based composting implementation and monitoring mechanism in Surabaya and Cebu (Compiled by the Author in 2012)

Scale	Surabaya	Cebu	Activities
Community	Households	Households	Involvement in community project, separating waste at source, using composting bins, making recycling products for marketing, and payment of collection fees.
	Community Carders	Barangay Environmental Officers	Implementing project activities with households, information sharing, monitoring the use of composting bins and operation of composting centres and reporting to the Environmental Facilitators/CESET.
	Environmental Facilitators	Cebu Environmental Sanitation Enforcement Team (CESET)	Community organisation, information sharing, monitoring, recording and evaluation of project progress and reporting to higher levels.
	Neighbourhood (RT)/ sub-districts (RW)	Barangay Office	Community management, overall responsibility in planning, implementation, reporting, verifying and monitoring project activities in respective project area.
City	Department of Cleanliness and Landscaping (DKP) in partnership with other stakeholders	Committee of Environmental Management in partnership with other stakeholders	Overall project coordination, provision of training, initial funds, monitoring, evaluation and selecting best models for certification.

As shown in Table 15-6, the project implementation and monitoring process in both case study cities required the completion of several steps common to the requirements and processes found in CDM project cycles.

Table 15-6: Project cycle of CDM and community-based composting projects in case study cities

Step	CDM project cycle	Community-based composting project cycle
Step 1	Development of the project idea, which often takes the form of a Project Idea Note (PIN).	Community groups forward their intent to city office directly or via barangay office in Cebu or Neighbourhood (RT)/ Sub-district office (RW) in Surabaya.
Step 2	Preparation of the official project documentation in a standardised form (PDD), making use of approved CDM methodologies. Key parts to PDD are description of the baseline and monitoring plan, analysis of environmental impacts, comments received from local stakeholders and description of additional environmental benefits. The PDD must be approved by the Designated National Authority of the host country, which also needs to confirm that the project fosters sustainable development.	After covering relevant issues, community groups prepare official project proposals with support of BEO in Cebu and Environmental Carder in Surabaya, detailing activity plans and budgetary requirements.
Step 3	Detailed check of PDD by DOE (Designated Operating Entity)—an independent, UN-approved auditor. DOE makes PDD publicly available, receives public comments, decides whether project should be validated and submits registration request to executive board.	Validity of proposal is assessed by CESET officer in Cebu or Environmental Facilitator in Surabaya city.
Step 4	Approval of project by CDM authority (Designated National Authority (DNA)) of host country.	Approval of proposal by solid waste management committee of respective barangay in Cebu City and sub-district office in Surabaya City.
Step 5	Registration of project by Executive Board (EB) of United Nations Framework Convention on Climate Change (UNFCCC), upon approval of validation report prepared by DOE	Project is registered at city office to implement provision of financial and technical assistance.
Step 6	Recording of emission reductions achieved after registration according to monitoring plan. Regular monitoring of project emissions throughout its lifetime. Project developers prepare monitoring report as outlined in PDD, including estimate of Certified Emission Reductions generated by project. Completed monitoring report is submitted to DOE for verification and certification.	BEOs in Cebu and Environmental Carders in Surabaya perform on-site monitoring of project implementation according to project plan.
Step 7	Detailed check of monitoring report by DOE	CESET officers in Cebu and Environmental Facilitators in Surabaya verify monitoring activities carried out by BEOs and Environmental Carders.
Step 8	Reception of CERs issued by EB upon approval of verification report prepared by DOE.	City office in collaboration with other key stakeholders assesses success of project activities using set criteria, indicators and scoring system and issues certificate for best projects under annual award system.

15.6 Conclusion and way forward

The experiences of the two cities reveal that community-based composting can achieve sustainable development and reduce GHG emissions. However, such projects are hampered by high costs and time-consuming monitoring and reporting procedures, making community-based composting projects un-practicable in applying the CDM mechanism. The study identified that a community monitoring mechanism—a strong component in the success of community-based composting programmes in the case study cities—can be used as a simple alternative to application and monitoring procedures of the CDM for small-scale projects. However, it was identified that the existing reporting and monitoring system in community-based composting projects are mainly focused on evaluating and monitoring the efficacy of activities rather than attempts to measure, report and verify the key parameters required for GHG calculations and CDM monitoring.

This study therefore recommends that the project partners work more closely with communities to develop local capacity to enable data development and collection necessary for compliance with the standard, accuracy and its measurability. Accuracy should be sufficient to reassure decision makers and the public of the integrity of the reported information. To address accuracy, the project partners should develop data input-output and reporting benchmarks within reasonable time and cost parameters. Data sources need to be accessible and reliable to enable regular updates in accordance with periodic inventorying. Further, local governments should be empowered to develop policy to address GHG emissions resulting from activities undertaken within their own boundaries, including community initiatives.

Chapter 16 Solid Waste Management 1: A Case of First Order Decay Model

Akihisa Kuriyama

Key Messages

- Monitoring of waste sectors including methane recovery from solid waste, manure, and waste water is more difficult than other sectors.
- The First Order Decay (FOD) model estimates methane emissions from solid waste disposal sites, but not emission reductions, especially from composting.
- Life Cycle Assessment (LCA), including carbon storage factor, can evaluate the mitigation potential of composting projects.

16.1 Experience from MRV process in the CDM

One of the key issues in CDM projects is to verify monitoring results. In general, monitoring reports from industrial processes such as Hydro fluorocarbon (HFC) reduction, waste gas utilisation and renewable energy pass the verification process. To examine this in further detail we analysed how many submitted monitoring reports had been issued, focusing only on the small scale for investigational simplicity. We calculated the ratio of issued monitoring reports to submitted monitoring reports in each sector to give the "issuance ratio". The issuance ratios in the waste sector, i.e. methane recovery & utilisation, methane avoidance and biogas, are lower than in the renewable energy sector such as biomass, hydro power and wind power.

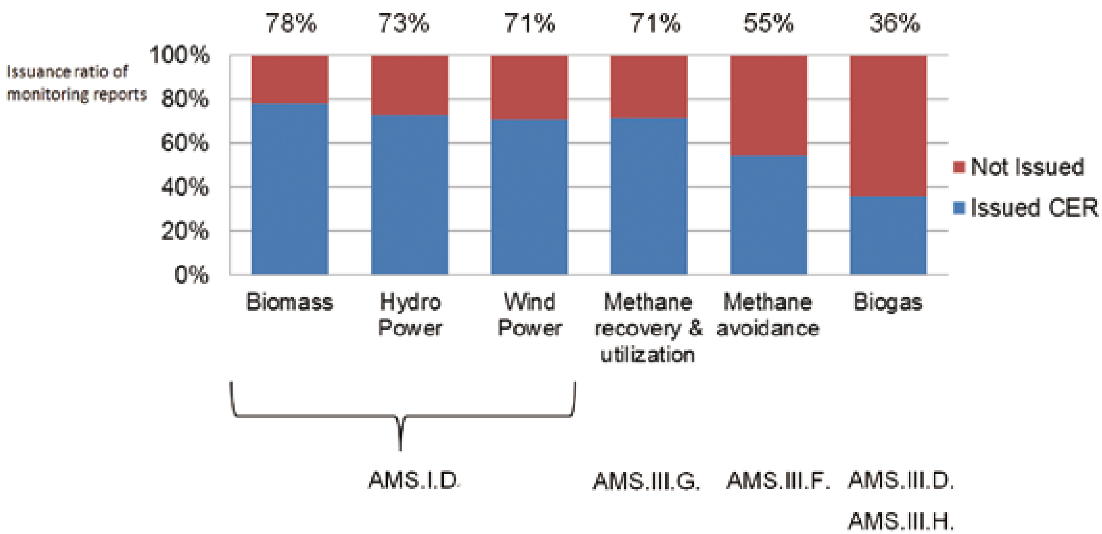
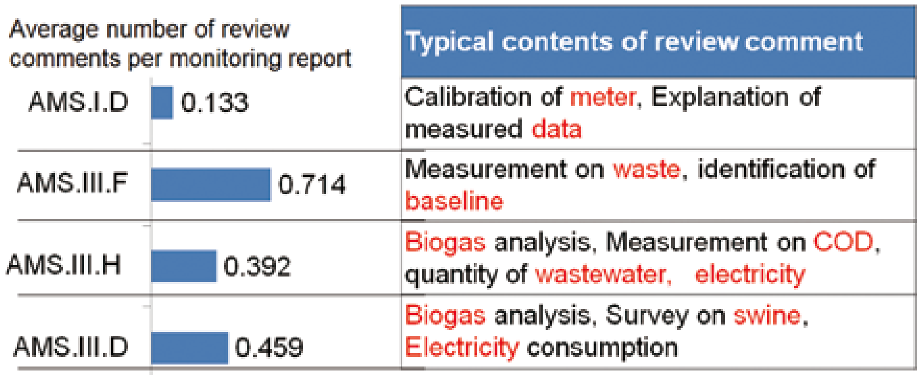


Figure 16-1: Issuance ratio of monitoring reports

The authors found that one of the reasons for the low issuance ratio in the waste sector was that monitoring reports therefrom had been subjected to more reviews than in the renewable energy sector. Figure 16-1 shows the average number of review comments per monitoring report for each of the methodologies—AMS.I.D (renewable energies), AMS.III.F. (composting), AMS.III.H (biogas) and AMS.III.D (biogas). AMS.III.F is very likely to be reviewed on, for example, measurement of waste and identification of the baseline. The biogas sector, which uses AMS.III.H. and AMS. III.D., received comments on biogas analysis and necessary data for surveys such as COD or number of swine. These frequent reviews in the waste sector are caused by the complexity of the survey monitoring process, as expressed in

Table 16-1. Although waste-type projects suffer from monitoring complexity in general, this report only investigated the monitoring methodology for methane recovery from landfill gas and methane avoidance by composting projects.

Table 16-1: Summary of comments in monitoring reports



16.2 Lessons learned from Fast Order Decay Model (Inventory and CDM)

In CDM methodology, the amounts of methane emissions from solid waste disposal sites are estimated by the first order decay (FOD) model[1]. For the small-scale CDM projects, AMS.III.G and AMS.III.F adopt this model. The FOD model was originally developed for national GHG inventories by the IPCC and can estimate methane emissions of each year based on waste type, waste condition, regional temperature and regional precipitation with adoption of a decay rate discount.

Much effort has gone into improving the estimation model for methane emission from landfill sites since the 1980s, but precise estimation of such is problematic due to the heterogeneous conditions of waste and landfill sites. As a result, several types of models are currently adopted in actual practice. Several researches have evaluated the above estimation models, one of which is Oonk (2010), which evaluated them in terms of accuracy, scientific base, transparency, validation and ease of operation, as shown in summary in Table 16-2. The advantages of the FOD model developed by the IPCC are availability of the equation, ease of operation, scientific base, transparency and flexibility of waste changes.

Table 16-2: Summary of models

		IPCC	TNO-model	GasSim	Landgem	Afvalzorg	Calmin	E-PRTR (Fr)	E-PRTR (Fi)
Operational	Availability	++	+	++	++	+	+	+	+
	Ease of operation	+	+	-	+	+	0	++	-
	Required input	0	+	+	0	+	0	0	+
Performance	Scientific basis	+	+	0	0	+	-	+	+
	Transparency	++	+	-	0	0	0	+	-
	Validated	0	+		-	0	0	0	0
Constraints	Waste changes	+	0	+	0	+	--	-	+
	Climate zones	0/+	-	-		-	+	-	-
Accuracy		0	0	0	-	0	-	0	0

Source: Oonk 2010
Note: '++' means very good and '--' means very poor

[1] The model differentiates between the different types of waste j with respective constant decay rates (kj) and fractions of degradable organic carbon (DOCj). The model calculates the methane generation occurring in year y (a period of 12 consecutive months) or month m based on the waste streams of waste types j (Wj,x or Wj,i) disposed in the SWDS over a specified time period (years or months). (UNFCCC)

In terms of accuracy, Scharff and Jacobs (2006) tested six different models (FOD model, Multi-phase model, LnadGEM, GasSim, EPER model France and EPER model Germany) at three landfill sites. The result of this study was that all estimations of FOD were placed at the centre of the range among the six models. From the studies above, it can be seen that FOD is a well-balanced model that can incorporate several conditions in terms of waste composition and climate, thus is one of the most appropriate models in estimation of methane emission from landfill sites. However, project developers have noted a discrepancy in FOD between estimated and actually measured emission reductions, as can be in Table 16-3, which shows the issuance rates of typical CDM projects by type. Both CER issuance ratios of methane recovery and utilisation, i.e., landfill gas recovery and methane avoidance (composting) are low, which implies GHG reduction estimation in solid waste sectors is less accurate than in other sectors.

Table 16-3: Summary of CER issuance ratio by project type

Project type	Average CER issuance ratio	Variance of CER issuance ratio	No. of projects
Methane recovery & utilisation	**0.45**	**0.09**	**113**
Biogas	0.56	0.12	127
Methane avoidance	**0.61**	**0.05**	**8**
Cement	0.65	0.12	19
Fuel switch	0.69	0.10	45
Waste gas/heat utilisation	0.72	0.06	120
Other renewable energies	0.78	0.11	19
Biomass	0.79	0.11	168
N_2O decomposition	0.80	0.11	43
Hydro power	0.81	0.17	514
Energy efficiency	0.81	0.14	40
Wind power	0.87	0.07	406
HFC reduction/avoidance	1.05	0.09	19

Source: IGES CDM Project Database (As of July 31 2012)

For the estimation of emission reduction by recovery of landfill gas, this discrepancy is acceptable because FOD is used only for the estimation of GHG reduction before projects start. During the project duration, landfill recovery projects adopt the amount of "methane captured and destroyed/gainfully used by the project activity" in monitoring methodologies. For example, CERs from landfill gas recovery are mechanically measured by gas meter and analysers. But for methane avoidance projects, especially composting projects, the FOD model for both estimation and calculation of emission reductions is adopted. Therefore, a large number of landfill recovery projects have been issued CERs, while some composting projects have had difficulty in receiving CERs.

16.3 Balancing the quality of GHG accounting and MRV requirement

As discussed in 16.1, the FOD model itself plays an important role in the estimation of methane emissions from landfill sites. The actual monitoring of landfill gas has been conducted by monitoring meters measuring captured landfill gas and monitoring reports thereof have been successful in receiving CERs under CDM. This points to the need for extension of the current MRV methodology for landfill gas under CDM.

However, monitoring of emission reductions by composting is difficult to verify, mainly due to the complexity in the logic behind the equation related to achieving emission reductions by composting as regards the definition of the crediting period.

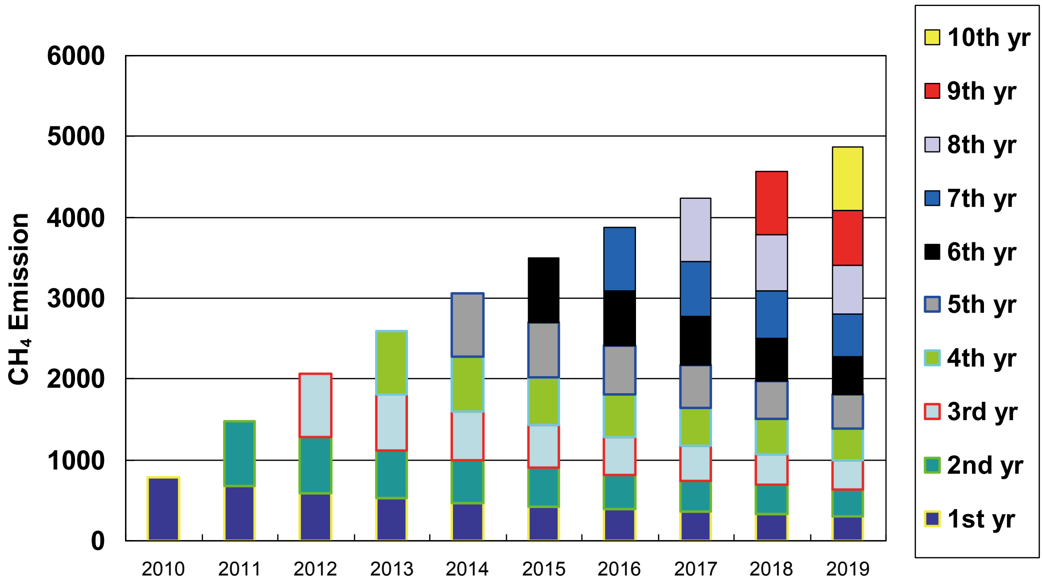


Figure 16-2: Calculation of FOD model

For example, if we assume a 10-year composting project that operates from 2010 to 2019, the emission reduction in 2010 should be calculated solely from the first year's methane emissions from the waste disposed in 2010. Similarly, the emission reduction in 2011 should be calculated from the cumulative amount of the second year's methane emissions from the waste disposed in 2010 and first year's methane emissions from the waste disposed in 2011. This calculation is based on the concept of the quantity of methane emitted each year, thus is suitable for the estimation of landfill gas recovery but not for composting. The activity of composting in 2010 can avoid all emissions of methane from not only between 2010 and 2020 but also after 2020. Further, this calculation means that the amount of methane avoided in 2019 is just a fraction of 2019's methane avoidance. This calculation provides less incentive to maintain project activities at the end of crediting period, and is the problem caused by the definition of "crediting period", for which GHG emissions are calculated for specific calendar years.

To tackle these issues, the authors suggest applying a Life Cycle Assessment (LCA) approach as LCA can account for all amounts of methane avoidance by the activity in 2010 to the emission reduction for 2010. At same time, the equation in the LCA approach for calculating emission reduction by composting can be greatly simplified to reduce the burden of preparation and verification of monitoring reports. This approach would also reduce the negative incentives associated with lowered emission reductions when project activities wind down towards the end of the crediting period.

In support of the above proposal, it should be noted that the US Environmental Protection Agency (US EPA) adopts an LCA approach to evaluate emission reductions by each type of waste management practice (EPA 2012a). Within the LCA framework, US EPA adopts a carbon storage factor for the emission reduction by composting. When the produced compost is applied to the soil, some of the carbon within the compost stabilises and becomes resistant to further rapid microbial decomposition (EPA, 2012b).

In conclusion, adopting LCA for emission reductions by composting enables simplification of the monitoring methodology and proper evaluation of its mitigation potential.

Chapter 17 Solid Waste Management 2: Life Cycle Assessment (LCA) Perspective

Janya Sang-Arun, Nirmala Menikpura

Key Messages

- 3Rs (reduce, reuse, recycle) is a holistic approach to achieve sustainable solid waste management and climate change mitigation
- Life cycle approach should be used as a tool for evaluation of waste treatment technologies and selection of climate change mitigation measures
- Avoidance of direct landfilling of organic waste and utilizing this waste for increasing food and energy production is the most effective waste treatment systems for climate change mitigation in the waste sector
- In developing countries, mechanical biological treatment (MBT) should be used for pre-treatment of unsorted waste prior to landfill because the greenhouse gas (GHG) emissions from this system is much lower than direct landfill and landfill mining. Additionally, there is high potential of resource recovery.

17.1 The 3Rs for sustainable solid waste management

Sustainable solid waste management should contribute to human health protection environmental quality and socio-economic development. To achieve these objectives, solid waste management strategies must go beyond purely technical considerations to incorporate political, institutional, social, financial, economic, and environmental realities. The 3Rs (reduce, reuse, recycle) is an approach to achieve sustainable consumption and production including solid waste management. It has been promoted to minimize waste generation, enhance resource circulation in the society and decrease waste flow to final disposal. And thus, it can also contribute to climate change mitigation.

The 3Rs promotes reduction of waste generation in the production and consumption stage by reducing demands of virgin resource and reuse of usable materials until it is no longer functions as its original purposes before sending them to recycling facility. Under this concept, the quantity of waste for collection, transport and disposal at the final disposal will be drastically decreased since a large percentage of waste composition is recyclables. Once the waste quantity decreases, especially organic waste, the potential of GHG emissions from the waste disposal will also decrease.

The recycling process can emit small percentage of GHG emissions. However, it can significantly contribute to avoidance GHG emissions from virgin resource extraction and other conventional production. Therefore, the 3Rs can significantly contribute to GHG emission reduction from other sectors as co-benefits including energy, agriculture, and industry.

17.2 Why life cycle approach should be applied for quantification of GHG emissions?

Life Cycle Assessment (LCA) seems to be a useful technique for analysing current systems and alternatives in order to identify the consequences with respect to GHG mitigation in all the sectors such as waste, energy, transport. There is a growing interest of application of LCA methodology in waste sector particularly for estimating the possible mitigation options of all the environment impacts via material and energy recovery from waste (Koroneos and Nanaki, 2012). LCA is a method for environmental assessment considering all the phases of life cycle such as collection, transportation, pre-processing, treatment and disposal. It enables to identify issues of concern and possible policies for mitigating more effectively taking into account the direct and indirect impacts associated with a particular waste management system. Therefore life cycle approach has much to offer in terms of selection and application of suitable waste management technologies to achieve specific waste management objectives and goals.

However, the current measurement of GHG emissions from the waste sector that based on the Intergovernmental Panel on Climate Change (IPCC) Guidelines has considered only direct emissions and not accounting for co-benefits of the 3Rs and waste utilisation technology. Therefore, many decision makers often select landfill gas recovery as promising climate change mitigation measures without concerning a long term climate impacts. Therefore, this report aims to describe how the life cycle approach can be used for accounting climate co-benefits of the 3Rs (e.g. resource recovery and avoided landfilling of organic waste from the waste management in a holistic approach which can facilitate selection of climate friendly waste management technologies.

17.3 Application of LCA for Nationally Appropriate Mitigation Actions (NAMAs)

LCA studies can provide useful analyses of the potential climate impacts and benefits of various waste management options. Furthermore, the concept of life cycle thinking would help local authorities to realise the indirect paths that could possibly decrease the GHG emissions and other environmental impacts from waste management.

The ultimate goal of application of LCA would be used for identifying inefficiencies of waste management, improving efficiency of the waste management system, enhancing development of the mitigation actions and offset protocols, and promoting implementation of appropriate technologies that benefits to not only the waste sector but also others. Therefore, LCA approach would be a useful tool for development of NAMAs and promoting GHG accounting and carbon crediting under a new market mechanism.

17.4 Application of LCA concept for GHG quantification in waste management

LCA is a holistic approach for “Measurement” of GHG emissions from the entire lifespan of any Municipal Solid Waste (MSW) management system. By applying the life-cycle approach, “hotspots” of GHG emissions can be identified more easily since it helps with a thorough assessment comprising all the phases of the life cycle from “Cradle to Grave”, including auxiliary material production (energy and raw materials), MSW collection and transportation, treatment and final disposal. Moreover, by applying LCA, potential of GHG emissions (directly or indirectly) from various waste management technologies and GHG savings can be quantified in a systematic way, and that would be very useful at the decision making stage.

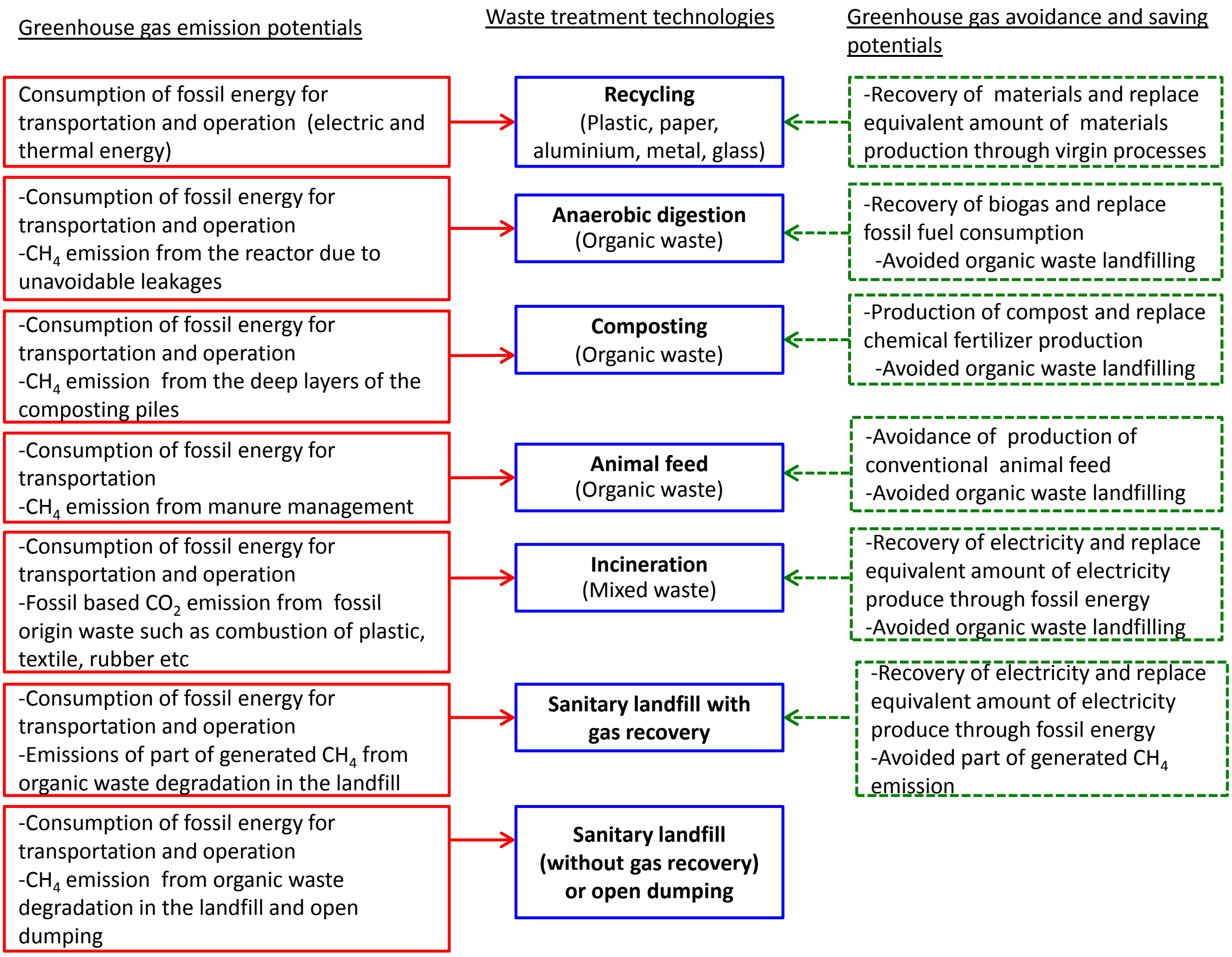
All the waste treatment methods emit a considerable amount of GHG directly or indirectly. For instance, the direct GHG emissions may be caused due to waste transportation, treatment and final disposal. Indirect GHG emissions may occur due to energy and material production, which is required for operation of the MSW management systems. Direct and indirect GHG emissions from various waste treatment technologies are highlighted in Figure 17-1. As an example, life cycle framework for assessing GHG emissions from an integrated waste management system is presented in Figure 17-2 which includes all the phases of life cycle and the life cycle inputs and outputs with respect to GHG emissions.

Total GHG emissions from a particular waste management system can be calculated as follows;

$$GHG_{\text{Total emissions}} = GHG_{\text{Transportation}} + GHG_{\text{Operations}} + GHG_{\text{Treatment and disposal}}$$

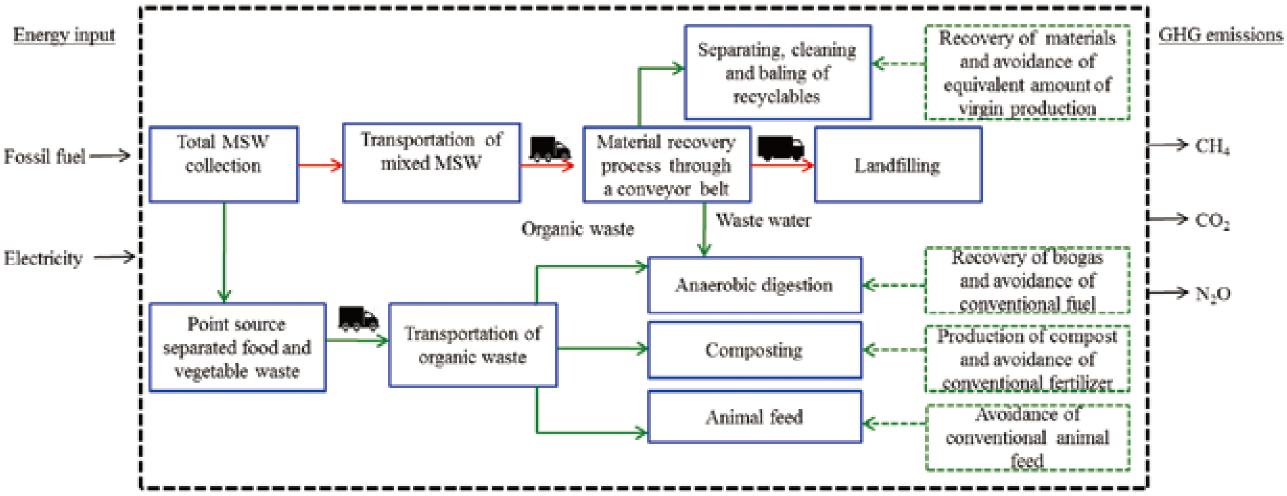
In contrast, organic waste disposal at the landfills can be stopped by implementing appropriate technologies like composting, anaerobic digestion. Therefore, methane emissions that would otherwise occur from organic waste degradation in landfills can be avoided. Furthermore, by adapting appropriate treatment methods, a significant amount of materials and energy can be recovered from the waste. These recovered resources would be useful to replace an equivalent amount of materials and energy that would have otherwise produced through the virgin production processes. Therefore, the associated GHG emissions from those virgin production processes can be avoided. By implementing appropriate waste treatment technologies for maximum resource extraction, GHG mitigation can be achieved due to avoided organic waste landfilling as well as resource recovery, (see Figure 17-1). The GHG mitigation and avoidance potential from individual treatment method can be estimated as follows;

$$GHG_{Total\ avoidance} = Avoided\ GHG_{Resource\ recovery} + Avoided\ GHG_{Landfilling}$$



Source: Authors

Figure 17-1: The potential of GHG emissions and GHG savings from different type of treatment technologies in LCA perspective



Source: Authors

Figure 17-2: Life cycle framework for assessing GHG emissions from integrated waste management system

According to Figure 17-1, every waste management practice generates GHG, both directly (i.e. emissions from the process itself) and indirectly (i.e. through energy consumption). However, the overall climate impact or benefit of the waste management system will depend on net GHGs, accounting for both emissions and indirect, downstream GHG savings. Life cycle inventory analysis needs to be done in order to account for the direct and indirect GHG emissions and GHG avoidance from the entire life cycle of MSW management technologies. Based on inventory analysis results, net GHG emissions can be quantified by subtracting the potential GHG savings from the life cycle GHG emissions that would be useful for making decision on selecting climate-friendly technologies.

Then the net GHG emissions from individual treatment methods can be estimated as follows;

$$GHG_{\text{Net emissions}} = GHG_{\text{Total emissions}} - GHG_{\text{Avoidance}}$$

All in all, LCA approach provides a meticulous data collection and calculations procedure to quantify the climate co-benefits from different waste management options and also to perform a quantitative assessment of optimizing climate co-benefits by maximizing resource recovery at local authority level. Thus, by applying life-cycle approach, priorities can be identified more easily and policies can be targeted more effectively with respect to promotion of climate friendly waste management technologies.

17.5 Case studies in Thailand

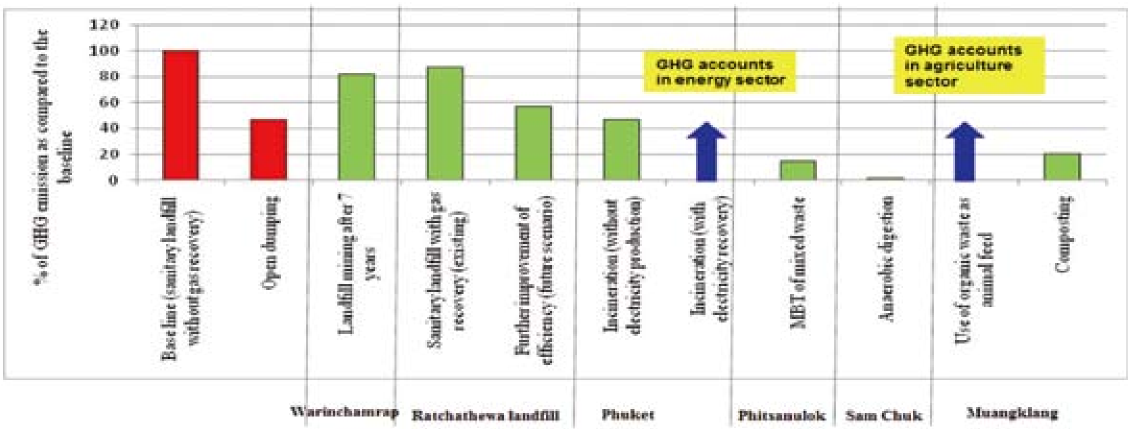
Thailand is selected for this study as it has various types of municipal solid waste treatment system including mechanical biological treatment (MBT) in Phitsanulok Municipality, anaerobic digestion in Sam Chuk and Muangklang Municipalities, landfill mining to waste plastic pyrolysis in Warin Chamrap Municipality, use of organic waste for composting and animal feed in Muangklang Municipality, sanitary landfill with gas recovery in Bangkok Metropolitan Administration, incineration with electricity generation in Phuket Island, and recyclable waste separation which is being practiced by both local authority and residents in many of municipalities in Thailand.

The GHG emissions from a life cycle of the above mentioned treatments were estimated by using the secondary data that provided by local authorities and the operators. Quantity of GHG emissions of each technology was varied depending on waste composition particularly on organic waste, except for incineration that depending on plastic waste. In addition, type of technology, machineries, transportation distances and management practices are other influencing factors on the GHG emissions especially when a life cycle approach is used for the estimation. The efficiency of GHG emissions reductions from these treatments were then compared with two baselines: deep sanitary landfill without gas recovery (>5 m depth) and shallow open dumping (<5 m depth).

As shown in Figure 17-3, GHG emissions from the deep sanitary landfill without gas recovery is higher than other treatments, while as the GHG emissions from open dumping is approximately 50% of the sanitary landfill. However, open dumping is no longer acceptable due to its negative impacts on health and environment. Therefore, many countries try to upgrade their final disposal sites from open dumping to sanitary landfill or incineration. As shown in the figure, to some extent, landfill mining and sanitary landfill gas recovery can reduce GHG emissions from the sanitary landfill: less than 10% reduction for landfill mining and less than 50% reduction for landfill gas recovery. The majority of GHG emissions are released to the atmosphere. The level of GHG emissions from incineration with no electricity generation are that of similar to open dumping, even though the source of emissions is different. However, investment and operation cost of incineration is very high. Furthermore, sanitary landfill and incineration do not associate efficient use of resource since many of valuable wastes are being buried or incinerated.

It is worth noting that GHG emissions from the incineration that equipped with electricity generation are accounted under the energy sector. GHG emissions from use of organic waste as animal feed are accounted under the agriculture sector.

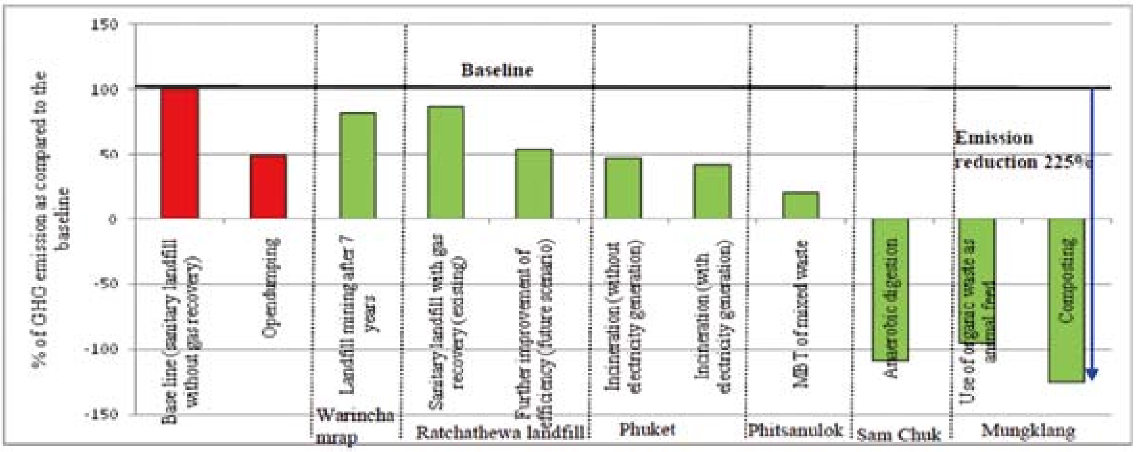
Based on a lifecycle approach, contribution of incineration for electricity generation in Phuket is not significantly different from incineration without electricity generation because the majority (59%) of generated electricity is used for the plant operation (Figure 17-4).



Baseline for mixed waste management is sanitary landfilling of mixed waste without gas recovery.
The baseline of organic waste utilisation is sanitary landfilling of organic waste without gas recovery

Source: Authors

Figure 17-3: GHG emissions from waste treatment facilities employed in Thailand – non-LCA



Source: Authors

Figure 17-4: GHG emissions from various waste treatments employed in Thailand – LCA

Amongst the waste treatments in Thailand, MBT, anaerobic digestion, and composting are a promising waste treatment technology for climate change mitigation due to several reasons: i) smaller amount of GHG emissions and less environmental impacts compare with open dumping, ii) provide co-benefits, depends on type of technologies, for instance, extending lifetime of landfill, providing soil amendment materials that can increase crop productivity, and generating alternative energy source.

Anaerobic digestion releases less GHG emissions than composting and MBT. In addition, it can contribute both energy and soil amendment materials; however the investment and operation cost is relatively higher than composting and MBT. It is noteworthy to mention that, emissions from these technologies can be varied depending on the advancement of technology and management practices.

The benefits of organic waste utilisation technologies are more obvious when a lifecycle approach is taken into consideration. As shown in Figure 17-4, anaerobic digestion, use of organic waste for animal feed and composting showed negative value because these treatments generate outputs that can replace or minimise GHG emissions in other sectors. For instance, anaerobic digestion generates biogas that can be used for replacement of fossil fuel use for electricity generation or firewood requirement for cooking. Anaerobic digestion and composting produce liquid fertiliser or compost that can minimise use of chemical fertiliser which can avoid GHG emissions from production of chemical fertiliser and on-farm emissions due to use of nitrogen fertiliser. In addition, all these biological treatments can avoid methane emissions from landfill. It is noted that climate benefits of use of discharge from anaerobic digestion and manure as organic fertiliser is not included in this estimation due to lack of data.

17.6 Policy recommendations

The benefits of organic waste utilisation are more obvious when its co-benefits on food and energy production are included in the estimation of GHG emission reduction. Therefore, it is recommended that reduce, reuse, utilisation of organic waste, and pre-treatment of organic waste prior to final disposal should be promoted and be included in the NAMAs as it could contribute to achieve sustainable solid waste management and climate change mitigation.

LCA can clearly illustrate the effectiveness of GHG emission reduction of each technology better than the conventional approach that focuses on direct emission reduction. Therefore, the LCA should be applied for MRV especially in developing countries where end-of-pipe solutions are often selected for improvement of municipal solid waste management.

Chapter 18 Forestry: Importance of Local Participation in MRV of REDD+

Henry Scheyvens, Taiji Fujisaki, Makino Yamanoshita

Key Messages

- REDD+ will not succeed unless local people understand the concept and believe that REDD+ promotes their interests.
- Forest monitoring is one way for the community to participate in REDD+ activities. Our Community Carbon Accounting Project demonstrated that community-based forest monitoring teams can take these measurements.
- Community participation in the forest monitoring contributes to building a sense of ownership which is tied to roles, responsibilities and rewards, and ultimately sustainable development.

18.1 Participation as key to REDD+

Participatory processes are important for forest management as they identify the values and needs of forest stakeholders, provide avenues for voices to be heard and acted on, provide checks and balances, and contribute to transparency and accountability. The history of forest management reveals the consequences of inadequate participation, including forest laws that privilege industrial interests over those of local communities, collusion between state actors and developers, weak forest law enforcement, and conflict between forest authorities and local people, all of which contribute to deforestation. Concern that REDD+ could inadvertently encourage governments and investors to seek greater control of forests, at the expense of about 1.3 billion (mostly poor) people in developing countries who live in and have customary rights to forests, explains why participation of local communities and indigenous peoples is one of the seven REDD+ safeguards (Figure 18-1) agreed by the UNFCCC COP. To succeed in reducing forest emissions, REDD+ needs to be socially acceptable, and to be socially acceptable, participation of local people is key.

The following safeguards should be promoted and supported when undertaking REDD+ activities:

(a) That actions complement or are consistent with the objectives of national forest programmes and relevant international conventions and agreements;

(b) Transparent and effective national forest governance structures, taking into account national legislation and sovereignty;

(c) Respect for the knowledge and rights of indigenous peoples and members of local communities, by taking into account relevant international obligations, national circumstances and laws, and noting that the United Nations General Assembly has adopted the United Nations Declaration on the Rights of Indigenous Peoples;

(d) The full and effective participation of relevant stakeholders, in particular indigenous peoples and local communities;

(e) That actions are consistent with the conservation of natural forests and biological diversity, and are not used for the conversion of natural forests, but are instead used to incentivize the protection and conservation of natural forests and their ecosystem services, and to enhance other social and environmental benefits; [1]

(f) Actions to address the risks of reversals;

(g) Actions to reduce displacement of emissions.

[1] Taking into account the need for sustainable livelihoods of indigenous peoples and local communities and their interdependence on forests in most countries, reflected in the United Nations Declaration on the Rights of Indigenous Peoples, as well as the International Mother Earth Day.

Figure 18-1: REDD+ safeguards agreed at the 16th UNFCCC COP

18.2 Types of participation

Participation can range from “token” or superficial types, where local people are simply told about an activity that is to take place, to more significant types, where they influence the decision for the activity, its implementation, modifications and evaluation. Table 18-1 lists possible types of community participation and attempts to interpret what these would mean for REDD+ activities.

Table 18-1: Types of community participation in REDD+ activities

Type	Characteristics	
Passive participation	People are told about a REDD+ activity that will happen or has already happened. The announcement is unilateral, but people's responses are not taken into account.	Less significant
Participation by giving information	People participate by answering questions posed by REDD+ project developers. This could begin at the feasibility stage. People do not have the opportunity to influence proceedings, as the findings are neither shared nor checked for accuracy.	
Participation by consultation	People are consulted by the REDD+ project developers, who listen to their views. The developers define both the problems and solutions, and may modify these in the light of people's responses. People are not involved directly in decision making.	
Participation for material incentives	People participate in the REDD+ activity by providing resources, for example labour, in return for payments or other incentives. They have no interest in prolonging activities when the incentives end.	
Functional participation	People participate by forming groups to meet predetermined objectives related to the REDD+ project. Such involvement is not at early stages of project cycles or planning, but rather after major decisions are made.	
Interactive participation	People participate in analysis, which leads to action plans and the formation of new groups or the strengthening of existing ones. Groups take control over local decisions, and so people have a stake in maintaining REDD+ structures or practices.	More significant
Self-mobilisation	People participate by taking initiatives independent of external institutions to initiate a REDD+ activity.	

Source: Modified from Pretty 1995

Passive participation and *participation by giving information* are obviously the least meaningful types of participation in terms of ensuring that REDD+ activities are supported locally and that the REDD+ activity is appropriate to local contexts. In contrast, *interactive participation* and *self-mobilisation* are the most meaningful types of participation for REDD+, though the potential for *self-mobilization* is limited by the fact that the concept of REDD+ can be difficult to grasp and the technical demands of REDD+ (i.e. credible estimation of the net emissions avoided by the REDD+ activities) are very high.

18.3 Why communities should be involved in forest measurement and other forms of forest monitoring

There are many ways in which communities can participate meaningfully in REDD+, from controlling use of forest resources, planting and maintaining trees, and monitoring and reporting on REDD+ activities. The COP has recognised the potential for this latter role in Decision 4/CP.15, which calls for the development of guidance for the “full and effective engagement of indigenous peoples and local communities in, and the potential contribution of their knowledge to, monitoring and reporting of [REDD+] activities” (Decision 4/CP.15).

Forest measurement is one way that local groups can participate in monitoring. This is a particularly meaningful activity for REDD+ as REDD+ payments will be performance-based, meaning that payments are contingent upon accurate and precise estimates of forest carbon stock changes, which requires ground-based forest measurement.

It is normally assumed that forest measurement is the exclusive preserve of trained experts. Sampling is necessary as it is impractical to measure all trees in a forest, so knowledge on sampling design is required. Expertise is needed to determine efficient sample plot sizes, shapes and dimensions, how to locate plots to avoid bias, how to map and stratify a forest according to management types and carbon densities, which carbon pools to focus on, what measurement instruments can be used, and how to minimise and represent errors in results. Laboratory analysis may be necessary, e.g. to estimate soil carbon, and additional technical work in the forest, such as destructive biomass sampling, may be useful to provide better estimates.

Given this complexity, it is easy to understand why little thought is usually given to involving local people in forest assessments, beyond the menial tasks of carrying equipment, cutting tracks, etc. However, some of the most important measurements for carbon stock assessment, such as tree diameter, are not technically difficult, though correct use of equipment, adherence to protocols to ensure consistency, and careful data recording are necessary. Moreover, in communities that traditionally manage and use forests, local people have intimate knowledge of forest resources, are skilled in identifying different tree species, and are aware of ecosystems boundaries, all of which can benefit carbon stock monitoring.

There are other good reasons for supporting community participation in forest carbon stock assessment. When communities themselves are forest owners and managers, it makes good sense for them to be involved in any efforts to generate scientifically verifiable data to monitor carbon stocks in their forests. With this capacity and knowledge, they will be in a much stronger position to understand the trade-offs of alternative forest uses and to negotiate with outsiders, such as carbon professionals. By participating in forest monitoring, local people will also have a better understanding of how REDD+ payments are generated and what must be done to maintain the payments, which can contribute to the permanence of emissions reductions.

18.4 The Community Carbon Accounting (CCA) Project

Together with its partners, IGES launched the Community Carbon Accounting (CCA) Project with the intention of developing and testing approaches for engaging communities in forest carbon stock change estimation. The CCA Project is being implemented at sites in Cambodia, Papua New Guinea (PNG), Indonesia, Laos and Vietnam according to local contexts, opportunities and needs (Figure 18-2), and is funded by the Ministry of Environment of Japan and the Asia-Pacific Network for Global Change Research.

The CCA Project methodology is *action learning*, which is an interactive inquiry process that balances problem solving actions with data-driven collaborative analysis or research. Action learning involves communities as co-researchers through a cyclical process of planning, action, observation and reflection. The action learning process is flexible and is determined according to the local context. The general approach is outlined in Figure 18-2.

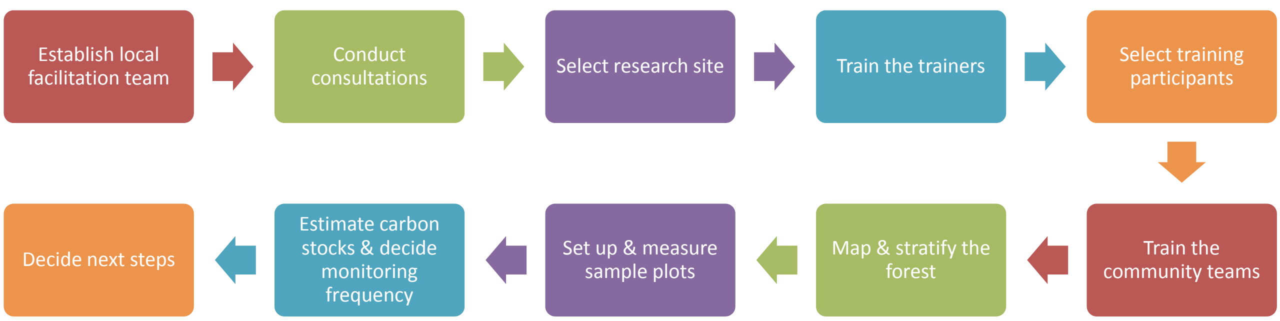


Figure 18-2: Process to develop and test approaches to engage communities in forest monitoring

The action learning begins with the establishment of a local facilitation team. It is important that the team has expertise in both forest carbon accounting and community engagement, and is able to work with all stakeholders. A consultation is then organized with stakeholders to explain the objectives and agree on suitable project sites. The stakeholders will be communities in the locality, relevant local government offices, the national forest department, and non-governmental organizations, research institutes and others active in the area. The consultation is followed by a training of trainers, which typically takes several days and involves classroom training on concepts and practical field-based training. Reference materials, equipment and field sheets must be prepared for this training. The local facilitation team organizes a meeting with the participating communities to further explain the measurement activities and their relationship with climate change. The communities select some of their members to participate in the training (they become the "community forest monitoring team"); the trainers encourage the inclusion of women to support their empowerment, and because in many rural societies, women have unique knowledge about forests because of their gender roles. Similar to the training of trainers, classroom and field-based training on plot establishment, measurement and data recording is conducted.

Forest boundary demarcation and stratification are conducted at this stage, or earlier in the process. Forest boundaries may already have been demarcated, especially when tenure arrangements have been formalized, but in other cases the facilitation team works with the community teams to delineate the boundaries using GPS, or with the aid of remote sensing.

After the training is conducted, the community team is organized to set up and measure the sample plots. They record the data using prepared field sheets, and the data is later transferred to a spreadsheet or database with inbuilt functionality to convert the measurements to timber and carbon stock estimates. The results are explained to the community, and next steps, e.g. a REDD+ feasibility study, are decided.

The CCA Project provides the following observations for REDD+ project developers and for governments in the process of establishing their national REDD+ architecture.

Communities can take accurate forest measurements:

With proper training, community teams can take and record forest measurements to provide accurate and precise forest carbon stock estimates. The estimates from community measurements fall well within the range of uncertainty for measurements in similar forest types, and the confidence internals for the estimates from the community measurements and from professional surveys are similar.

Community teams retain the skills they have learnt:

In January 2012, Project partners observed a Bunong community forest monitoring team in Mondulkiri Province, Cambodia set up nested rectangular and variable radius circular sample plots, take measurements for estimating biomass in living trees and deadwood, and record the data (Photo 18-1). The community team had received training one year earlier under the Project on forest sampling and measurement, and

Photo 18-1: Project partners observing a Bunong community team in Cambodia demonstrating plot establishment

they demonstrated that they had retained the knowledge and skills from this training. Local people who participate in a well-designed training program can be relied upon for future forest assessments.

The training of trainers is critical and well prepared training programs are essential:
The training of communities on forest measurement is not a simple task. Literacy rates may be low and communities may have received misinformation on issues such as carbon trading. In all Project countries, a structured training of trainers (ToT) was organized to ensure trainers possessed the necessary knowledge on forest carbon accounting and effective techniques for training communities on forest sampling. While classroom training is useful to discuss the purpose of the monitoring and to introduce concepts, the Project found that local people respond best to practical exercises, and that sufficient time must be allocated for participants to repeatedly practice setting up sample plots, measuring biomass and data recording.

Flexibility is required when deciding who should do what:
Clearly, a lot of technical work associated with the sampling design and data processing (e.g. construction or selection of allometric equations to estimate biomass from measurements) cannot be undertaken by communities, but projects engaging communities in REDD+ should not have rigid views on what communities can and cannot do. Some communities may have members who are competent with computers and own computers. In such cases, the responsibility for data entry could be given to the community.

Low cost, easy-to-use instruments and methods can be developed and used, with a view to communities owning the necessary equipment:
Thought should be put into the design and use of low cost, easy-to-use instruments and methods, without sacrificing scientific rigour. For example, in Cambodia, Project partners introduced: a method to estimate tree diameter above buttressed sections that only requires a short length of bamboo and a plastic ruler or calliper (Photo 18-2). The aim should be self-reliant teams that can be depended upon for estimation of forest carbon stocks according to pre-determined monitoring intervals. The community forest monitoring teams should thus own the equipment necessary to set up and measure sample plots.

Photo 18-2: Partners innovating with a simple yet effective method for estimating bole diameter above buttresses

Other potential roles for communities in monitoring:
Other ways that communities can contribute to monitoring for REDD+ include ground-truthing for the interpretation of remotely-sensed data. Communities can also provide information on local drivers of deforestation and degradation, such as accessibility to forests, biomass removals and disturbance, and their changes over time, which would help with spatial modelling of land use changes to develop emissions scenarios. Living close to or within forests, local communities can also provide useful information for monitoring safeguards on rights, governance, biodiversity, leakage and permanence. Engaging communities could enable more frequent monitoring on a wider array of safeguard variables and at the same time contribute to the transparency and accessibility of the information by having

more groups involved in its collection.

18.5 Conclusion

Forest measurement to estimate and monitor forest carbon stocks is usually done by trained professionals. The Community Carbon Accounting Project has demonstrated that community-based forest monitoring teams can also take these measurements. So, who should take the measurements? Trained professionals or community teams? In terms of the measurements themselves, the professional and community teams produce similar results, so competency in measurement is not the issue. The issue is instead one of “ownership”, which is tied to roles, responsibilities and rewards, and ultimately sustainable development.

In tropical developing countries, millions of people live in and on the edge of forests, and rely on forests for a range of ecosystems services. In this context, REDD+ will not succeed unless local people understand the concept and believe that REDD+ promotes their interests. Finding ways in which local people can participate meaningfully in REDD+, and tying rewards to their involvement, is one way of building the necessary sense of local ownership required for REDD+ policies. Herein lies the first reason for engaging community teams in forest monitoring. A second reason is that as they reside near the forests and often have intimate knowledge about forest resources, they can contribute additional data for forest monitoring that would be missed by professionals during their occasional visits.

For further information on the CCA Project, see http://www.iges.or.jp/en/fc/activity_cca.html

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