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NAMA Guidebook

Manual for practitioners working with mitigation actions

MONRE

IMHEN

CLIMATE CHANGE DEPARTMENT
MINISTRY OF ENVIRONMENT

GOVERNMENT OF MONGOLIA
MINISTRY OF ENVIRONMENT AND GREEN DEVELOPMENT

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BACKGROUND

"Nationally Appropriate Mitigation Actions" (NAMAs) in a measurable, reportable, and verifiable (MRV) are relatively new in the history of climate change negotiations. The term was first used in 2007 at the thirteenth session of the Conference of the Parties (COP13) of the United Nations Framework Convention on Climate Change (UNFCCC), but which was gradually and further developed in subsequent COP decisions.

Some people tend to consider NAMAs to be a new initiative involving a number of issues that need to be defined either at the international negotiation level or by the relevant decision makers at the national level. However, the truth is that efforts related to mitigate greenhouse gas (GHG) emissions have generally taken place as part of sustainable development policies.

Two examples would be a transport related project in which city planners have decided to introduce new measures in attempting to improve the flow of traffic in congested areas or a problem involving open dumping but which can be solved by developing a waste management project that results in the generation of energy and compost for use in agriculture related activities. Both of the above would typically be considered mitigation actions.

From the point of view of finance and donors, loans and grants for use in environmental and social projects have been available for quite some time, although the climate change component of ODA has recently started to be taken into consideration in a more explicit manner. The rationale used in providing development assistance is to aim at improving the social, economic and environmental conditions of developing countries, while also at the same time helping to achieve their sustainable development.

Past experience is being used to invite developing countries to step forward and design their own individual low carbon society blue print and then strategically implement that plan in its concrete realization. This will typically encompass finance, low carbon technologies, and improved capabilities, and the resources that will be needed by partnering with developed country governments and a variety of other key stakeholders. These expectations have led to efforts to increase the amount of support for them, and different collaboration schemes have been expanded upon in a variety of different ways, including international and domestic financing, carbon financing, and various approaches, etc., and with that a trend appearing to remain dominant into the future.

The agreement reached regarding NAMAs in the Cancun Agreements is nothing less than a reflection of all these facts, and through a concept where all the conditions involved in mitigation related projects, get linked together in a more systemic and synergetic way. The fact that a definition has not been provided yet allowed ample opportunities for experimentation for both developed countries ready to provide assistance and for developing countries looking to comply with their sectoral strategies, while not only being of benefit at the national level but also at the global scale.

We believe that NAMAs provide a real opportunity for developing countries to direct their efforts at the realization of a low-carbon development path. To date, literature on NAMAs has been both accessible and prolific, but with a particular focus on their theoretical background or detailing the steps involved in developing a NAMA.

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The focus of this Guidebook is therefore on providing an easy-to-read document for practitioners working in the implementation phase of NAMAs. The idea is to provide a "living document" that will involve the constant compilation of case studies of the actual experiences of developing countries "at the ground level" . The lessons learned can then be extracted from those examples and by adding new case studies shared by our international partner organizations, future steps to take can be inferred. Without discrediting any other efforts we believe that the compilation of real examples will be the core difference with all the other numerous documents published regarding this matter.

Chapters 1 and 2 summarize the historical background of NAMAs, as based on the development of international negotiations under the UNFCCC, and the theoretical aspects that make up the elements of NAMAs, and the building blocks involved in the preparation of NAMAs. Chapter 2 also introduces the links between sustainable development and the low-carbon development plans of developing countries, as well as financial sources and other support schemes.

Two different approaches to take with NAMAs (namely, the top-down approach and the bottom-up approach) are explained in Chapter 3 with the purpose of providing decision-makers with options to use in the early planning stage. The top-down approach attempts to cover overall sectoral emissions at the macro level via use of statistical information and models, whereas the bottom-up approach basically focuses on emissions and emissions reduction potential at the activity level (entity, project, or the parts of a program) and aggregates them into a larger mass, which is the equivalent of the total emissions from the sector concerned.

Chapter 4 is a compilation of case studies, although mainly in the Asian region but with the important addition of a Latin American case study. Finally, the Guidebook concludes with Chapter 5, which provides key lessons and recommendations obtained in the implementation of the above.

The intention with this Guidebook was to make useful and practical information available to anyone involved in the implementation of NAMAs. Our belief is that the knowledge made available in this document could be very useful in either the replication of projects or the creation of new ones. This initiative was made possible through a collaboration of several different organizations and hence we hope that it will serve as a tool in encouraging dialogue with new partners and further enriching future editions of this document.

ACKNOWLEDGEMENTS

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We would like to thank our partner organizations in Japan, namely the National Institute for Environmental Studies (NIES), the Institute for Global Environmental Strategies (IGES), and MHIR, for contributing to the writing of this Guidebook and for participating in its overall coordination.

We are extremely thankful to the Ministry of Environment of Cambodia (MOEC), the Ministry of Natural Resources and Environment of Lao PDR (MONRE), the Ministry of Environment and Green Development (MEGD), Mongolia, and the Ministry of Natural Resources and Environment (MONRE), Vietnam, for contributing their case studies. It was extremely beneficial to work together and create the new knowledge that can be shared through this document.

Special thanks go out to our colleagues from the World Resources Institute (WRI and CEP), for generously sharing some of their own experiences and also participating in the review of this document.

Invitation:

We would very much welcome any messages of intent to share new case studies for use in the publication of the 2nd edition of this Guidebook. Any comments or inquiries can be sent to:

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ORGANIZATION OF BASIC ELEMENTS OF NAMAS

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The Copenhagen Accord and subsequent requests made at the 16th and 17th Conferences of the Parties (COP16 and COP17) for additional submissions have resulted, to date, 57 developing countries and one group having submitted information on their Nationally Appropriate Mitigation Actions (NAMAs) to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat. A number of other developing countries are also in the process of preparing their NAMAs. It is generally understood that the aim of NAMAs is to achieve a deviation from Business as Usual (BAU) emissions by 2020 in developing countries, however, the definition of NAMAs has remained rather ambiguous, with quite a bit of room for different interpretations. This has led to a significant amount of diversity in the NAMAs submitted both in terms of their type and their scope, ranging from project-based actions, sector-based actions, and policies and measures, and right through to economy-wide targets. However, despite the ambiguity of the concept and the diversity of the NAMAs submitted the core feature of NAMAs is that they revolve around the context of sustainable development, and can provide significant low carbon development path opportunities for developing countries.
This chapter provides basic information which can be of aid to the various stakeholders involved when considering possible NAMAs. The first section of this chapter discusses the COP decisions that are related to NAMAs and clarifies what has been agreed upon as minimum NAMA requirements and what is left up to the discretion of developing countries. The second section then identifies the basic elements and approaches which policymakers and other stakeholders need to take into account. The third section introduces various international schemes, both within and outside the UNFCCC framework, and which can be of help to developing countries when formulating and implementing their NAMAs.

2.1 Elements of NAMAs agreed in UNFCCC COP decisions

By | Makoto Kato (Overseas Environmental Cooperation Center, Japan)

2.1.1 Introduction

While mitigation actions in developing countries have been in place and in its essence these are not necessarily new, such actions in the context of the UNFCCC emerged recently. Since the nature of mitigation actions communicated to the Convention, as mitigation pledges by Non-Annex I (NAI) parties are framed by recent COP decisions, it is important to sort out what has been agreed as minimum requirements, and what is being left to the discretion of developing country parties particularly important.

2.1.2 Historical background

The UNFCCC, as the legal foundation of the international regime, generally provides its ultimate objectives, and requires parties to provide national communications on their Greenhouse Gas (GHG) emissions. The Kyoto Protocol sets legally binding targets for Annex I (AXI) Parties only; while for NAI parties the Clean Development Mechanism (CDM) was the only way to participate in mitigation actions at the UNFCCC regime. However, when COP started negotiating a post 2012 regime a lot of attention was paid to how increasing GHG emissions by NAI parties would be mitigated, together with those concerning AXI, thus making the issue of mitigation by NAI an essential part of the negotiation package.

The Bali Action Plan (1/CP.13) adopted at COP13 in 2007 was the first COP decision to explicitly mention NAMAs, and established a negotiation process for a future regime through the Ad Hoc Working Group on Long-term Cooperative Actions (AWG-LCA), including mitigation actions to be taken by NAI, and with a view to achieving an agreement in 2 years' time. The Copenhagen Conference in 2009, despite rather high expectations, only took note of the Copenhagen Accord, which literally contained ideas concerning NAMAs in more detail, including a call for pledges from NAI. However, based on this, the Cancun Agreement was adopted to formalize those ideas, and the subsequent Durban Decisions then added procedures and format of reporting through Biennial Update Report (BUR) and International Consultation and Analysis (ICA). The AWG-LCA concluded the matters that concerned it at COP 18, and thus issues related to NAMAs were decided either to be dealt with by the Subsidiary Bodies or continued to be discussed at the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP).

2.1.3 Elements of NAMAs in the UNFCCC context

It is primarily important to note that NAMAs expressed by NAI are diverse, and that due to its inherent nature NAI can design any kind of NAMAs, being in accordance with their national development policies and circumstances. At the same time, being made alongside the series of abovementioned COP decisions, the elements of NAMAs are framed. In other words, the following elements can be perceived to be the minimum requirements to fulfill when designing NAMAs, together with the general directions that NAI parties are expected to take.

- **NAMAs are always subject to measurement, reporting, and verification (MRV)**
  MRV has been a constantly indispensable element both at the outset of negotiations and when COP decisions regarding NAMAs were adopted, and it is understood that when NAI are implementing NAMAs, any such mitigation actions, will be subject to an MRV. The Cancun Agreements state that while internationally supported NAMAs will be ' MRVed' domestically they are also subject to international MRV, while also having decided that domestically supported NAMAs would be 'MRVed' domestically.

- **NAI have access to support by technology, financing, and capacity-building**
  According to the Bali Action Plan, as well as the subsequent COP decisions it is stipulated that NAI can be supported with technology, financing and capacity-building, and that AXI parties shall provide enhanced support for the preparation and implementation of NAMAs (para 52, 1/CP.16) .

- **NAMAs should aim (at least) at a deviation from business-as-usual emissions (BAU) in 2020**
  It was agreed in 2/CP.16 that NAI would take NAMAs in the context of sustainable development, being supported and enabled with technology, finance and capacity-building, and with the aim of achieving a deviation in emissions relative to BAU emissions in 2020 (para 48, 1/CP.16).[1] In other words, a deviation from BAU emissions in 2020 is a minimum requirement for NAMAs, and which is exactly why it is so important to both consider and clarify assumptions and methodologies used to set any such BAU emission goals when designing and implementing NAMAs.

[1] Most of the pledges expressed to date were made in response to the Copenhagen Agreement, and thus any such pledges recorded at FCCC/AWGLCA/2011/INF.1 do not necessarily contain information regarding a deviation from BAU emissions in 2020. This therefore makes quantifying GHG emissions and their mitigation as the next step rather important.

- **NAMAs are reported in BURs and described with quantitative goals and progress indicators**
  As a hint for use in shaping the technical nature of NAMAs, the Guidelines for BURs (2/CP.17 Annex III) include a lot of the important parts that constitute NAMAs. For example, NAMAs should clarify:
  (a) Information on the nature of the actions, coverage (i.e. sectors and gases), quantitative goals, and progress indicators;
  (b) Information on methodologies and assumptions;
  (c) Objectives of the action and steps taken or envisaged to achieve that action;
  (d) Information on the progress of implementation of the mitigation actions and the underlying steps taken or envisaged, and the results achieved, such as estimated outcomes and estimated emission reductions, to the extent possible; and
  (e) Information on international market mechanisms.

- **NAMAs are encouraged to be linked to low carbon development strategies and planning**
  NAMAs are considered to be a driver for the co-benefits of sustainable development, and NAMAs are encouraged to be developed within the larger context of national planning (para 65, 1/CP.16)

2.2 Shaping NAMAs : Essential building blocks and steps

By | Koji Fukuda, Kentaro Tamura (Institute for Global Environmental Strategies)

This section explores andidentifiesthe basic but essential building blocks that need to be taken into account when designing NAMAs,while also introducinga strategic way of thinking about
1) how NAMAs can beutilizedinpractice to achieve a broader range of national sustainable development goals,and
2) how to establish links between upstream national visions/targets with on-the-ground activities.
The possible diverserange of approaches and pathwaysto take whenformulating NAMA tailored to the individual national circumstances and needs are also discussed.

2.2.1 Link between NAMAs and sustainable development

It is always useful to start with the long-term vision overalland national development aspiration when initially designing NAMAs:theyare envisaged as being implemented with**in the context of sustainable development** and toprovide practical opportunities for developing nationsto steer towards taking a **low carbon development pathway.**

NAMAs as a tipping point toward low carbon development
Low carbon development (or low emission development in UNFCCC negotiations) is a concept that revolves around sustainable development, and has beensteadily gaining growing attentionfrom theinternational community. There is no agreed definition for what constitutes “low carbon”, but with King (2009), after having reviewed various attempts to define it, having identified some of the common

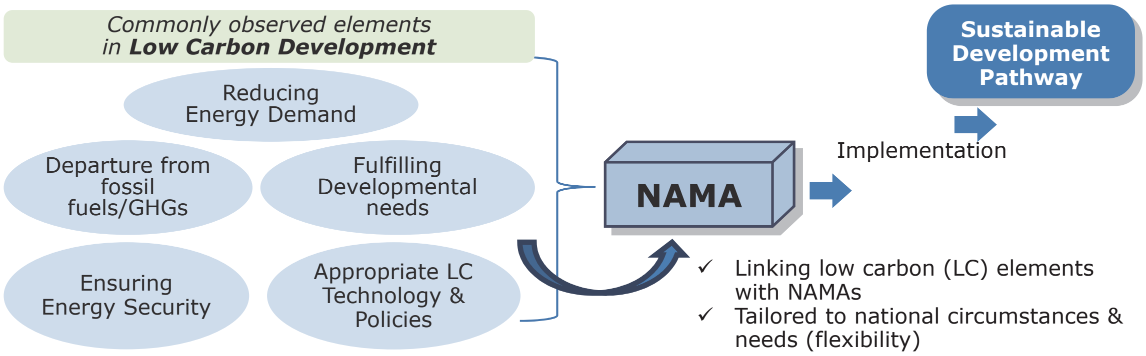
elementsthat are indispensable in achieving sustainability, which are as shown in Figure 2.1.:

(i) reducing energy demand;
(ii) moving away from carbon-intensive fossil fuels and their associated GHG emissions;
(iii) continuing to meet the developmental needs of all groups across society, but especially those of the poor and/or vulnerable;
(iv) ensuring energy security; and
(v) adopting appropriate technologies and policies that continuously lead toward a low carbon society,

An emphasis on energy and departure from fossil fuel utilization distinguishes the low carbon development concept from more general sustainable development paths, but low carbon development does serve as an integral part of sustainable development.

For developing countries, low carbon developments can provide various leapfrogging opportunitiesthat will be in accordance with their different stages/levels of development. For example, for Least

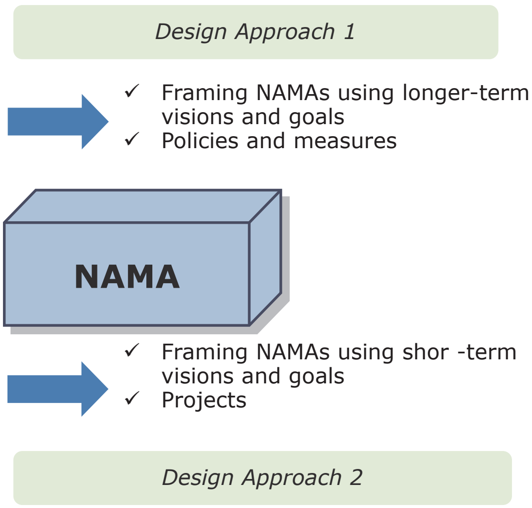
Figure 2.1. Low Carbon Development as an integral part of Sustainable Development



Developed Countries (LDCs) they canprovide the opportunity to take a late comer's advantageby tappinginto low carbon technologies, thereby avoiding the carbon lock-in associated with conventional modernization and urbanization pathways. Likewise, for middle-income countries they can provide theopportunity to escape from the "middle income trap" by transforming a resource-intensive economy to a more efficient and competitive one.

These opportunities are indeed well recognized and captured by developing countries in Asia. Thailand, for example, has a draft National Master Plan on Climate Change 2011-2050 that presents a long-term vision which aims at being a low-carbon society within the next 40 years. In addition, the 11th National Economic and Social Development Plan 2011-2016 calls for a low carbon economy being part of the national development strategy. Similarly, Vietnam launched the Socio-Economic Development Strategy 2011-2020 that set a mid-term vision of being an industrialised country by 2020, and with low carbon development clearly being viewed as an opportunity to transform a resource-intensive economy into a more resource-efficient and competitive one. NAMAs, therefore, can serve to be an effective tipping point toward low carbon development.

Figure 2.2. NAMA Design Process



That realisation of such opportunities and national visions make understanding the different approaches to use when formulating NAMAs particularly useful in the design process (Figure 2.2). One approach is to start with an upstream vision: position NAMAs over the long-term but toward the realisation of sustainable, low carbon development, and provide developing countries with cost-effective and technically feasible mitigation policy and measure options.

This approach enables NAMAs to be embedded within national developmental priorities and thus ensures policy coherence that is coupled to multi-sectoral engagement. The establishment of links between NAMAs and long-term visions is then followed by strategic planning that includes a set of concrete measures to use in achieving the vision concerned. The second approach focuses on positioning NAMAs within short-term visions instead, and with goals that emphasize the links between NAMAs and existing policies and measures. In this case the scope of NAMAs can be considered as being limited to one mitigation sector. Both approaches have their own individual advantages and challenges, and thus require different sets of technical capabilities. Thorough strategic thinking is therefore needed a priori when assessing which approach is best suited for a particular country reflecting national circumstances, degree of political acceptability, existing capabilities, and national vision on sustainable development. Indeed, developing Asian countries are demonstrating a wide range of diversity in the approaches they take when crafting NAMAs. This will be further elaborated upon in Chapter 3 and empirical examples then provided in Chapter 4.

2.2.2 Reflecting developing countries' priorities: Diversity and sectoral comprehensiveness

There is general understanding within the UNFCCC context that the NAMAs of developing countries aim at achieving a deviation from BAU GHG emissions by 2020 (paragraph 48, 1/CP.16), but the definition of NAMAs has basically remained ambiguous, with room left for different interpretations being made by the country concerned. This flexibility consequently led to a significant range of diversity in submitted NAMAs in terms of the type and sectoral coverage; ranging from activity that enables the conditions needed for mitigation, project-level mitigation actions, sector-level actions, policies, and measures, and to economy-wide targets (Fukuda and Tamura 2011).

Here, the enabling conditions include preparation of National Communications, including GHG inventories, and the identification of NAMAs per se. Project-level actions are essentially CDM-like mitigation projects, although with differing levels of maturity and project design details. Economy-wide targets include sub-categories such as absolute emission reduction targets that use a specific base year, emission reduction targets that use BAU emissions, as well as intensity emission targets (emission reductions per GDP) and carbon neutrality (keeping the level of emissions at the same as or less than carbon sinks).
Given what has been proposed to date by the different countries the sectoral coverage of NAMAs is likely to be more comprehensive than that of the CDM. The CDM is a market-based mechanism, and hence tends to be more biased toward specific sectors. On the other hand, it is ultimately developing

countries that decide the sectoral scope of NAMAs[1]. From the standpoint of sectoral inclusiveness it is therefore worthwhile pointing out that building, transportation, agriculture, and forest sectors are all fairly evenly covered by NAMAs. Those sectors are often not sufficiently tapped nor captured by CDM, even though they can have significant implications for the sustainable development of developing countries. This then suggests a possible strategic utilization of NAMAs; the harnessing of both NAMAs and CDM in a complementary manner in thereby identifying and realizing a broader range of mitigation potential and needs at an appropriate scale.

Table 2.1. Diversity of Submitted NAMAs

Category 1	Category 2	Category 3		Category 4			
Enabling Conditions[1]	Project-level Activities	Sector/ policy-level Activities		Economy-wide Targets			
				Intensity targets (GDP)	Absolute targets		
					Base Year	BAU	Carbon Nutrality[2]
Afghanistan Georgia Tajikistan	Ethiopia Jordan Mongolia Morocco The former Yugoslav Republic of Macedonia	Algeria Argentina Armenia Benin Botswana Cambodia Cameroon Central African Republic Chad Colombia Congo Côte d'Ivoire	Eritrea Gabon Ghana Madagascar Mauritania Mauritius Peru San Marino Sierra Leone Togo Tunisia	China India	Antigua Barbuda (1990) Marshall Islands (2009) Republic of Moldova (1990)	Brazil Chile Indonesia Israel Mexico Papua New Guinea Republic of Korea Singapore South Africa	Bhutan Costa Rica Maldives

Note: [1] Category 1 includes such mitigation related actions as preparation for Initial National Communication (INC), GHG Inventories, identification of BAU emission paths, and identification of actual NAMAs themselves, among others.
[2] Carbon neutrality refers to achieving zero net GHG emissions by balancing total anthropogenic GHG emissions with the total amount of carbon sequestrations, emission reductions, and offsets.

Source: Fukuda and Tamura (2011), modified.

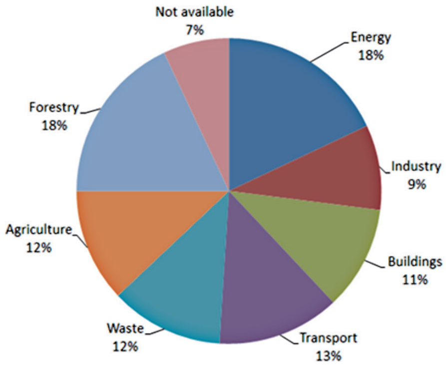
2.2.3 Key elements of NAMAs

The NAMA formulation process requires thorough planning with respect to how to design and link the different building blocks used together, followed by a national consensus creation process through multi-stakeholder consultations. Even in cases where NAMAs could also have been decided upon in a decidedly top down fashion, for example like Indonesia, ensuring stakeholder engagement and national consultations remains the key to successful implementation and with a strong sense of ownership. This nation-wide, inclusive exercise can be indeed extremely time-consuming and labor-intensive in nature; the process typically requiring the effort, commitment, and skills of all those involved, along with an expected institutional capacity in leading, facilitating, and concluding the process to enable informed national decision-making. However, the reward of this transformation can be enormous; if well-designed NAMAs can serve as the tipping point for steering a country towards a low carbon development path, which can then attract and mobilize additional support and investment.

[1] An exception could be crediting NAMAs in which the market continues to play a dominant role.

What, then, should constitute NAMAs? The integration of national circumstances and sectoral prioritization is required on a country by country basis alongside their differing national circumstances, but the below diagram summarizes the major steps, tools, and institutions that are essential when formulating NAMAs embedded in a national plan, and subsequent implementation stages.

Figure 2.3. Sectoral Convergence of Nationally Appropriate Mitigation Actions (NAMAs) submitted to the UNFCCC Secretariat



Source: ECN ECOFYS, 2012

While keeping the key steps and tools of the planning stage of NAMAs in mind it is essential to also build on and elaborate upon the three dimensions (technical, mainstream, and institutional) involved in NAMAs, and which can then lay the foundation for a national NAMA formulation consensus to be reached.

Technical dimension: NAMAs need to be based on an accurate understanding of current and future GHG emissions trends, possible mitigation options, and their cost implications. This dimension constitutes: 1) an understanding of current GHG emissions and projection of future GHG emissions; 2) identification and prioritization of mitigation options; and 3) cost estimates of mitigation options. Each component requires technical expertise with analytical capacity at national level, which in part, can be supplemented by harnessing domestic technical institutions and experts. This strategic engagement of domestic institutions is indeed needed to ensure long-term national capacity development, as well as to ensure national ownership and confidence in the process. Further technical assistance and capacity development can be injected to help closing the capacity gap required for analysis, identification, and implementation of mitigation options/scenarios for NAMAs. Even in the case of project-level NAMA formulations this kind of technical information can serve as a robust basis for policymakers to strategically prioritize specific mitigation projects that are consistent with national development plans and priorities.

Figure 2.4. Major Steps and Tools at Formulation Phase of economy-wide NAMAs

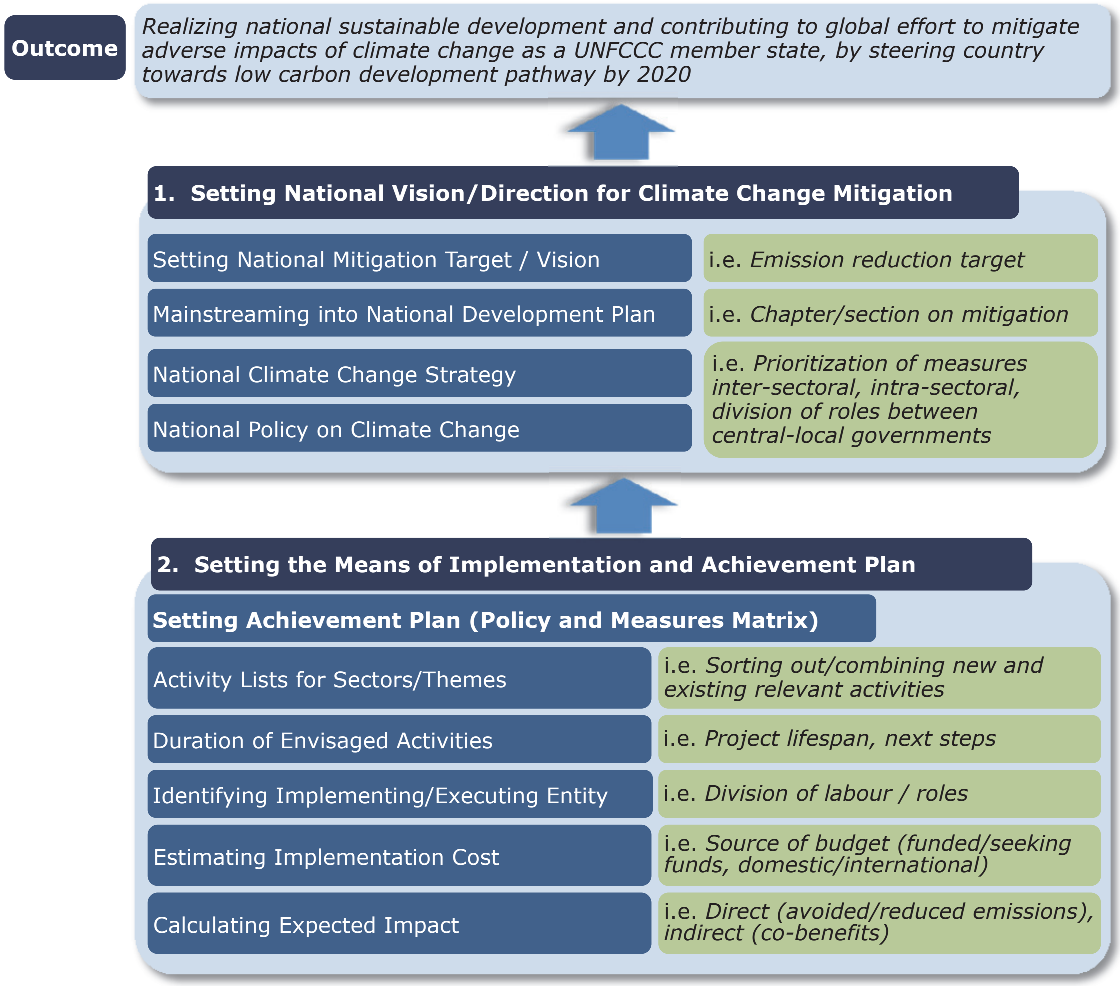
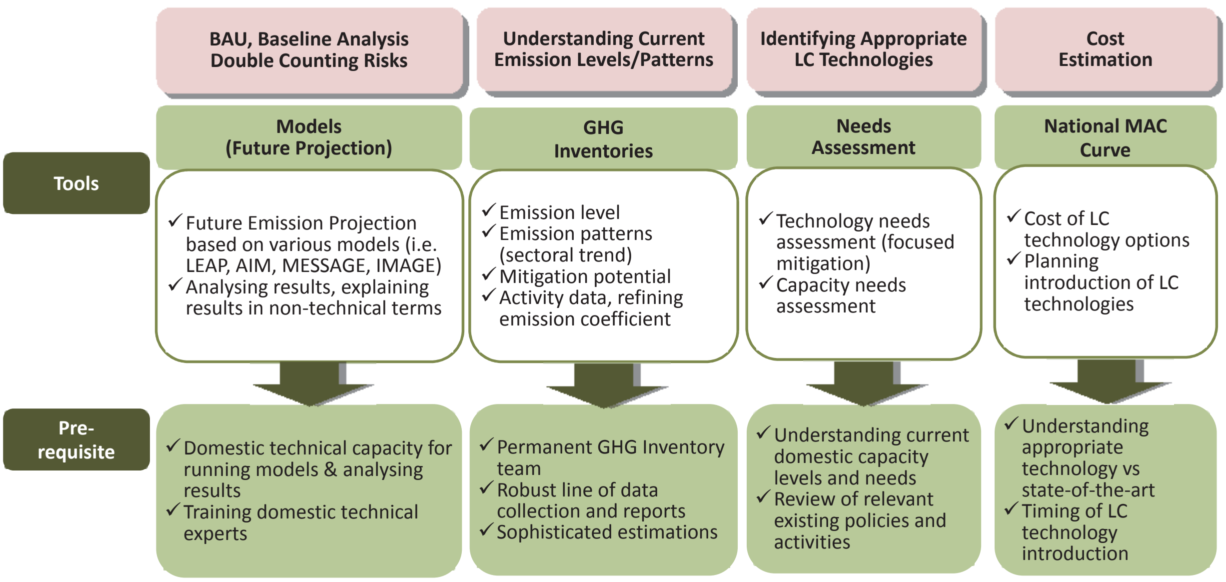


Figure 2.5. Tools that Support Technical Dimensions and Prerequisites



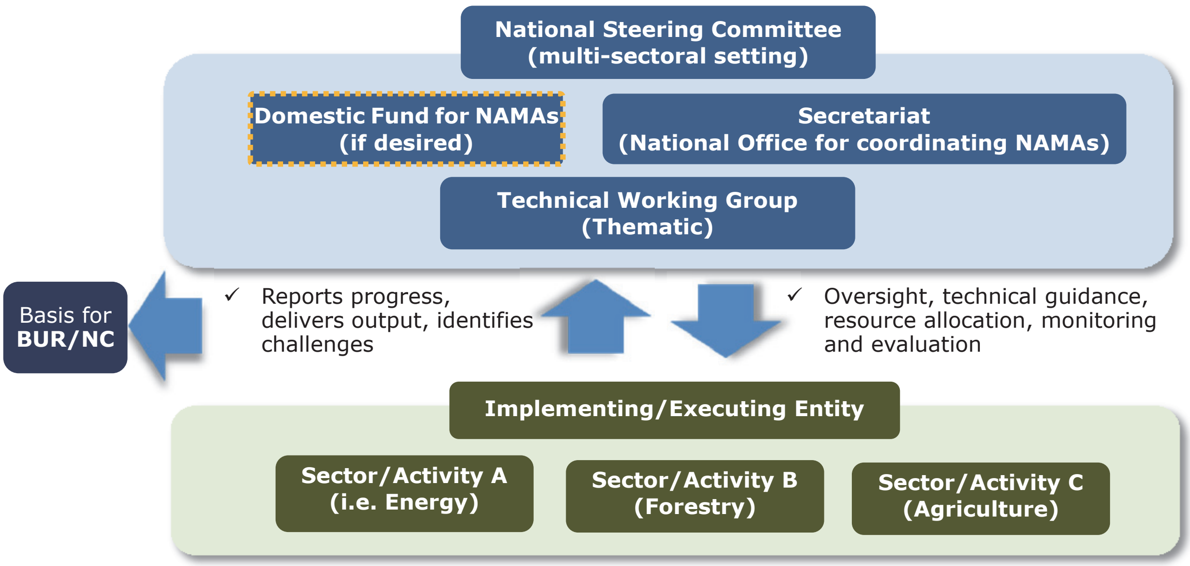
Mainstream dimension: In principle, NAMAs need to be embedded within overall national priorities. This dimension consists of three components: 1) inclusion of a climate change mitigation agenda within national development plans and priorities; 2) identification of priority sectors, policies, and measures; and 3) the development of mitigation action plans with operational details. Mainstreaming is essential in ensuring policy and sectoral coherence, and provides a rationale for future budget allocations.

For the first and second component, it is important for a country to seize the right "timing" of mainstreaming to ensure that climate change mitigation agenda is adequately captured. For example, injecting climate change mitigation agenda at the planning year/stage will be critical to be reflected and align with the life-cycle of 5-year development plan. The same principle applies to alignment with sectoral policies, by capturing drafting and revising process for the climate change agenda to be taken into account. Such careful planning on "when" and "how" could expedite ensuring consistencies and coherence among existing plans and policies within the country.

For the third component, from operational perspective, it is also ideal that the mitigation action plans resulting from mainstreaming efforts reach the certain level of specificity (clearly identifying envisaged goals, outcomes, outputs, durations and cost estimations for each actions defined). This will certainly increase predictability of the impacts of NAMAs, help avoiding NAMAs to become simple wish-lists, and help interested donors and investors to better identify areas of support with confidence.

Institutional dimension: NAMAs need to be formulated through a cross-ministerial decision-making process that can be used to coordinate and reconcile diverse domestic interests. This dimension again consists of three components: 1) the establishment of a national, cross-ministerial decision-making process on climate change mitigation, preferably being a high-level setting and therefore capable of reconciling any potential conflict between the different institutions involved; 2) coordination of the different stakeholders involved in the mitigation efforts; and 3) task allocation of NAMAs formulation and implementation among the ministries and stakeholders concerned.

Figure 2.6. Model Institutional Framework that Supports NAMA Formulation and Implementation



Ensuring harmony between the different institutions with their different mandates and priorities requires solid managerial and facilitative capabilities and experience (Fukuda and Tamura 2012). That role can, however, be further reinforced by affording appropriate legal status to the coordinating entity. The appointment of any such coordinating entity, however, requires political considerations and capacity assessments to be taken into account in thereby ensuring harmonization proceeds accordingly. And in addition to these elements a country may opt to create a domestic fund to use to amass and channel resources designated for NAMAs implementation.

2.2.4 Progress observed in Southeast Asia and lessons learnt

Fukuda and Tamura (2012) provide comparative assessments of NAMA formulation processes in five ASEAN countries—Cambodia, Indonesia, Lao PDR, Thailand and Viet Nam—along with the three analytical dimensions. This section provides snapshots of the progress and efforts made by these ASEAN countries over the three dimensions of NAMAs.

Technical Dimension of NAMA Formulation

Observations

- There are observable differences in the level of in-house capabilities of the five countries. At moment Cambodia and Lao PDR display the gap between existing domestic technical capabilities and technical expertise required for analyses and country projections, whereas the other countries are equipped with higher levels of technical capabilities.
- Data collection and sharing across the different ministries pose a challenge to all the countries. However, various initiatives are being implemented in thereby addressing this issue. For example, Indonesia advanced in establishing a legal basis for national GHG inventories and the placement of a permanent team, while Viet Nam is also in the process of establishing institutional arrangements regarding inventories.
- Indonesia and Thailand are also creating voluntary emission reduction schemes with quite robust accounting rules and emission reduction systems. These measures contribute to the streamlining of data collection and sharing, and strengthen the MRV foundation.

Lessons Learnt

- All the countries has room for the further improvement and sophistication of their technical capability to capture GHG emission trends using BAU estimates, mitigation potential, and associated cost. Enhancing these technical capabilities based on detailed needs assessment can contribute to furthering a sense of ownership of NAMAs.
- Ideally multiple sets of projection models need to be identified, selected and utilized that will then trigger national technical discussions and improve projection accuracy, while also enabling cross-country comparisons.
- Existing initiatives to improve the collection and sharing of data can provide mutual opportunities within the region, and experience then shared between neighbouring countries that will induce positive technical spill-overs. Support modality for any such south-south cooperation therefore needs to be elaborated upon towards robust national data management and sharing system.

Mainstream Dimension of NAMA Formulation

Observations

- While mainstreaming efforts can be observed in all the countries there is a contrast in terms of the lead entity involved in the mainstreaming process. Developmental ministries were assigned to play the lead role in Indonesia and Viet Nam, but environmental ministries and agencies in the case of Cambodia and Thailand. Further analysis could prove helpful in assessing how and to what extent any such difference in the lead entity and their capabilities can affect the actual implementation of the mainstreaming process in each country.

- Most of the countries try to ensure NAMAs' contribute to sustainable development via use of existing sectoral policies and programmes (energy efficiency, renewable energy, forestry, agriculture) as the initial point when considering NAMAs.

Lessons Learnt

- Regardless of which entity takes the lead in the NAMA formulation process they must have the appropriate capabilities, experience and confidence to lead, coordinate, and facilitate the domestic process involved.
- Drawing from existing sectoral policies and programmes is a reasonable entry point for NAMAs. It is important to view NAMAs as a continuous process involving raising the level of mitigation actions over time rather than a one-off event, and through which developing countries can increase the level of mitigation actions and expand the scope of mitigation activities. This is an area where the mainstream dimension interacts with the other two dimensions (technical understanding of mitigation potential and cost estimate, and institutional arrangements for decision-making and implementation).

Institutional Dimension of NAMA Formulation

Observations

- All the five countries have established high-level cross-ministerial policy processes. However, further analysis is necessary regarding identifying how they actually work. In particular, the question of how the design and formulation of NAMAs should be discussed is yet to be determined in some of the countries, for example Thailand and Viet Nam.
- The emergence of NAMAs creates evolving dynamics in how climate change mitigation is managed domestically in many developing countries. Any such change results in "Institutional congestion", as is indeed observable in most of the countries examined. Many NAMA-related initiatives and similar but not identical initiatives, for example Low-Emission Development Strategies (LEDS) and national green growth strategies, are simultaneously emerging in each country. This could potentially result in a sound level of competition between the various initiatives, but in reality there can be unnecessary overlapping and inefficiency alongside fragmentation of resources, which then leads to institutional congestion.

Lessons Learnt

- Physical establishment of climate change institutions is an important initial step in the NAMA
- formulation process, but it does not automatically prove the robustness of any such institution nor become a proxy for institutional capabilities to effectively handle multi-sectoral reality. The ideal situation would be capability assessments and developments being planned and then provided to the designated lead entity in strengthening the NAMA formulation process.
- Relieving any potential institutional congestion requires both improving the capabilities of the domestic coordinating bodies involved in the various sectoral initiatives and streamlining the variety of NAMA-related support provided through harmonization efforts among international donors.

2.2.5 The way forward

In essence, NAMAs do provide practical opportunities for developing countries; if well-designed they can serve as an effective tipping point for transforming countries towards low carbon development, which is the essential component in envisaged sustainable development. Flexibility being attached to country's individual interpretations of NAMAs does allow for developing countries to tailor to and incorporate their differing national circumstances but can also pose the risk of resulting in a poor design if not well planned. Strategic thinking is therefore highly recommended with regard to how to best seize any such opportunity. Linking upstream national visions/targets to on-the-ground activities can be one approach used in NAMAs formulations and which will therefore be further explored in the following chapters.

The design, selection, and effective utilization of the steps and tools used with NAMAs are also crucial in increasing the robustness of the formulation process, along with planning on how to invest in and strengthen the three dimensions involved in NAMAs: technical, mainstream, and institutional dimensions.

NAMA formulation processes can already be observed to have made progress in many developing countries, but various practical challenges still remain. NAMAs require concerted and coordinated efforts by all the domestic stakeholders during their formulation stage. This process ensures appropriate interpretations to remove any conceptual ambiguity and in accommodating the variety of mitigation needs.

NAMAs being considered using a timeframe and envisaging the possible evolution of component activities also enables them to be linked to longer-term sustainable development. And in this sense, therefore, NAMAs should not be regarded as a one-off event and instead a continuous process through which developing countries can increase their level of mitigation actions while also expanding their scope over time. Strategic long-term consideration of adopting more ambitious mitigation targets and/or activities, as well as expansion into other mitigation sector activities and areas over time could both therefore also be very useful in the process.

Developing countries also need to take into consideration strategic thinking with regard to how to best utilize NAMAs to attract more international support in terms of finance, low carbon technologies, and capability creation. Schemes that can be used to support NAMAs will be discussed in the following Section 2.4.

References:

Fukuda, K., and K. Tamura (2011) "An Analysis of Non-Annex I Parties NAMAs: Challenges for Designing International Support and Implementing an Effective MRV Framework" *Negotiating a Low Carbon Transition in Asia: NAMAs and MRV.* Hayama: Institute for Global Environmental Strategies.

Fukuda, K., and K. Tamura (2012) "From NAMAs to Low Carbon Development in Southeast Asia: Technical, Mainstreaming, and Institutional Dimensions" *IGES Policy Brief* #23 Hayama: Institute for Global Environmental Strategies.

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2.3 NAMA finance and support schemes

By | Yuqing Ariel Yu, Kentaro Tamura, Koji Fukuda and Noriko Shimizu (Institute for Global Environmental Strategies)

NAMA finance aims to effectively mobilize financial resources for developing countries to use in formulating and implementing NAMAs. There are also various other non-financially based schemes that can be used as support when preparing and implementing NAMAs. NAMAs tend to have a greater focus on integrating climate policy actions with the sustainable development goals of developing countries, and therefore NAMA support, in principle, should not be limited to specific projects and instead program based and available across the entire sector or industry.

The lack of a clear definition for a NAMA indicates that there exists considerable room for flexibility and customization when designing NAMA support schemes. International support for NAMAs is currently available both from the UNFCCC (Section 4.1) and externally to the UNFCCC through bilateral and multilateral initiatives (Section 4.2).

2.3.1 UNFCCC schemes

Financial Mechanism used by UNFCCC

The existing operating entity of the UNFCCC financial mechanism—the Global Environmental Facility (GEF)—has distributed the largest amount of mitigation finance to date but is in fact not dedicated to supporting NAMAs. The GEF fourth and fifth replenishments (2006-2014) resulted in only two approved Asian projects having been specified in title as NAMA projects, although many projects may actually be closely analogous to NAMAs and have the potential to be recognized as NAMAs by recipient countries in the future.

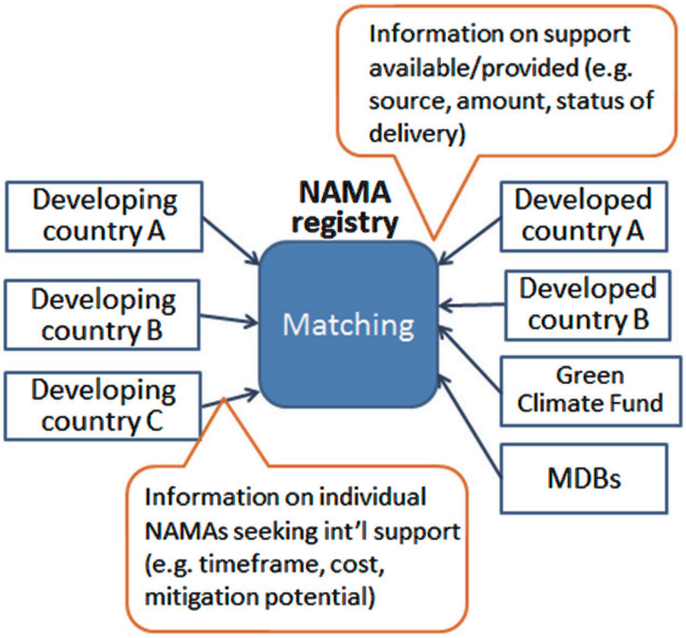
However, that situation is expected to change after the operationalization of several emerging UNFCCC schemes. The intention with the new operating entity of the UNFCCC financial mechanism—the Green Climate Fund (GCF)—is to become the main global fund for use in climate financing matters and aims at pursuing a country-driven approach, while also promoting environmental, social, economic and developmental co-benefits (GCF, 2011).

NAMA Registry

Another emerging UNFCCC scheme involves a NAMA Registry[2]. The NAMA Registry incorporates two major functions: 1) facilitating matches between NAMAs seeking international support with finance, technology, and capability creation support; and 2) providing NAMAs with international recognition (Figure 2.7). Before the official launch of the registry any developing countries that sought NAMA support and recognition and donors offering potential support would submit information to a prototype of the registry. 12 activities from 5 developing countries had been registered as NAMAs seeking preparation support by August 2013, along with 24 activities from 8 developing countries as NAMAs seeking implementation support.

[2] For further details of the NAMA Registry, see http://unfccc.int/cooperation_support/nama/items/7476.php

Figure 2.7. Matching Function of the NAMA Registry

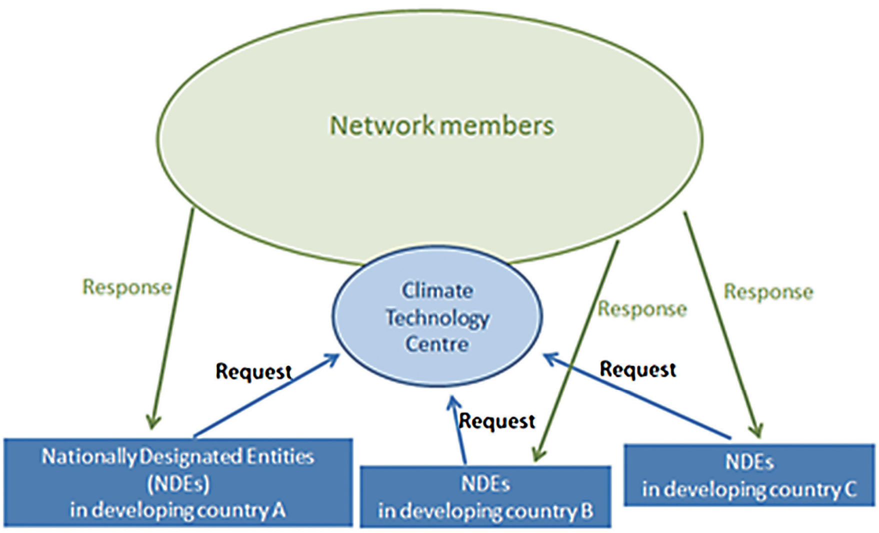


They included Indonesia and the Cook Islands seeking implementation support and Germany and the UK, along with the GEF, submitting information on available support. No matches between them have taken place yet but which can be expected to occur after the registry has been officially launched.

Climate Technology Centre and Network (CTCN)

The Climate Technology Centre and Network (CTCN)—the operational arm of the UNFCCC Technology Mechanism—is another emerging scheme that can assist developing countries to prepare and implement their NAMAs (Figure 2.8)[3]. The CTCN does not provide any direct funding to developing countries and instead aims to support the development and transfer of climate change mitigation and adaptation technologies in developing countries through the provision of expert technical assistance (CTCN, 2013). Developing countries can make requests through Nationally Designated Entities (NDEs) to the Climate Technology Centre (CTC), which the CTC and the Climate Technology Network (CTN) then respond to. Further details regarding its operation and arrangements are, however, yet to be determined.

Figure 2.8 Climate Technology Centre and Network



[3] For further details on CTCN, see http://www.unep.org/climatechange/ctcn/

Framework for Various Other Approaches: Joint Crediting Mechanism

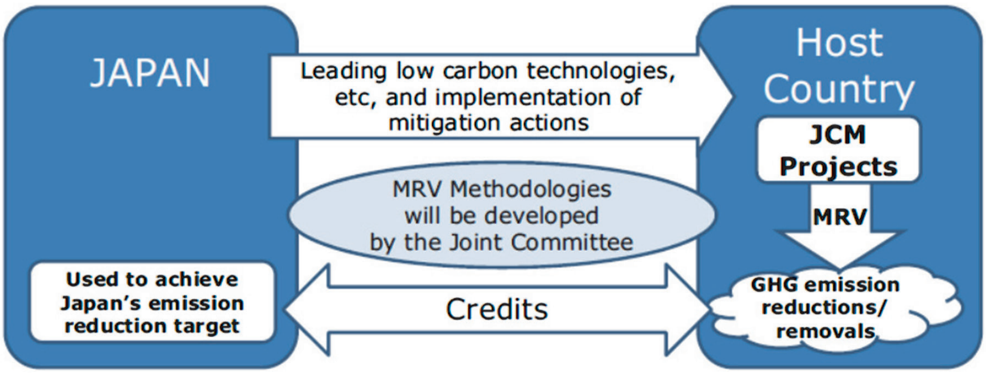
The Japanese government is proposing use of a Joint Crediting Mechanism (JCM) as a scheme within the framework used for various other approaches, but which is still being discussed. The JCM is a scheme through which Japanese low carbon technologies can be transferred to mitigation projects in the host developing country and verified reductions or removals from mitigation projects then used as part of internationally pledged GHG mitigation efforts by the two reciprocal countries in the future (Figure 2.9). The JCM is currently operating as a non-tradable crediting mechanism. As of January 2014 the Japanese government had concluded bilateral JCM agreements with ten developing countries' governments (Mongolia, Bangladesh, Ethiopia, Kenya, the Maldives, Viet Nam, Lao PDR, Indonesia, Costa Rica, and Palau).

2.3.2 Bilateral and multilateral initiatives

Bilateral initiatives

The expectation is that NAMA support will rely on bilateral funding, at least over the short term, due to several reasons (Tilburg et al., 2012). First, the political nature of NAMAs is somewhat incompatible with the non-political stance that Multilateral Development Banks (MDBs) typically maintain. Second, agreements being reached on acceptable criteria for NAMA support is more difficult with multilateral than bilateral sources of support. Third, some developed countries are demonstrating a very strong will to prove the NAMA concept and are pushing forward with their climate negotiations.

Figure 2.9. Joint Crediting Mechanism proposed by the Japanese government



Source: Ministry of the Environment, Japan

Table 2.2. A selection of bilateral support for NAMA readiness involving Asian countries

Type of instrument	Lead institute(s)	Bilateral initiative/program	Description	Supported countries
Finance institute	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	TRANSfer	Develop climate change strategies within the transport sector for registration as NAMAs	Indonesia, Colombia, and South Africa
	Japan international cooperation agency (JICA)	Master plan for energy conservation	Support government agencies to acquire the data collection skills and framework formulation regarding reducing energy intensity	Malaysia, Vietnam, South Africa, and Turkey
	The Nordic environment finance corporation (NEFCO) and the Nordic working group for global climate negotiations (NOAK)	Nordic Partnership Initiative	Increase the capacity of host countries to evaluate, structure, and implement NAMAs	Vietnam and Peru
Research institute	Centre for Clean Air Policy (CCAP)	MAIN dialogue	Increase the capacity of developing countries to design and develop ambitious NAMAs that can leverage contributing-country funds in achieving both greenhouse gas and sustainable development goals	China, Indonesia, Malaysia, Philippines, Thailand, Vietnam, and Latin American countries
	ECN and Ecofys	Mitigation Momentum	Support the development of NAMAs by contributing to the development of concrete NAMA proposals and foster cooperation and knowledge exchanges within the NAMA community	Indonesia and 4 other countries
	Ecofys	NAMA database	Track ongoing NAMA activities ranging from feasibility studies to implemented actions using publicly available sources	n/a
	Overseas Environmental Cooperation Center (OECC)	Human capability creation for NAMAs development and MRV implementation	Create human and institutional capabilities with regard to NAMA development and MRV implementation	Cambodia, Lao PDR, Mongolia and Vietnam
	World Resources Institute (WRI)	Measurement and performance tracking (MAPT)	Support the development of MRV systems for NAMA	India, Thailand, and 4 other countries

Source: Hansel et al., 2012; UNEP, 2012

Note: This is not a complete list as many bilateral efforts are received very little publicity. Bilateral initiatives were organized alphabetically according to their head institute.

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NAMA Preparation

Germany, the United Kingdom, Norway, and Japan are the major countries that have provided NAMA support to date. The majority of bilateral support has focused on preparatory and readiness activities. These activities incorporate a broad range of elements and focus on different phases of NAMA development, from awareness rising and institutional creation, and then right through to NAMA proposal development (Tilburg et al., 2012). In some cases, NAMA readiness support is combined with support for related concepts such as low-emission development strategies or MRV systems. Most of this support to date has come from fast-start finance (Cameron, 2012). Fast-start finance ended in 2012, and it is therefore unclear what mechanisms will be utilized to support NAMA preparation in the future. It can also be observed that support for NAMA readiness has been separated from support for NAMA implementation; that is, those who have supported NAMA preparation re yet to have also committed to financing any resulting NAMAs (Cameron, 2012). This dichotomy of NAMA financing therefore leads to the question of coherence and coordination being involved in international support. Table 2.2 summarizes a selection of bilateral NAMA preparation initiatives involving Asian countries.

NAMA Implementation

Within Asia two NAMAs are seeking external support for their implementation. Indonesia's sustainable urban transport initiative revolves around the goal of achieving urban transport emissions of 15% below BAU by 2020 in specific pilot cities. This NAMA is being supported by the International Climate Initiative of the German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU) with regard to its preparation and it is envisaged that this cooperation will continue to be in place for its implementation (Indonesia, 2012). In addition, the Cook Islands' NAMA involving support for the implementation of 100% renewable electricity sources by 2020 has received funding from Japan under the Pacific Environment Community Fund for the purchase and installation of solar photo voltaic systems for several islands and with funding from New Zealand for the remaining islands. The Cook Islands is seeking even more assistance to implement their NAMA and to achieve their overall goal of 100% renewable electricity sources by 2020 and the phased-in goal of achieving 50% by 2015 (Cook Islands, 2012).

Norway's funding for Indonesia's REDD+ activities is one of the few examples of support for full-scale implementation having being committed to. In addition to meeting the costs of readiness and capability building Norway continues to provide payments to Indonesia, being based on verified emissions reductions. This bilateral support has very clearly contributed to Indonesia's 41% GHG emissions reduction target, although it has yet to be recognized as a NAMA.

South-South initiatives

South-south flows have emerged as a new channel for NAMA support. For example, a project entitled "Analysis issues and options for implementing NAMAs", led by India's Energy and Resources Institute (TERI) and in partnership with China's Tsinghua University, Brazil's Vitae Civilis, and South Africa's University of Cape Town, aims to develop a framework for use in assessing the appropriateness of a given mitigation action within the context of a particular developing country (Hansel et al., 2012). South-south initiatives have already gained more and more attention from the international community than before, and do present opportunities for additional climate financing.

Multilateral initiatives

NAMA Preparation

Several UN agencies are taking the lead in supporting the preparation of NAMAs. UNDP's Low Emission Capacity Building Programme (LECB) aims at strengthening technical and institutional capabilities at the national level for identifying and formulating NAMAs. The LECB is supported through contributions from the European Commissions, the German BMU, the Australian Department of Climate Change and Energy Efficiency, and AusAID, while is implemented by the UNDP. This program runs through to 2016 and is active in 25 countries throughout the world. Other multilateral initiatives include UNEP's NAMA pipeline and the program for facilitating implementation and readiness for mitigation. Table 2.3 summarizes multilateral initiatives for NAMA preparation involving Asian countries.

Table 2.3. A selection of multilateral initiatives for NAMA readiness involving Asian countries

Multilateral initiative	Description	Lead institute(s)	Supported countries
Low emission capacity building programme	Identify and formulate NAMAs, low emission development strategies, and mitigation action	UNDP	Bhutan, China, Indonesia, Malaysia, Philippines, Thailand, Vietnam, and other 17 countries
Facilitating Implementation and Readiness for Mitigation	Strengthen national mitigation plans and identify and elaborate NAMAs	UNEP	Indonesia, Vietnam, and 5 other countries
NAMA pipeline	Used for all submissions to the UNFCCC from developing countries and countries in transition towards creating NAMAs.	UNEP Risoe Centre	n/a

Source: Hansel et al., 2012

NAMA Implementation

There are presently no multilateral climate funds dedicated for use with NAMA implementation, although many initiatives of MDBs do bear a strong resemblance to NAMAs. In Asia, the Climate Investment Funds' Clean Technology Fund has provided the largest amount of mitigation finance and is supporting mitigation actions in six countries[4] (Table 2.4). The Asian Development Bank's Clean Energy Financing Partnership Facility and Climate Change Fund are the key mechanisms used to mobilize resources in the Asian region for use in addressing climate mitigation through technical assistance and grant components of investment projects. Although multilateral initiatives in Asia have shown little indication on whether or not NAMAs are explicitly included in their approach, the experience gained and knowledge learned from using MDBs to support mitigation actions will enable them to become a potentially important channel for NAMA financing.

Table 2.4. Multilateral funds and initiatives supporting Asian mitigation activities (USD millions)

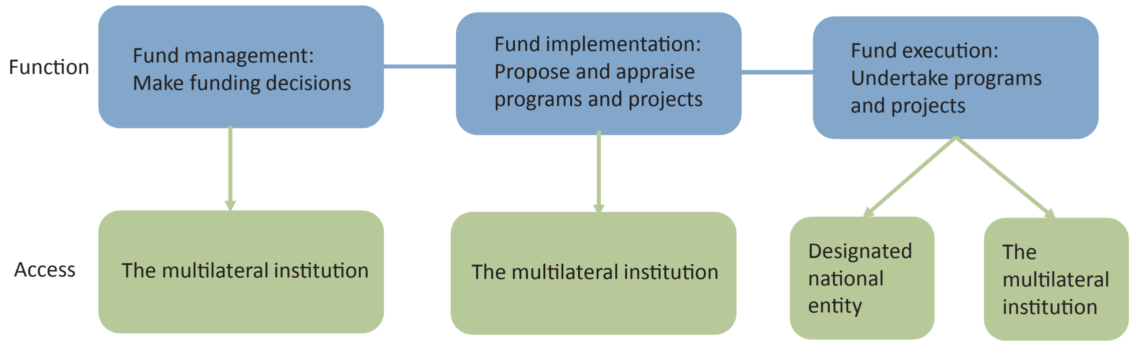
Fund	Amount approved/disbursed	Projects
Clean Technology Fund (CTF) of Climate Investment Funds (CIF)	520	19
GEF 4th replenishment	377	74
GEF 5th replenishment	207	32
ADB Clean Energy Financing Partnership Facility (CEFPF)	90	97
ADB Climate Change Fund (CCF)	29	0.24
Global Energy Efficiency and Renewable Energy Fund	29	4
WB Scaling Up Renewable Energy Program	24	11

Sources: Climate Funds Update, CEFPF, and CCF websites

[4] CTF Asian countries are Indonesia, Vietnam, India, Kazakhstan, Philippines, and Thailand.

Multilateral mitigation funds, including GEF and CTF, use an international access model, in which fund management and implementation are undertaken at the international level by a multilateral institution and with fund execution either taking place at the national level or remaining within the multilateral institution (Figure 2.10). Direct access and enhanced access modalities[5] have not been observed in mitigation and NAMA financing by multilateral funds at the implementation stage.

Figure 2.10. International Access modality



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Green Climate Fund (2011) *Governing instrument for the Green Climate Fund.* http://unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf

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Republic of Indonesia (2012) *NAMA implementation Indonesia sustainable urban transport.* http://unfccc.int/files/cooperation_support/nama/application/pdf/nama_implementation_indonesia_sustainable_urban_transport_initiative.pdf

Tilburg, X. van, F. Roser, G. Hansel, L. Cameron, and D. Escalante (2012) *Status report on nationally appropriate mitigation actions—mid-year update.* May 2012. ECN and Ecofys.

UNEP (2012) *NAMA finance study: Examples from the UNEP bilateral finance institutions climate change working group.* http://www.unep-fin.org/article/publications/3-unep-bfi-ccwg/35-nama-finance-study-examples-from-the-unep-bilateral-finance-institutions-climate-change-working-group.html

UNFCCC (2011). *Durban outcomes.* http://unfccc.int/essential_background/items/6825.php

[5] Direct access modality keeps fund management at the international level, while enables fund implementation and execution to take place at the national level. Enhanced access modality delegates all three functions—management, implementation, and execution—to national designated entities.

Chapter 3

APPROACH OF NAMA DECISIONS

Institutions such as the ministries in charge of climate change or environmental issues are responsible for developing short and long term strategies in order to mitigate the effects of climate change. Most of them take into consideration not only local circumstances but also the goal of achieving low carbon paths, and ultimately sustainable development, but putting them into practice at the ground level has revealed that setting emission reduction targets is not as simple as it may first seem.
This chapter introduces two different approaches to use when calculating mitigation reductions that can be of use in both the planning and implementation of NAMAs. The top-down approach involves NAMAs being selected based on national GHG emission reduction target decisions and then a breakdown of each sector's targets, action plans, and projects. In contrast to that the bottom-up approach focuses on emissions and emission reduction potential at the activity level (entity, project, or the individual parts of a program) and then considers them overall, which is the equivalent of the total emissions from the sector concerned.
Measurement, Reporting, and Verification (MRV) is an important additional component to the planning stage that is required with NAMAs. This chapter therefore provides some information regarding MRVs with respect to policy based NAMAs and uses the Kyoto Protocol Target Achievement Plan (KPTAP), which was developed in Japan, as a concrete example.

3.1 Top-down approach

By Kazuya Fujiwara (Mizuho Information and Research Institute)

3.1.1 Basics of Top-down Approach

The "Top-Down approach" involves NAMAs being based on national GHG emissions reduction target decisions and then a breakdown of the individual sector, action plan, and project targets. The point that has to be taken into consideration is that NAMA development using this approach must be consistent with the overall national and local strategies, current policies, and future projections regarding economic and technological developments, etc.

In countries where national GHG emissions reduction targets and national strategies regarding low-carbon development have already been determined, NAMAs get developed as more elaborate action plans using the aforementioned national targets and strategies. In this case it is likely that GHG reduction potential and GHG abatement costs, etc. will be taken into consideration in the preparatory stage of national targets and strategies being set.

Ensuring the greater feasibility and effectiveness of NAMAs requires GHG emissions trend projections, calculating the cost of installing new technologies and systems, and researching the economic impact. NAMA development is therefore sometimes accompanied by analysis that utilizes models.

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3.1.2 Roles of models

3.1.2.1 Roles of models

As mentioned above models can provide quantitative data with respect to the cost or impact of GHG mitigation actions. Models therefore have a significant role in developing NAMAs because any such data is often an essential component used in determining national targets and the roadmap development process. A number of researchers have designed a large variety of models for use in the field of low carbon society research. Policy makers and stakeholders can also gain very useful information about mitigation actions via analysis of those models and in thereby ensuring more appropriate decision making takes place.

3.1.2.2 Features of each model

Models used in low carbon society research can be divided into two groups; top-down and bottom-up. Top-down models apply economic theories in socio-economic situations and macro-economic analysis, while bottom-up models amass data from individual technology or economic activity to use in analysis. Some major models categorised as top-down models include ENV-Linkages (by OECD) and AIM/CGE (by NIES, Japan) etc. and bottom-up models: MARKAL (by IEA et al.), MESSAGE (by IIASA), and AIM/Enduse (by NIES, Japan), along with many others. The table below shows the features and output that are used as input by policy makers for each model.

Table 3.1. Features and output of models

		Model	Explanation
Top down	Focus on the overall economic processes	ENV-Linkages	A recursive dynamic neo-classical equilibrium model created using a database on national economies, which can be used to deal with multi-sectoral and multi-regional assumptions and to connect economic activities to environmental pressure such as GHGs. (*1)
		AIM/CGE	A multi-sectoral and multi-regional computable general equilibrium model for assessing future economic activities, including mitigation activities, and based on analysis of energy efficiency improvements made in all the sectors using technology developments. (*2)
Bottom up	Focus on the individual energy technologies	MARKAL	A generic model tailored for data input that represents the evolution over the typical period of 40 to 50 years of a specific energy system at the national, regional, state or province, or community level. In addition, the basic components are specific types of energy or emission control technology, and thus the model is used to select the combination of technologies that minimize the overall cost. (*3)
		MESSAGE	A system engineering optimization model used for mid- to long-term energy system planning, energy policy analysis, and scenario development. The model provides a framework for representing an energy system and with all its interdependencies form resource extraction, imports and exports, conversion, transport, and distribution through to the provision of end-user energy systems. (*4)
		AIM/Enduse	A dynamic recursive model in one year steps and a linear optimization framework through which system costs can be minimized and which takes constraints such as service demands and the availability of energy technology into account. The model can be used to estimate energy consumption and GHG emissions driven by technological change. (*5)

*1: OECD(2008). 'An Overview of the OECD ENV-Linkage Model.'
*2: NIES(2011). 'Structure of Energy Supply in AIM/CGE model'.
*3: IEA Website. http://www.iea-etsap.org/web/Markal.asp
*4: IIASA Website. http://webarchive.iiasa.ac.at/Research/ENE/model/message.html
*5: O.Akashi and T.Hanaoka(2012). "Technological feasibility and costs of achieving a 50 % reduction of global GHG emissions by 2050: mid- and long-term perspectives" *Sustainability Science* 7:139–156

The AIM model research team has a lot of experience in researching low carbon society projects and has participated in policy consultations in the Asia-Pacific region using AIM/CGE and AIM/Enduse models. In addition, an additional analysis tool called ExSS (Extended Snapshot tool) has also been developed by the team. ExSS is a comprehensive estimation tool for socio-economic indicators and environmental load emissions such as GHG emissions and was designed based on the concept of "back-casting" . The structure of ExSS is designed to be flexible so that a wide range of socio-economic structures of future societies can be taken into account.

3.1.3 Process of NAMAs development

Top-down NAMA composition can be broken down into 3 processes. Succinctly speaking, the entire process involves the following: (1) creating future vision plans, (2) feasibility analysis of the future vision plans, and (3) in depth deliberations regarding the possible ways of pursuing the future vision plans.

3.1.3.1 Creating future vision plans

NAMAs development starts with envisaging 'visions' , or ideal future images. The development of those visions requires that a variety of determinants of the future society be stipulated qualitatively.

The first step is to amass data on the shape the future industrial structure and people's lifestyles will take. The next step is to then develop future projections in the various sectors concerned using examples from literature that has been amassed and aggregated, and then used to describe qualitatively the concepts involved in the future visions. The final step is fitting all the information from each step together, and which then allows the future vision to be depicted in a quantitative manner. Precluding any infeasible visions requires that a range of information be added in thereby making the future visions more accurate in the middle of the process and in the final step. The quantitative future visions should then be verified using existing research to ensure there is no huge gap between them.

ExSS, which was developed by the AIM model research team, is a tool used to depict future visions. ExSS provides information on changes in future energy demands and GHG emission trends. ExSS can provide rough sketches of the visions and illustrate a wide range of future visions, and which means it can be easily used to estimate future GHG emissions with changing parameters that could affect developing pathways. Analysis with the ExSS model along with good communication between policy makers and researchers can therefore facilitate target setting that is tailored to a country's needs and reduction potential targets.

3.1.3.2 Feasibility analysis of the future vision plans

The next step to conduct feasibility analysis of the future vision plans. How the AIM model can be used to assess the feasibility of future vision plans will therefore be described in the following section.

3.1.3.2.1 Collection of socio-economic indicators

Assessing the feasibility of future vision plans using analytical models requires

[BOX 1] Low carbon society research experience in Japan: "Japan Low Carbon Society 2050 project"

The "Japan Low Carbon Society 2050 project" involves a research project that aims at providing possible low carbon society scenarios around 2050, and in which about 60 researchers are participating under the coordination of NIES. How society will have evolved in 50 years' time and the development of a roadmap that will enable that vision was technically and specifically conceived by the abovementioned researchers, and resulting in the output of scenarios A and B. Scenario A is an aggressive, rapidly cycling, and rotating, and technology-oriented society; while Scenario B depicts a slow and nature-oriented society. The scenarios and indices used in the project do not deviate from scenarios resulting from previous studies, and thus the outcomes of the project are considered fairly reliable. (For more details please visit: http://2050.nies.go.jp/s3/index_j.html)

Scenario A: Vivid	Scenario B: Slow
Technology-driven	Nature-oriented
Urban/Personal	Decentralized/Community
Technology breakthrough Centralized production /recycle	Self-sufficient Produce locally, consume locally
Comfortable and Convenient	Social and Cultural Values
2%/yr GDP per capita growth	1%/yr GDP per capita growth

Source: Japan Low-Carbon Society Scenario towards 2050 Project (http://2050.nies.go.jp/s3/index_j.html)

socio-economic indicators to be amassed, which are often called 'driving forces', and which include GDP, industrial production, and transport volume, etc. The data is used in the models to analyse the feasibility of the future vision plans provided by the previous step in a quantitative manner. The future socio-economic indicators can be obtained from each country's development plans, and national projections based on the various forecasting models available, etc.

3.1.3.2.2 Estimation of mitigation potential of technologies

A variety of energy conservation technologies will need to be introduced to avoid any negative deviations from the future low-carbon vision plan.. Use of the AIM/Enduse model enables how each type of low-carbon technology will contribute to be anticipated in estimating abatement costs and the effect of low-carbon political instruments (e.g. carbon tax policy), etc. AIM/Enduse has a huge database on technology, and the model can also be used to depict detailed technology transitions over time. For example, estimating how many conventional vehicles can be replaced by hybrid vehicles is possible and consequently the emission reductions and the additional cost of replacements in the target country.

AIM/Enduse can provide information regarding the potential GHG emission reductions and abatement cost of each type of technology. Model users can prioritize policy actions based on the results, and moreover, it can be possible to achieve the expected emissions reduction via use of policy actions through information on how the government has conducted mitigation policies to date and the selected technologies that will be introduced.

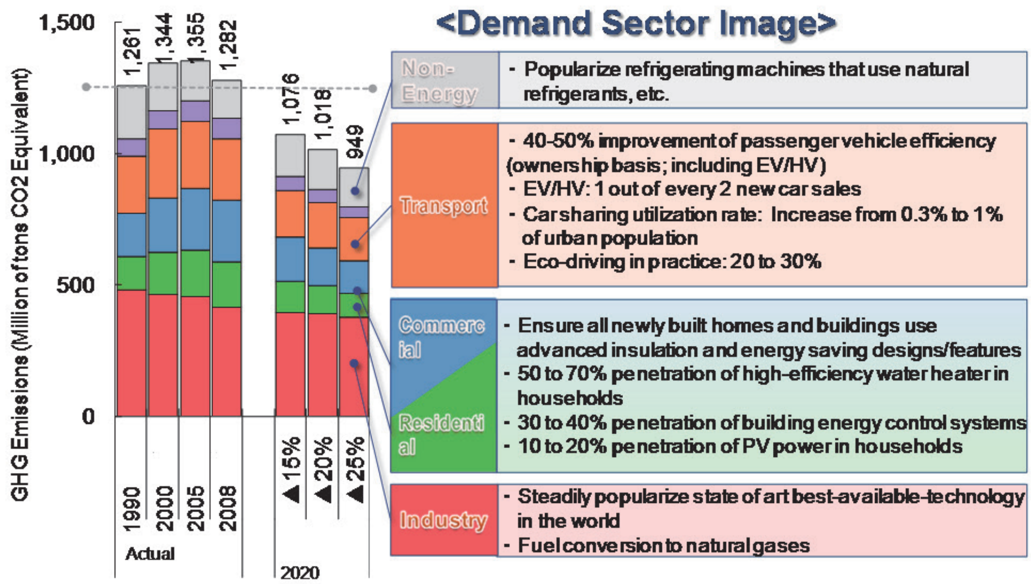
3.1.3.2.3 Estimation of economic impact from introduction of countermeasures

Active use of low-carbon vision plans requires the impact analysis of a variety of mitigation policies. The AIM/CGE model was designed for exactly this kind of analysis. AIM/CGE deals with economic activities in a country using an advanced general equilibrium model and can map out the relationship between macro-economic activities, environmental policies, and other environmental burdens. For example, it can be used to evaluate the economic impact of a specific policy in a target country.

3.1.3.3 Actions to follow low-carbon visions

The aforementioned procedure can be used by the reader to design low-carbon visions and determine specific emission reduction targets. The next step, however, is to plan a strategy to carry out mitigation actions using the low-carbon vision plan that was selected. A low-carbon vision plan cannot be realized without adopting specific countermeasures, and thus mitigation policies are required. In other words,

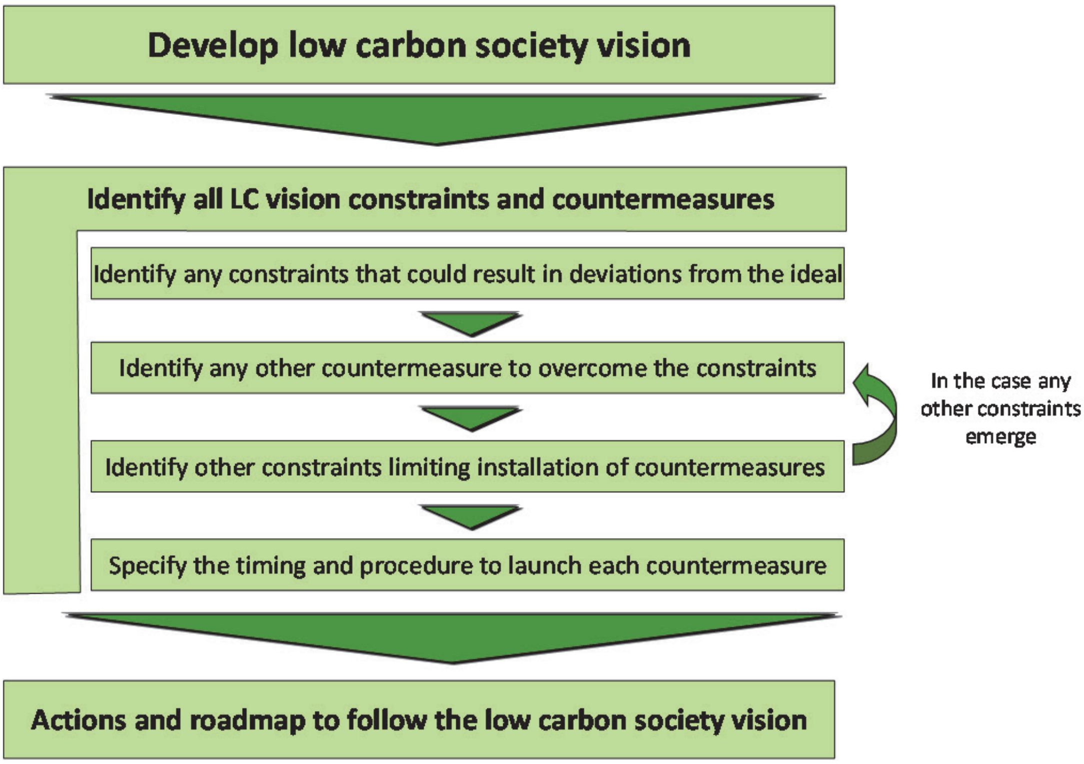
Figure 3.1. An example of AIM/End use analysis in Japan



Source: Nishioka S., 2011 International Symposium "Learning the way to building Low Carbon Society"; (http://www.challenge25.go.jp/roadmap/symposium_report_en.html#keynote) before action takes place there will be a gap between on-going society and the low-carbon vision plan, but countermeasures will contribute to closing that gap and removing any impediments.

Once a strategic pathway towards a low-carbon vision plan has been considered a possible procedure to be used is provided in the figure below. The first step is to acknowledge any gap between current society and the low-carbon vision plan (ideal society) in thereby identifying any factors (constraints) that will result in a deviation from the ideal vision. Secondly, all possible countermeasures to overcome the constraints should be listed. In this step, other constraints that will limit policy being used can emerge and they should be eliminated as well by identifying possible countermeasures and then using them. Repeating these steps can then identify which policies should be launched in what particular sequence and reveal the necessary time span needed to for the expected outcome. In addition, the timing of when each policy should be used must be taken into consideration because most policies will take a certain amount of time to come into effect.

Figure 3.2. Roadmap development flow



Source: 1st General Meeting of Investigative Committee of "Mid- and Long-Term Roadmap for Global Warming Countermeasures", 2009
(http://www.env.go.jp/earth/ondanka/mlt_roadmap/comm/com01-01.html)

Planning and designing NAMAs can be conducted by researchers or policy makers only but it can also be helpful to enrol experts from various fields or citizens to thereby help make the design process more efficient via interviewing them and gaining the opportunity to brain-storm with experts and policy makers.

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3.2 Bottom-up approach

By | Makoto Kato (Overseas Environmental Cooperation Center, Japan)

3.2.1 Basics of bottom-up approach

The bottom up approach to planning mitigation actions has been put into practice in several national and local efforts, together with the top-down approach.[1] The top-down approach attempts to deal with overall national or sectoral emissions targets with use of macro data from statistical information and models, but the bottom-up approach basically focuses on emissions and emission reduction potentials at the activity level (entities, projects, or constitutes of programmes) and then aggregates them, which is then close to the equivalent of the total emissions from the sector. Also it can be said, the national or sectoral emission with breakdown of activities.

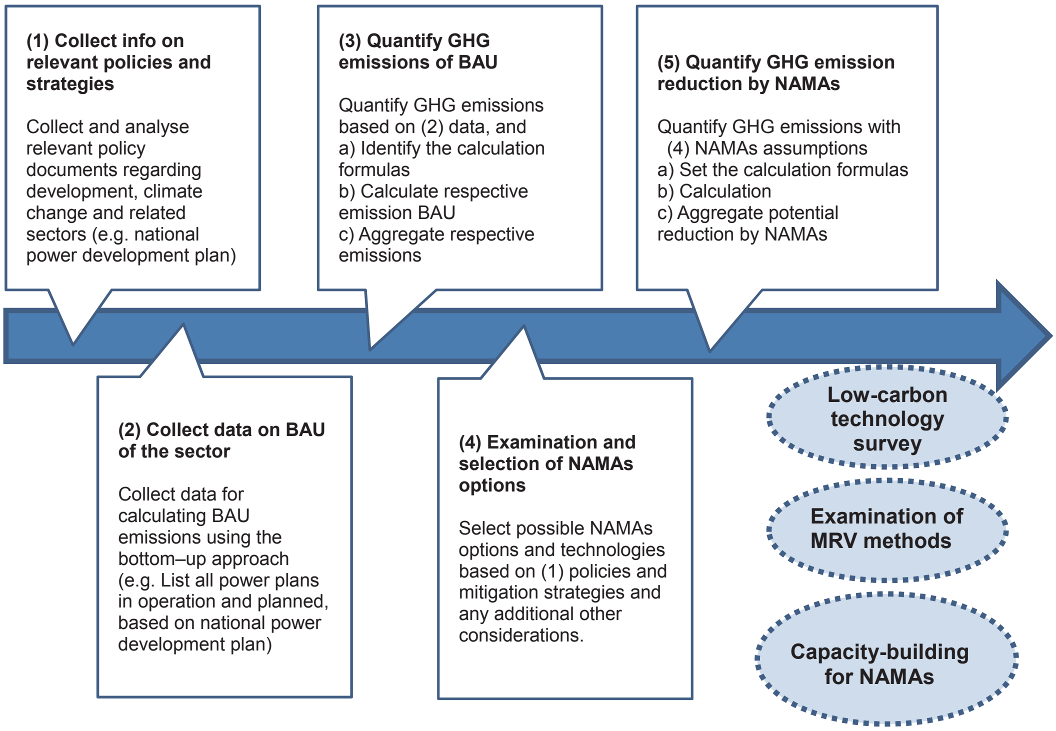
3.2.2 Steps for NAMA design using the bottom-up approach

The following section provides the simple steps to be taken when designing NAMAs (including ex ante quantification).

[1] For example, Japan's Kyoto Protocol Target Achievement Plan (KPTAP) and Japan's Guidance on Local Governments Action Plan on Climate Change Mitigation

1
2
3
4
5

Figure 3.3 Steps for the design of NAMAs



a) Step 1: Building on existing sectoral policies/plans

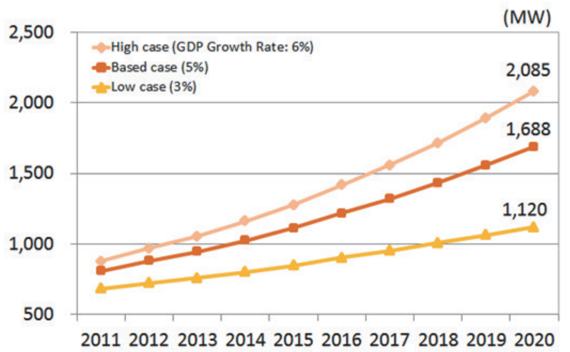
In practice the bottom-up approach calculations using a model can be skipped in some cases. This does not mean, however, that the bottom-up approach ignores macro considerations and instead that it has already taken existing sectoral policies or planning documents and their respective projections into consideration as a result of the macro level analysis. And based on that consideration, the overall national or sectoral emissions and their future growth can be interpreted using information from the relevant documents, such as, sectoral development policies and plans.

For example, a national power development plan usually contains a country' s historical electricity demand and supply data, along with future projections (typically using a specific model). This information is used as a key reference a priori, which means before starting to list all the individual emission sources for aggregation.

Typically some of the information is available not in GHG terms and instead in kWh (for energy demand and supply) or amount of fuel. However, this type of information has in many cases resulted from careful analysis conducted in light of the relevant sector' s developmental perspective, and hence can provide a good foundation to use in identifying business-as-usual (BAU) scenarios and determining emission reduction targets.

If constraints with respect to the time, budget, and technical expertise exist with the use of models then the recommendation is that existing sectoral policies and plans be used, which contain quantitative information as mentioned above.

Figure 3.4. Historical Data and Energy Demand Projection in Cambodia



b) Step 2: Listing emission sources at the activity level (to identify BAU)

The main characteristic of the bottom-up approach suggests listing all the emission sources at the activity level of the sector. For example, Cambodia' s power development plan contains not only the country' s entire past power demand and supply but also historical data on the power supplied by the respective power plants. Similar information may also be available from other sources, such as reports from power companies to the relevant national authority, thus making it relatively easy to identify activity data (electricity supplied and amounts of fuel consumed) from each individual power plant. All this data should be listed to the fullest extent possible and the overall sectoral data consolidated.

Compared with the sectoral data resulting from the top-down approach aggregated data from the bottom-up approach typically certain constraints with respect to the accuracy of the coverage, but it' s strength lies in depicting a clearer picture of the distribution of major emission sources and more specific background information, which can then be very helpful when considering what specific mitigation actions can be planned. In addition, this type of information can be helpful in NAMA financing preparation, which typically requires more specific information than just macro level data. However, as stated in a later section, clarifying these breakdowns can be very useful when taking mitigation actions for implementation (including finance), as well as monitoring the progress of mitigation actions in a quantitative manner, namely measurement, report, and verification (see Chapter 3.3 MRV).

Figure 3.5. List of existing and planned power plants in Cambodia with generation capacity information

No.	Project Name	Type	Capacity (MW)	Year	Condition as of Dec. 2011
1	Independent Power Producers(A)	Heavy Fuel Oil	340	-	Operating
2	Independent Power Producers (B)	Coal	13	-	
3	Independent Power Producers(C)	Hydro	13	-	
4	Independent Power Producers (D)	Wood, Biomass	6	-	
5	Kamchay	Hydro	194	2012	Under Construction
6	Kirirom III	Hydro	18	2012	
7	Stung Atay	Hydro	120	2012	
8	Stung Tatay	Hydro	246	2013	
9	Lower Stung Russei Churum	Hydro	338	2013	
10	100 MW Coal Fired Power Plant	Coal	100	2013	
11	270 MW Phase 1 of the 700MW Coal Fired Power Plant	Coal	270	2014 ~2015	PPA singed
12	100 MW Coal Fired Power Plant	Coal	100	2016	PPA singed
13	430 MW Phase 2 of the 700MW Coal Fired Power Plant	Coal	430	2017	FS completed
...	...	Coal	α*	20XX	May be developed*
	Total		2188+α		

c) Step 3: Converting listed activity data into GHG emissions (for identifying BAU)

Activity data (such as the electricity generated and the amount of fuel consumed, and future projections) that has been amassed and listed can be converted into GHG terms via emission factor multiplication. That information is typically available from national GHG inventories or data sets used in the CDM. This approach makes quantifying GHG emissions using past historical records rather easy, but in terms of future projections, and only in some cases, emission projections from individual emission sources are available, whereas in other cases they are not. In any such case, however, the overall trends provided by the sectoral policy overall can be tentatively reflected.

d) Step 4: Examination of interventions and technologies, and selection of NAMA options

Existing sectoral development policies and plans should provide a general idea of what actions, which are relevant to sustainable development or mitigation actions, should be used. For example, "increase wind power generation by 2030", or "upgrade the technological level of coal fired power plants by 2015" being mentioned in policy documents can be useful reference material. These types of general directions can be built upon and their usefulness increased by adding more concrete ideas from GHG mitigation perspectives. In particular, NAMAs can allow for higher levels of technology or specifications to be used through domestic efforts and/or international support, thus making the identification of exactly what type of mitigation technology a country would like to introduce very important. Technology surveys have therefore been regarded as an essential component of many capacity-building support

programmes[2]. Technology Needs Assessments (TNAs) can also be good reference material.
At this stage a clearer picture will have emerged in terms of specific GHG mitigation against BAU, and its associated cost, together with other background information (such as the decisions made by the stakeholders or any other special circumstances), and which ca be very helpful for a country when implementing mitigation actions.

Figure 3.6 List of existing and planned power plants in Cambodia with generation capacity information, and possible intervention of mitigation measures

No.	Project Name	Type	Capacity (MW)	Year
1	Independent Power Producers(A)	Heavy Fuel Oil	340	-
2	Independent Power Producers (B)	Coal	13	-
3	Independent Power Producers(C)	Hydro	13	-
4	Independent Power Producers (D)	Wood, Biomass	6	-
5	Kamchay	Hydro	194	2012
6	Kirirom III	Hydro	18	2012
7	Stung Atay	Hydro	120	2012
8	Stung Tatay	Hydro	246	2013
9	Lower Stung Russei Churum	Hydro	338	2013
10	100 MW Coal Fired Power Plant	Coal	100	2013
11	270 MW Phase 1 of the 700MW Coal Fired Power Plant	Coal	270	2014 ~2015
12	100 MW Coal Fired Power Plant	Coal	100	20[illegible]
13	430 MW Phase 2 of the 700MW Coal Fired Power Plant	Coal	430	[illegible]017

Introduction of high-performance boiler

Promotion of renewable energy (hydro, solar, biomass

e) Step 5: Quantification of potential mitigation amount by NAMAs

Similar to step 3 the NAMA options identified in step 4 should be converted into GHG terms. The quantification of GHG will take place at the activity level (entity, project, or contents of a programme), and hence the emission reduction can also be quantified at the same level, and then aggregated into the macro level. Depending on the sector, or the nature of the mitigation actions, some individual activities can utilize a default value when quantifying the aggregate mitigation effects. For example, the mitigation effect of 1 unit of wind power generator can be based on a default value, and the number of any such units introduced will then represent the aggregate mitigation effects, if it then effectively avoids any over estimation and with conservativeness taken into consideration.
Utilizing default values can also be helpful at the MRV stage. The introduction of default values in some areas (typically when energy efficient products or vehicles, etc. will be introduced) of existing mitigation plans and their verification can contribute to a more streamline and less complicated MRV and with respect to anyone that is not necessarily very familiar with the detailed technical matters of GHG quantification. (See Chapter 3.3 MRV.).

[2] MOEJ/OECC' s capacity-building programme for Mongolia has had a strong focus on a survey of appropriate technologies, including the possible introduction of new low carbon technologies, and with diagnoses provided by technology specialists etc.

3.3 MRV of policy based NAMAs

By | Masayoshi Futami (Overseas Environmental Cooperation Center, Japan)

3.3.1 Introduction

NAMAs get implemented by developing country parties in the context of sustainable development, and are supported and enabled by technology, financing, and capacity-building, in a Measurable, Reportable, and Verifiable (MRV) manner (UNFCCC 1/CP.13, Bali Action Plan). In 2009, the Copenhagen Accord (UNFCCC 2/CP.15) requested developing countries to submit NAMA plans to the secretariat in a format provided by UNFCCC.

The Cancun Agreements (UNFCC 1/CP.16) confirmed that developing country parties would need to implement NAMAs with the aim of achieving a deviation in emissions relative to Business As Usual (BAU) emissions by 2020. Decision 2/CP.17 (2012) indicated that NAMA progress would be aggregated into a Biennial Update Report (BUR) that needed to be submitted by 2014; moreover, International Consultation and Analysis (ICA) of BUR would take place under a Subsidiary Body and with the aim of increasing the transparency of NAMAs and their effect. In summation, developing country parties would need to provide information, in a tabular format, on actions taken to mitigate climate change, and addressing anthropogenic emissions from sources and removals using sinks of all GHGs not controlled by the Montreal Protocol.

- Developing country parties shall provide the following information of NAMA in a BUR (UNFCCC 2/CP.17 Annex III): Name and description of the mitigation action, including information on the nature of the action, coverage (i.e. sectors and gases), quantitative goals, and progress indexes;
- Information on methodologies and assumptions;
- Objectives of the action and steps taken or envisaged to achieve that action;
- Information on the progress of implementation of mitigation actions and the underlying steps taken or envisaged, and the results achieved, such as estimated outcomes (metrics, although depending on the type of action) and estimated emission reductions, and to the fullest extent possible; and
- Information on international market mechanisms

Japan formulated the "Kyoto Protocol Target Achievement Plan (KPTAP)" in order to stipulate the measures needed to reliably achieve the target of the 6% reduction promised by Japan in the Kyoto Protocol. Similar to components of NAMA in BURs KPTAP also takes into consideration exactly what sectors to measure, how measurements are made, when to measure them, and by whom, and with reports made and verification of the ex-post effects of each adopted measure.

As discussed in the previous section, the Top-down approach and the Bottom-up approach were created for use in predicting these scenarios. The Bottom-up approach can be used when assumptions about investment and saving policy decisions are the main driver in short-term scenarios (IPCC 2007). The KPTAP developed mitigation actions that integrate each sectoral plan and trial calculations made by the ministries responsible in a bottom-up approach[1]. The KPTAP used concrete assumptions, designated the institutions to be in charge, determined the duration of mitigation actions, and the cost in each sector in order to clarify the magnitude of the responsibilities and implementation steps, and for the purpose of simplifying the ex-post verification.

Taking into account that lessons from the MRV of policies of developed countries can serve as reference material for the MRV of NAMAs (GIZ version 8.6), this chapter will introduce the KPTAP's mechanism as an example of policy level MRV.

[1] In order to development the plan from each sector, top-down model is utilized in micro-frame discussion.

3.3.2 Components of the KPTAP

Each ministry clearly specifies the department responsible for formulation, evaluation, and examination, and introduces the PDCA (Plan-Do-Check-Action) cycle. Furthermore, the departments responsible within each ministry are required to share their experiences with CO2-saving, know-how, and technology with all the other departments. In order to ensure transparency the government then publishes the results of examinations, evaluating not only total emissions but also effort made with respect to the target values and past recorded figures, while also placing attention on the progress of each individual item and organization.

The KPTAP provides mitigation measures information in a tabular format and via anthropogenic emissions from sources and removal by sinks of all GHGs are addressed as NAMA elements. The KPTAP specifies targets for greenhouse gases (GHGs), individual countermeasures, their evaluation indexes, expected extent of GHG emissions reduction, roles to be fulfilled by each stakeholder with the countermeasures, and the policies of both central and local governments. The mitigation action table shown below was created by the ministries responsible in each sector and the examples (Promotion of intelligent transport system) are explained in Tables 3.2 and 3.3.

Countermeasures evaluation indexes are stipulated as the targets of individual countermeasures that were designed to achieve the targets of each GHG and approximate targets for each sector of energy-originating carbon dioxide. The expected reduction in GHG emissions (carbon dioxide equivalent) resulting from countermeasures is calculated by then combining the individual factors. Clarifying the premise of cumulating at the time of formulation of the KPTAP then enables ex-post verifications to take place.

Table 3.2. List of measures and policies in the Transport sector (Promotion of intelligent transport system)

Specific Countermeasure	Countermeasure Evaluation Index (Estimates of FY2008-FY2012)	Measure by Each Actor	National Policy	Example of Policies Expected to be Implemented by Local Governments	Countermeasure Effect: Estimated Volume of Emissions Reductions	Countermeasure Effect: Assumption Made in Calculating the Estimated Volume of Emissions Reductions*
Traffic demand management for automobiles	Length of improved bicycle paths (10,000km) 2008 approx. 2.6 2009 approx. 2.8 2010 approx. 3.0 2011 approx. 3.2 2012 approx. 3.4	Traffic business operator: -Promoting measures for traffic demand management (TDM) Citizen: -Using a bicycle	-Promoting measures for traffic demand management (TDM) -Improving and supporting the environment for cycling -Implementing and supporting pilot programs contributing to the promotion of cycling	-Promoting measures for traffic demand management (TDM) -Improving the environment for cycling -Implementing pilot programs contributing to the promotion of cycling	(10,000t-CO_2) 2008 approx. 26 2009 approx. 28 2010 approx. 30 2011 approx. 32 2012 approx. 34	-Passenger cars' travel distances shorter than 5km -Conversion ratio to cycling -CO_2 emission coefficients for each speed
Implementation of Intelligent Transport Systems (ITS): Electronic Toll Collection systems (ETC)	Utilization rate of ETC (%) 2008 approx. 77 2009 approx. 79 2010 approx. 81 2011 approx. 83 2012 approx. 85	Citizen, business operator: -Using ETC Expressway company: -Implementing measures to promote the dissemination of ETC	-Implementing measures to promote the dissemination of ETC	−Promoting the pioneering introduction based on the Green Purchasing Act	(10,000t-CO_2) 2008 approx. 19 2009 approx. 19 2010 approx. 20 2011 approx. 20 2012 approx. 21	-Vol. of traffic jams for each toll booth -No. of vehicles passing through each toll booth -CO_2 emission coefficients for each speed
Implementation of ITS: Vehicle Information and Communication Systems (VICS)	Dissemination rate of VICS (%) 2008 approx. 19.0 2009 approx. 19.5 2010 approx. 20.0 2011 approx. 20.5 2012 approx. 21.0	Citizen, business operator: -Using VICS	-Promoting the dissemination of VICS	-Promoting the collection and provision of traffic information -Promote the pioneering introduction based on the Green Purchasing Act	(10,000t-CO_2) 2008 approx. 225 2009 approx. 230 2010 approx. 240 2011 approx. 245 2012 approx. 250	'-Improved speed through dissemination of VICS -CO_2 emission coefficients for each speed

Table 3.3.Example of Evidence of Reduced Emissions Resulting from Countermeasures of the KPTAP (Promotion of intelligent transport system)

Practical countermeasures:
Promotion of Intelligent Transport System (ITS)

Projected emissions reduction:
Approx. 2.6 million tons of CO_2

Premise of forecast at the time of cumulating:

Electronic Toll Collection System [ETC]
ETC utilization ratio
Amount of traffic congestion resulting from toll gates
Number of vehicles that passed through toll gates
Improved speed due to the nonstop effect
CO_2 emission factors from speed and model

Vehicle Information Communication System [VICS]
VICS penetration rate
Improved speed due to VICS penetration
CO_2 emission factors from speed

Description of evidence and details (e.g. itemization) of how the "projected emissions reduction" were calculated:

ETC
Promotion of the ETC system assumes that traffic congestion will be reduced since automobiles will not have to stop at toll gates. The projected CO_2 emissions reduction was calculated as follows:

[CO_2 reduction through promoting use of the ETC system]
= [Reduction from nonstop effort] + [Reduction resulting from eased traffic congestion at toll gates]

(1) [Reduction by nonstop effort]: Approx. 165,000 tons of CO_2 [1]
The CO_2 reductions achieved from the nonstop effect at toll gates are calculated for each individual toll gate, and then the values aggregated.
[Reduction from nonstop effort]
= {(Amount of CO_2 emissions when automobiles with no ETC system pass through toll gates) – (Amount of CO_2 emissions when automobiles with the ETC system pass through toll gates)} × Area length of toll gate × Number of vehicles passing through toll gates (ETC vehicles/day) × 365 days

(2) [Reduction resulting from eased traffic congestion at toll gates]: Approx. 30,000 tons of CO_2 [2]
The CO_2 reductions achieved by improving traffic congestion through the improved processing capacity at toll gates are calculated, and the values aggregated.
[Reduction resulting from eased traffic congestion at toll gates]
= {(Amount of CO_2 emissions during traffic congestion) – (Amount of CO_2 emissions when traffic congestion is eased)} × Length of traffic congestion × No. of vehicles passing through toll gates (ETC vehicles/hour) × Annual hours of traffic congestion/year

[Projected emissions reduction] = [1] + [2]
= Approx. 165,000 tons of CO_2 + Approx. 30,000 tons of CO_2
= Approx. 200,000 tons of CO_2

VICS
Assuming that the speed of automobiles will be improved through the introduction of VICS, the projected CO_2 emissions reduction is calculated as follows:

The number of km an automobile traveled in 2010 with their speed having been improved by use of VICS is estimated to be approx. 550 billion traveler kilometers. [3]

The amount of CO_2 reduction is calculated from the average speed difference before and after the introduction of VICS. (Approx. 4.4 g of CO_2/km) [4]

The projected CO_2 emissions reduction is calculated as "Number of km an automobile traveled in 2010" (in traveler kilometers/year)

[Projected CO_2 emissions reduction]
= [3] + [4]
= Approx. 550 billion traveler kilometers/year × Approx. 4.4 g of CO_2/km
= Approx. 2.4 million tons of CO_2

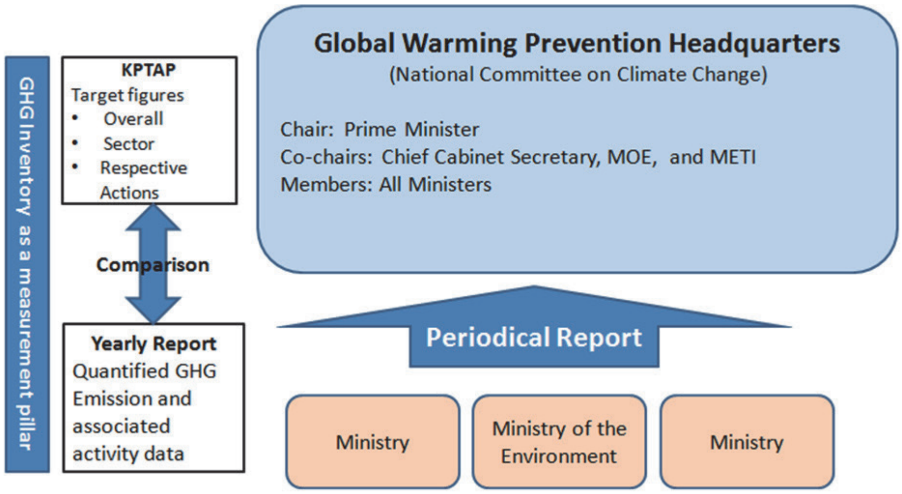
3.3.3 Tracking of KPTAP

Japan' s Government comprehensively evaluates the progress of countermeasures and policies stipulated in the KPTAP and the level of emissions. Furthermore, and in order to constantly assess the effectiveness of the KPTAP and make it more reliable, the Government reinforces policies as necessary by verifying every year after the formulation of the plan the measure' s evaluation indexes for each countermeasure.
The Japanese experience and the KPTAP will be used here as an example of NAMA planning and MRV as the evaluation of the countermeasures at policy level.

(1) Basic Concept

Ensuring the effectiveness of the KPTAP makes developing and amassing comprehensive data concerning the status of target achievements for each GHG as well as data concerning the progress of individual measures and policies essential. Every year the Global Warming Prevention Headquarters (GWPH) under the cabinet of Japan strengthens policies as necessary after examining the progress of policies formulated by the government. In other words, the government revises countermeasures evaluation indexes established for each countermeasure. The tracking information is amassed and reviewed by the ministries responsible and the results reported to the GWPH (Figure 3.7).
Evaluation indexes are then broken down into factors that include the volume of activities, number of households, floor area, and GHG emissions per unit of activities. Emissions and removal projections get evaluated by the volume of activities and GHG emissions per unit of activity. The results of these evaluations are then used by the Government of Japan to comprehensively review the achievement of the individual GHG and countermeasure targets, as well as the countermeasure evaluation indexes for the countermeasures concerned.

Figure 3.7. Institutional Arrangement for Monitoring the Progress of KPTAP



(2) Current review

The GWPH recently revised the measures and policies adopted in order to realize progress being made by the KPTAPs and then summarized the results. Japan' s 2011 total GHGs emissions of nearly 1.37 billion tons (the preliminary figures have been converted into carbon dioxide, with the same applying throughout) had increased by 3.6% when compared to the reference year (Table 3.4).

Table3.4. GHG emissions

(in millions of ton)

	Reference year (Percentage of total)	2011 figures (Quick estimation) (Comparison with reference year)	2010 target (Comparison with reference year)
Energy-derived carbon dioxide	1,059 (84%)	1,173 (+10.7%)	1,076 through 1,089 (+1.6% through +2.8%)
Industrial sector	482 (38%)	420 (-12.8%)	424 through 428 (-12.1% through -11.3%)
Business and other sectors	164 (13%)	247 (+50.6%)	208 through 210 (+26.5% through +27.9%)
Household sector	127 (10%)	189 (+48.1%)	138 through 141 (+8.5through +10.9%)
Transportation sector	217 (17%)	230 (+5.8%)	240 through 243 (+10.3% through +11.9%)
Energy conversion sector	67.9 (5%)	86.1 (+26.8%)	66 (-2.3%)
Non energy-derived carbon dioxide	85.1 (7%)	69.1 (-18.8%)	85 (-0.6%)
Methane	33.4 (3%)	20.1 (-39.9%)	23 (-32.3%)
Chlorine monoxide	32.6 (3%)	22.0 (-32.6%)	25 (-24.2% through -24.0%)
Three CFC alternatives	51.2 (4%)	23.5 (-54.0%)	31 (-39.5%)
Total	1,261 (100%)	1,307 (+3.6%)	1,239 through 1,252 (-1.8% through -0.8%)

Notes:
Reference year figures are the carbon dioxide emitted during the reference year in Japan, determined in 2007.

Table 3.5 summarizes the emission reductions identified through the current revision of measures and policies, and evaluation indexes for measures prescribed in the KPTAP. In thereby providing a summary of the data the government revised the performance of measures of from 2005 through to 2011 and in thereby also identifying the latest situation (e.g. additional/advanced measures and policies). At the same time the trends with their performance were evaluated and compared to projections made at the time the KPTAP was formulated (Table 3.5). Moreover, the ministries responsible discussed the addition and enforcement of more measures and policies in accordance with the PDCA cycle described above (Table 3.5).

Table 3.5. Review table of promotion of intelligent transport system with KPTAP evaluation index (example)

Specific measure	Evaluation indexes	Actual figures 2005	2006	2007	2008	2009	2010	2011	Projected figures 2008	2009	2010	2011	2012	Evaluation of performance trends etc. compared to projections*1	Addition and enforcement of measures and policies
Efforts made in transportation sector															
Promotion of Intelligent Transport Systems (ITS), such as introduction of ETC	Emission reduction (10,000 t of carbon dioxide)	14	16	19	19	21	22	22	19	19	20	20	21	Achieved goals or performance trends were higher than the projection.	During 2012, a mileage discount campaign took place.
	ETC use rate (%)	60	68	76	79	85	88	88	77	79	81	83	85		
Promotion of ITS, such as introduction of VICS	Emission reduction (10,000 t of carbon dioxide)	194	214	225	231	235	240	246	225	230	240	245	250	Performance trends basically as expected.	During 2012 the number of rest stops was increased and road traffic information provision systems upgraded.
	VICS prevalent rate (%)	16	18	19	19.5	19.8	20	20.4	19	19.5	20	20.5	21		
Promotion of ITS (building central control traffic lights)	Emission reduction (10,000 t of carbon dioxide)	70	80	90	100	110	110	120	100	110	110	120	130	Performance trends basically as expected.	During 2012 centralized control of traffic signals took place. A plan to systematically implement centralized traffic signal controls in the future was made.
	Unit	28,000	32,000	36,000	38,000	40,000	43,000	45,000	38,000	40,000	42,000	44,000	47,000		
	10,000 persons	674	—	—	1,000	1,000	1,080	1,290	970	1,140	1,300	1,460	1,630		

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EXPERIENCES OF NAMA DEVELOPMENT IN ASIA AND THE WORLD

Chapter 4 introduces some case studies of the planning, development, and implementation of NAMAs in Asia and an additional case study of the development of a NAMA in the Latin American region carried out by the World Resources Institute (WRI).

The four Asian case studies utilized the bottom-up approach. Namely, capacity-building programs that took place in Cambodia (agriculture/energy), Lao PDR (transport), Mongolia (energy supply) and Viet Nam (waste), all of which the Overseas Environmental Cooperation Center, Japan (OECC), was involved in and which were funded by the Ministry of Environment, Japan (MOEJ). Alongside the OECC the Ministry of Environment, Cambodia (MOEC), the Ministry of Natural Resources and Environment (MONRE), Lao PDR, the Ministry of Environment and Green Development (MEDG), Mongolia, and the Viet Nam Institute for Hydrology, Meteorology and Environment (IMHEN) introduce their own experience with the processes and elements involved in developing NAMAs, and which include the compilation and analysis of policy document and activity data, identification of BAU and specifications of NAMAs through quantification of GHG, co-benefits, and institutional arrangements, etc.

The above are still on-going projects but the practical experience gained in the application of generic approaches to specific country cases is very useful in that it typically reflects the differing national circumstances and nature of the sectors concerned.

4.1 Experience gained developing NAMAs in the agriculture sector in Cambodia

By
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Host Country Information:

Host Country	Kingdom of Cambodia
Implementing Organization	Ministry of Environment

Sector

General:	Agriculture/Energy
Specific:	Biogas

1. Background (Introduction)

Cambodia is the least developed country that is a Party of the UNFCCC but fully supports global efforts to reduce GHG emissions, as based on UNFCCC principles. Cambodia has been active in implementing GHG mitigation projects via various schemes including the CDM and a voluntary market. However, Cambodia is yet to have submitted a list of NAMAs to the UNFCCC Secretariat in response to invitations that were included in COP decisions. In seizing this opportunity, therefore, Cambodia is taking part in an initiative made possible by the Ministry of the Environment of Japan (MOEJ) entitled "Capacity-building cooperation project for development of NAMAs in a MRV manner between Cambodia and Japan."

2. Development context

Cambodia recognizes the importance of GHG mitigation in the realization of low carbon development and sustainable economic growth. The Green Growth Roadmap and Cambodian Climate Change Strategic Plan that have been developed would suggest win-win-win situations for their economy, environment, and society. NAMAs should also be accordingly elaborated upon.

3. Preparatory process

1) Compilation and analysis of policy documents

First, the sectors and mitigation actions to focus on were selected through compilation and analysis of the relevant policy documents and expert opinions. The key documents of pertinent ministries and national agencies included the following: National Strategic Development Plan Update 2009-2013, Statistical Yearbook of Cambodia 2008, Green Growth Roadmap, Initial National Communication and National Biodigester Programme (NBP) 2012 Baseline Study, and Report on Power Sector of the Kingdom of Cambodia.

According to those documents roughly 24% of the population is connected to the electricity grid in Cambodia, with direct fuel combustion of biomass from wood sources, such as fuel wood and charcoal, being the dominant fuel source, and actually accounting for almost 90% of the total energy sources available. This situation has been depleting the forests and has led to a widespread scarcity of biomass. Direct fuel use in the industrial and commercial sectors is, however, relatively low.

In this context, and while the Cambodian NAMA Working Group provided four potential mitigation actions, which include the introduction of biodigesters, dissemination of solar home systems, improving the energy efficiency of buildings, and the installation of biomass power generation plants, the introduction of biodigesters in the biogas sub-sector was identified as a priority action after having taken into account the availability of data as well as potential co-benefits, including reducing the need for fuel wood and charcoal.

2) Compilation of activity data

(a) BAU emissions

The Cambodian NAMA Working Group set two BAU emission scenarios for use in the biogas sub-sector, including CH_4 emissions from animal manure and CO_2, CH_4 and N_2O emissions from the combustion of fossil fuel and biomass. The Cambodian GHG inventories suggested that emission sources in the biogas sub-sector could be associated with the following three categories: agriculture, energy, and LULUCF (Land Use, Land-Use Change and Forestry). Biogas, or CH_4 emissions from animal manure was categorized as belonging to the agriculture sector, while CO_2, CH_4, and N_2O emissions from the combustion of fossil fuel and CH_4 and N_2O emissions from the combustion of biomass, all of which could be reduced by biogas use, were categorized as emissions from the energy sector (Table 1). In the GHG Inventories CO_2 emissions from the combustion of non-renewable biomass was classified as belonging to the LULUFC sector; however, for the sake of simplification the Cambodian NAMA Working Group regarded it as emissions from the energy sector.

Table 1. Emission sources in the biogas sub-sector, categories, and baseline emissions

Emission sources in biogas sub-sector	Categories in GHG inventories	BAU emissions
1. CH_4 emissions from animal manure	Agriculture	CH_4 emissions from animal manure [BAU emissions in the agriculture sector]
2. CO_2, CH_4, and N_2O emissions from combustion of fossil fuel	Energy	CO_2, CH_4 and N_2O emission from combustion of fossil fuel and biomass [BAU emissions in the energy sector]
3. CH_4 and N_2O emissions from combustion of biomass	Energy	
4. CO_2 emissions from combustion of non-renewable biomass	LULUCF	

(b) Compilation of activity data

CH_4 emissions from animal manure [BAU emissions in the agriculture sector]

a) Collected data

The following data was provided by the Department of Animal Health and Production, Ministry of Agriculture, Forestry and Fisheries (MAFF):

- Actual number of cows, pigs, poultry, and buffalos in 2000 through to 2011,
- Projected number of pigs and poultry in 2012 through to 2020.

b) Alternative values for missing data

Cambodia has no country specific values with regard to emission factors for the defined livestock population, and hence default values from the "2006 IPCC Guidelines for National Greenhouse Gas Inventories" (IPCC, 2006) were used. The projected number of cows and buffalos in 2012 through to 2020 were estimated using the Compound Annual Growth Rate from 2001 through to 2011.

3) Identification of BAU

CH_4 emissions from animal manure [BAU emissions in the agriculture sector]

(a) Methodologies

BAU emissions in the agriculture sector were estimated using the Tier 1 methodology of "2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use, Chapter 10 EMISSIONS FROM LIVESTOCK AND MANURE MANAGEMENT" (IPCC, 2006).

$$CH_{4\,Manure} = \sum_{(T)} \frac{(EF_{(T)} * N_{(T)})}{10^6}$$

Where:

$CH_4Manure$	CH_4 emissions from manure management, for a defined population, $GgCH_4yr^{-1}$
$EF_{(T)}$	Emission factor for the defined livestock population, $kgCH_4head^{-1}yr^{-1}$
$N_{(T)}$	Number of heads of livestock species/category T in the country
T	Species/category of livestock

4) Specification of NAMAs

(a) Summary of mitigation action

The selected mitigation action was to promote the introduction of biodigesters, which is a relatively cheap and environmentally friendly technology. The activities include a program that supports use of biodigesters, including increasing awareness of the advantage of biogas technology, increasing access to subsidies and soft loans, increasing the number of biodigester masons and program supervisors, and promoting effective use of bio-slurry for crops, rice, and fish food, and as a botanical pesticide.

(b) Technological specifications

The sustainability of biodigester use very much depends on the technology used, adaptability to climate, availability of materials, and the cost and skill requirements of their construction. The NBP therefore conducted technological assessments of the following nine models: Flooding drum models, Janatha Fixed Domes, KT 1 Fixed Domes, Chinese Fixed Domes, Plastic Bag digesters, GGC Model Fixed Domes, Deenbandhu Fixed Domes, Vacvina Digesters, and KT 2 Fixed Domes. The NBP then identified the Deenbandhu Fixed Dome as being the most appropriate model with respect to the situation in Cambodian; and by improving the Deenbandhu Fixed Dome, or the Farmer' s Friend Biodigester Model for Cambodia, a more durable and credible version, was developed and disseminated for use.

5) Quantification of GHG emission reduction by NAMAs

(a) NAMA emissions

a) Gases included in the selected mitigation action

The Cambodian NAMA Working Group identified the gases concerned in the selected mitigation action. N_2O emissions from animal manure and CO_2, CH_4, and N_2O emissions from the combustion of kerosene and diesel were excluded for the sake of simplification and as they are only a minor source of emissions. (Table 2)

Table 2. Gases included in the selected mitigation action

Emission source	GHG	Include/Exclude	Justification
Animal manure	CO_2	Excluded	CO_2 neutral
	CH_4	Included	Main emission source
	N_2O	Excluded	-Minor emission source -Too difficult to measure, report, and verify
Combustion of fossil fuel	CO_2	Partially included	Emissions from combustion of LPG are only included as demand for it is steadily increasing every year.
	CH_4	Partially included	
	N_2O	Partially included	
Combustion of non-renewable biomass	CO_2	Included	Main emission source
	CH_4	Included	- Minor emission source
	N_2O	Included	- Easy to measure, report, and verify

b) Calculation method

The amount of emission reduction resulting from use of biodigesters was calculated using the following formula:

Emission reduction achieved through installation of biodigesters (tCO_2e) =
Emission reduction per biodigester (tCO_2e/unit) ×
Number of biodigesters in use by 2020 (units) × Ratio of operating digesters (%)

The emission reduction per biodigester was estimated using a combination of two methodologies: small-scale CDM methodology "AMS-III.D: Methane recovery in animal manure management systems" and Gold Standard methodology "Technologies and Practices to Displace Decentralized Thermal Energy Consumption" .

c) Base year and target year

The Cambodian NAMA Working Group set the base year to be 2000 and the target year 2020.

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d) NAMA Target value

The Cambodian NAMA Working Group decided the number of biodigesters that would be in use by 2020 via the following three scenarios: (i) 6,000 units per year with financial support, (ii) 3,000 units per year without financial support, and (iii) 70,000 units per year, or the equivalent of 25 % of all rural households, as technically being possible. In these scenarios the target ratio of operating digesters was set to be 96%, which was the actual NBP number in 2012.

(b) Calculation of emission reduction achieved through use of biodigesters

CH_4 emissions from animal manure

a) Methodologies

Emission reduction from animal manure was estimated using the small-scale CDM methodology "AMS-III.D: Methane recovery in animal manure management systems". NAMAs do not need to be as comprehensive as CDMs and hence the baseline emissions did not include UFb: Model correction factor to account for uncertainties (0.94).

[Emission reduction per biodigester]

$$\mathrm{ER_y} = BE_y - PE_{PL,y} - PE_{flare,y}$$

[Baseline Emissions]

$$\mathrm{BE_y} = GWP_{CH4} * D_{CH4} * \sum_{j,LT} MCF_j * B_{0,LT} * N_{T,hh} * VS_{LT,y} * MS\%_{BI,J}$$

Where:

BE_y	Baseline emissions in year y
GWP_{CH4}	Global Warming Potential (GWP) of CH_4 (25)
D_{CH4}	Density of methane (0.67kg/m^3 at 20°C and 1 atm)
J	Manure treatment type index
LT	Animal type
$B_{0,LT}$	Maximum CH_4 production capacity from manure per animal for defined livestock population (m^3CH_4/kg-dm)
$N_{T,hh}$	Livestock of defined population per household
$VS_{LT,y}$	Adjusted volatile solid excretion per day on dry-matter basis for defined livestock population at project site, in kg-dm/animal $VS_{LT,y}$ =(Average site weight/Default weight) * (op. days) * $VS_{default}$
MCF_j	Methane conversion factor for manure treatment j
$MS\%_{Bl,j}$	Portion of applicable treatment system j

[Projected Emissions]

$$\mathrm{PE_{PL,y}} = 0.1 * GWP_{CH4} * D_{CH4} * \sum_{i,LT} B_{0,LT} * VS_{LT,y} * MS\%_{i,y} * N_{T,hh}$$

Where:

$PE_{PL,y}$	Emissions due to physical leakage of biogas in year *y*
$MS\%_{i,y}$	Fraction of manure handled using system *i* in year *y*

$$\mathrm{PE_{flare,y}} = \left(BE_y - PE_{PL,y}\right) * (1 - \eta_{flare,h})$$

Where:

$PE_{flare,y}$	Projected emissions from flaring of the residual gas stream in year y
η_{flare}	Flare efficiency in hour h and based on measurement or default value (0.90)

a) Collected data
The following data was calculated using the number of rural households and livestock provided by the "Statistical Yearbook of Cambodia 2008" :
- NT,hh: Livestock of defined population per household.

b) Alternative to missing data
Cambodia has no country specific values for the parameters, including $B_{0,LT}$: Maximum CH_4 production capacity from manure per animal for defined livestock population (m^3CH_4/kg-dm), $VS_{LT,y}$: Adjusted volatile solid excretion per day on dry-matter basis for defined livestock population at project site, in kg-dm/animal, and MCF_j: Methane conversion factor for manure treatment j, and hence default values from the "2006 IPCC Guidelines for National Greenhouse Gas Inventories" (IPCC, 2006) were used. The default value from "Decision 15/CP.17, Revision of the UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to the Convention" (UNFCCC, 2011) was utilized for GWP_{CH4}: Global Warming Potential (GWP) of CH_4 and also the result of "NBP 2012 Baseline Study" (NBP, 2012) substituted for $MS\%_{i,y}$: Fraction of manure handled in system *i* in year *y*.

4. Institutional arrangements

In order to facilitate the availability of information and experts' consultation a Cambodian NAMA Working Group, which consists of the Ministry of Environment (MOE), the Ministry of Industry, Mines and Energy (MIME), the Ministry of Agriculture, Forestry and Fisheries (MAFF), the Ministry of Public Works and Transport (MPWT) and the National Biodigester Programme (NBP), was temporarily established.

5. Summary of concrete mitigation actions

The actions described above can be utilized as a potential NAMA for use in the agriculture/energy sector. The mitigation potential of the actions is as outlined below:

A. Specific measures: Installation of biodigesters

B. Projected emissions reduction:
Scenario 1: Approx. 220,153 tCO_2/year (with ODA)
Scenario 2: Approx. 140,097 tCO_2/year (without ODA)
Scenario 3: Approx. 1,929,671 tCO_2/year (technical potential)

(a) Total number of biodigesters in use (units)

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Scenario 1	18,000	24,000	30,000	36,000	42,000	48,000	54,000	60,000	66,000
Scenario 2	18,000	21,000	24,000	27,000	30,000	33,000	36,000	39,000	42,000
Scenario 3	18,000	88,000	158,000	228,000	298,000	368,000	438,000	508,000	578,500

(b) GHG emissions reduction achieved through use of biodigesters (tCO_2e)

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Scenario 1	60,042	80,056	100,069	120,083	140,097	160,111	180,125	200,139	220,153
Scenario 2	60,042	70,049	80,056	90,062	100,069	110,076	120,083	130,090	140,097
Scenario 3	60,042	293,537	527,032	760,527	994,023	1,227,518	1,461,013	1,694,508	1,929,671

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C. Assumptions made:
Emission reduction per biodigester (tCO_2e/unit), Total number of biodigesters in use (units), and Ratio of operating biodigesters (%)

D. Description and details of NAMA

(a) Installation of biodigesters
Biodigester plants produce biogas that can be used to replace fuel used by households, primary examples being wood and fossil fuels, and mainly used in cooking. Biogas emitted from manure is captured by the biodigester and then burnt prevent GHG emissions being then released into the atmosphere, thereby contributing to a reduction in GHG emissions.

(b) Calculation of GHG emissions reduction
GHG emissions reduction (tCO_2e)
= GHG emissions reduction per biodigester (tCO_2e/unit) × Total number of biodigesters in use (units) × Operation ratio of biodigesters (%)

a) GHG emissions reduction per biodigester
The total GHG emissions can be calculated using a combination of animal waste management systems and wood fuel emissions. The average household in Cambodia emits approx. 3.93 tCO_2eq per year. Households in the project emit on average approx. 0.46 tCO_2eq per household per year, and hence the total GHG mitigation would therefore be approx. 3.47 tCO_2eq per household per year.

b) Number of biodigesters in use and operation ratio of biodigesters

NAMAs Scenario	Annual number of biodigesters in use (units/year)	Operation ratio of biodigesters (%)	Remark
Scenario 1	6,000	96	With ODA
Scenario 2	3,000	96	Without ODA
Scenario 3	70,000	96	Technical potential of 25% of rural households[1]

6. Policy-level MRV

There are currently no MRV policies/tools in place for NAMA implementation in Cambodia. The preparation of Biennial Update Reports (BUR) and the national GHG inventory within national communication is part of the report and monitoring system. However, as a Least Developed Country (LDC) Party Cambodia can submit its BURs at its own discretion.

7. Co-benefits

Biodigesters confer social, environmental, and economic co-benefits on its users, and which include:

- Reducing the drudgery of stockpiling wood, and for women in particular;
- Avoiding health hazards associated with indoor air pollution and the open fires of wood fired stoves;
- Enabling educational activities and household work in the evening via the brighter light produced by biogas lamps;
- Reducing local environmental pollution through a better waste management system, and improving the soil via use of bio-slurry;
- Reducing deforestation; and
- Reducing expenditure on cooking and lighting fuel.

In the present phase the Cambodia NAMA Working Group has not decided to do an MRV of these co-benefits.

[1] SNV estimated that at least 25% of rural households have the technical potential to install a biodigester in Cambodia (SNV, 2005).

8. Lessons learnt/Next steps

The Cambodian NAMA Working Group selected the NBP as a pilot exercise for the period of August 2012 through to 2013. The Cambodian expert team still did not have the necessary capabilities to understand the process of NAMA development, including the methodology and technological assessments used. The Cambodian NAMA Working Group is therefore considering the following activities as the next steps to take:

- Establishment of an official National NAMA Working Group. This would involve focusing on reviewing the current role of existing agencies, such as the National Climate Change Committee, and its technical Climate Change Technical Team, Climate Change Department, and other to-be established institutions such as the Joint Committee on the Joint Crediting Mechanism,
- Seeking to register the NBP as a UNFCCC registered NAMA,
- Increasing capability creation activities into other sectors according to the priority areas of Cambodia, which include transportation, biomass power generation, and solar energy, as well as other key sectors with GHG mitigation potential in Cambodia. Flexibility would need to be ensured for Cambodia with respect to methodological assessments of the development of NAMAs,
- Developing tools and guidelines for NAMA implementation and MRV,
- Sharing information with other countries in the region on their NAMA development.

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4.2 Experience gained developing NAMAs in the transport sector in Lao PDR

By
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Host Country Information:

Host Country	Lao People's Democratic Republic (PDR)
Implementing Organization	The Ministry of Natural Resources and Environment (MONRE), Department of Disaster Management and Climate Change (DDMCC)/Ministry of Public Works and Transport (MPWT)

Sector

General:	Energy/Transport Sector
Specific:	Introduction of Electric Vehicles

1. Background (Introduction)

The Lao PDR has been mainly implementing GHG mitigation projects including a CDM in the energy sector in thereby addressing global climate change, and in order to accelerate the mitigation initiative, as well as to prepare a NAMAs submission to the UNFCCC Secretariat, a 'Capacity-building cooperation project for NAMAs development in a MRV manner' between the Ministry of the Environment, Japan (MOEJ) and the Ministry of Natural Resources and Environment, Lao PDR (MONRE)' took place from September 2012 through to March 2013. This case study is based on the experience gained in that project.

2. Development context

Over the past few years Lao PDR has made considerable progress in strengthening and reforming the policies and instruments used to enhance environmental sustainability, and the government is aiming to reinforce its actions by promoting low-carbon growth. This vision was clearly indicated in both the current 7th National Socioeconomic Development Plan and the Climate Change Strategy, which were approved in 2010.

3. Preparatory process

1) Compilation and analysis of policy documents

The initial part of the project involved compiling and analyzing the relevant policy documents before selecting which sector to focus upon, and then identifying possible mitigation actions in the selected sector. The relevant documents included: "The Seventh National Socio-Economic Development Plan (2011-2015)", "Strategy on Climate Change of the Lao PDR", "The National Strategy and Action Plan on Environmentally Sustainable Transport, Lao PDR" and "Renewable Energy Development Strategy in Lao PDR".

In the Lao PDR GHG emissions increased the most in the LULUCF sector between 1990 and 2000. However, GHG emissions in other sectors, namely energy, industry, agriculture, and waste, have also shown relatively small but steady increases[1]. A focus on the transport sector was proposed in a discussion by the Technical Working Group on Climate Change. This was primarily due to a recent rapid increase in the number of vehicle registrations, which is resulting in an increase in GHG emissions in the Lao PDR, and secondly due to potential co-benefits that would address other socio-environmental issues such as air-pollution, traffic congestion, and traffic accidents.

A detailed mitigation action plan of the transport sector was yet to have been developed by the Lao PDR, and hence potential NAMA options within the transport sector were pinpointed after taking into careful consideration the relevant policies in the Technical Working Group on Climate Change.

[1] The Fist National Communication (2000), The Second National Communication (Draft ver. as of Oct. 2012)

Table 1. NAMAs options within the transport sector in the Lao PDR

No.	Category	NAMAs Options
1	Fuel switching/ Improved fuel efficiency of vehicles	Introduction of electric vehicles (government cars, buses, and shuttle buses for tourism)
2		Promotion of utilization of electric vehicles
3		Promotion of utilization of four stroke engine tricycles
4		Use of alternative fuels (bio-ethanol and biodiesel)
5		Regulation of fuel quality
6		Regulation of fuel economy
7		Regulation of exhaust gases
8		Promotion of eco-driving
9	Improved traffic efficiency	Development and promotion of public buses
10		Development and promotion of BRT
11		Bicycle lanes
12		Car park project
13		Banning of trucks
14		Signalization of major intersections
15		Ring road project
16		Introduction of ITS
17		Traffic Control Management Center
18		Establishment of a truck terminal and physical distribution centers
19	Other	Installation of LED Signals

Of the above listed NAMA options the Technical Working Group on Climate Change decided to focus upon the "Introduction of electric vehicles" as a model case due to the following reasons: an energy policy priority in the Lao PDR in thereby utilizing electricity generated from an increasing number of hydropower plants as an alternative to imported fossil fuel; and the availability of data from on-going project regarding a Low Emission Public Transport System by the Japan International Cooperation Agency (JICA).

2) Compilation of activity data

(a) BAU emissions

a) Data used in BAU emission calculation

The following data was used to calculate BAU emissions by 2020 in the transport sector.

- Number of vehicles registered: 2012, Vehicles Registration Statistics in Lao PDR by year, Ministry of Public Works and Transport (MPWT), Lao PDR
- Fuel efficiency by vehicle type (km/l): JICA. 2012. JICA Basic Data Collection Study on Low Emission Public Transport System in Lao PDR / Data provided by MPWT (for motorbikes and passenger cars only)
- Distance traveled by vehicle type (km/day): JICA. 2012. JICA Basic Data Collection Study on Low Emission Public Transport System in Lao PDR
- Projected number of vehicles registered by 2020: JICA. 2012. JICA Basic Data Collection Study on Low Emission Public Transport System in Lao PDR
- Calorific value of gasoline and diesel: Ministry of Environment, Thailand[2]

[2] Most gasoline and diesel in Laos is imported from Thailand, and hence the country specific values for the calorific values of Thailand were used.

b) Alternatives to missing data

- There are no country specific values regarding the emission factors for gasoline and diesel in Lao PDR and hence default values provided in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories were used in the calculation.
- Fuel efficiency by vehicle type (km/l) in 2020 was estimated to have increased 1% every year.

3) Identification of BAU

(a) Methodologies

The following equation was used in the BAU emission calculation[3].

$$BE_y = \sum_i \left(SFC_i \times NCV_{BL,i} \times EF_{BL,i} \times DD_{i,y} \times N_{i,y} \right)$$

Where:

BE_y	Total BAU emissions in year y (tCO_2)
SFC_i	Specific fuel consumption of vehicle category i in year y (l/km)
$NCV_{BL,i}$	Net calorific value of fossil fuel consumed by vehicle with BAU (MJ/l)
$EF_{BL,i}$	Emission factor of fossil fuel consumed by vehicle with BAU (tCO_2/MJ)
$DD_{i,y}$	Estimated annual average distance travelled by registered vehicle category i in year y (km)
$N_{i,y}$	Estimated number of registered vehicles in category i in year y

4) Specification of NAMAs

(a) Summary of mitigation actions

The selected NAMA option involved promoting the use of electric vehicles as an alternative to conventional gasoline or diesel vehicles, and with related infrastructure developments such as battery stands. The amount of energy supplied by hydropower plants is expected to significantly surpass energy demand from 2015 on, and the grid CO_2 emission factor estimated to be as low[4] in the Lao PDR, and hence this option would be beneficial in enabling the utilization of domestic low emission electrical energy, and reducing the consumption of fossil fuels that are all imported from neighboring countries, as well as in mitigating air-pollution in urban areas.

(b) Technology specifications and cost analysis

The applicability and sustainability of the use of electric vehicles very much depends on their technological specifications, infrastructure development, and cost, and hence a further study is taking place as part of the Study on Low Emission Public Transport System in Lao PDR made by the JICA.

5) Quantification of GHG emission reduction by NAMAs

(a) NAMA emissions

a) Target year

The target year was set to be 2020 with regard to NAMA emissions.

b) Calculation Method

The emission reduction from the NAMA is the difference between the baseline emissions and projected emissions for by 2020. The baseline emissions were calculated using the following equation[5].

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[3] Small-scale CDM methodologies: AMS- III.C "Emission reductions by electric and hybrid vehicles"

[4] Current CO_2 emission factor is estimated to be 0.135 tCO_2/MWh, as provided by data from Eletricite du Laos (EDL) and the Thai Greenhouse Gas Management Organization.

[5] Small-scale CDM methodologies: AMS- III.C "Emission reductions by electric and hybrid vehicles"

$$BE_y = \sum_i \left(SFC_i \times NCV_{BL,i} \times EF_{BL,i} \times DD_{i,y} \times N_{i,y}\right)$$

Where:

BE_y	Total baseline emissions in year *y* (tCO_2)
SFC_i	Specific fuel consumption of baseline vehicle category i (l/km)
$NCV_{BL,i}$	Net calorific value of fossil fuel consumed by baseline vehicle (MJ/l)
$EF_{BL,i}$	Emission factor of fossil fuel consumed by baseline vehicle (tCO_2/MJ)
$DD_{i,y}$	Annual average distance travelled by projected vehicle category i in the year *y* (km)
$N_{i,y}$	Number of projected operational vehicles in category i in year *y*

The projected emissions were calculated using the following equation[6]:

$$PE_y = \sum_i \left(SEC_{PJ,i,y} \times EF_{elect,y} /(1 - TDL_y) \times DD_{i,y} \times N_{i,y}\right)$$

Where:

PE_y	Total projected emissions in year y (tCO_2)
$SEC_{PJ,i,y}$	Specific electricity consumption by projected vehicle category i per km in year y in urban conditions (kWh/km)
$EF_{elect,y}$	CO_2 emission factor of electricity in year y (tCO_2/kWh)
TDL_y	Average technical transmission and distribution losses with providing electricity in year
$DD_{i,y}$	Annual average distance travelled by projected vehicle category i in the year y (km)
$N_{i,y}$	Number of projected operational vehicles in category i in year y

c) NAMAs Target Value

The percentage of electric vehicles to be introduced in relation to the estimated number of vehicles owned by their type in 2020 was taken from the JICA Basic Data Collection Study on Low Emission Public Transport System in Lao PDR, 2012.

(b) Calculation of emissions reduction achieved through introducing electric vehicles

a) Data used in emission reduction calculation

- Distance traveled by vehicle type (km/day): JICA. 2012. JICA Basic Data Collection Study on Low Emission Public Transport System in Lao PDR
- Electrical Economy by vehicle type (kWh/km): JICA. 2012. JICA Basic Data Collection Study on Low Emission Public Transport System in Lao PDR
- Grid Electricity emission factor (tCO_2/MWh) was estimated using data from Eletricite du Laos (EDL) and the Thai Greenhouse Gas Management Organization.

b) Alternative to missing data

- Fuel efficiency by vehicle type (km/l) in 2020 was estimated to increase 1% every year.

[6] Small-scale CDM methodologies: AMS- III.C "Emission reductions by electric and hybrid vehicles"

4. Institutional Arrangements

The Technical Working Group on Climate Change was organized in order to facilitate related discussions between the ministries concerned and consultations with experts. The Working Group is chaired by MONRE, and incorporates the MPWT, the Ministry of Industry and Commerce (MIC), the Ministry of Energy and Mines (MEM), the Ministry of Science and Technology (MOST), the Ministry of Agriculture and Forestry (MAF), the Ministry of Health (MoH), and the Ministry of Education and Sport (MoES). The Technical Working Group was established as a subsidiary body of the National Environmental Committee to deal with the technical side of climate change related issues, and in particular specific topics that include NAMAs, REDD+, and CDM.

5. Summary of concrete mitigation actions

The selected NAMA option can be summarized using the following format:

A. Specific measures: Introduction of electric vehicles

B. Projected emissions reduction:
Approx. 318,973 tCO_2 by 2020 (Target Year)

(a) Target number of electric vehicles to be introduced by 2020

Category	Number of EVs	Percentage to total vehicle ownership (%)
Motorcycles	698,000	50
Passenger cars	45,000	10
Trucks	-	-
Tuk tuks/Minibuses	4,000	100
Song thews/Medium size buses	12,000	10
Large buses	1,000	10
TOTAL	-	40

C. Description of NAMA

(a) Introduction of electric vehicles

CO_2 emissions from the fuel combustion of road vehicles can be reduced by replacing conventional gasoline or diesel vehicles with electric vehicles.

(b) Calculation of GHG emissions reduction

GHG emissions reduction (tCO_2) = Baseline emissions – Projected emissions

Baseline emissions

$$BE_y = \sum_i \left(SFC_i \times NCV_{BL,i} \times EF_{BL,i} \times DD_{i,y} \times N_{i,y} \right)$$

Where:

BE_y	Total baseline emissions in year y (tCO_2)
SFC_i	Specific fuel consumption of baseline vehicle category i (l/km)
$NCV_{BL,i}$	Net calorific value of fossil fuel consumed by baseline vehicle (MJ/l)
$EF_{BL,i}$	Emission factor of fossil fuel consumed by baseline vehicle (tCO_2/MJ)
$DD_{i,y}$	Annual average distance travelled by projected vehicle category i in the year y (km)
$N_{i,y}$	Number of projected operational vehicles in category i in year y

Projected emissions

$$PE_y = \sum_i \left(SEC_{PJ,i,y} \times EF_{elect,y} / (1 - TDL_y) \times DD_{i,y} \times N_{i,y} \right)$$

Where:

PE_y	Total projected emissions in year y (tCO_2)
$SEC_{PJ,i,y}$	Specific electricity consumed by projected vehicle category i per km in year y in urban conditions (kWh/km)
$EF_{elect,y}$	CO_2 emission factor of electricity in year y (tCO_2/kWh)
TDL_y	Average technical transmission and distribution losses in the provision of electricity in year
$DD_{i,y}$	Annual average distance travelled by projected vehicle category i in the year *y* (km)
$N_{i,y}$	Number of projected operational vehicles in category i in year *y*

(c) GHG emissions reduction by vehicle type

Category	Total Emission Reduction (tCO_2/year)	Emission Reduction per vehicle (tCO_2/year/vehicle)
Motorcycles	161,204	0.2
Passenger cars	56,280	1.3
Trucks	-	-
Tuk tuks/Minibuses	42,537	10.6
Song thews/Medium size buses	21,065	1.8
Large buses	37,887	37.9

6. Policy-level MRV

The number of electric vehicles introduced in Lao PDR will need to be reported in thereby monitoring the progress of the NAMA option selected. The vehicle registration system in the Lao PDR currently records eight different types of vehicles and their year of registration, and which the MPWT is responsible for. The impact could therefore be reviewed by subdividing its vehicle categories into power sources (gasoline, diesel, hybrid, LPG, and electricity etc.) at their initial registration or annual vehicle inspections. Fuel efficiency and data on their distance travelled used in the calculations every few years may also need to be reviewed by the Technical Working Group on Climate Change in thereby ensuring the utmost accuracy.

7. Co-benefits

Introducing electric vehicles could result in the following social, environmental, and economical co-benefits:

- Reduced air pollutants from exhaust gases
- Reduced noise/vibration
- Reduced cost of purchasing gasoline or diesel at the individual level
- Reduced odor from exhaust gases

One hundred percent of the petroleum used in the Lao PDR is imported from abroad, which is of significant cost to the national economy and negatively affects their energy security. Replacing petroleum with domestically generated hydro-electricity can thus contribute to addressing these issues, in addition to the above mentioned benefits.

8. Lessons learnt/Next steps

The NAMA development experience provided useful findings that can be used in the next steps to take, which are as follows:

- Establishment of a country specific default value for fuel efficiency by vehicle type will be useful in the GHG emission quantification of NAMAs options in the transport sector, but capacity building on transport data collection may be required.
- Development of the rest of the listed NAMAs options will be necessary, and with, in particular, "Alternative fuel introduction (bio-ethanol and biodiesel)", "Regulation of fuel quality", "Development and promotion of public buses", and "Car Parks (park and ride)" being considered priorities by the Technical Working Group.
- Consideration of financial schemes to be utilized in NAMA implementation will be essential.

References

- The Seventh National Socio-Economic Development Plan (2011-2015) (2011)
- Strategy on Climate Change of the Lao PDR (2010)
- The National Strategy and Action Plan on Environment Sustainable Transport, Lao PDR, March (2011)
- Renewable Energy Development Strategy in Lao PDR, October (2011)
- JICA Basic Data Collection Study on Low Emission Public Transport System in Lao PDR, Final Report, October (2012)

4.3 Experience gained developing NAMAs in the energy supply sector of Mongolia

By
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Kunihiro Ueno (Climate Experts Ltd.)
Fumihiko Kuwahara (SUURI-KEIKAKU CO., LTD.)

Host Country Information:

Host Country	Mongolia
Implementing Organization	Ministry of Environment and Green Development of Mongolia (MEGD)

Sector

General:	Energy supply
Specific:	Combined heat and power plant

1. Background (Introduction)

Mongolia is located in a severe continental climate area, with temperature of about -10 °C to -40 °C during winter, thus Ulaanbaatar, where almost half of the population lives, is the coldest capital in the world.

The electricity and heating demand have increased rapidly due to the influx of people from rural areas to Ulaanbaatar who look for income-generation opportunities. Coal-fired power plants (Combined Heat and Power plant: CHP) provide the majority of power generated in Ulaanbaatar. In particular, CHP3 and CHP4 are the biggest coal fired CHP plants in the capital. Since CHPs contribute a major part in the total GHG emissions of Mongolia, improving the efficiency of CHPs and reducing internal use are listed up as GHG emission reduction measures in the Mongolian NAMAs list which was submitted to UNFCCC in accordance with Copenhagen Accord. Therefore, as a prioritized action, improving efficiency of CHP3 and CHP4 in view of tackling their dominant GHG emissions is analyzed.

This paper is structured as follows; Section2 briefly describes a preparatory process. Section3 explain an example of an institutional level arrangement. Section4 proposes NAMA options and Section5 suggests Policy level MRV. Section6 analyses co-benefits effect of NAMAs, finally lessons learnt and key challenges are summarized in Section5.

2. Preparatory process

1) Compilation of policy documents and data collection

Historical trends and future GHG emission projections with respect to heat and electricity generation were then calculated using the data and national plan shown below.

Historical trends
- Energy Statistical Indicators 2006-2011 (Energy Regulatory Commission)
- Mongolia statistical yearbook 1999-2011 (National statistical office of Mongolia)

Projections
- Mongolia: Updating Energy Sector Development plan: Interim report-PN TA.NO 7619-MON (Asian Development Bank)

Energy supply data was amassed using statistical documents and policy papers for use in then calculating the Business As Usual (BAU). The main energy supply facilities of Mongolia include CHPs, Heat Only Boilers (HOB), and individual ger stoves. All that activity data was amassed and aggregated in thereby covering the entire energy supply sector (the data covers more than 95% of energy supply BAU emissions). The data is shown below:

【Electricity】
・Electric power generation (generating-end) : unit (GWh/year) ・Electric power supply (sending-end) : unit (GWh/year) ・Electric demand : unit (GWh/year)
【Heat】
・Heat supply : unit (Gcal/year) ・Heat demand : unit (Gcal/year)
【Coal consumption】
・Coal consumed in power generation : unit (ton×10^3/year) ・Coal consumed in heat production : unit (ton×10^3/year)

2) Calculation of BAU

Energy generation emissions were calculated using the activity data amassed from the main facilities (CHPs, HOBs, and individual ger stoves), and which came from the above mentioned documents. We adopted the bottom-up approach to use to estimate overall energy supply sector emissions and in integrated the individual activity data from each facility. Emissions from the energy supply sector were estimated to be 9,137 $tCO_2 \times 10^3$ in 2006, but which is expected to have increased to up to 13,363 $tCO_2 \times 10^3$ by 2020. National inventory data from the energy sector indicates emissions of 10,220 $tCO_2 \times 10^3$, thus making the aggregated emissions from the energy supply data consistent with the inventory. The calculations used are shown below.

【Electricity】

BAU y (electricity) $= \sum_m EG_{m,y} \times SFC(E)_{m,y} \times EF_{Coal}$

- $EG_{m,y}$: Energy supply from each CHP (m) per year y. (kWh/year)
- $SFC(E)_{m,y}$: Specific amount of fuel consumed when generating electricity at each CHP (m) per year y. (g/kWh)
- EF_{coal} : Emission factor of lignite from 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2.96 tCO_2e/t-coal). CO_2 emission factor for lignite was utilized to represent the value of coal as it is the main type of coal used in Mongolia.
- y : year 2005-2020

they

【Heat】

Heat production from CHP,

BAU y (Heat) $= \sum_m HG_{m,y} \times SFC(H)_{m,y} \times EF_{Coal}$

- $HG_{m,y}$: Energy supplied by each CHP, (Gcal/year)
- $SFC(H)_{m,y}$: Specific amount of fuel consumed in producing heat at each CHP (m) per year y. (g/Gcal)
- EF_{coal} : Emission factor of lignite from 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2.96 tCO_2e/t-coal).
- y : year 2005-2020

Heat production from HOB and Individual Ger Stoves;

BAU y (Heat) $= \sum_m HG_{m,y} \times EF_{Coal}$

- $HG_{m,y}$: Energy supplied by HOBs and individual Ger Stoves (ton/year)
- EF_{coal} : Emission factor of lignite from 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2.96 tCO_2e/t-coal).
- y : year 2005-2020

3) Specification of NAMA

Comprehensive introduction of low carbon technologies in the coal-fired combined heat and power plants (CHPs) used in the central energy system of Mongolia would reduce coal-derived CO_2 emissions as well as air pollutants.

In a Feasibility Study (FS) made by Suuri-Keikaku Co., Ltd., questionnaires and on-site interviews were used at CHP3 and CHP4. In addition, quantification of GHG emission reductions and MRV methods were also fully examined.

The project at CHP3 assumes the introduction of low O_2 boiler system, a speed control for the boiler water pump, a resin coating over the surface of the blades of the condenser pump, better insulation, replacement by the top runner transformer, and light emitting diodes, all with respect to the operational aspect. The project at CHP4 assumes the introduction of more energy efficient technology – for example highly efficient turbines and combustion systems at the facility level, and adoption of equipment management technology at the operational level. These activities will increase the energy efficiency of CHPs while reducing how much coal they consume, and thus contributing to a reduction in CO_2 emissions.

As proposed in its submission to the UNFCCC the above mentioned NAMAs are expected to take place with international support, including finance and technology transfers, as well as capability creation. At this point Mongolia is seeking a variety of ways to finance these actions, for example from bilateral and multilateral financial sources, including ODA and soft loans. In addition, and in order to increase the scale of the mitigation actions and utilize all possible funding sources in facilitating the transfer of technologies, financing through mechanisms such as the Joint Offset Crediting Mechanism (JCM) and other innovative means of finance are also expected to occur.

4) Quantification of Emission Reduction by NAMAs

$$ER(H)_y = \left(FC(H)_{BAU,y} - FC(H)_y\right) \times EF_{Coal} = QH_y \times \left(SFC(H)_{BAU,y} - SFC(H)_y\right) \times EF_{Coal}$$

$FC(H)_{BAU,y}$: Fuel consumed for heat supply in BAU (without NAMA measure) per year y (t-coal/year)

$FC(H)_y$: Fuel consumed for heat supply with NAMA measure per year y (t-coal/year)

EF_{coal} : CO_2 emission factor of fuel (t CO_2/t-coal)

QH_y : Total amount of net distributed heat per year y (Gcal/year)

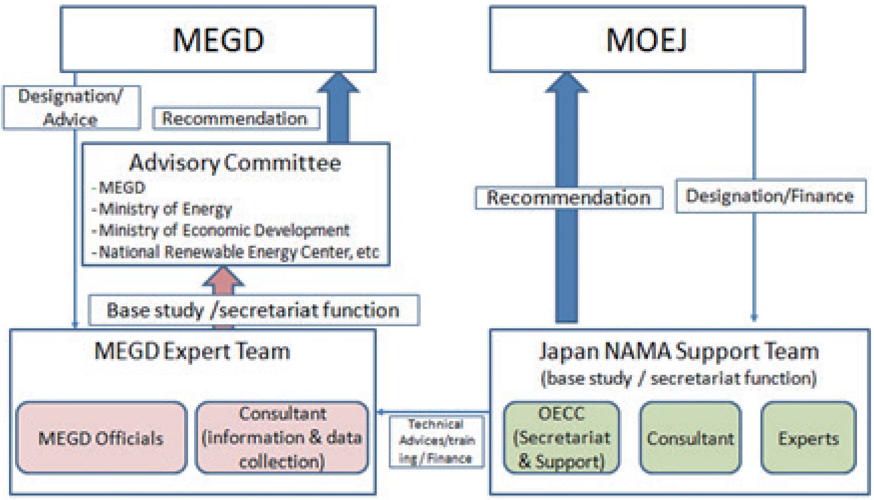
$SFC(H)_{BAU,y}$: Specific amount of fuel consumed per unit of net distributed heat in BAU without NAMA (t-coal/Gcal)

$SFC(H)_y$: Specific amount of fuel consumed per unit of net distributed heat in BAU with NAMA (t-coal/Gcal)

3. Institutional arrangements

Institutional level arrangements have been organized between the Ministry of Environment and Green Development of Mongolia (MEGD) and the Overseas Environmental Cooperation Center (OECC) with respect to the following activities.
(1) The establishment of a NAMA advisory committee.
(2) The advisory committee is composed of selected experts from relevant organizations.
(3) The MEGD functions as the secretariat for the advisory committee.
(4) The advisory committee discusses output from the project and provides recommendations.
(5) The advisory committee is chaired by the MEGD but with support from OECC.

Figure1. Institutional arrangement for the NAMA project



4. Proposed NAMAs options

A. Specific measures:

Multiple application of energy efficiency improvement measures at CHP3

B. Projected emissions reduction:

Approx. 77,360 tCO_2/year

C. Premise for forecast once taken:

	Potential Measures at CHP3	Improvement of energy efficiency of heat production [%]	Improvement of energy efficiency of power generation [%]
Boiler	- Improved Combustion (Low O_2 operation)	3.87	6.87
Auxiliary and Electricity	- Adoption of speed control for Boiler Feed water Pump Replacement by Top runner Transformer - Adoption of Light Emitting Diodes and Resin coating of Blades surface of Condenser Pump - Better insulation		

2008-2010 Average	Coal consumption intensity with heat production	179.6		$*10^{-3}$ t-coal/Gcal
	Coal consumption intensity with power generation		369.8	$*10^{-3}$ t-coal/MWh
2015	Improvement of energy efficiency of heat production	3.87		%
	Improvement of energy efficiency of power production		6.87	
2015	Emission reduction from heat generation	36,824		tCO_2/year
	Emission reduction from power generation		40,536	
	Total emission reduction	77,360		

A. Specific measures:
Multiple application of energy efficiency improvement measures at CHP4

B. Projected emissions reduction:
Approx. 208,888tCO_2/year

C. Premise for forecast once taken:

	Potential Measures at CHP4	Improvement of energy efficiency of heat production [%]	Improvement of energy efficiency of power generation[%]
Boiler	Installation of Soot Blowers	0.32	6.57
Turbine	Replacement by high efficiency turbine (rotors, blades, inner casings, and governor)		
Electricity	- Replacement by top runner LEDs		
	- Adoption of LEDs		
Auxiliary and piping	- Resin coating over blade surface of CWP		
	- Resin coating over blade surface of CP		
	- Better insulation		

2008-2010 Average	Coal consumption intensity with heat production	183.1		*10^{-3} t-coal/Gcal
	Coal consumption intensity with power generation		366	*10^{-3} t-coal/MWh
2015	Improvement of energy efficiency of heat production	0.32		%
	Improvement of energy efficiency of power generation		6.57	
2015	Emission reduction from heat generation	5,267		tCO_2/year
	Emission reduction from power generation		203,621	
	Total emission reduction	208,888		

5. Policy level MRV

After the NAMA has been implemented ex-post evaluations of the status of efforts will need to be made by the government in association with evaluation indicators established for the countermeasures. The existing report and review system in Mongolia with respect to activity data from each sector would presumably be applicable in evaluating the impact of implemented NAMAs, however, the availability of a NAMA MRV system has yet to have been confirmed. Starting in 2013 we are therefore planning to conduct studies on the existing MRV system that can then be used in ex-post evaluations of NAMAs.

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6. Co-benefits

Acceding to the FS made by Suuri-Keikaku Co., LTD, the emission of air pollutants (PM10) were estimated for a scenario in which the amount of coal consumed would be reduced by 1% at CHP3 and CHP4 as a result of energy conservation measures. Reducing the amount of coal consumed at CHP3 and CHP4 by 1% would reduce the amount of PM10 from 4,318 (ton/year) to 4,293 (ton/year). The health benefits resulting from that measure can be calculated by subtracting the monetary value of the implemented measure scenario respective to without the measure scenario, which then reveals the health benefit to be equal 679,000 USD when the amount of coal consumed is reduced by 1%.

7. Lessons Learnt/Key challenges

(1) We calculated BAU emissions using activity data from the main energy supply facilities (CHPs, HOBs, and ger stoves) and based on Energy Statistical Indicators 2006-2011 and the Mongolia Updating Energy Sector Development Plan. However, BAU emissions typically include uncertainties, for example any time lag with the expected introduction of the new planned CHP, and also the amount of electricity imported from China and Russia in meeting increasing demand in the future. BAU emissions are non-linear, thus making it difficult to calculate BAU emissions for the energy sector using the bottom-up approach. The uncertainty included in the BAU scenario is quite high, thus making it better to focus on the aggregation of mitigation projects as an integration of NAMA options an initial step. The effect of a NAMA effect can be better revealed by summing up the potential projects rather than using the quantity of actual emissions.

(2) It is important to recognize that potential NAMAs should be embedded within a Low Emission Development Strategy or comparable national strategy. Looking for planned projects with large amounts of business potential and GHG emission reductions is an indispensable component, and with the possibility of making a profit generation and growth in demand for the host country being particularly crucial in selecting realistic NAMA projects.

(3) Institutional arrangements are crucial in the creation of BAU and NAMA options because the data and strategies need to be considered together through inter-ministerial cooperation in a particular sector. At the same time, it is also important that the appropriate commitment of the ministries responsible is reached with potential NAMA projects.

(4) It is important to take into account the co-benefits of reducing pollution and contamination through a NAMA project. There are many cases where priority on measuring pollution is overly high when compared to the mitigation actions of the host country. In that case, however, the expectation is that the setting of standards for use with eligibility criteria be considered with NAMAs that will have co-benefits.

References

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4.4 Experience gained developing NAMAs in the waste sector in Vietnam

By | Anh Do (Institute of Meteorology Hydrology and Environment, Viet Nam) Yuko Komiya (Overseas Environmental Cooperation Center, Japan)

Host Country Information:

Host Country	Socialist Republic of Viet Nam
Implementing Organization	The Vietnam Institute of Meteorology, Hydrology and Environment (IMHEN)

Sector

General:	Waste sector
Specific:	Municipal Solid Waste (MSW)/Waste water

1. Background (Introduction)

Preparation for implementing NAMAs in Vietnam is underway[1], as demonstrated by the "National Target Program to Respond to Climate Change (NTP)" and the "National Climate Change Strategy". Waste management in Vietnam is one of the most important sectors for reducing GHGs due to poorly managed landfill that can be a serious threat to the environment, including the generation of landfill gas (methane), which is a major greenhouse gas (GHG).

In order to contribute to improving the waste treatment system and introducing measures that will help realize a low carbon society, a joint working group was developed between OECC and IMHEN to work on NAMAs in the waste sector under the "NAMA Capacity Building Project", as supported by the Ministry of the Environment, Japan (MOEJ), in 2012. This section will introduce OECC's and IMHEN's approaches to developing NAMAs in the waste sector in Vietnam during 2012.

[1] As of 6 June2014 the Government of Vietnam was yet to have submitted its plan on NAMAs to the UNFCCC.

2. Developmental context

Vietnam' s National Target Program to Respond to Climate Change (NTP) requests that any responses to climate change follow the principle of sustainable development. The NTP specifically identified activities in thus responding to both the immediate and potential long-term impact of climate change, calling for actions that abate GHG emissions, promote international cooperation in scientific and technological activities, and apply and transfer climate friendly technologies. This is also in line with the Viet Nam National Green Growth Strategy, as adopted as Prime Minister Decision No. 1393/QĐ-TTg in September 2012, which also highlights the need for developing sustainable waste management practices. Additional waste-related policies are stated below.

3. Preparatory process

1) Compilation and analysis of policy documents

Several documents were first reviewed in thereby identifying policy arrangements (targets, visions, and development plans, etc.), the technological issues, and organizational arrangement in the waste sector in Vietnam. Some of the documents examined included: "the Second National Communication of Vietnam (SNC)" , "National Target Program to Respond to Climate Change (NTP)", "National Strategy on Climate Change" (Decision No.2139), "National Strategies for Integrated Management of Solid Waste up to 2050 and Vision towards 2050", "Approval of project of greenhouse gas emission management and management of carbon credit business activities to the world market" (Decision No.1775), and "2011 National Environment Report", along with other relevant research papers.

Review of the literatures revealed the majority of GHG emissions in the waste sector to be generated by anaerobic decomposition of municipal solid waste disposed of via landfill. Analysis of the political and institutional arrangements in the waste sector then helped identify the key organizations needed to engage in the development of a national level NAMAs plan in the waste sector of Vietnam.

2) Compilation of activity data

For the purpose of this project a list of landfill sites was developed with the purpose of amassing data from each and for use in identifying business-as-usual (BAU) in terms of GHG emissions and technology gaps for each landfill site in Vietnam.

The data on landfill sites collected included:

- Current names and locations (e.g. provinces and cities) of all landfill sites
- Capacity and depth of the layers of each landfill site
- Annual waste volume in each landfill site
- Current technologies used at each landfill sire with regard to waste management
- Expected closing year of each landfill site

Landfill site data was initially collected from the "2005 Report on Environment Impact Assessment of Landfills" provided by the Ministry of Natural Resources and Environment (MONRE) and other sources such as online reports that had been released by the relevant government organizations, NGOs, and Japanese research institutes. However, due to outdated data collection systems and an inadequate data management system of the waste sector in Vietnam the available landfill site data was very limited and not sufficient enough to use to estimate a BAU scenario. Complementary data collection activities were therefore undertaken with the assistance of URENCO (Urban Environment Company), a public entity that is in charge of collecting and managing urban MSWs in Vietnam. A BAU for each landfill site was then estimated after organizing all the data amassed from above.

3) Identification of BAU

This project involved two BAU scenarios being developed as the basis for then developing NAMA scenarios. Scenario 1 was based on the hypothesis that the current annual growth rate of solid waste generation in Vietnam would be approximately 10%, given the recent trends with increases in waste generation outlined in the "2011 National Environmental Report" published by MONRE of Vietnam (MONRE, 2011: 16). Scenario 2 assumed that the annual growth rate of solid waste would be 3.27%, as based on a research paper by the National Institute for Environmental Studies (NIES), Japan (Osako et al. 2011).

Table 1. Comparison of two BAU scenarios

	Scenario 1	Scenario 2
Annual waste growth rate	10%[2]	3.27%[3]
Theoretical basis for BAU prediction	Based on the growth rate of urban solid waste during the period of 2007-2010	Prediction based on estimated future growth in population and GDP during the period of 2010-2020.

4) Specification of NAMAs

The project takes into consideration two methods of either avoiding or reducing methane emissions from landfill sites. The first concerns reducing the amount of organic waste itself generated, while the second concerns the treatment and disposal of organic waste under aerobic conditions in thereby minimizing methane being emitted during the process of its biological decomposition. Utilizing waste to produce energy through waste-to-energy technology (e.g. incineration that generates power, and methane capture, collection and utilization) can reduce GHG emissions in two ways: by avoiding methane that would have been produced by decomposing organic waste and as a substitute for fossil fuel being used to produce energy.

The following technologies were proposed for use in this project and for the purpose of reducing GHG emissions in the waste sector:

- Semi-aerobic landfill technology
- Aerobic landfill technology
- Bioreactor landfill
- Land-fill gas capture and flaring (or to produce energy)
- Incineration (and to produce energy, mainly for power generation)
- Refuse Derived Fuel (RDF)/Refuse Plastics Fuel (RPF) (and to produce energy, mainly for power generation)
- Biogas digester and energy use
- Composting

[2] Source: MONRE (2011) "National Environmental Report 2011: Solid Waste"

[3] Source: Osako et al. (2011) "Establishment of waste database and assessment of municipal solid waste management system in South Asian countries"

The Vietnamese working group analyzed each technology and selected the semi-aerobic landfill technology as their first NAMA option, given that all the collected waste currently gets treated at landfill sites and the technology represents a low-cost option to improve the situation with landfill sites in a relatively simple manner and using locally available materials.

5) Quantification of GHG Emission Reduction by NAMAs

(a) Composition of BAU scenarios

Future increases in the amount of municipal solid waste as well as the amount of GHG emissions were calculated using the two BAU scenarios (Table 1).

(b) Estimated future increase in solid waste generation in Vietnam until 2030

Future changes in the amount of municipal solid waste generated in Vietnam until the year 2030 were calculated by multiplying the amount of solid waste disposed of in each municipality in 2009 by the predicted waste growth rates (10% or 3.27% respectively) from Scenarios 1 and 2[4].

(c) Estimated future increase in GHG emissions from the waste sector in Vietnam until 2030

We used the First Order Decay (FOD)[5] model to calculate future GHG emissions from the landfill sites in Vietnam, which is recommended by the IPCC in its *2006 Guidelines for National Greenhouse Gas Inventories* (2006). The formula used in the FOD model is as follows:

$$BE_y = \varphi \cdot (1-f) \cdot GWP_{CH4}(1-Ox) \cdot \frac{16}{12} \cdot Frac \cdot DOC_f \cdot MCF \cdot \sum_{t=y_0}^{y} \sum_{j} A_{j,t} \cdot DOC_j \cdot (1-e^{-k_j}) \cdot e^{-k_j \cdot (y-t)}$$

Φ	1	Model correction factor
F	0	Methane capture factor (IPCC default)
GWP_{CH4}	25	Global Warming Potential of methane (IPCC AR4)
Ox	0	Oxidization factor of methane (IPCC default)
16/12	1.33333	CH_4/C molecular ratio
Frac	0.5	Fraction of methane in SWDS gas (IPCC default)
DOC_f	0.5	Fraction of decomposable DOC (IPCC default)
MCF		MCF for "unmanaged depth >5m" SWDS (IPCC default)
$A_{j,t}$		Annual amount of organic waste of type *j* in year t. $A_{j,t} = A_t * \%A_j$
DOC_j		DOC content of waste type *j* (table)
J		Waste type
k_j		Methane generation rate of waste type *j* (table)
$(1-e^{-kj})$		Constant used in calculating geometric series using *t*
y_0		Initial year of the targeted waste disposal
Y		Target year considered

[Source: IPCC2006: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume5]

4 Information on the amount of urban solid waste disposed of in each municipality in 2009 was obtained from Osako et al. (2011: 9-10)

5 The FOD method takes the time factors involved in the degradation process into account, and produces annual emission estimates that reflect this process, which can take years, and even decades. The estimated annual emissions produced by the two methods are therefore not comparable. The FOD method produces better estimates regarding annual emissions whereas the IPCC default method has its own merits e.g. in studies comparing potential reductions in CH4 emissions via use of alternative waste treatment methods. (2006 IPCC Guideline)

The following assumptions needed to be made with use of this formula:

- Decay rate of the different types of waste in landfill sites (Default IPCC values were used.)
- Composition of waste (Average of 6 cities' data was used.)
- Increasing rate of waste amount (Assumption made in the scenarios of 10% and 3.27% growth per year)
- Methane Correction Factor (MCF)[6]

The composition of the urban solid waste was calculated using data from the six main cities of Vietnam, namely, Ha Noi, Hai Phong, Hue, Da Nang, Ho Chi Minh, and Bac Ninh. Data, which was derived from Vietnam's "National Environmental Report 2011: Solid Waste", regarding the composition of urban solid waste outside these six cities is, however, currently unavailable. (Table 2)

Table 2. Average composition of domestic waste (wet base)

Type of waste		Composition ratio (%)
Slowly degrading waste	Paper waste	5.2
	Textile waste	3.2
	Wood/straw waste	3.3
Moderately degrading waste	Other non-food organic putrescible/ garden and park waste	0.0
Rapidly degrading waste	Food waste/sewage sludge	63.9
Other non-degradable waste		24.4

[Source: MONRE (2011) National Environmental Report 2011: Solid Waste, p. 21]

The default value of 0.5 in Table 3 below, which was obtained from the IPCC 2006 Guidelines, was used for the Methane Correction Factor (MCF).

Table 3. Default MCF

Type of Site	MCF	Site in Vietnam
Anaerobic	1.0	Open dumping (unknown depth) sanitary landfill
Semi-aerobic	0.5	Semi-aerobic managed solid waste disposal sites
Unmanaged (waste depth >5m)	0.8	Open dumping (deep waste >5m)
Unmanaged (waste depth <5m)	0.4	Open dumping (shallow waste <5m)
Uncategorized SWDS	0.6	Uncategorized solid waste disposal sites

[Source: IPCC2006: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume5]

4. Institutional arrangements

A Vietnamese NAMA working group was established by OECC and IMHEN at the beginning of the project in order to facilitate the collection of information and to provide experts' consultations. The working group specializes in the waste sector and was composed of several relevant organizations and institutions set under MONRE, along with other relevant ministries.

[6] The MCF takes into account the methane generation potential of the site. The amount of methane produced partly depends upon the available oxygen and level of compaction of the waste.

5. Summary of concrete mitigation actions

Example: Use of semi-aerobic landfill technology

Projected emissions reduction:

Scenario 1: Approx. 48,788,238 tCO_2e (2013-2020) (waste growth rate: 10%)

Scenario 2: Approx. 31,434,874 tCO_2e (2013-2020) (waste growth rate: 3.27%)

Information used in calculating GHG emissions

The following data was collected for use in assessing the emissions and mitigation potential from a set of landfill sites.

- Annual amounts of organic waste

  Data on annual amounts of organic waste at each landfill site was collected from URENCO. The two emission scenarios were developed with estimates up to 2020 by using the volume of waste in 2009 as the base year and multiplying it by the estimated annual growth rates of 10% and 3.27%, respectively.

- The average composition of solid waste (Fraction of DOC decomposable)

  The composition of urban solid waste was calculated using data from the six main cities of Vietnam. And in this case the data came from the Vietnam Environmental Report 2011.

- Value of MCF

  The First Order Decay (FOD) model was used to calculate the methane emissions from landfill sites. Based on Table 3 above, the default MCF value of 1.0 for the BAU was used as not enough information was available on all the landfill sites to identify their respective conditions and depths, while 0.5 was used as the default MCF for the project scenario that utilized semi-aerobic technology to manage the disposal sites.

Description and details of NAMAs

(a) Use of semi-aerobic landfill technology

With this method the waste is segregated into organic and inorganic waste via use of mechanical separation equipment. The inorganic waste then gets further separated into recyclable and non-recyclable while the organic waste is biologically treated to produce compost.

(b) Calculation of GHG emissions reductions

1) Model

The FOD model is the most widely used approach and recommended by the IPCC (2006) with respect to calculating methane emissions from landfill sites.

2) Parameters

Actual data and IPCC default value were used in the FOD model as parameters.

3) GHG emissions reduction

The GHG emissions reduction is the differences between the BAU and NAMA scenarios (1 and 2), and which can be calculated as follows.

$$\frac{[BAU\ GHG\ emissions\ (tCO_2e)]}{[1]} - \frac{[GHG\ emissions\ with\ NAMA\ scenarios\ (1\ \text{and}\ 2)]}{[2]} = \frac{[GHG\ emissions\ reduction\ (tCO_2e)]}{[3]}$$

[1]BAU GHG emissions

-Scenario 1: Approx. 97,576,475 tCO_2e (2013-2020) (waste growth rate: 10%)

-Scenario 2: Approx. 62,869,748 tCO_2e (2013-2020) (waste growth rate: 3.27%)

[2]GHG emissions with NAMA scenarios (1 and 2)

-Scenario 1: Approx. 48,788,238 tCO_2e (2013-2020) (waste growth rate: 10%)

-Scenario 2: Approx. 31,434,874 tCO_2e (2013-2020) (waste growth rate: 3.27%)

[3]GHG emissions reduction

-Scenario 1: Approx. 48,788,238 tCO_2e (2013-2020) (waste growth rate: 10%)

-Scenario 2: Approx. 31,434,874 tCO_2e (2013-2020) (waste growth rate: 3.27%)

*In this case the GHG emissions reduction is the same as with the NAMA scenarios (1 and 2).

6. Policy-level MRV

In Vietnam regulations for waste management operators are determined by MONRE and other ministries and agencies, but do not get very strictly enforced due to limited human resources, unclear mandates, fragmented and overlapping roles of various government agencies, and limited interagency coordination. This has resulted in the incentive to properly operate landfill sites or for industries to invest in waste treatment being rather limited at the moment, and which has resulted in the proliferation of inexpensive, unsafe methods of disposal—such as open dumping.

7. Co-benefits

The developed NAMA can be expected to reduce the risk of fire, effluvium, leachate, and landslides, all of which are major problems that can occur in anaerobic conditions, while also realizing a reduction in methane gas emissions at landfill sites. The technology to be used in this NAMA proposal would also contribute to the early stabilization of landfill sites, with the cost of operation and maintenance being relatively low.

8. Lessons learnt/Next steps

1. Refining BAU scenarios

The data currently available on solid waste generation in Vietnam is rather incomplete, which therefore makes it challenging to accurately estimate the growth rate of solid waste in the future. In addition, the method used with the calculations in the development of the NAMA scenarios has room for improvement. In more concrete terms, the following should be considered in thereby refining the quantification of future GHG emissions from the landfill sites: 1) collection of other relevant data, including the waste collection rates of each pertinent municipality; 2) potential changes in the waste growth rate in Vietnam in the future (as opposed to the current NAMA scenarios in which the growth rate is presumed to remain constant).

2. Further elaboration of NAMA options

Researching the current situation of all the landfill sites, possibly through onsite surveys, is considered necessary in thereby analyzing whether it would be appropriate to utilize semi-aerobic landfill technology at them. At the same time, other GHG emission reduction technologies for use in the waste sector, including segregation, recycling, methane recovery and incineration, should also be closely scrutinized in evaluating their potential within the context of Vietnam.

3. Capacity buiding with regard to a better data collection system

The implementation of NAMAs in an MRV manner requires clarification of the roles of the implementing organizations and the modality of the MRV at both the project and policy levels, respectively. The working group will need to aim at developing a modality for the domestic institutional arrangements for NAMA implementation in the waste sector. In developing that modality the WG will have to take into consideration the necessary domestic coordination through analyzing any gaps, and improve the existing national mechanism and framework in the light of the cross-cutting themes of NAMAs in an MRV manner, and endeavor to ensure harmony with the existing national system and framework.

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4.5 Experience gained developing NAMAs in the transport sector of Mexico

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Case Studies:

<a> Energy Efficiency Program for Freight Trucks
<b> Optimization of Public Transport Routes and Vehicle Fleet Renewal
<c> Integrated Urban Mobility Systems

Host Country Information:

Host Country	Mexico
Implementing Organization	It is anticipated that Mexico’ s Ministry of Transport and Communications (SCT) and Ministry of the Environment (SEMARNAT) would implement the freight NAMA and that either BANOBRAS (the Mexican Development Bank) or PROTRAM (the Public Transport Federal Support Programme) would implement the integrated urban mobility NAMA. It is not, at this stage, possible to speculate who would progress the public transport optimization NAMA.

Sector

General:	Transport
Specific:	<a> freight sector, <b> public transport sector, and <c> integrated urban mobility.

1. Background (Introduction)

This section summarises the experience of developing two NAMA proposals (one a national level freight NAMA and the other for integrated urban mobility systems), and one feasibility study (for the optimization of urban public transport) in Mexico (these are three of several NAMAs proposed for the transport sector in Mexico).

Transport is responsible for approximately 20% of total GHG emissions in Mexico and it is the second fastest growing sector in terms of energy consumption. Climate change mitigation in the sector is therefore a high priority (CTS EMBARQ México, 2012).

The main challenge is faced in cities, which are rapidly urbanizing. In the early 1950s most of Mexico's population lived in rural areas, but approximately 80% of its population is now concentrated in urban areas (INEGI, 2010). This rapid urbanization has been accompanied by high rates of motorization (supported in part by fuel subsidies), poor quality public transport services, and poor pedestrian and cycling infrastructure. This has contributed to urban degradation, atmospheric pollution, congestion, traffic accidents, sedentary lifestyles and social exclusion, which have led to a significant deterioration in the population´s quality of life.

Car ownership is high and increasing (if current trends continue then there will be 70 million vehicles in Mexico by 2030 (World Bank, 2009)) and the vast majority of Mexico's Federal Budget is focused on urban road construction (DOF, 2011). Public transport patronage is, however, also high. Seventy-five percent of commuters use public transport (a sector characterised by highly polluting vehicles) or Non-Motorised Transport (NMT) (CTS EMBARQ México, 2007).

The challenge of climate change mitigation in the transport sector is not limited to passenger transport. Freight transport is responsible for approximately 30% of GHG emissions from Mexico's transport sector (INE, 2009).

It is in this context that CTS EMBARQ México responded to Mexico's Ministry of Economy's (Secretaría de Economía) call for NAMA proposals in 2009. It developed a NAMA entitled 'Programa de Eficiencia Energética para Camiones de Carga' (Energy Efficiency Program for Freight Trucks, hereafter referred to as 'freight NAMA') and a NAMA 'Optimización de Rutas de Transporte Público y Renovación' (Optimization of Public Transport Routes and Vehicle Fleet Renewal, referred to here as 'route optimization NAMA'). In 2011 the Mexican Ministry of the Environment (SEMARNAT) approached CTS EMBARQ México to help prepare a NAMA to be included in Mexico's Market Readiness Proposal to the Partnership for Market Readiness (PMR). In response it developed a proposal for a credited NAMA to support the integration of urban mobility measures in the transport sector (Integrated Urban Mobility Systems).

The aim of all three transport NAMAs is to reduce GHG emissions while realising associated co-benefits. The NAMAs, and related experiences, are summarised in the rest of this section.

2. Development context

These three NAMAs have been developed based on both climate change mitigation and sustainable development considerations. This is reflected in the anticipated co-benefits outlined in the respective proposals (see Section 7) and their wider policy frameworks. It is also underpinned by the inherent link between measures that support sustainable development and that reduce GHG emissions by reducing the need to travel, shifting travel demand to less energy intensive modes, and improving the energy efficiency of modes of transport.

Mexico's National Development Plan (Plan Nacional de Desarrollo 2013 to 2018) (PND) outlines Mexico's development strategy for a six year period, the most recent version of which covers the period 2013 to 2018 (Gobierno de la República, 2013). It outlines national goals, development priorities and related strategies that can support the realisation of 'Vision 2030,' a document that sets out Mexico's long-term commitment to sustainable development and national economic, social and environmental aspirations for 2030. The PND is referred to as a starting point for national development and dictates related policy that is then incorporated into sectoral plans. Mexico's climate change strategy (see Section 3 below) is a component of the PND's 'environmental sustainability' pillar. One of their related objectives is to improve air quality and reduce GHG emissions through the use of more efficient fuels, sustainable mobility programmes, and the elimination of policies and infrastructure that support the use of fossil fuels. Its objectives also include developing transport infrastructure, such as urban mass rapid transport systems, to generate economic activity while promoting environmental sustainability.

Mexico's wider policy and legislative framework also reflects the integration of development and climate change mitigation considerations. The Federal Government's General Law on Climate Change (DOF, 2012) for example (another initiative that is outlined in Section 3 below) was developed to support Mexico's transition towards a competitive, sustainable and low carbon economy.

This high-level strategy is reflected in individual policies and initiatives. The Integrated Urban Mobility Systems NAMA, for example, seeks to better integrate two existing urban transport programmes, which have aims that include supporting low carbon growth in the transport sector. These two programmes are the Federal Mass Transit Program (PROTRAM), which is part of the National Infrastructure Fund (FONADIN) and the Urban Transport Transformation Program (UTTP). They are both managed by the National Works and Public Services Bank (BANOBRAS) and were launched to promote more sustainable, efficient and cost-effective transport systems. These existing programmes have benefited from both climate finance (the Clean Technology Fund) and development finance (from the Bank for Reconstruction and Development).

3. Preparatory process

1. Compilation and analysis of Policy Documents

Mexico has, and is continuing to, develop an institutional, policy and regulatory framework to support climate change mitigation activities. In 2005 it created the Inter-ministerial Commission on Climate Change (CICC), which coordinates the activities of the Federal Ministries in charge of formulating and implementing national policies for climate change mitigation and adaptation. The CICC developed the first National Climate Change Strategy (NCCS) (CICC, 2007), which was developed to complement Mexico's National Development Plan (PEJ, 2007), one of five strategic themes of which is environmental sustainability. The CICC established the first Special Programme on Climate Change (PECC) to cover the period 2008 to 2012 (PEJ, 2009) to implement the provisions of both the National Climate Change Strategy and National Development Plan. The PECC outlined public policies for eight sectors, which include 'transportation and communication infrastructure,' with the objective of reducing domestic GHG emissions by 50% by 2050 (from a 2000 baseline). This initial climate policy was recently followed by a second National Strategy for Climate Change, which was published in June 2013. It outlines a 10, 20 and 40 year vision that consolidates state policies around climate change and also specifies activities by sector, such as developing a comprehensive public transportation system and sustainable mobility program in order to reduce emissions from the transport sector.

These domestic policies are complemented by a General Law on Climate Change (DOF, 2012), which was published in June 2012 and entered into force in October 2012. It applies to Federal, State and Municipal Governments in Mexico. It proposes activities including:

- Developing strategies, programs and projects that mitigate GHG and promote Integrated Mass Transport Systems;
- Promoting the increase of Sustainable Mass Transport Systems, with high efficiency standards, that favour the substitution of fossil fuels;
- Promoting the development of NMT infrastructure; and
- Developing efficiency standards for new light and heavy duty vehicles.

A low-carbon scenario analysis for Mexico (known as MEDEC) was conducted in 2008 as part of the World Bank's Investment Framework for Clean Energy (Johnson et al, 2010). This incorporated a transport sector component that involved testing 13 different strategies for CO_2 emission reduction in the sector. It is in the context of both the measures proposed by the MEDEC study and other existing transport programmes that the three transport NAMAs introduced here were selected and developed. The freight NAMA was developed to realise potential synergies with the Ministry of Environment's (SEMARNAT) Programa de Transporte Limpio (Clean Transportation Program) (SEMARNAT, 2012), which aims to reduce fuel consumption, GHG emissions, and operating costs of domestic freight and passenger transport. The Integrated Urban Mobility NAMA proposal directly builds upon two existing initiatives – PROTRAM (FONADIN, 2008) and the UTTP, proposing better integration between the two.

2. Compilation of activity data

The baselines for the three NAMAs were informed by the following activity data:

- Number of vehicles in the fleet (disaggregated by type)[1]
- Intensity of use (km per year)
- Gross Efficiency (km per litre)
- Fuel efficiency.

[1] In the case of the freight NAMA they were disaggregated according to whether they were light (sub-divided into: sub-compact, compact, luxury goods, passenger and light, cargo and light) or heavy (sub-divided into buses, heavy load vehicles and mass transit).[1] For the integrated mobility NAMA emission were calculated based on the following vehicle types: sub-compact, compact, luxury and sport, Sport Utility Vehicles, Mass Transit Systems, buses, heavy and light duty.

3. Identification of BAU

The input parameters (activity data) were used to calculate the following variables:

- Fuel consumption: in litres per year, calculated by dividing efficiency by mileage
- Mileage by vehicle type: the number of vehicles was multiplied by the use intensity (km/year/vehicle) to obtain mileage (km/year), which was then disaggregated by vehicle type
- Net emissions: emission factor ($kgCO_2$/litre) divided by net efficiency ($kgCO_2$/km)
- Total emissions: net emissions multiplied by mileage to give $MtCO_2$/year.

These were used to estimate the GHG emissions to inform the baseline for the three NAMAs. The GHG emissions were forecasted from 2010 to 2025, assuming an average annual economic growth of 3.2%. In the route optimisation and integrated mobility NAMAs, the number of vehicles for the selected Metropolitan areas was estimated proportionally to the population living in those areas. The BAU has also been based on a number of assumptions, which include no routes being optimized, no hybrid buses, parking systems or NMT infrastructure being introduced.

4. Specification of NAMAs

The three NAMA proposals were grounded in climate change and transport policy (as outlined above), and the individual concepts were developed and refined based on expert knowledge of low carbon transport planning and an extensive review of international research and local policies. This was complemented by stakeholder consultation. In the context of the freight NAMA, for example, the review of research and policy ascertained that it is only feasible to target medium- and large-sized freight operations. The evaluation and appraisal of the climate change mitigation options that were identified through the review of research and policy were also tested against a number of criteria, which resulted in the proposed measures being further refined.

5. Quantification of GHG Emission Reduction by NAMAs

The quantification of emission reductions for the Integrated Urban Mobility NAMA will be based on the number of cities (with at least 500,000 inhabitants) applying to the two initiatives that the NAMA seeks to build on – PROTRAM and UTTP and estimated using the activity data listed above. The NAMA proposal has a number of different components, and in order to calculate the maximum potential GHG emission reduction the impacts were considered sequentially.[2]

The boundary for the integrated urban mobility NAMA has not yet been defined, although the proposal for the freight NAMA was for the unit of measurement to be set at the individual vehicle level, and for the route optimization either on the route operated or number of passenger trips.

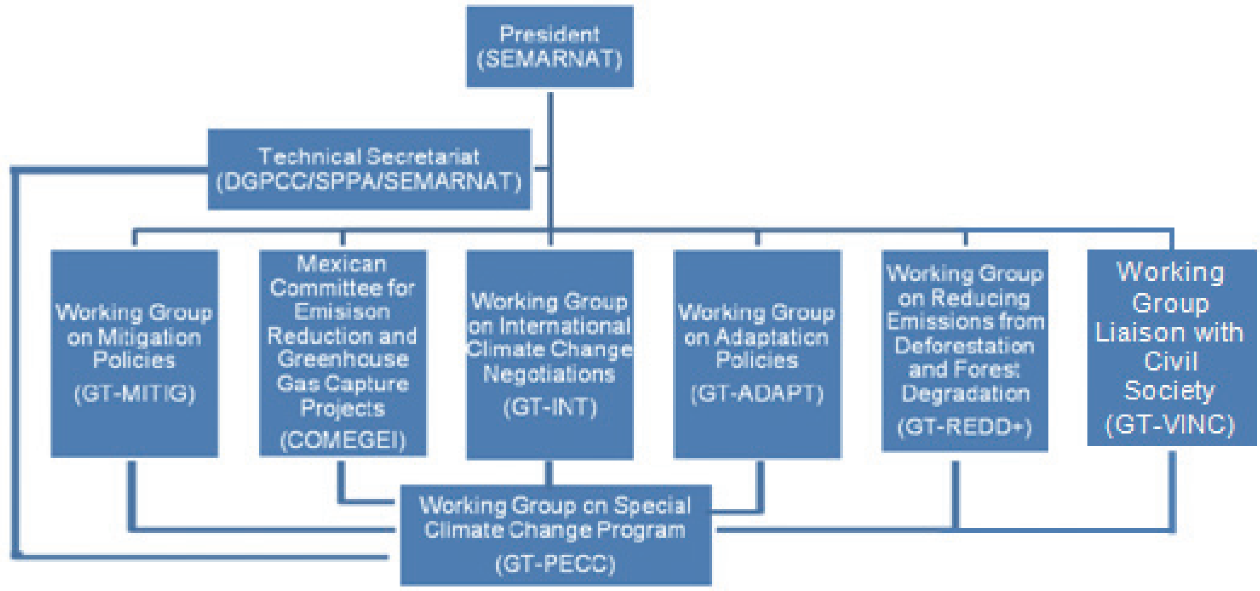
1
2
3
4
5

[2] The estimated impact of the BRT system was modelled first, then the implementation of parking meters and then the route optimization component. It was then determined if the optimized routes could cover the demand created by the implementation of the parking measures. This found that no extra supply of public transport would be needed and so the calculations for hybrid buses were done based on the fleet obtained after the implementation of component 3 (optimization). Component 5 (NMT) was modelled independently because there is no direct linkage with the other components. Finally, the maximum mitigation potential was calculated as the sum of the mitigation potential of each strategy (CTS EMBARQ México).

4. Institutional arrangements

The CICC co-ordinates domestic bodies that have been established to respond to climate change. The CICC is led by SEMARNAT, which is the focal point and the institution in charge of implementation. The CICC is comprised of senior representatives from other Ministries including: Energy (SENER), Agriculture (SAGARPA), Transport (SCT), Economics (SE), Social Development (SEDESOL), Health (SSA), the Interior (SEGOB), Foreign Affairs (SRE), Navy (SEMAR), Education (SEP) and Tourism (SECTUR), with a proposal also to include a new Ministry for Territorial Planning (SEDATU). It is responsible for formulating related policy and incorporating it into sectoral programmes. The composition of the CICC is outlined in Figure 1[3] below.

Figure 1: The Inter-Ministerial Climate Change Commission (CICC).



The experience with these NAMAs has been that inter-Ministerial communication and co-ordination is challenging when it comes to developing concrete activities. It is further complicated by the fact that the SCT only has jurisdiction over inter-State and Federal level interventions with States and Municipalities having responsibility over other measures. This has had an impact on the nature of the three transport NAMAs outlined here, and related challenges have contributed to the decision not to further develop the route optimization NAMA at this stage. SEMARNAT is currently taking a co-ordinating role of NAMAs, and is in the process of developing a domestic 'NAMA registry,' to document, consolidate and communicate their related activities.

[3] DGPCC stands for 'General Directorate of Climate Change Policy.' This function is encompassed within the SPPA (which stands for the 'Vice-Ministry of Environmental Planning and Policy.' The DGPCC is the technical secretary for the CICC and monitors the implementation of the PECC. In turn, SPPA is responsible for formulating and co-ordinating national climate change policy.

5. Concrete mitigation actions in summary

<a> The freight NAMA was developed in the knowledge that emissions from the sector can be significantly reduced through the implementation of relatively simple measures that have already been tested in numerous countries. It proposed the introduction of three different types of technological and operational measures to improve vehicle fuel efficiency in domestic medium- and large-sized enterprises. These are as follows:

- Enhancing the aerodynamics of freight vehicles. Improving aerodynamics has been shown to enhance vehicle fuel economy through reducing resistance. Aerodynamics can be improved via the introduction of integrated roof units, extensions to the vehicle cabs, side shields and air deflectors. Minimising the gap between the cab and trailer, adding side skirts, and storing the cargo in low, tight tarpaulins or similar can also improve aerodynamics (which has the potential to reduce emissions by more than 85 $MtCO_2$ equivalent over the period 2010 to 2035).
- Automatic Inflation Systems (AIS). AIS is a system that can be installed in vehicles to monitor tyre pressure. It is an alternative to monitoring tyre pressure manually, the optimal inflation of which enhances vehicle fuel economy (estimated 20 $MtCO_2$ equivalent over the period 2010 to 2035).
- Eco-driving training. These training programmes have been shown to result in significant energy efficiency improvements (with an estimated mitigation potential of 55 $MtCO_2$ equivalent over the period 2010 to 2035) (Martinez et al, 2012b).

<b> The route optimization NAMA proposes to increase the efficiency of public transport operations in the 56 Metropolitan areas of Mexico by:

- Restructuring public transport routes. This would be based on an optimization study conducted on the public transport routes of all 56 Metropolitan areas in Mexico. There is currently an oversupply of vehicles, and this NAMA would analyse demand to identify redundant routes and other inefficiencies.
- Vehicle fleet renewal. Public transport vehicles that are more than 12 years old would be replaced with more efficient models that incorporate the most advanced technologies to reduce fuel consumption and reduce GHG emissions (Martinez et al, 2012a).

The mitigation potential has been estimated as 117.55$MtCO_2$ equivalent from 2010 to 2035.

<c> The third NAMA would support the integration of urban transport measures. It would build upon two existing urban transport programmes – PROTRAM and UTTP. A key element of PROTRAM is that city level 'Integrated Sustainable Mobility Master Plans' (PRIMUS) are needed before related funding is applied for. This NAMA would develop the components of an Integrated Urban Mobility System to satisfy the PROTRAM funding requirements for cities. The exact climate change mitigation measures that would comprise these local level plans would depend upon the context, but it is anticipated that a combination of five components would be the introduced, namely: Mass Transit Systems (such as Bus Rapid Transit, trams, light rail, trains and metros), optimization of existing public transport routes, vehicle technologies (such as hybrids), NMT infrastructure (such as cycling paths and footways), Transport Demand Management (TDM) measures (such as car-sharing) and Intelligent Transit Systems (ITS) (CTS EMBARQ México, 2012). It is estimated that if all five strategies are implemented simultaneously, 22.34 $MtCO_2$ could be mitigated over the period 2010 to 2025.

6. Policy-level MRV

1. Current situation

The three NAMAs described in this Section of this Chapter have not yet reached the stage of development where a detailed MRV methodology has been defined. A number of different options have, however, been proposed in relation to each and methodologies outlined. Mexico already has a process for estimating GHG emission reductions from transport sector interventions, and this is underpinned by existing data collection. There are, however, significant modifications that need to be made to make this acceptable for the MRV of transport NAMAs, and SEMARNAT is currently working with GIZ to develop and adopt new methodologies, systems and processes as necessary.

2. Potential

In terms of 'Measurement,' indicator sets have been proposed for each of the three NAMAs. The indicators for the freight NAMA are outlined in Table 1, in Table 2 for the route optimization NAMA, and Table 3 for the Integrated Mobility NAMA [in Appendix 1]. These indicators are based on climate change mitigation considerations rather than co-benefits, and they will also be the basis for Validation, which would be conducted by a third party. It is not, however, proposed that all of the indicators are applied to the MRV process – they should be refined alongside the methodology and proposal.

The NAMAs propose annual reporting, and this is something that is being discussed at the national level with a streamlined reporting approach being developed. A national level platform for MRV, with involvement from the different entities and institutions working on climate change mitigation, is being discussed and designed, ultimately for management by SEMARNAT, to improve efficiency. In the context of the transport sector SEMARNAT is currently working with GIZ to review the data that is already being collected in Mexico and which can inform MRV methodologies adopted by domestic transport NAMAs. SCT, the National Institute of Statistics and Geography (INEGI), the Mexican Petroleum Institute and the Mexican Transport Institute (IMP) all have existing (and official) databases that can be used to support the measurement of GHG emission reductions from the sector. There is, however, still a considerable amount of work that needs to be done to support a transition from Mexico's current process for estimating emission reductions from transport sector interventions to one that will be adopted for NAMAs. The monitoring and verification requirements will also vary between NAMAs.

3. Challenges

MRV of climate change mitigation activities in the transport sector is always complex and requires extensive data collection and robust calculation methodologies for it to be accurate. The indicators proposed by these three NAMAs (see Appendix 1) have been selected for their utility but also to support relatively simple measurement and evaluation on a large-scale.

7. Co-benefits

The three NAMAs each aim to enhance the energy efficiency of a component of the transport sector (respectively freight, public transport and urban transport systems), the direct positive impacts of which are social, economic and environmental. The three NAMA proposals each explicitly detail the anticipated co-benefits of proposed activities, which owing to the nature of the proposed activities (which aim to reduce GHG emissions from the transport sector by reducing reliance on, and increasing the energy efficiency of, privately owned vehicles) are very similar. The main transport co-benefit of the Integrated Urban Mobility NAMA, for example, is to improve the quality of life of citizens and to increase the accessibility and mobility of the urban poor. The measures that it seeks to encourage are expected to reduce travel times, air pollution, traffic congestion and traffic fatalities and injuries. The reductions in air pollution that it will create will in turn lead to positive health impacts and an associated reduction in the public cost associated with managing ill health, co-benefits which have also been referred to in these NAMA proposals.

Improved air quality (specifically in terms of emissions of carbon monoxide, nitrogen oxides and particulates) is the co-benefit that is focused on the most in the three proposals. This is also the only co-benefit that it is suggested will be subject to MRV.

8. Lessons learnt/Next steps

A lot of lessons have been learnt from the process of developing these NAMAs. These include the following:

Relevance of the NAMA approach for the transport sector: The adoption of measures that avoid, shift and improve demand for, and energy efficiency of, freight and passenger transport can support a significant reduction of domestic GHG emissions. The preliminary estimation was that measures in the freight NAMA proposal could result in an estimated cumulative reduction of 290 megatonnes of CO_2 by 2035). The financial analysis conducted in the NAMA development process also indicates that GHG emission reduction in the freight sector can enhance the competitiveness of operators and be highly profitable.

Supporting role of institutions: Inter-Ministerial Committees can support the development of transport NAMAs, although these three NAMAs were developed in a very 'bottom-up' manner with the initial impetus for the freight and route optimization NAMAs being a call for NAMA development by the Ministry of Economy (SE), which offered financial aid (aided by international support) to project developers to prepare concepts. At the same time SEMARNAT led an effort to promote more in-depth project design in sectors where there was a high interest in developing a NAMA, such as in the transport sector. The Integrated Urban Mobility NAMA was developed following an approach to a NAMA developer (CTS EMBARQ México) by SEMARNAT to help prepare a NAMA to be included in Mexico's Market Readiness Proposal to the PMR.

The risk of NAMA selection criteria supporting the realization of short-term 'low hanging fruit' over larger long-term impacts: The time period over which emission reductions will be measured has an impact on the measures selected. In the context of the freight NAMA, for example, a technological measure that would have had the largest impact (both economic and environmental) over the long-term but that was the most expensive option and have relatively limited benefits in the short-term, was not selected.

The cost of mitigation actions not only has an impact on the components of a NAMA, but also on the sub-sector that it aims to reduce emissions from. In Mexico the 'hombre camion' sub-sector (small-scale freight operators) is responsible for a high volume of GHG emissions, but the complexity of this sector means that any related activities would have considerably higher financial costs. The freight NAMA outlined here therefore proposes to reduce emissions from medium- and large-scale freight operations.

Positive impact of stakeholder consultation on NAMA development: The value of extensive stakeholder consultation cannot be overstated. The three NAMAs were developed based upon extensive consultation within SEMARNAT and with other key stakeholders including Ministries, Chambers, academics and other experts. This resulted in the identification of new ideas and evolution of concepts. SEMARNAT continue to be very engaged in the activities and are pursuing opportunities for them to be taken further. It is also important to talk to stakeholders to either rule ideas out or to obtain buy-in. The experience of CTS EMBARQ México has been that the best ideas on paper may not be the most effective or most attractive to stakeholders in practice.

Domestic ownership and buy-in can support NAMA development and increase likelihood of implementation: Two of the three NAMAs introduced in this section (the freight and integrated urban mobility NAMAs) have **moved forward owing to extensive support of Federal entities,** notably SEMARNAT. The SE commissioned the development of NAMA concepts (as mentioned previously), but of the 23 different projects that were developed in different sectors under this call it was only those with true ownership that were supported for further development.

The value of continuity across political administrations: There has been a continuity of commitment to climate change, as reflected in related government policies, across the last three administrations, and this has supported the development and promotion of NAMAs. This has been particularly notable across the last two, which is partly attributable to the General Law on Climate Change (DOF, 2012) and also to the **high and sustained related political will of senior Government officials and increasing pressure from civil society.**

MRV challenges: Estimating impacts on behaviour change can be particularly challenging. The impact of the eco-driving component of the freight NAMA, for example, is dependent upon the behavior of multiple users and the estimated emission reductions had to be quantified on the basis of what drivers would be taught to do, as opposed to the likelihood of actual behavioural change. A key component of this NAMA was therefore the incorporation of 'audits' that would evaluate the general performance of a freight operator using GPS (Global Positioning System) technology. GPS can track vehicle performance including fuel consumption, average speed and idling time, and the NAMA proposes to give freight operators a grant to cover half of the cost of this technology. Once they install this device, the 'normal' performance of a vehicle would be registered for 3 months (to form the "BAU baseline scenario"). Then, the training, the aerodynamic, and the tire system will be provided (half grant for each) and the performance will be compared with the baseline data previously obtained. This will be also used for the MRV.

International support: International donors can allocate financial support based on political considerations rather than on merit of activities seeking support. Sensitivities prevent further elaboration here, but related experiences demonstrate that the effective distribution of international funding could therefore be enhanced by the presence of an independent intermediary to support the project selection process.

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APPENDIX 1[1]

Table 1: Indicators that support the Monitoring and Verification of freight NAMAs.

Measurement							Verification		
Impact Indicators	**Description and Objective of Indicator**	**How is it measured?**	**What sources are used?**	**When is it measured?**	**Who measures it?**	**Necessary actions and/or assumptions with measurement**	**What gets verified?**	**How is it verified?**	**When is it verified?**
Fuel consumption. Unit: Liters per year	Quantitative indicator that provides information on any decreases in fuel consumption arising from increased on-road efficiency resulting from improved technology and/or driver training.	Through energy diagnoses carried out by CONUEE, and through which the companies (including those participating in the driving training program) register their fuel consumption.	Registry of the National Information Subsystem for Energy Management (SNIAE)	Annually	This indicator gets registered through CONUEE. SEMARNAT has access to this information, and hence INE can calculate the resulting emissions.	-The fuel consumption registry should consist of three types of entries: 1. Consumption of vehicles participating in the technical driving program. 2. Consumption of vehicles that have been technologically improved. 3. Consumption of vehicles with no technological or operational improvements.	-Reduced fuel consumption	-Cross-verification of CONUEE's databases, which list all the vehicles and can be used to verify their consumption from invoices and perception surveys.	Annually

1 Transport NAMAs in Mexico: Preliminary translation of Appendix 1 from Spanish (not revised).

Emissions per year. Unit: Megatons of CO_2 per year	Quantitative indicator used in calculating resulting emissions after utilizing the suggested strategies.	By multiplying fuel consumption by its emission factor.	Emission factors per country or as reported by IPCC, and fuel consumption.	Annually	SEMARNAT through INE.	-Ensure an updated database of emission factors by vehicle technology type is available.	-Calculation methodology and variables taken into account. -Update of the base line and its considerations. -Comparison of the emission reduction goal with actual reduction.	By reviewing and validating the results, as well as reviewing the applicability of the calculations. In the same manner, possible errors and omissions get calculated and confidence levels defined.	Validated before implementing the measure and thereafter verified annually.
Number of vehicles with technological improvements. Unit: Number of vehicles per year.	Support indicator used to control the program.	With new vehicles through their sale registries. With used vehicles SCT issues certificates and maintains a registry of vehicles that have been modified.	SCT's registries.	An annual compilation using the registries of all the vehicles is made.	SCT coordinates with state and municipal governments, and private transportation companies. The measured results are submitted to SEMARNAT.	-Preparation of a framework agreement (SCT-SEMARNAT-Chambers and associations of freight vehicles) related to technological and operational improvements.	-The goal of vehicles that have been technologically improved compared to the actual number reported. -If the goal is not met then the reasons must be listed.	-Cross-verification of SCT's registries with the information reported. -Surveys completed by the users of improved units in thereby evaluating the perception of the benefits obtained.	Annually
Number of trained drivers. Unit: Number of drivers per training period and per year.	Support indicator used to control the program.	Through the registries of training courses taught and certified by SCT. Training gets repeated every 2 years with the objective of preventing the repeat of any bad driving habits and registered annually.	Registries of training workshops.	At the end of each course.	SCT coordinates with state and municipal governments, and private transportation companies. The measured results are submitted to SEMARNAT.	-Preparation of a framework agreement (SCT-SEMARNAT-Chambers and associations of freight vehicles) related to best driving practices. -Include training methodologies. -Develop instructors.	-The goal of the training compared to the number of trained drivers. -If the goal is not met then the reasons must be listed.	-Cross-verification of SCT's registries with the information reported. -Surveys completed by workshop users in thereby evaluating the perception of the benefits obtained. -Verification of follow-up workshops held every three years.	Annually

Companies that have participated in the technical driving training program. Unit: Number of companies per year.	Support indicator used to supervise the technical driving program and evaluate the performance of this mitigation measurement.	Carried out through SNIAE's registry and which is managed by CONUEE. The companies report whether they have participated in the technical driving program and if so how many drivers were trained.	SNIAE's registry.	Annually.	This indicator gets registered through CONUEE. SEMARNAT then uses it to calculate the proportion of companies that have increased their enrolment in technical driving programs.	-A section should be included in SNIAE to thereby enable companies to register that information.	-Number of companies that have participated in the driving training program, as well as the program's follow-up activities.	- Cross-verification of data reported by CONUEE with the registry bases. -Surveys completed by companies that have applied got the technical driving program in thereby verifying the perceived benefits against the reported benefits.	Annually

Source: Martinez *et al*, 2012b.

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Table 2: Indicators that support the Monitoring and Verification of the route optimisation NAMA

Measurement					Verification	
Indicator	**Description and objective s**	**Variables**	**How it is measured**	**Special considerations**	**What gets verified**	**How it is verified**
Main Measurement Indicators. Impact indicator.						
Total Emissions (MTCO2e/year)	Used to evaluate the total emissions ex ante and ex post of the project's implementation in thereby identifying the mitigation potential, which is the main NAMA indicator.	-Net Emissions (KgCO2e/ km). -Distance travelled (Km/year)	Net emissions get multiplied by the total kilometers traveled ex ante and ex post of the project. The reduction in emissions is the difference between them.	-	-Calculation methodology and variables taken into account. -Updates of the base line and its considerations. -Comparison of the emission reduction goal to the actual reduction.	By reviewing and validating results, as well as reviewing the applicability of the calculations. In the same manner, possible errors and omissions get calculated and confidence levels defined.
Net Emissions (KgCO2e/ km)	This indicator is a traceability parameter that enables emissions ex ante and ex post to be measured in an effective manner and with reference to the same base.	-Efficiency (Km/L of fuel used) -Emission factor (KgCO2e/L of fuel used)	Measured by dividing the fuel emission factor by the average efficiency of the fleet that is being optimized.	-		
Distance traveled by the system (Km/ year)	This indicator is a key factor in not only in emission calculations but also optimization.	-	The ex ante information is obtained using geographic information on the routes and turns made each day. At the same time, oversupply analysis takes place in thereby calculating the optimal size fleet and thus the optimal kilometers.	For this item the data of each route has to be trustworthy, therefore necessitating reliable databases and control of existing routes.	-Average distances traveled by route. -Number of units that comprise the route.	-Selection of a random sample of optimized routes, positions, and measurement of distances using tracking software. In the same manner units belonging to the route get enumerated and checked against the number of units that should exist according to the optimization studies.

Vehicle Efficiency (Km/L of fuel used)	Vehicle efficiency is a very important parameter because to a large extent it determines the progress of this NAMA. It is not an easy parameter to measure, and therefore quite a few tests have to be made in thereby ensuring the reliability of the data.	-Distance travelled (Km) -Fuel used (L)	Fuel consumption tests take place at specific fixed distances and under different conditions, for example in heavy traffic and at higher ambient temperatures, etc. Efficiency decreases as a result of vehicles aging and due to a variety of human error factors; therefore, optimization requires calibrating an average efficiency model and specific to the route or city where the study took place.	Efficiency has to be constantly recalculated in thereby revealing the most important factors, and the base line constantly modified according to new data obtained and after a period of specific behavior.	-Efficiency of vehicles -Age of vehicles.	- Selection of a random sample and measurement of fuel consumption and the distances traveled at different times. The results then get compared to previous measurements.
Support Measurement Indicators. Impact indicator.						
Number of Scrapped Vehicles (Number of Scrapped Vehicles/ year)	This indicator enables follow-up activities in the program and ensures no oversupply is occurring.	-	One scrapping certificate per unit is issued, which are then registered in a database.			The scrapping registration must be carried out by the agency responsible for public transportation in every state coordinated by the Ministry of Transport and Communications (SCT).
Percentage of decrease in travel time (% of decrease/ year)	This indicator is important in measures applicable to the transportation sector because more efficient transfer times are a constantly sought benefit.	-Average speed of vehicles (km/hour) and their distance traveled (km/year) ex ante and ex post	Travel time is calculated by dividing the kilometers traveled by the vehicles' average speed. This is carried out both ex ante and ex post in thereby obtaining the percentage of decrease.			-

Percentage of Vehicle Renewal (% of Renewal/year)	This indicator enables identification of how many vehicles have been renewed and then comparison with the established goals.	-Number of renewed vehicles. -Fleet broken down into age groups.	The number of renewed vehicles is divided by the total fleet of vehicles more than 12 years old.	-Necessitates having a standardized and up-to-date database of the vehicle fleet and their ages. -The percentage of renewal should be registered by the entity in charge of public transportation in each state and coordinated by SCT.	-Number of renewed vehicles.	-Cross-verification of the number of renewed vehicles per route using the databases of renewal registries.
Increase in number of trips. (Number of trips/year)	This parameter is useful in identifying whether the new service is achieving any results in terms of the users concerned.	-Number of passengers per year.	-Through payments made using prepaid electronic cards. The number of trips then enables it to be compared with the base line.	-		
Fugitive Emissions (MTCO2e/year)	These are related to modal distribution changes, occupational factors and the speed of all the vehicles that are not part of the project per se, but are part of its implementation.	-Reduced of emissions per passenger.	Calculated by multiplying the emission savings per passenger by the number of additional passengers to the base line in thereby identifying the reduction in extra emissions.	Fugitive emissions are a parameter that is generally considered complex to measure because they depend on a number of factors: demographic and political, etc. A methodology based on the characteristics of each route therefore needs to be developed.		
Decrease in emissions per passenger. (MTCO2e/passenger *year)	This support indicator is useful in calculating the fugitive emissions that the project might include and either positively or negatively.	-Number of passengers per year. -Mitigation potential.	The project's mitigation potential is divided by the number of passengers.	-		

Source: Martinez *et al*, 2012a.

Table 3: Indicators that support the Monitoring and Verification of the urban mobility system NAMA.

INDICATOR		MONITORING	VERIFICATION
Indicator	**Strategy[2]**	**How it is measured/monitored**	**Verification sources**
GEI Emissions per year *($MtCO_2$/year)*	C1	Fuel consumption multiplied by the corresponding emission factor.	Verify if the calculated emissions meet the previously established mitigation goals.
	C2, C3,C4 & combined		
	C5	Kilometer savings	
Kilometers of bus-lanes built for BRT per year *(km/year)*	C1	Appropriate State Transport Agencies register and monitor the kilometers of bus-lanes built for BRT per year	Verify that all the lanes reported are fully operational and if the goal of kilometers built wasn't reached then list the reasons why in an attempt to improve the process in the next steps.
Kilometers traveled by BRT *(km/year)*	C1	Appropriate State Transport Agencies register and monitor the kilometers traveled by BRT per year	Verify that the traveling registers match the reports.
Number of vehicles using parking meters per year *(#vehicles/year)*	C2	Concessionaire creates a data base of the number of vehicles using parking meters per year	Verify the information has come directly from the automatic report systems of the parking meters. Verify that all the parking meters reported by the concessionaire exist and are fully operational
Frequency of use of the parking meters per year	C2	Concessionaire registers the number of times a single vehicle uses parking meters per year and calculates the statistical frequency of all the vehicles using parking meters. The recommendation is that a modal shift survey is utilized to complement this parameter and determine if users are really decreasing use of their cars.	Verify all the data matches the reports and check the results and methodology of the survey.
Average Occupancy of public transport vehicles *(#passengers/vehicle /year)*	C1,C3	New public transport systems must have register and control systems from which specific databases can be obtained. This includes the number of passengers per vehicle per year	Verify using a representative sample of routes the registers of average occupancy over a specific period of time.

[2] C1: Mass Transit Systems; C2: Transport Demand Management; C3: Optimization of existing public transport routes; C4: Vehicle technology; C5: Non-motorized transport.

Number of scrapped vehicles per year *(#vehicles/year)*	C3	Appropriate State Transport Agencies register the number of public transport vehicles scrapped per year as part of the optimization program	Verify that the scrapped vehicles match their plates and the number of oversupplied vehicles from the optimization study.
Number of optimization studies carried out ex ante *(#studies)*	C3	Appropriate State Transport Agencies register the number of routes that were analyzed.	-
Percentage of progress in route optimization *(%/year)*	C5	Appropriate State Transport Agencies calculate the number of routes that have been optimized. Compare this information with the established goals and determine the percentage of progress made	Verify if the percentage of coverage meets the established goals. If not, identify the reasons why, propose possible solutions, and redefine the goals
Fuel consumption *(liter/year)*	C4	Bus owners register the fuel consumption of hybrids per year	Verify if the consumption of fuel of hybrid buses has in fact been reduced as originally assumed (30% approx.). If not identify the reasons why. Determine if that reduction can possibly be achieved and what is needed to do so.
Number of new hybrid buses per year *(#hybrids/year)*	C4	Bus assemblers create a database of the total number of hybrid buses sold per year	Verify sales statistics and reports
Kilometers traveled by bicycles *(km/year)*	C5	The concessionaire of the public bicycle system creates a database that includes the kilometers traveled by bicycle per year	Verify using a representative sample that the bicycles are in fact traveling the kilometers reported. Verify that the automatic report systems work properly and that the information in the data base is correct.
Percentage of progress in coverage of the public bicycle system *(%/year)*	C5	The concessionaire of the public bicycle system calculates the area covered and the number of bicycle stations built per year. This information is then compared with the established goals and the percentage of progress made determined	Verify if the percentage of coverage meets the established goals. If not, identify the reasons why, propose possible solutions, and redefine the goals.

Source: CTS EMBARQ México, 2012.

Chapter 5

FACTS OBTAINED FROM ANALYSIS OF NAMA INTRODUCTIONS AND FUTURE PROSPECTS

By
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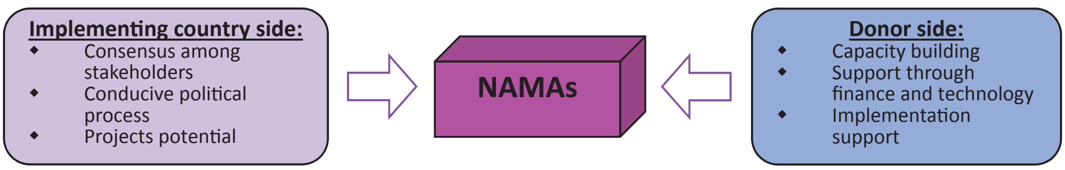
This section aims to share lessons learned from prospective NAMA implementation countries and then based on their actual experience gained in the process, extract some ideas regarding future activities that will support increased knowledge sharing and capabilities. Most of the experiences summarized here were drawn from existing capacity development support programmes for NAMAs implemented in various developing Asian countries by OECC Japan, including Cambodia, Lao PDR, Mongolia and Vietnam, but with an additional contribution made by the World Resources Institute (WRI/EMBARQ) in Mexico.

5.1 Essence of NAMA formulation support experience

- NAMAs provide the opportunity to gain recognition and support for activities: No internationally agreed upon definition for NAMAs exists, but "nationally appropriate" mitigation actions are significant in the sense that NAMAs can act as a catalyst for the design of policies, strategies, and institutional frameworks in a manner distinctive to the individual country and attract recognition and support for these activities.
  Depending on the individual situation of the nation concerned, NAMAs can be identified and designed by prioritizing sectors, responding to the country's needs through a consensus being reached by the stakeholders involved, and by creating their own relevant policy mix. This process not only provides a sense of ownership, thus ensuring that domestic experts take the lead in designing and implementing NAMAs rather than external stakeholders, but also paves the way to attracting different stakeholders and investors, for example from the private sector and support organizations such as donors. Above all, NAMAs have the potential to unite national/local developmental perspectives and through the support of donors attract interest at the international level with respect to the production of global public goods.

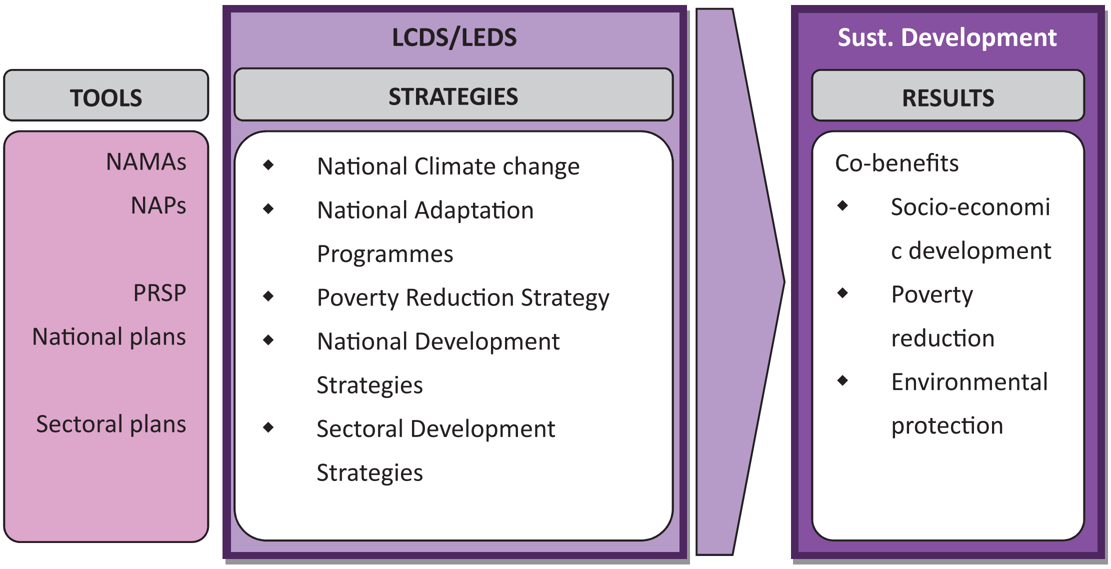


- NAMA capacity building activities can result in synergetic results in development: Experience in NAMA formulation support programs have been of aid to progress in countries in areas that include:
  1) Prioritization of sectors and sub-sectors via NAMA developments that are in accordance with national policies and strategies,
  2) Increasing the capabilities and enhancing the understanding of key officials of recipient countries with respect to quantification of GHG emissions,
  3) Determination of business-as-usual (BAU) and NAMA scenarios,
  4) Quantification of emission reductions via prospective NAMAs,
  5) Identification of mitigation technology needs, among others.

  These interventions have proved to be effective in constructing a foundation for NAMA readiness.

Any such support, however, only positions recipient countries at the entry point of the NAMA agenda. Ensuring continuity in capacity building activities will necessitate sustainment of the NAMA introduction process in thereby ensuring the anticipated GHG emission reductions resulting from NAMAs.

- NAMAs are the common thread for sustainable development and low carbon development strategies (LCDS): Implementing countries have expressed the importance of NAMAs as a tool to use in achieving sustainable development. At the same time several similarities with forward-looking national economic development plans or strategies that encompass low-emission and/or climate-resilient economic growth, referred as to low carbon (or low emission) development plans (OECD, IEA 2010), can be identified. Examples of which include:
  1) Increased economic benefits from the introduction of new mitigation technologies, together with investments and business opportunities that may result from them and;
  2) Social benefits (such as increased opportunities for income generation and/or generating job creation opportunities and better access to public services); and
  3) Ensuring environmental protection (or integrity) by achieving GHG emission reductions and improved air or water quality, among others.



Since LCDS are composed by taking account of national strategies in diverse areas that include poverty eradication, health, or economic growth, it has been recognized that NAMAs can be used as a tool that can be of help in prioritizing interventions. In other words, the "nationally appropriate" characteristic of NAMAs implies prioritizing mitigation actions that are derived from nationally determined strategies and plans, and hence NAMAs are typically in line with reducing emissions or a low carbon development path.

- Implementing NAMAs confirm urgent needs of capacity building at host countries: Experience gained in supporting the formulation of NAMAs clearly revealed that there is an urgent need for capacity building in a vast array of issues that range from support for effective and meaningful engagement in international level negotiations and decision making processes which can affect the domestic policy environment, to more specific and concrete measures such as establishing a methodological framework for quantification and projection of GHG emissions and estimation of emission reductions by NAMAs. Those needs stem from the commonly observed fact that implementing countries are in many cases under-staffed, they operate with limited budget, and availability of and access to reliable and up-to-date data is relatively rare. These constraints taken together makes it even more pressing to train key domestic personnel at the different levels involved in a systematic manner, and encompassing the different aspects that originate in policy formulation and then through to measurement and quantification techniques, etc. that can allow to host countries to smoothly implement their strategies.

- Working with NAMAs provide the opportunity for the institutional framework used for policy-related decisions in the implementing countries to be strengthened: The fact was observed that in many of the developing Asian countries NAMAs involve a national team that is typically composed of government officials with different fields of expertise and experience, and which can encompass energy, transport, agriculture, and specific climate change areas such as GHG inventories and the CDM. The diversity in the skill sets and backgrounds of the national team members enables countries to identify and deepen their understanding of the variety of benefits that NAMAs could potentially bestow while also catalyzing sustainable development. Despite the challenges and constraints they face the supported countries have proved capable of organizing "committees" or "working groups" that are made up of key officials from different ministries. These multi-sectoral committees then enable expedited decision-making at the governmental level in different matters related to the environment and other cross-cutting issues, while at the same time facilitating communication between the ministries and other stakeholders involved and the development of political support for related activities, such as the concept of NAMAs. The relatively diverse membership of the related groups can also help to ensure the continuity of support for NAMAs, and even in the event of a change in the Government administration.
  The latter point is worth elaborating upon; in essence, national NAMA formulation exercises create a testing ground for cross-sectoral cooperation and synchronization, and if effectively coordinated and facilitated by the lead agency they can facilitate a trustful relationship between the domestic stakeholders with their differing institutional mandates, something which is essential in building a national consensus regarding NAMAs. In addition, that type of facilitation can be further enhanced by winning the political credit of higher level decision makers.

- NAMAs as a window to use in introducing finance and technology: NAMAs provide an opportunity for different types of financial schemes to be accessed and the transfer of environmentally friendly technologies to take place in a more flexible manner. Experience reveals that consensus building and increased convergence of the goals from different stakeholders involved, for example the government and the private sector, facilitate discussions being held on introducing NAMAs via the highlighting of potential benefits such as access to finance, environmentally friendly technology, and knowledge through increased capacity building.

- Measurement, Reporting, and Verification (MRV): The development of a robust MRV system is a prerequisite in NAMAs attracting an adequate level of finance and mitigation technology. The NAMA formulation support program of OECC identified the different aspects of its design by taking countries' concerned needs into account and avoiding too much complexity via use of simple but comprehensive methodologies (which will necessarily vary between the countries concerned). The requirements identified include 1) the design of an appropriate institutional arrangement that incorporates an inclusive approach, 2) improved quantification of emissions through technical guidance/training and dispatching experts to work together with in-country officers in charge in-situ; and 3) report requirements including increased capabilities in thereby preparing for Biennial Update Report (BUR) requirements. This point accentuates the value to host countries of actively participating in the MRV process as they can then determine firsthand the results of introducing (or not) any such mitigation actions. The overt visibility of the results can serve to further political and public support for the pursuit of mitigation actions.

- Top-down approach: Methodologies used to calculate emission reductions can vary according to the objective. The top-down approach can be useful from the perspective of trying to determine future energy use and emissions and utilizing a variety of different assumptions, hence the use of different models are frequently referred. It would be fair to say that one difference that exists to the bottom-up approach is that the latter tends to provide an overview of emission reduction options while the top-down approach is for use when working with aggregated data that might be useful when working with long-term plans or strategies.
- Bottom-up approach: The bottom-up approach provides an opportunity for implementing countries to commence with existing mitigation efforts at the ground level and to then connect them to the NAMA concept in thereby establishing continuity. In the support programme, the bottom-up methodology adapted by experiences in Japan for planning and implementing domestic mitigation actions was introduced as a reference. The advantage identified in use of this method was to allow mitigation plans to be made through the following concrete set of steps:
  1) Setting roles and task demarcation (who is responsible for taking what actions),
  2) Assessing and understanding the cost and benefit of particular actions, and
  3) Estimating the level of GHG emission reductions at the activity level.

  This approach consequently proved to be very practical in the identification of useful policy actions to take each individual sector.

5.2 Next steps and practical insights

Experience gained form use of NAMAs is still very limited. Many donor countries and organizations have been working in an experimental manner, with the experience of each country appearing to differ from the others. Some of the most important areas that require improvement when working with host countries are listed below. The individual experiences may reveal even more key issues that hopefully can be further elaborated upon in the next edition of this document.

- Institutional arrangements and implementation: Careful observation reveals countries working with OECC to have opted for the bottom-up approach when formulating NAMAs, and developing NAMAs for a specific sector (Cambodia: transport, energy; Laos: transport; Mongolia: energy efficiency; Vietnam: waste management). This means that rather than focusing on strategies at the macro level or working with model based projections OECC has focused on a single sector and subsector in an attempt to gather the most comprehensive and accurate data at the ground level in thereby determining potential emission reductions. The discovery was made that the amount of input required in each of the following four stages of NAMA developments varies according to the differing national circumstances: 1) Capacity building, 2) NAMA design, 3) NAMA implementation, and 4) Investment in low carbon technologies. The reduced number of implemented NAMAs then leaves additional room for the useful expansion of analysis in thereby covering different sectors according to national GHG emission patterns and the priorities of the country concerned. This step-based approach to NAMA formulation enables countries to ensure the comprehensiveness of NAMAs and demonstrate their rationale and the selection process to potential donors.

- Establishment of MRV systems: MRV[1] is another area that requires a substantial amount of technical support. There are still observable gaps in the different aspects of existing domestic systems, and which include training that allows for the acquisition of basic skills and the necessary understanding involved in measuring emissions utilizing simple methodologies and the development of related metrics (sustainable development metrics, indexes, and calculation of GHG emissions and GHG emission reduction methodologies). Furthermore, clarification of the concept of MRV itself is necessary because of the substantial differences between the respective types of MRVs that exist (E.g. maturity, level of knowledge and experience, policy implications, and required level of accuracy, etc.). Since mitigation actions are structured in different layers (namely, National, Sectoral, Local, Programme, and Project, etc.) MRVs can be also applied in differing layers, which therefore necessitates analysis of their elements and pinpointing the context in which the concepts get used. To date "MRV of NAMAs" are therefore being considered and experimented by developing countries and under the UNFCCC.

- Potential linkages with regional initiatives and financing opportunities: The NAMA registry is an initiative taken by the UNFCCC that aims to provide a window for developing countries to showcase their NAMA proposals and eventually find matches with potential financers. Other initiatives such as the NAMA Facility, established by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), and the Department of Energy and Climate Change (DECC) of the United Kingdom (UK) established a fund that can be accessed in a competitive scheme, aimed at supporting transformational NAMAs. Another initiative coming from developed countries such as the Joint Crediting Mechanism (JCM) that is promoted by the Government of Japan, and which is one option to use to access financial resources and also environmentally friendly technologies. The JCM is a bilateral scheme between host countries and Japan, and which aims to facilitate diffusion of leading low carbon technologies as well as implementation of mitigation actions that will then also contribute to the sustainable development of developing countries. Transformational NAMAs, which can require considerable investment, might therefore find support through this scheme. Considering the different potential aspects of NAMAs more initiatives might arise in the future, however, the challenge remains of raising more funding in a more collaborative manner, and from the private sector in particular.

[1] This Guidebook was prepared in parallel to a Guidebook on MRV, ("One Hundred Questions & Answers bout MRV in Developing Countries", edited and published by the Institute for Global Environmental Strategies (IGES)). More detailed information on MRVs can be found in this publication.

5.3 Potential areas for future collaborations

- Collaborations between donors and research organizations: There is a growing interest by differing donors and research organizations across the globe with differing skillsets and experience to cooperate in a coordinated manner, and not only in climate change issues but also in the broad range of related aspects of the development process. Taken in this context, NAMA formulation provides a platform for any such cross-sectoral cooperation to push the NAMA agenda forward, and regardless of the observed slow progress or rhetorical divisions between the positions of the countries involved at the international negotiation level. At the national level it is highly likely that any country that succeeds in establishing a robust MRV system will benefit by attracting potential donors who will naturally be eager to see how the funds have been used. Developing countries can also benefit by facilitating mutual coordination between partners in thereby avoiding potential duplications but also creating synergy between donors.
  That type of coordination can be epitomized by the Support Program to Respond to Climate Change (SP-RCC) of Vietnam, which brought JICA, AFD, CIDA, World Bank, GIZ, and AUSAID together as a single platform. The SP-RCC was established in an attempt to support the implementation of the National Target Program to Respond to Climate Change (NTP-RCC) of Vietnam in a coordinated manner and involving mitigation, adaptation, and cross-cutting issues such as a financial mechanism. These experiences provide an innovative business model for donor harmonization in the area of NAMA formulation. That type of platform can also facilitate a streamlining of the support approach and requirements among donors, and therefore reducing the administrative burden incurred by short-staffed ministries with different sets of requirements for different donors.

- Capacity-building programs: Evidence has proved that developing countries will require capacity building support in the different stages of the NAMA and MRV cycles, and each stage brings different types of content requirements. However, and needless to say, the needs of each individual country can be either similar or substantially different from another country, thus making it a challenge for donor countries or support organizations to organize courses and prepare curricula. This is therefore another area where donors can profit from collaborations.

- Involvement of other stakeholders: Different donors and research institutions will result in a variety of programs, thus allowing for more flexible selections and designs of mitigation actions. Implementing countries will increasingly require collaborations with other stakeholders such as the private sector and academia, and since NAMA's require solid government participation the implementing countries can promote a formal type of networking through industry-academia-government collaboration schemes or public private partnerships, and which can be parallel to collaboration networks with donors in the case of supported NAMAs.

- Facilitation of South-South cooperation: Another layer of support can also be added that facilitates mutual learning between neighboring countries. Any such fora (preferably in regular and rotational form) can provide practical opportunities to showcase best practices, lessons, and challenges, and enhance regional solidarity in tackling climate mitigation overall.

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