Development of the Indonesian NAMAs Framework

Background Study - final draft

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Disclaimer

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Contents

Figures

Tables

Abbreviations

ADB	Asian Development Bank
AF	Adaptation Fund
AFOLU	Agriculture, Forestry and Other land-use
AL	Aggregation level
APBN	Anggaran Pendapatan dan Belanja Negara (State Budget)
APBD	Anggaran Pendapatan dan Belanja Daerah (Regional Budget)
APL	Areal Penggunaan Lain (Outside of national forest estate)
AWG-KP	Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol
BAP	Bali Action Plan
BAPPENAS	Ministry of National Development Planning/National Development Planning Agency
BAU	Business-as-usual
BOE	Billion barrels of oil equivalent
BPN	Badan Pertanahan Nasional (National Land Agency)
BPS	Badan Pusat Statistik (Indonesian Central Statistics Bureau)
BRT	Bus rapid transit
BUR	Biennal Update Report
Cap	Capita
CH4	Methane
CIFOR	Centre for International Forestry Research
CFCs	chlorofluorocarbons
CO2	Carbon Dioxide
CO2eq	Carbon Dioxide equivalent
COP	Conference of the Parties
CBDR	Common but differentiated responsibilities
CCS	Carbon Capture and storage
CDM	Clean Development Mechanism
DOC	Degradable organic content
ENS	Energy not served
EPC	Engineering, Procurement and Construction
ERS	Emission Reduction Scenario
ESDM	Ministry of Energy and Mineral Resources
FAO	Food and Agriculture Organization
GAIKINDO	Gabungan Industri Kendaraan Bermotor Indonesia (Association of Indonesian Automotive Industries)
GDP	Gross domestic product
GEOMOD	Geographical Modeling
Gg	Gigaton
GHG	Greenhouse gas
GHGe	Greenhouse gas emission
HPH	Hak Pengusahaan Hutan (Natural forest concession holders)
GW	Gigawatt
GOI	Government of Indonesia
Ha	Hectare
HCFCs	Hydro chlorofluorocarbons
HCV	Heavy Commercial Vehicle
HSD	High speed diesel
HTI	Hutan Tanaman Industri (Industrial Plantation Forest)
ICA	International Consultations and Analysis

ICEE	Integrated Carbon Ecology and Economics model
ICCSR	Indonesia Climate Change Sectoral Roadmap
ICRAF	World Agroforestry Centre
IDO	Industrial diesel oil
IEA	International Energy Agency
IGCC	Integrated gasification combined cycle
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producers
ISIC	International Standard Industrial Classification
LAPAN	The Institute of Aviation and Space Agency
kJ	Kilojoule
kWh	kilowatt hour
LCV	Light commercial vehicle
LDC	Least Developed Countries Fund
LOLP	Loss of load probability
LNG	Liquefied natural gas
LULUCF	Land Use, Land-Use Change and Forestry
m2	Quadratmeter
MBOE	Million Barrels of Oil Equivalent
MDGs	Millenium Development Goals
MFO	Marine fuel oil
MoA	Ministry of Agriculture
MoE	Ministry of Environment
MoFin	Ministry of Finance
MoFor	Ministry of Forestry
MRV	Measuring, Reporting and Verification
MSW	Municipal/Domestic Solid Waste
Mt	Megaton
MVA	Megavolt-Ampere
NAMAs	Nationally Appropriate Mitigation Actions
NATCOM	National Communication
NFI	National Forest Inventory
NMT	Non-Motorized Transportation
N2O	Nitrous oxide
NPV	Net Present Value
OECD	Organisation for Economic Cooperation and Development
O&M	Operations and Maintenance
PES	Payment for Environmental Services
Ppm	Parts per million
PU	Ministry of Public Work
RAD GRK	Local mitigation action plan
RAN-GRK	National Mitigation Action Plan on greenhouse gas emission reduction
RAN-PI	National Action Plan on Climate Change
R&D	Research and Development
REDD+	Reducing Emissions from Deforestation and Degradation
RIL	Reduce-Impact-Logging
Rp	Rupiah
RPJM	Rencana Pembangunan Jangka Menengah (Regional Long Term Development)
RPJP	Rencana Pembangunan Jangka Panjang (Long-Term Development Plan)
RUKN	Rencana Umum Kelistrikan Nasional (Master Plan of National Electric Power)
RUPTL	Rencana Usaha Penyediaan Tenaga Listrik (National Electricity Development Plan)
SWDS	Final disposal areas
SBI	Subsidiary Body on Implementation
SCCF	Special Climate Change Fund

SCP	Sustainable Consumption and Patters
SFM	Sustainable Forest Management
SIDS	Small Island Developing States
SNC	Second National Communication
SUTIP	Sustainable Urban Transport Improvements Project in Indonesia
SUV	Sport Utility Vehicle
SWDS	Solid Waste Diposal Site
t	tonne
Transmigrasi	Ministry of Manpower and Transmigration
TOD	Transit oriented development
TOE	Tonne of oil equivalent
TWh	Terawatt hour
UKP4	Presidential Unit of Supervision and Control of Development
UNDP	United Nations Development Program
UNFCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
Vkm	Vehicle kilometres travelled

Preface

Since pre-industrial times, the increase of greenhouse gas emissions due to human activities have led to a marked increase of greenhouse gas concentrations in the atmosphere that will lead to the increase of global temperature. This climate change issue becomes one of the most important global issues. The United Nations Framework Convention on Climate Change (UNFCCC) has addressed this issue through its ultimate objective of stabilization of greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system as stipulated in Article 2 of the Convention.

Series of Conference of the Parties (COP) of the UNFCCC meetings have emphasized the need for deep cuts in global greenhouse gas emissions are required according to science, and as documented in the Fourth Assessment Report of the IPCC, with a view to reducing global greenhouse gas emissions so as to hold the increase in global average temperature below 2^0C above pre-industrial levels. These global coherent efforts are conducted based on the principle that the Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities.

The basis for contributions from developing country Parties as a group has been laid down in the Bali Action Plan as the outcome of the COP 13 Meeting in Bali through nationally appropriate mitigation actions (NAMAs). At COP 16 in Cancun, Mexico, again agrees that developing country Parties will take NAMAs in the context of sustainable development, supported and enabled by technology, financing and capacity building, aimed at achieving a deviation in emissions relative to “business as usual” emissions in 2020. Furthermore, COP 16 reaffirmed the existence of two categories of NAMAs by developing country Parties, namely: (i) domestically supported mitigation actions as unilateral or voluntarily NAMAs, and (ii) internationally supported mitigation actions as supported NAMAs.

However, there are a lot of questions still lingering about NAMAs. Several key elements such as ways of financing or MRV (measurement, repoting and verification) standards and guidelines for different NAMA types need to be further developed in order to get to an effective NAMA framework on international aas well as national levels.

This report provides guidance on how to establish NAMAs across different sectors in Indonesia. It outlines the key steps when establishing NAMAs towards a multi-sectoral GHG mitigation framework. Key steps comprise the establishment of asectoral baselines and the aggregation into a multi-sectoral baseline, potential mitigation actions of sectors, national business as usual baseline and aggregated mitigation actions, and the way to select in meeting the national emission reduction target in line with national development priorities. This document also contains a more detailed description on several sectors and sub-sectors, namely power, transportation & industry as sub-sectors of the energy sector as well as the waste and land based sector.

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I. Background

I.1 LONG-TERM GOAL AND EMISSIONS

I.2 CURRENT STATUS OF INTERNATIONAL NEGOTIATIONS

I.3 NATIONAL PROGRESS AND MITIGATION TARGETS

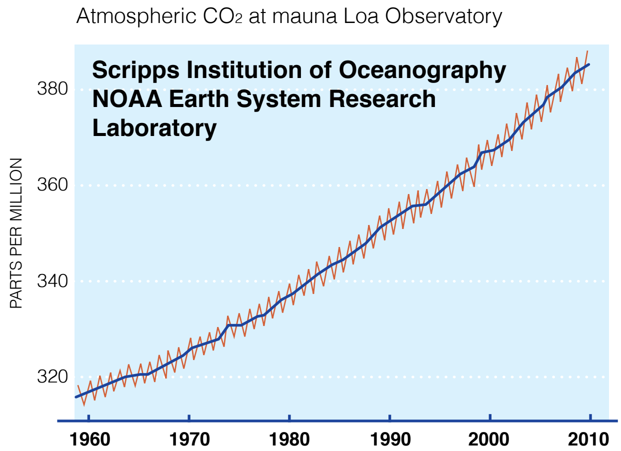
I.4 RAN-GRK: NATIONAL ACTION PLAN

I.1 LONG-TERM GOAL AND RANGE OF EMISSION ALLOWANCES

LONG-TERM GOAL

Since pre-industrial times, the increase of greenhouse gas emissions due to human activities have led to a marked increase of greenhouse gas concentrations in the atmosphere that will most likely lead to the increase of global temperature. The IPCC Fourth Assessment Report 2007 indicates that if the global average temperatures increase more than 2°C above pre-industrial levels, global impacts may be irreversible. In other to prevent this, greenhouse gas concentrations in the atmosphere need to be stabilized at the level of 450 ppm CO_{2eq} (IPCC, 2007):

Figure I.1
The CO2 Measurements at the Mauna Loa Observatory.



July, 2009

"A wide range of direct and indirect measurements confirm that the atmospheric mixing ratio of CO_2 has increased globally by about 100 ppm (36%) over the last 250 years, from a range of 275 to 285 ppm in the pre-industrial era (AD 1000–1750) to 379 ppm in 2005".

As shown by measurements made at the Mauna Loa Observatory (NOAA ESRL), annual mean concentrations of CO_2 in 2008 were around 384.83 ppm (Figure I.1). Other studies show higher levels: according to a study by the Hadley Centre (Murphy et al., 2004), greenhouse gas concentrations in 2004 were at 430 ppm $CO_{2\text{-}eq}$, rising at an increasing rate of 2.5 ppm per annum.

It has been acknowledged in the UNFCCC Decision on the outcome of the work the AWG-LCA under the Convention, that

> "deep cuts in global greenhouse gas emissions are required according to science, and as documented in the Fourth Assessment Report of the IPCC, with a view to reducing global greenhouse gas emissions so as to hold the increase in global average temperature below 2°C above pre-industrial levels, and that Parties should take urgent action to meet this long-term goal, consistent with science and on the basis of equity" (FCCC/CP/2010/7/Add.1).

An important question in this context, is when emissions should peak, and what the eventual stabilisation level should be. The IPCC Fourth Assessment report indicates that to achieve the global long-term stabilization level of atmospheric concentration of 450 ppm CO_{2eq}, under the most stringent scenarios using the 'best estimate' assumption of climate sensitivity, global greenhouse gas emissions should peak by 2020 at the latest, and be around 50% below 1990 levels by 2050.

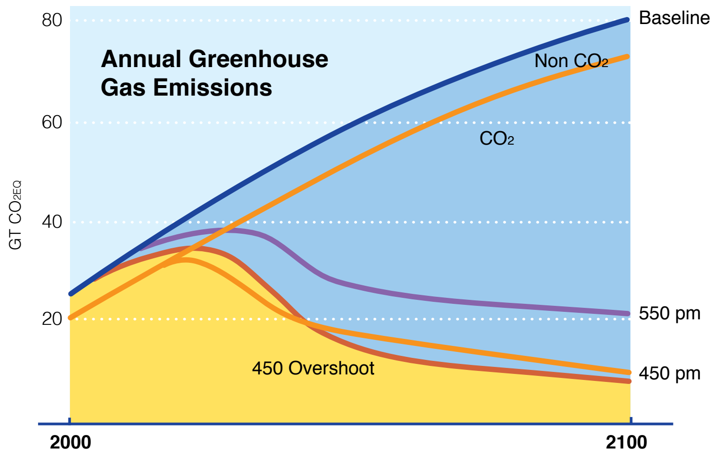


Figure I.2
Different Period of Stabilization Levels

Source:
Ralph Simms, IPCC/IEA, December 2008

EMISSIONS FOR ANNEX I AND NON-ANNEX I 2020-2050

To achieve the ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC), as stipulated in article 3, paragraph 1, "Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly the developed country Parties should take the lead in combating climate change" (FCCC/INFORMAL/84: 2). Moreover, the Copenhagen Accord (2009) recognizes "that the time frame for peaking will be longer in developing countries", and that Parties "should cooperate in achieving the peaking of global and national greenhouse gas emissions as soon as possible" (FCCC/CP/2009/L.7).

The Cancun Agreements further state that developed countries are urged to "increase the ambition of their economy-wide emission reduction targets, with a view to reducing their aggregate anthropogenic emissions of carbon dioxide and other GHG not controlled by the Montreal Protocol to a level consistent with that recommended by the IPCC AR4" (FCCC/CP/2010/7/Add.1/paragraph 37). However, the Fourth Assessment Report also states that it will be impossible to reach the global target of 450 ppm CO2eq if only developed countries reduce their emissions. Consequently, the IPCC recommends that (i) by 2020 Annex I countries as a group should cut their emission by 25% to 40% below their 1990 level and non-Annex I countries as a group, should substantially deviate from baseline in Latin America, Middle East, East Asia and Centrally-Planned Asia, and (ii) by 2050 Annex I countries should cut their emission by 80% to 95% below their 1990 level, and for Non-Annex I countries, substantial deviation from baseline in all region (Table I.1) (IPCC 2007). The results of a study conducted by Michel den Elzen & Niklas Hohne, further note that, in line with the important IPCC recommendations: "substantial deviation from baseline" for Non-Annex I countries requires emission reductions up to 15% to 30% below business as usual" (Den Elzen/Hoehne 2008a,b).

Table I.1

Box 13.7, IPCC WG III, Fourth Assessment Report

The Range of the Difference between Emissions in 1990 and Emission Allowances in 2020/2050 for Various Concentration Levels for Annex I and Non-Annex I Countries as a Group*

Scenario Category	Region	2020	2050
A-450 ppm $CO_{2\text{-eq}}$[b]	Annex I	-25% to -40%	-80% to -95%
	Non-Annex I	Substantial deviation from baseline in Latin America, Middle East, East Asia, and Centrally Planned Asia	Substantial deviation from baseline in all regions
B-550 ppm $CO_{2\text{-rq}}$	Annex I	-10% to -30%	-40% to -90%
	Non-Annex I	Deviation from baseline in Latin America and Middle East, East Asia	Deviation from baseline is most regions, especially in Latin America and Middle East
C-650 ppm $CO_{2\text{-eq}}$	Annex I	0% to -25%	-30% to -80%
	Non Annex I	Baseline	Deviation from baseline in Latin America and Middle East, East Asia

a. The aggregate range is based on multiple approaches to apportion emissions between regions (contraction and convergence, multistage, Triptych and intensity targets, among others). Each approach makes different assumption about the pathways, specific national efforts and other variables. Additional extreme cases –in wich Annex I undertakes all reductions, or Non-Annex I undertakes all reductionss– are not included. The range presented here do not imply political feasibility, nor do the results reflects cost variance.
b. Only the studies aiming at stabilization at 450 ppm CO2-eq assume (temporary) overshoot of about 50 ppm (see Den Elzen and meinshausen, 2006)

Source:
IPCC Working Group III, Chapter 13, Box 13.7, page 776

Table I.2

Substancial deviation from baseline by Non-Annex I countries as a group

Emission Reduction Trade-Offs for meeting Concentration Targets - Conclusions

- New allocation studies confirm the reduction in Box 13.7.
- For non Annex I countires as a "substancial deviation from baseline" is now specified: 15-30% for 450 ppm $CO_{2\text{-eq}}$, 0-20% for 550 ppm $CO_{2\text{-eq}}$ and from 10% above to 10% below baseline for 650 ppm $CO_{2\text{-eq}}$ in 2020. The first 10% can be "no-regret options"
- If Annex I countries as a group reduces 30% below 1990 level, non-Annex I need to reduce about 10-25% below baseline for meeting 450 ppm $CO_{2\text{-eq}}$
- Baseline assuming ongoing rapid growth on emissions in non-Annex I countries (higher than IPCC SRES range), the reductions will be higher
- Avoiding deforestation relaxes the reductions for Annex I and non-Annex I countries

Source:
Den Elzen/Hoehne 2008a. b

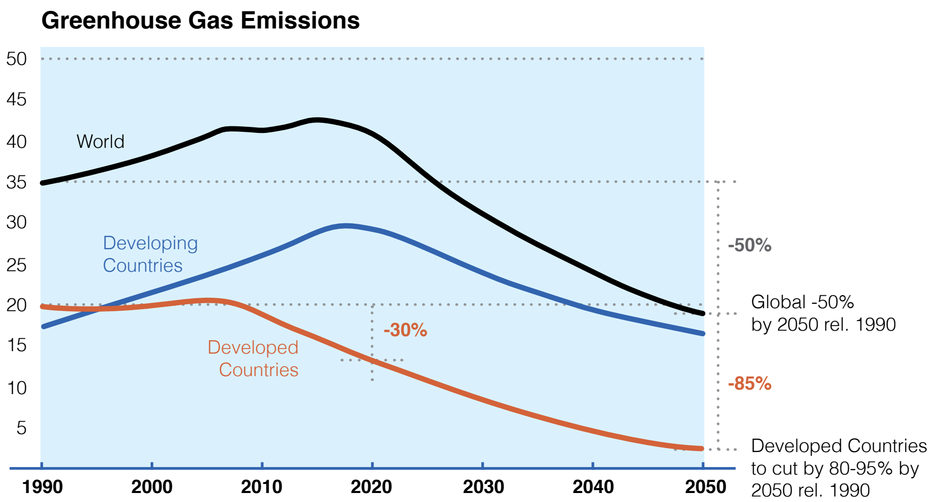


Figure I.3

Emission Pathways for Different Groups of Countries & Global Emissions. An overall reduction of 50% below 1990 levels is required by 2050 in order to achieve the 2°C target.

Source:
EU Climate Change Expert Group 'EG Science', 2008

I.2 CURRENT STATUS OF INTERNATIONAL NEGOTIATIONS

International negotiations on climate change under the UNFCCC, have focused to a large degree on reaching a comprehensive framework for enhanced action on mitigation, adaptation as well as other key elements. Topics on mitigation include setting overall targets and schedules for emission reduction, sharing emission reduction between Parties, providing financial, capacity and technology support for actions, and development of market based emissions reduction instruments such as emission trading systems.

As part of the Bali Action Plan (BAP), Decision 1/CP.13 adopted at COP13 in Bali in 2007, forms the basis for current negotiations, with five main building blocks addressing inter alia:

(i) A shared vision for long-term cooperative action, including a long-term global goal for emission reductions, to achieve the ultimate objective of the Convention,
(ii) Enhanced national/international action on mitigation of climate change,
(iii) Enhanced action on adaptation,
(iv) Enhanced action on technology development and transfer to support action on mitigation and adaptation, and
(v) Enhanced action on the provision of financial resources and investment to support action on mitigation and adaptation and technology cooperation.

According to the Bali Action Plan, negotiations on the future climate regime should consider

> "nationally appropriate mitigation actions by developing countries in the context of (i) sustainable development, (ii) supported and enabled by technology, financing and capacity-building, and (iii) in a measurable, reportable and verifiable manner" (FCCC/CP/2007/6/Add.1/paragraph 1.b.ii).

With this important provision, the Bali Action Plan further specifies that the basic balance between Annex I and Non-Annex I country efforts needs to be in line with article 4 of the Convention, particularly paragraph 3, 4, 5 and 7, and also serve as a basis to move towards the establishment of a framework for nationally appropriate mitigation actions by developing countries under voluntary NAMAs and supported NAMAs to support emission reduction in developing countries within the UNFCCC framework (FCCC/CP/2007/6/Add.1).

Annex-I Parties reconfirm their commitment to implement individually or jointly the quantified economy-wide emissions targets for 2020, while the non-Annex I Parties in the Copenhagen Accord agree to implement mitigation actions (FCCC/CP/2009/L.7).

> "Mitigation actions subsequently taken and envisaged by Non-Annex I Parties, including national inventory reports, shall be communicated through national communications consistent with article 12.1(b) every two years on the basis of guidelines to be adopted by the Conference of the Parties. Mitigation actions taken by Non-Annex I Parties will be subject to their domestic measurement, reporting and verification, the result of which will be reported through their national communications every two years. Non-Annex I Parties will communicate information on the implementation of their actions through National Communications, with provisions for international consultations and analysis under clearly defined guidelines that will ensure that national sovereignty is respected. Nationally appropriate mitigation actions seeking international support will be recorded in a registry along with relevant technology, finance and capacity building support" (FCCC/CP/2009/L.7/paragraph 5).

At COP16 in Cancun, Parties again emphasize

> "the need for deep cuts in global greenhouse gas emissions and early and urgent undertakings to accelerate and enhance the implementation of the Convention by all Parties, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities" and "agrees that developing country Parties will take nationally appropriate mitigation actions in the context of sustainable development, supported and enabled by technology, financing and capacity building, aimed at achieving a deviation in emissions relative to "business as usual" emissions in 2020" (FCCC/CP/2010/7/Add.1/paragraph 48).

Moreover, it invites "developing countries that wish to voluntarily inform the Conference of the Parties of their intention to implement nationally appropriate mitigation actions in association with this decision to submit information on those actions to the UNFCCC secretariat" (FCCC/CP/2010/7/Add.1/paragraph 50), and provide "information on nationally appropriate mitigation actions for which they are seeking support, along with estimated costs and emission reductions, and the anticipated time frame for implementation" (FCCC/CP/2010/7/Add.1/paragraph 54).

The Cancun Agreements reaffirm NAMAs by developing country Parties in two categories: (i) domestically supported mitigation actions as unilateral or voluntarily NAMAs and (ii) internationally supported mitigation actions as supported NAMAs. (FCCC/CP/2010/7/Add.1/paragraphs 62 and 61) Furthermore, Parties also "decide[s] to set up a registry to record nationally appropriate mitigation actions seeking international support and to facilitate matching of finance, technology and capacity-building support to these actions" (FCCC/CP/2010/7/Add.1/paragraph 53). The UNFCCC Secretariat is tasked with to record and update submissions on NAMAs seeking international support, submissions on support available from developed countries, and actual support provided for NAMAs. In this respect, the Registry can contribute as an interface between developing and developed countries, on finance, technology and capacity-building support. Establishing this registry and associated "matching processes" further at the UNFCCC Secretariat, raises 3 (three) issues: (i) requirements for a mechanism for each NAMAs category, (ii) requirements for guidelines as a basis for formatting the submission, and (iii) how to institutionalize the registry processes.

I.3 NATIONAL PROGRESS AND MITIGATION TARGETS

PROGRESS AT NATIONAL LEVEL

Indonesia continues its efforts towards the implementation of its commitments under the Convention, to contribute to a global mitigation effort in accordance with the principles and provision of the Convention. Indonesia has presented its First National Communication to the UNFCCC in 1999 and the Second National Communication (SNC) has been completed this year. Furthermore, the Government of Indonesia has begun developing a national policy framework on climate change which includes the initial National Action Plan on Climate Change (RAN-PI, 2007).

The National Development Planning Agency (BAPPENAS) has published two reports on climate change mitigiation: "Indonesia's Response to Climate Change" (, 2008), and the "Indonesia Climate Change Sectoral Roadmap (ICCSR 2010).

NATIONAL EMISSION REDUCTION TARGET

At the G20 Summit Meeting in Pittsburg, in September 2009, Indonesia has committed to establish the necessary policies and measures, including related required instruments that would cut national emissions between 26% and 41% by 2020 from a "business as usual " situation, through voluntary mitigation actions and with international support[1]. Following this announcement, and Indonesia subscribing to the Copenhagen Accord of December 2009, the National Council on Climate Change (DNPI) has reported NAMA ambitions to the UNFCCC Secretariat on January 30, 2010, in the format set forth by the Appendix II of the Copenhagen Accord. The submission includes seven major focus areas for achieving the 26% national emission reduction target in 2020, as shown in Table I.2.

[1] G-20 Leaders Summit, 25 September 2009, Pittsburgh, PA. http://forestclimatecenter.org/files/2009-09-25%20Intervention%20by%20President%20SBY%20on%20Climate%20Change%20at%20the%20G-20%20Leaders%20Summit.pdf

Table I.3

Indonesia Nationally Appropriate Mitigation Actions Submitted to the UNFCCC Secretariat on January 30, 2010.

Nationally Appropriate Migation Action	Emission Reductions
The Reduction will be achieved, inter alia, through the following action: 1. Sustainable Peat Land management 2. Reduction in Rate of Deforestation and Land Degradation 3. Develop ment of Carbon Sequestration Projects in Forestry and Agriculture 4. Pro motion of Energy Efficiency 5. Develop ment of Alternative and Renewable Energy Sources 6. Reduction in Solid and Liquid Waste 7. Shifting to low-E mission Transportation mode	**26% by 2020**

I.4 RAN-GRK: NATIONAL ACTION PLAN

The National Mitigation Action Plan on greenhouse gas emission reduction (RAN-GRK) is a working document that provides the foundation for various ministries / institutions and local governments for the implementation of mitigation actions (RAN-GRK, 2011). The purpose of RAN-GRK, is twofold. It provides an overview of the national potential for mitigation actions, and it initiates the design of programmes and actions to reduce emissions.

RAN-GRK aims to provide guidance for concrete actions needed to reach the 26-41% emission reduction target by 2020. NAMAs are crucial for the Action Plan implementation for three reasons: (i) NAMAs are meant to provide important means for operationalizing the RAN-GRK, (ii) NAMAs can help Indonesia to tap the Green Climate Fund and other international funds, and (iii) NAMAs should enable Indonesia to obtain UNFCCC recognition for its mitigation efforts (GIZ, 2011).

The NAMA Framework presented in this document, serves as input to RAN-GRK for planning, developing and implementing NAMAs in a structured way.

CHALLENGES FOR RAN-GRK

As indicated in BAPPENAS (2011), the implementation of the RAN-GRK faces several challenges. There are national mitigation targets, but there is no national BAU baseline against which to measure the reduction. Constructing a BAU baseline is non-trivial and requires detailed insights in emissions and mitigation opportunities now and in the future. There is a need for a business-as-usual baseline scenario, based on detailed sectoral data and in line with national development priorities. A second challenge for RAN-GRK is to translate national targets to sectoral ambitions (or targets), while there is no accurate data on available on the emission projections and mitigation potential per sector. Hence, there is currently no plausible calculation to back up an establishment of sectoral targets. Thirdly, a review is needed for mitigation actions that could contribute to reaching the target. Fortification of the evidence base on which costs and potentials for mitigation actions is based, has priority alongside the establishment of a baseline and a detail assessment of mitigation potential per sector. Finally, there is currently no monitoring system in place for RAN-GRK. Especially in the context of NAMAs, a system for monitoring, evaluating and reporting (MRV) on actions and support, is required (internationally).

LOCAL ACTION PLANS

As part of RAN-GRK, each province will need to develop a Local Action Plan on Greenhouse Gas Emissions Reduction (RAD-GRK). The contributions of local (provincial) governments are expected to include:

- Calculation of mitigation potential and construction of a provincial BAU baseline.
- Development of a strategy for emission reduction
- Proposal for selected local GHG mitigation actions
- Identify the key stakeholders/institutions and financial resources.

II. Nationally Appropriate Mitigation Actions (NAMAs)

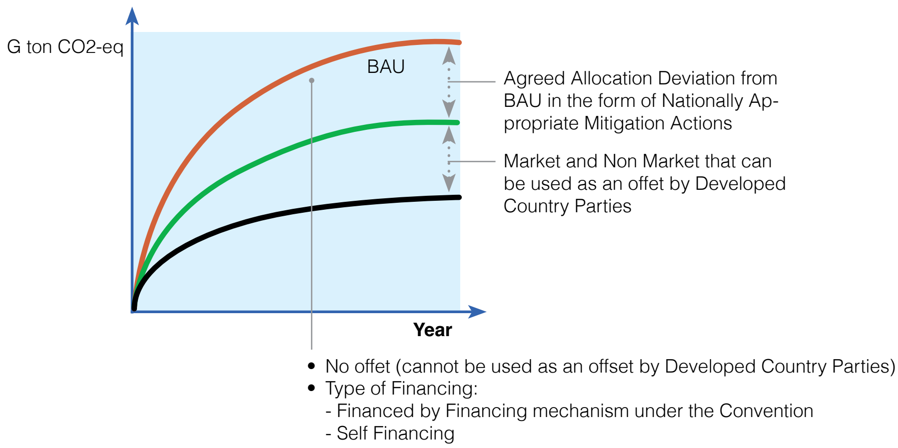
II.1 NAMAs BY DEVELOPING COUNTRY PARTIES

Nationally Appropriate Mitigation Actions (NAMAs) are expected to be the main vehicle for mitigation actions in developing countries under a future climate agreement. NAMAs are thought to provide a new opportunity for developing countries to take action on their large and rapidly increasing emissions, while managing the growth, social, and development needs.

Since the introduction in the Bali Action Plan, NAMAs have been categorised according to their source(s) of funding in discussions and submissions to the UNFCCC (e.g. EU submission, 2009). As Figure II.1 shows, NAMAs had been categorized as: (i) being financed by own resources and international support, to achieve an agreed deviation from business-as-usual through NAMAs, which can not be used as an offset by developed country Parties, and (ii) being financed through market and non-market mechansims that can be used as an offset by developed countries.

Figure II.1

Nationally Appropriate Mitigation Actions (NAMAs)



The negotiations have so far been slow to converge on a further definition and scope of NAMAs. The interpretation of NAMAs as captured by submission to the Copenhagen Accord by the various Parties in 2010, is very broad and ranging from sectoral approaches at sub-national level to national multi-sectoral action plans consisting of various concrete mitigation actions. So far, NAMAs appear to be generally understood to include any kind of action (by government) that reduces GHG emissions. Views still differ on the institutional structure that is needed for NAMA development, on financing and implementation, as well as on ways to measure, report and verify (MRV) the actions.

As international instrument, a NAMA should be able to promote mitigation actions across a vast difference of national and global situations and needs, allowing developing countries to design their actions according to their unique circumstances. Furthermore, national NAMA approaches should be in line with the agreed global understanding, which is especially the case for internationally supported NAMAs.

THREE CATEGORIES OF NAMAs

Significant progress has been made at COP16 to categorize NAMAs by developing country Parties (see Figure II.2) according to the following cateogries[2] (FCCC/CP/2010/7/Add.1/):

- Unilateral NAMAs/Domestically Supported NAMAs (unsupported or supporting through own resources): mitigation actions undertaken by developing country Parties on their own, to achieve certain emission reductions without international (outside) support under the UNFCCC framework. The emission reduction achieved would be counted towards the developing country Party, and the MRV is most likely to be conducted domestically. The required funding comes from domestic financial sources. Unilateral NAMAs may focus on cost-effectiveness and low cost-per-ton mitigation, but also on ease of implementation and benefits towards particular national development priorities. Indonesia has announced that it intends to achieve 26% national emission reduction by 2020 through unilateral NAMAs.
- Internationally Supported NAMAs: These actions classify as mitigation actions by developing country Parties, supported directly by developed country Parties under the UNFCCC framework. Supported NAMAs will most likely cover moderate-to-high cost mitigation options. For internationally supported NAMAs, the generated emission reductions cannot be used to offset emissions by developed country Parties in meeting their GHG emission reduction commitments. MRV is likely to be performed internationally in accordance with guidelines to be developed under the Convention. For Indonesia, supported NAMAs can contribute to the national emission reduction target range from 26% up to 41% emission reductions.
- Credited NAMAs (credit generating NAMAs): A third type of NAMA funding considers income from selling carbon credits on a (future) international carbon market. Under this type of financing, the carbon credits can be used as an offset by developed country Parties to supplement their domestic mitigation efforts in meeting their "quantified economy-wide emission reductions targets". (See e.g., Jung et. al. 2010a)

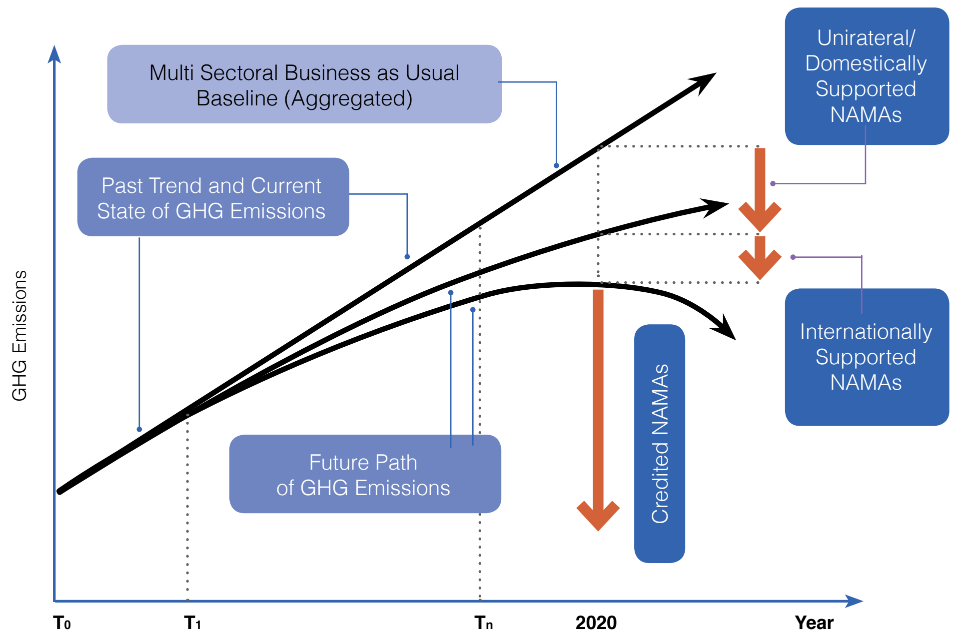


Figure II.2
NAMAs by Developing Country Parties

(own elaboration)

2 Note that in figure I.1 the first two categories are combined

II.2 CONCEPTUAL BASELINE SCENARIO

For the implementation of some NAMAs, developing countries may require support in the form of funding, technology transfer, or capacity building. This includes assistance for development of investment strategies, and design and implementation of policies. The BAP and the Copenhagen Accord include a strong call for "new and additional" financial sources to assist developing countries in dealing with climate change issues. Furthermore, the Cancun Agreements state in accordance with article 4, paragraph 3, of the Convention, that "developed country Parties shall provide enhanced financial, technological and capacity-building support for the preparation and implementation of NAMAs of developing country Parties and for enhanced reporting by these Parties.". The discussion below shows that progress is slow, and there is no detailed mulitlateral finance mechanism yet.

Over a decade ago, COP7 established three special funds: the Special Climate Change Fund (SCCF) and Least Developed Countries Fund (LDC) under the Convention, and the Adaptation Fund (AF) under the Kyoto Protocol. The SCCF and the LDC Fund are operational and are managed by the Global Environment Facility (GEF). The World Bank acts as trustee for the Adaptation Fund. The question is, if the architecture of the current funds is suitable for scaling up to serve global multilateral mitigation and adaptation finance (United Nations 2010). An analysis presented at the AWG-KP Fourth Workshop in Vienna in 2007 (UNFCCC 2007), concludes that a sufficient level of funding is available, but that at its current level (and continues to rely mainly on voluntary contributions), funding will not be sufficient to address the future financial flows needed for mitigation and adaptation. Further up-scaling, new and additional, predictable and adequate funding as well as improved access therefore need to be provided for developing countries in accordance with the Convention. As stipulated in the Cancun Agreements, under the "fast-start finance" scheme, the COP takes note of the

> "collective commitment by developed countries to provide new and additional resources of USD 30 billion for the period 2010-2012, with a balanced allocation between adaptation and mitigation. In order to enhance transparency, developed country Parties are invited to submit to the UNFCCC secretariat information on the resources provided to fulfil the above commitment, including ways in which developing country Parties access these resources." (FCCC/CP/2010/7/Add.1/paragraph 95)

And under the "long-term finance" scheme, it is recognized that

> "developed country Parties commit, in the context of meaningful mitigation actions and transparency on implementation, to a goal of mobilizing USD 100 billion per year by 2020 to address the needs of developing country Parties" (FCCC/CP/2010/7/Add.1/paragraph 98).

Even though there are concrete figures in the agreed text, still more clarity is needed on sources of funding, the design of the mechanism, and the matching between demand and offering of support.

For the post-2012 climate regime, the UNFCCC negotiations have currently not yet managed to establish a mechanism that links actions and support on a multilateral basis. However, COP16 in Cancun a step has been made by the establishment the

“Green Climate Fund”. The fund aims to help developing country Parties setting the course for low-carbon development and adaptation to climate impacts. The fund will support projects, programmes, policies and other activities in developing country Parties using thematic funding windows (FCCC/CP/2010/7/Add.1).

In accordance with the Bali Action Plan, and reaffirmed in the Cancun Agreements, funds provided to developing country Parties may come from a “wide variety of sources, such as public and private, bilateral and multilateral and alternative sources” (FCCC/CP/2007/6/Add.1). These alternative sources can, for example, be channeled in the form of grant, trust funds, incentive system (like in energy conservation programmes) or market mechanisms. Domestic public and private sources could be used for domestically supported NAMAs. Bilateral sources can be accessed through direct engagement outside the UNFCCC mechanism.

Up to the present, a NAMA registry has not been set-up. A registry can record NAMAs seeking international support, and facilitate matching of finance, technology and capacity-building support. The absence of a registry may casuse delays: Referring to Decision 1/CP.16, paragraph 53, as long as the envisaged registry is not functional, any sources of finance directly provided for internationally supported NAMAs which are not channeled through the UNFCCC registry might not be recognized as contributions under the Convention serving the goal achievement of a developing country.

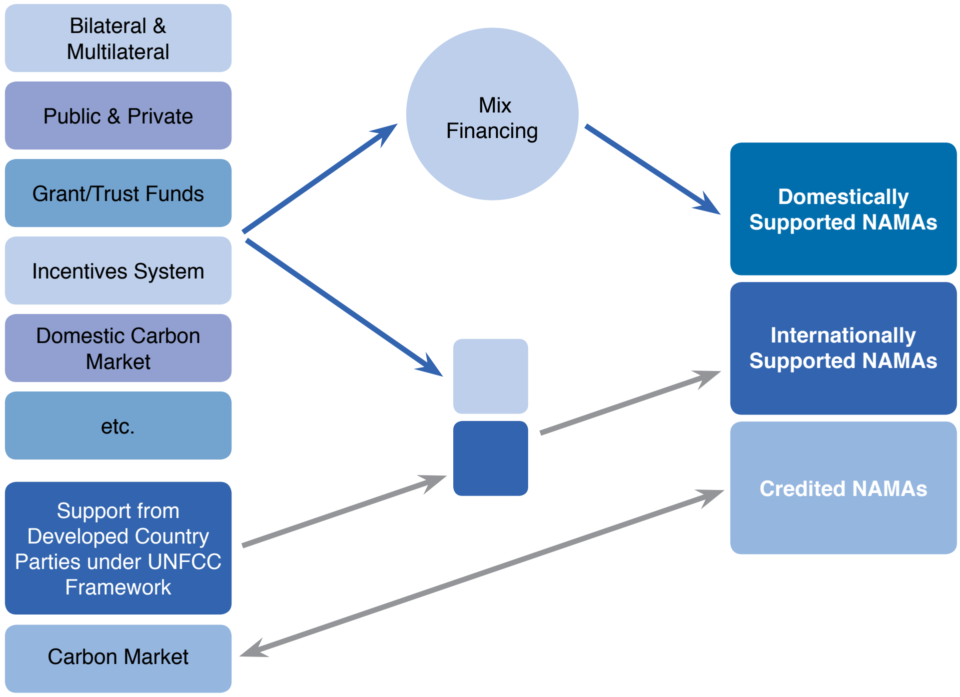
The UN Secretary General’s High-level Advisory Group on Climate Financing (AGF, established February 2010) has considered the goal of mobilizing US$100 billion per year by 2020, and concluded that it is challenging but feasible to meet this goal. Funding will need to come from a wide variety of sources as mentioned above. Instruments based on carbon pricing seem particularly attractive because they both raise revenue and provide incentives (United Nations 2010).

Although their currently is no carbon market for NAMAs, if it would be established this could be a source of revenue for mitigation actions. The emission reduction resulting from credited NAMAs, will in that case likely be used as an offset by a developed country Party, to supplement their domestic mitigation efforts in meeting their targets.

Currently, the carbon price is not sufficient to drive development and deployment technologies at large scale. The main concern for low-carbon investments depending on revenues from carbon markets, is the risk of low (or even zero) carbon prices. Technology development benefits from predictable carbon prices. A future carbon market, in line with global long-term ambitions for emission reduction (see Chapter 1: 50% below 1990 levels in 2050), could generate revenues proportional to additional support needs. If such a carbon market will be established depends on if developed countries agree to a binding cap or target. Because only then could there be a stable demand for carbon credits (provided there will be a stable regulatory framework).

A possible financing scheme for each NAMA category is described in Figure II.3 below:

Figure II.3
Possible Financing Scheme for NAMAs



(own elaboration)

II.3 MEASURABLE, REPORTABLE AND VERIFIABLE (MRV)

The measurement, Reporting and Verification (MRV) of mitigation actions, has a central position in the 2007 Bali Action Plan, the 2009 Copenhagen Accord, and the 2010 Cancun Agreements. By quantifying the impacts of mitigation actions, MRV can report on whether actions are actually undertaken and implemented effectively. MRV can provide information on whether existing mitigation actions are sufficient to achieve the GHG emission reduction ambitions. Also, it can provide insight in the balance between support needed and support received. NAMAs and MRV are inseparably linked, because without MRV the effectiveness of NAMAs cannot be determined. The details of MRV requirements in a post-2012 climate regime can have wide implications for the effectiveness of global mitigation efforts.

The Copenhagen Accord outlines general guidelines for conducting MRV in the context of NAMAs. However, a number of details on MRV still need to be formulated internationally before it can be made an effective part of the post-2012 policy toolkit. Some of the key issues in international negotiations regarding MRV are:

(i) Focus areas, such as national emission level and its emission path, mitigation actions and achieved emission reduction,

(ii) Asssociated contents of post-2012 MRV framework whether only technical issues will be considered,

(iii) Coverage range of a reporting including its mechanism, and

(iv) Required institutions at international and national levels which integrate MRV standards when coordinating the implementation of NAMAs.

It should be kept in mind that MRV guidelines will be developed under the Convention, as stated in COP 16 Decision 1/CP.16:

> "affirming that internationally supported mitigation actions will be measured, reported and verified domestically and will be subject to international measurement, reporting and verification in accordance with guidelines to be developed under the Convention, and that domestically supported mitigation actions will be measured, reported and verified domestically in accordance with general guidelines to be developed under the Convention." (FCCC/CP/2010/7/Add.1/paragraph 61 and 62)

For certain NAMAs it may be difficult or impossible to actually monitor GHG emission reductions, especially when activities only lead to indirect GHG effects (e.g., capacity building, enhancing readiness for developing NAMAs). In this case, the focus of MRV will rather be on indirect outcomes than on direct GHG emission reductions.

An MRV system for Indonesia will need to be robust, credible (accountable), and transparent. In preparating an MRV system, at least 5 key elements will need to be elaborated on further, on a national level:
(i) possible coverage for MRV and its required mechanism (i.e., the scope),
(ii) identification of required (modelling) tools,
(iii) required national processes and respective linkages to the UNFCCC guidance,
(iv) how to institutionalize the required national processes, and
(v) assignment of job desks for related institutions.

II.4 NAMA REGISTRY AND REPORTING ON NAMAs

As an outcome of the Cancun climate negotiations, a registry will be set-up to record NAMAs seeking international support, and to facilitate the matching of finance to support needs. Supported NAMAs might need to submitted information such as estimated costs, esimtated GHG emission reductions, and anticipated time frame for implementation. But this is yet unclear. Developed country Parties are invited to submit to the UNFCCC Secretariat information on support (available and provided) for NAMAs. The Secretariat will record and regularly update this information on NAMAs seeking international support, availability of support, and support provided. Furthermore, the Secretariat will record in a separate section of the registry (FCCC/CP/2010/7/Add.1):
(i) NAMAs to be implemented by Non-Annex I Parties as already communicated and contained in the document FCCC/AWGLCA/2011/INF.1,
(ii) Additional NAMAs submitted in association with voluntarily NAMAs (as stipulated in paragraph 50), and
(iii) Internationally supported mitigation actions and its associated support.

ENHANCED REPORTING TO THE UNFCCC

The COP decides to enhance reporting of national communications (and inventories) from Non-Annex I Parties on mitigation actions and their effects, and support received. On this point, some flexibility will be given to the least developed country parties and small island developing states (FCCC/CP/2010/7/Add.1).

Non-Annex I Parties should submit their national communications to the COP every four years. Every two years, a biennial update report, containing updates of national GHG inventories including a national inventory report and information on mitigation actions, needs and support received should also be submitted by developing countries.

On MRV, COP decides that internationally supported NAMAs will be subject to international MRV in accordance with guidelines to be developed under the Convention, and domestically supported mitigation actions will be subject to domestic MRV in accordance with general guidelines to be developed under the Convention (FCCC/CP/2010/7/Add.1).

As part of the Cancun Agreements, a process for International Consultations and Analysis (ICA) of biennial reports would be conducted under the UNFCCC Subsidiary Body on Implementation (SBI), with the aim to increase transparency of NAMAs through analysis by technical experts in consultation with the Party concerned. Through a facilitative sharing of views, which might result in a summary report including the national GHG inventory report, information on NAMAs, analysis of the impacts and associated methodologies and assumptions, progress in implementation and information on domestic MRV and support received (FCCC/CP/2010/7/Add.1/paragraphs 60 and 64).

The key tasks of national communication (reporting – inventories), biennial update report, MRV and international consultations & analysis are shown by Table II.2.

Table II.1

Cancun Outcomes: The Associated Key Tasks of NatCom, Biennial Update Report, MRV and ICA

NATIONAL COMMUNICATIONS (REPORTING - INVENTORIES)
Non-Annex I Parties - Developing Country Parties
Key Tasks: NatCom Every 4 Years and Biennial Update Reports
• Enhance Reporting in National Communications, including Inventories, from Parties not included in Annex I to the Convention (non-Annex I Parties) on (i) Mitigation Actions and their Effects, and (ii) Support Received; with additional flexibility to be given to the Least Developed Country (LDC) Parties and Small Island Developing States (SIDS): a) The Content and Frequency of National Communications from non-Annex I Parties will not be more onerous than that for Parties included in Annex I to the Convention. b) Non-Annex I Parties should submit their National Communications to the Conference of the Parties, in accordance with article 12, paragraph 1, of the Convention every 4 years or in accordance with any further decisions on frequency by the Conference of the Parties taking into account a differentiated timetable and the prompt provision of financial resources to cover the agreed full costs incurred by non-Annex I Parties in preparing their National Communications. c) Developing countries, consistent with their capabilities and the level of support provided for reporting, should also submit: (i) Biennial update reports, containing: updates of national ghg inventories including a national inventory report, and (ii) Information on Mitigation Actions, Needs and Support Received.
MRV - INTERNATIONAL CONSULTATIONS AND ANALYSIS
Developing Country Parties
Domestically Supported Mitigation Actions - Internationally Supported Mitigation Actions
• Internationally Supported Mitigation Actions will be Measured, Reported and Verified (MRV) domestically and will be subject to International Measurement, Reporting and Verification in accordance with Guidelines to be developed under the Convention. • Domestically Supported Mitigation Actions will be Measured, Reported and Verified (MRV) Domestically in accordance with General Guidelines to be developed under the Convention. • Conduct a process for International Consultations and Analysis of biennial reports in the SBI, in a manner that is non-intrusive, non-punitive and respectful of national sovereignty; the International Consultations and Analysis aim to increase transparency of mitigation actions and their effects, through analysis by technical experts in consultation with the Party concerned, and through a facilitative sharing of views, and will result in a summary report. • The information considered should include the National GHG Inventory Report, information on (i) Mitigation Actions, including a Description, Analysis of the Impacts and Associated Methodologies and Assumptions, (ii) Progress in Implementation and Information on Domestic Measurement, Reporting and Verification, and (iii) Support Received; Discussion about the appropriateness of such domestic policies and measures is not part of the process; Discussions should be intended to provide transparency on information related to unsupported actions.

Source: FCCC/CP/2010/7/Add.1

II.5 NAMAs AS POLICY INTERVENTIONS

To support mitigation actions, a variety of policies, measures and instruments are available. These include regulations and standards, taxes and charges, tradable permits, voluntary agreements, information instruments, subsidies and incentives, research and development. The effectiveness climate policies will depend on national and sectoral circumstances, their designs, interactions and the ways of implementation. The integration of climate change into national and sectoral development policies is therefore of prime importance to the success of climate change mitigation. Without detailed knowledge of the context, it is difficult to develop an effective NAMA.

Low-carbon development planning to deliver on mitigation ambitions should therefore not only to take into account the priorities of each sector on its own, but also consider broader criteria including human wellbeing, productivity and the sustainability of natural services. Although this approach goes beyond Indonesia's commitment under the Convention, it is nonetheless an opportunity to strategically pursue national development and mitigation priorities.

CLIMATE CHANGE IN DEVELOPMENT DECISIONS

Mainstreaming of climate change in development decisions is arguably needed to capture the full potential of NAMAs in achieving the 26-41% emission reduction. Single instruments are unlikely to be sufficient, and it is more likely that a portfolio of policies will be required. So when making projections of future emission pathways, it is important to assess a blend of policy approaches, and evaluate both short and longer-term emission reductions.

There is a growing understanding of possibilities for mitigation, and which approaches and instruments are most suitable for creating synergies and avoiding conflicts with other dimensions of sustainable development. As practised in other countries, climate change will need to be reframed as a "business chance" and an "innovation opportunity". The ideas being promoted as so-called win-win opportunities may benefit the industries and the climate alike, and result in both mitigation of climate change and increased competitiveness.

NAMAS AND CONCRETE POLICY INSTRUMENTS

In general NAMAs may use a large spectrum of policy instruments of emission reduction that have been known and reported as:

- General economic and fiscal policies, such as carbon tax, abolishment of fossil fuel subsidies, emissions trading;
- Targeted economic and fiscal policies, such as subsidies for energy saving investments, feed-in tariffs for renewable energy technologies, or financial incentives,
- Standards, such as vehicle energy consumption, building codes & certification, appliance standards and labelling for energy efficiency,
- Information, know-how transfer and education such as public awareness campaigns, energy analyses (audits), demonstration and training activities, and
- Research and development of new low-carbon technologies that are more appropriate to face the issue of climate change and that need to be assessed at national level to evaluate its applicability prior to its implementation phase.

Some of these proposed policy instruments are being implemented - examples include carbon taxes in Norway and feed-in tariffs in Germany. In Indonesia, building codes and certification, appliance standards and labelling are introduced to promote greater energy efficiency and conservation (GoI, 2009).

II.6 BASELINE SCENARIO

In order to assess the impact of a mitigation action, one needs to consider what would have happened without the action. A so-called baseline scenario provides a reference against which the impact of the mitigation effort is measured. Therefore, understanding the baseline scenario is of paramount importance in developing NAMAs. The emission reductions of the NAMA are, simply put, the difference between the emissoins under the baseline and the actual emissions. In the context of addressing climate change mitigation, a baseline could be interpreted as:

- A non-intervention scenario.
- A scenario that considers the likely future evolution of activities and developments.
- A scenario that, based on long-term simulation, considers uncertainties related to the system and its key constraints.

In a more compact way, a baseline scenario can be defined as "a scenario that is a plausible and consistent description of how a system might evolve into the future in the absence of explicit new GHG mitigation policies" (UNFCCC 2008).

For establishing baselines as part of the National Communications, guidance provided by the UNFCCC states that for baseline projections, "the possible evolution of activities that affect GHG sources and sinks should be considered, including consideration of: (i) Macroeconomic and demographic trends, (ii) Structural shifts in the economy, (iii) Projections of the main GHG emitting activities and sinks, and (iv) The evolution of technologies and practices, including saturation effects and the likely adoption of efficient technologies that affect GHG emissions." (UNFCCC 2008).

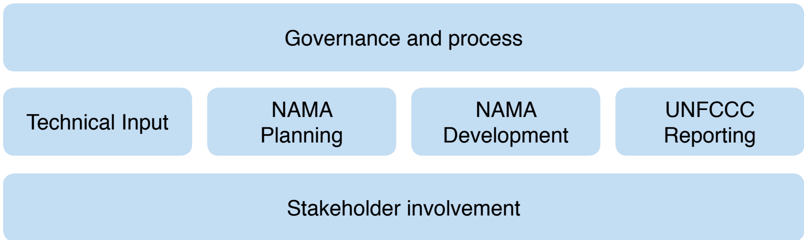
In establishment of a national business as usual (BAU) baseline, data availability is a key consideration. As the economy is made up of various sectors and sub-sectors, with multiple layers of complexity (e.g. with a power system), there is a good case to be made to construct the national baseline bottom-up through the aggregation of sectoral data through intermediate, or sectoral baselines. This process would require all sectors to make projections for the coming decades, which are then combined into a national reference projection. The associated required tasks are described in some detail in Section III.3 and in part V on respective sectors.

III. Proposed NAMAs Framework

INTRODUCTION

The Government of Indonesia (GoI) intends to achieve its national greenhouse gas emission reduction target through the implementation of NAMAs. Because of the magnitude of the abition and its close links to development (co)benefits, it makes sense to integrate climate considerations into development planning. NAMAs cover many sectors and sub-sectors, line-ministries and implementation is likely to require action on different levels of governance (i.e. national, regional, provincial). To provide consistency and prevent contradictions, it is therefore useful to have a clear NAMA framework that is accepted by all government and non-government stakeholders. Such a framework could provide guidance, but at the same time allow for enough flexibility to accommodate the different (and often unique) situations.

Figure III.1
NAMA Framework



The logical framework for developing and implementing NAMAs includes the following building blocks: (i) governance and process, (ii) technical aspects, e.g. GHG emissions estimation; (iii) NAMA planning activities, including identification and prioritisation of potential actions, (iv) NAMA development where policies, measures and instruments are designed and implemented; (v) required national processes and linkages to the UNFCCC procedures & mechanisms, etc. (iv) coordination and dialogue of relevant stakeholders; and Figure III.1 schematically combines these elements into a 'NAMA framework'.

Within the NAMA Framework, GoI can identify which policies and measures are most appropriate, and evaluate what the associated impacts and risks will be for environment, livelihoods and the economy. As part of the planning within the framework, analyses may include long-term emission pathways, adequate modeling and collection of robust data, and an inquiry into required governance structures at national, local and sectoral levels.

To ensure a full and sustainable implementation of NAMAs, strong ownership by government must be ensured. This requires improved communication and cooperation among different ministries, departments and agencies across all levels of governance. One way to address this challenge of coordination and integration, is to establish a central government institution in charge of coordinating communication, processes and implementation of national mitigation actions (see below).

In addition to the national goals, a coordinated approach to developing and implementing NAMAs increases Indonesia's credibility internationally, and may help to capture international support and/or revenues from crediting schemes. Moreover, a framework can contribute to improving the credibility and standing of sectors or companies within the nation, region, and globally.

The remained of this section presents various considerations for the detailing of the NAMAs framework.

III.1 GOVERNANCE AND PROCESS

As discussed in section II, development and implementation of NAMAs may involve mutliple sectors and parts of government, and the impacts of NAMAs may not be limited to GHG mitigation alone. NAMA planning therefore requires an approach that is based on integration and coordination. Mitigation effort is no longer delegated to just one ministry or just a few institution but to the whole cabinet or the entire administration. Incorporating mitigation policy more deeply into policy strategies is important in order to ensure that it is extended more fully to specific policy instruments (Mickwitz et al. 2009). To establish this integration and coordination function, there is either a need for the creation of new institution, or for strengthening and reframing the existing national development institution(s). Tasks for these institutions include:

- General guidance to the NAMA development process
- Ensure the alignment of NAMAs with national development priorities
- Facilitate mainstreaming of mitigation into all stages of policy making
- Collect and aggregate information on mitigation actions, and
- Reflection on progress and adjusting to new circumstances

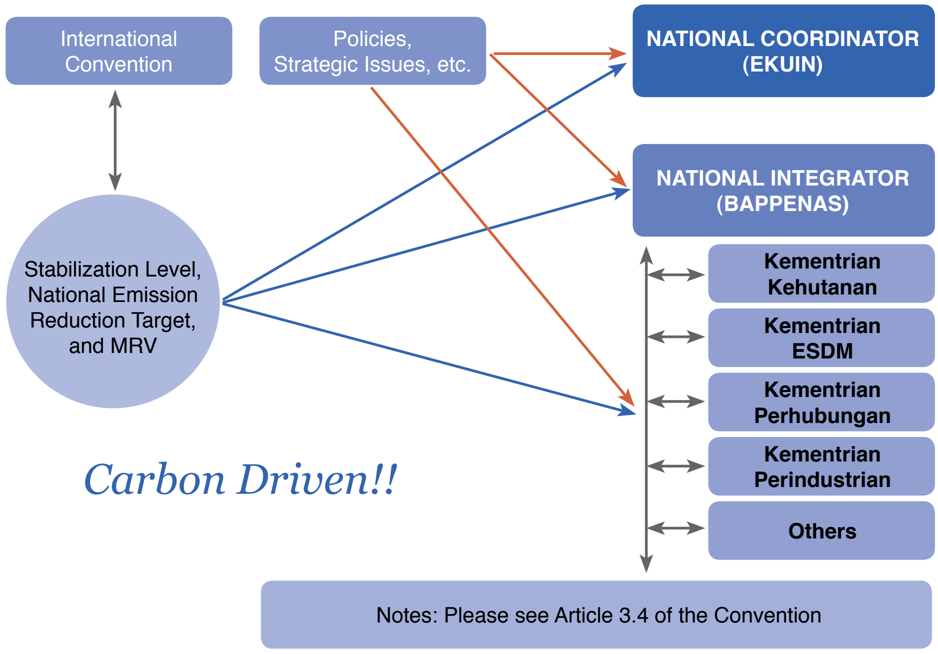
As mentioned, NAMA development involves many stakeholders, each with their own role and responsibilities. Their actions, with the aim of developing NAMAs, form the nationally integrated processes. They get guidance from the integrator and coordinator.

Consistent with the national integrated processes[3], the National Development Planning Agency (BAPPENAS) may act as a national Integrator, and the Economic Coordinating Ministry as a national Coordinator. The institution in change of national development planning is a logical candidate, since climate change policies and measures should ideally be integrated with national development programmes as stipulated in the Convention, article 3, paragraph 4.

[3] National integrated processes describe the coordinated interactions among (government) stakeholders to achieve a common policy goal, such as reaching the national GHG mitigation

Figure III.2

National Development Plannng Agency (BAPPENAS) as an Integrator



(own elaboration)

In Indonesia, the National Development Plannng Agency (BAPPENAS) could act as integrator (see Figure III.2). Based on cost effectiveness and the previous described implementability level features, BAPPENAS might establish a national priority list and aggregated potential mitigation actions to establish NAMAs in meeting the national emission reduction target. Tasks for the integrator include:

- Setting medium and long-term goals;
- Constructing a national BAU baseline based on an aggregated sector data, and analysing trajectories for national emission reduction;
- Identifying potential mitigation actions, and their aggregate mitigation potential;
- Establishment of carbon budgets for each sector;
- Assessing investment and mitigation costs, system abatement costs, financing and support requirements, and lead time for implementation and impact;
- Provide assistance with design and implementation of policies, measures and instruments.

Due to the wide scope of mitigation actions, and the specific knowledge required to make assessments on concrete actions, it is advisable that these tasks are conducted with the support of sectoral working groups consisting of related ministries, state owned enterprises, associations and prominent experts/specialists. Figure III.3 shows how a working group structure could work, using the example of the energy sector.

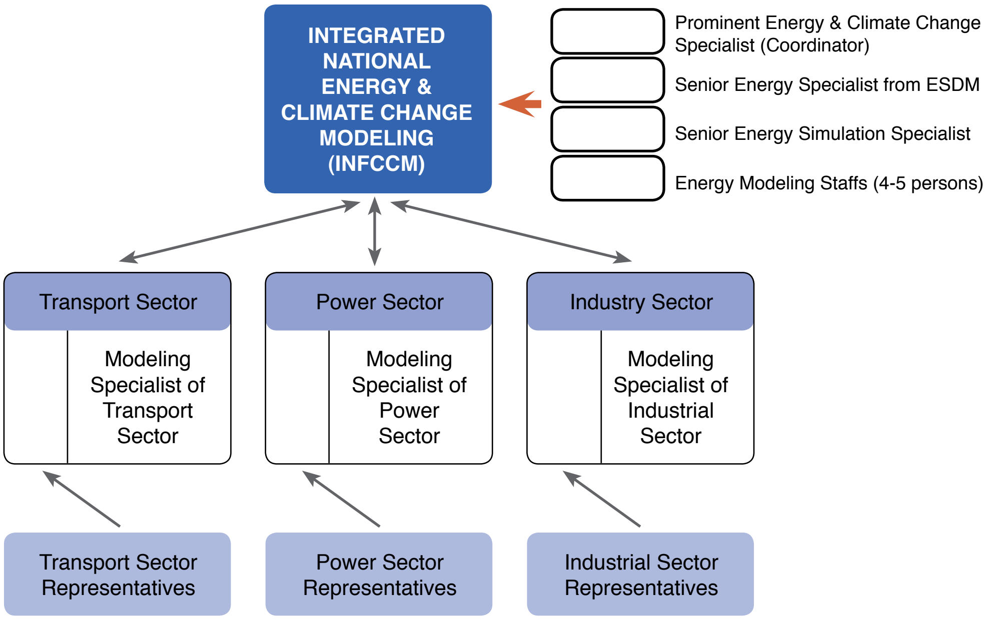


Figure III.3
Proposed Energy Working Group, Structure & Composition

(own elaboration)

III.2 TECHNICAL INPUT

Techincal input is a key building block of the NAMA Framework, as it directly influences the information on which decisions are made. Technical input includes data collection and analysis, providing input for the construction of a BAU baseline, knowledge on the state of technologies, and analyses of policy interventions. In this section, the emphasis is on providing input for a BAU baseline.

ESTABLISHING A BASELINE

When mitigation ambitions are formulated as target, as is the case in Indonesia (26% and 41% reduction in 2020), the establishment of a baseline against which the targets are measured is needed. Such a baseline is a projection of future emissions, and strongly builds on technical input. Note however, that although technical input is the single most important ingredient for establishing a baseline, there is some room for policy makers to influence the level at which the baseline is set. The outcome of the projections is, for example, dependent on the expectations around the impact of current and future policy, and on assumptions regarding population and economic growth.

Hence, an evaluation of the performance of the (non)intervention scenarios is a key step in establishing a baseline. As mentioned previously, the associated emission reduction is the difference between the BAU baseline and actual performance of the intervention. The evaluation of interventions should therefore be established as a main part of the proposed national integrated process. This is a good example of a component where technical experts and policymakers work together directly, using technical input to support NAMA planning.

Factors that might need to be incorporated in the establishment of the BAU baseline scenario are:

1. Scenario projections without climate policy, and on continuation of current policy,
2. Market features and trends,
3. Uncertainties,
4. Evolution of supply and demand,
5. Cost effectiveness, and
6. Expected performance of the system.

Independent of the scenario, there will be uncertainty in quantifying the BAU baseline projection. This is an inevitable consequence of future uncertainty, driven by factors such as trends in technology/process/fuel, plant age/replacement life, demand growth, etc.

BOTTOM-UP AGGREGATION OF SECTORAL DATA

A national overview of emissions, such as needed for the construction of a BAU baseline, can be established by first constructing an aggregate baseline for each sector, and then combine these into a national BAU baseline (or: aggregated BAU).

The reasons for choosing a bottom-up approach to establish an aggregated BAU baseline, is that it is best able to access required detailed knowledge per sector. Each sector possibly can comprise of: (i) sub-sectors, like in industry sector, or (ii) many sub-national levels in accordance with national circumstances, like with REDD+, or (iii) many interconnected and isolated systems, like in the power sector. The bottom-up approach has several advantages over a top-down approach:

- Reflects more the imbedded system conditions at national and sub-national levels that have specific sectoral conditions and dynamics,
- Better able to deal with differences in existing policy instruments at sectoral levels,
- More focused on available technologies and their expected development.

A top-down approach is a suitable starting point for studying processes within the economy (sources of emissions) on the basis of observed historical characteristic. For sectoral analyses however, the top-down approach has serious limitations and possible deviations from reality can occur due to data inconsistencies when (top-down) making assumptions on sub-sectors, or at sub-national levels. Another possible approach is a combination of bottom-up and top-down approaches in which some sectors at a national level apply top-down approaches to establish its aggregated BAU baseline. As mentioned above, this hybrid approach can still give rise to possible discrepancies.

As part of the MRV of NAMAs, actual performance of the actions needs to be measured – arguably on a detailed level (i.e. per sub sector, or even per action). It is advisable to use the bottom-up approach for assessing aggregate performance, even though initially more coordination and preparation efforts are required (such as to provide associated complete data that will be further described in each of the sector parts).

STEPWISE CONSTRUCTION OF A BASELINE

For the bottom-up approach as described by Figure III.4, three layers can be identified at which data is collected and processed:

1. 3rd Layer: The highest level of detail. The main task is the establishment of a BAU baseline for each sub-sector. In the power sector, for example, a BAU baseline can be constructed by summing up in absolute value the baselines of each of the interconnected power systems (including each isolated system). Required integrated processes in the Industry sector, for example, need to include the sub-sectors, cement, pulp and paper, iron and steel, and textile.
2. 2nd Layer: The middle layer. The main task is the establishment of an aggregated BAU baseline per main sector. Under these processes, for example, the aggregated BAU baseline of energy sector is constructed by summing up in absolute value of each aggregated BAU baseline of power, industry and transport sectors.
3. 1st Layer: The highest level of aggregation. The main task is the establishment of the national BAU baseline/aggregated BAU baseline. Under these processes, the national BAU baseline is established by summing up emissions of each sector BAU baseline, creating a consistent overall long-term CO_2 emissions pathway.

These three steps might be applied in the same time frame over the next two or three decades (or at least up to 2020).

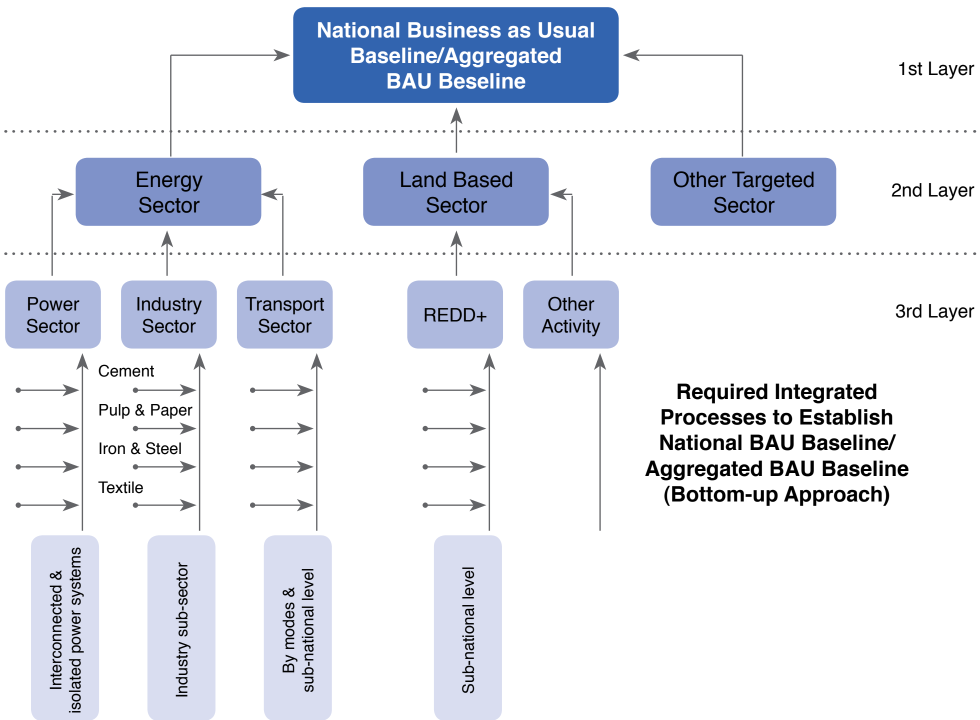


Figure III.4
Required Processes to Establish National Business as Usual Baseline/Aggregated Business as Usual Baseline

(own elaboration)

The national integrated process to establish a national BAU baseline (distributed over the three layers above) has a clear flow, is predictable and convergent. This reflects the application of the bottom-up approach. Detailing of the different steps in constructing a baseline can take place at a (sub)sectoral level. Especially in Layer 3 quite some variation is expected, as the most effective way to collect and process data strongly depends on the (sub)sector.

NATIONAL CARBON BUDGETS

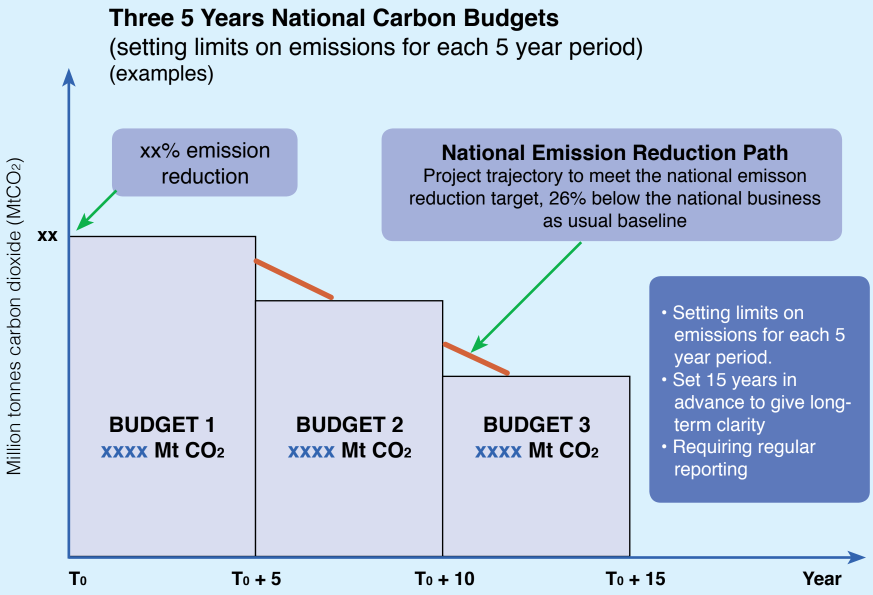
In developing Indonesia's mitigation actions, a mechanism to manage mitigation actions is required: both for setting priorities, and for evaluating progress in meeting the national emission reduction target. Moreover, NAMAs should be monitored and reported on a regular base in any case.

National carbon budgets, where each sector is assigned a share of the overall emission reduction ambition, could provide the mechanism to manage these requirements. After having established aggregated mitigation ambitions, the national carbon budget as well as sectoral carbon budgets can be established – the actual selection of potential mitigation actions could then be conducted in a way that allows sector development planners to choose the right action according to cost effectiveness and feasibility.

This national carbon budget can guide and inform the planning sectoral and planning efforts in setting the limit of the total amount of GHGs that can be allowed to be put into the atmosphere at a particular time period. For instance, as shown by Figure III.5, the three 5 years national carbon budgets describe the projected trajectory to meet the national emission reduction target which is 26% below the national business as usual baseline.

Carbon budgets allow for a less centralised approach to prioritizing and selecting NAMAs, while keeping an overview of progress towards the aggregate ambition.

Figure III.5
National Carbon Budget



(own elaboration)

III.3 NAMA PLANNING

As described by Figure III.6, national integrated processes (the collective and coordinated interactions of all stakeholders to further NAMAs) consist at least of six main tasks[4]:

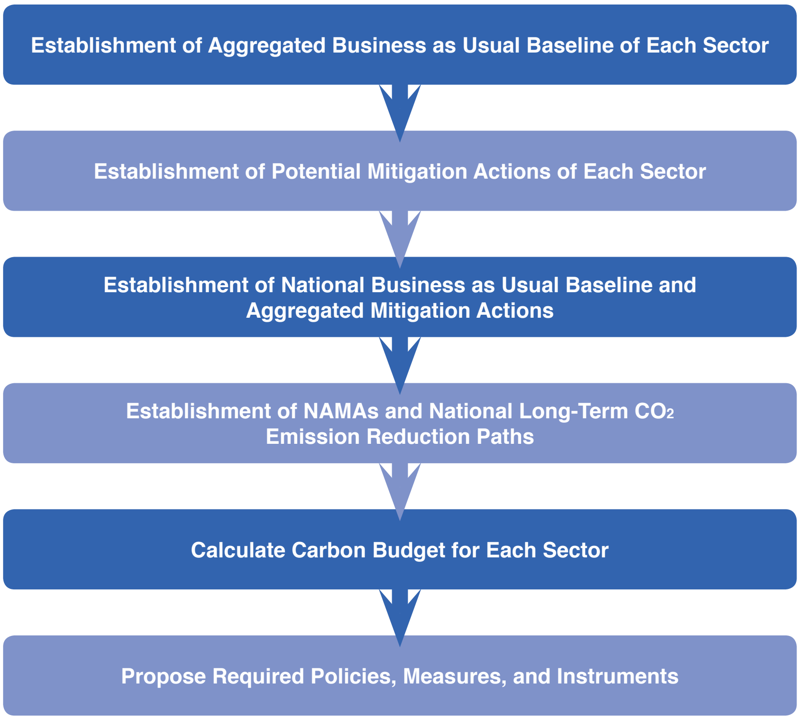


Figure III.6
Main Taks of National Integrated Processes

(own elaboration)

1. The establishment of an aggregated BAU baseline for each sector, which estimates its long-term GHG emissions path on year-to-year basis.
2. The establishment of potential mitigation actions for each sector, and provide a long-term CO_2 emission reduction scenario of each potential mitigation action, and its long-term CO_2 emissions reduction path on a yearly basis, sequentially rank it according to the agreed time frame.
3. The establishment of a national BAU baseline (aggregated BAU baseline), and aggregated mitigation actions which are passed through the national integrated processes: (a) national BAU baseline is established by summing up in absolute value of each aggregated business as usual baseline of each sector and its long-term CO_2 emissions path, (b) selection of potential mitigation actions of each sector. This selection involves merging and ranking processes that consider cost effectiveness and implementability level, and construction of associated long-term emission reduction path. The aggregated emission reduction path illustrates CO_2 savings from the various potential mitigation actions in total (accumulated) and on a yearly basis,
4. The establishment of NAMAs and national long-term CO_2 emission reduction paths in meeting the national emission reduction target; select from aggregated mitigation actions those to be put under the categories of domestically supported mitigation actions (unilateral NAMAs) and internationally supported mitigation actions (supported

[4] All tasks need to consider the same time frame over the next decades at least until 2020.

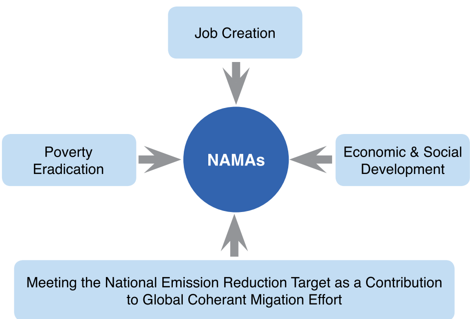
NAMAs) according to its CO_2 emission reduction path level, and construct a national emission reduction path; further propose from the remaining aggregated mitigation actions which are not selected under the above NAMAs categories those to be put under credited NAMAs (see also 'further considerations' below),

5. Calculate carbon budget for each sector, and further provide important information on (a) emissions reduction levels, (b) investment/mitigation costs, (c) system abatement costs, (d) financing requirements for each NAMAs categories; and (e) time frame for implementation.
6. Propose required policies, measures and instruments.

PRIORITIZING NAMAs

It has been reaffirmed in the Cancun Agreements that "social and economic development and poverty eradication are the first and overriding priorities of developing country Parties, and that the share of global emissions originating in developing countries will grow to meet their social and development needs". This provision contains important elements that need to be taken into consideration in the establishment of national mitigation actions[5].

Figure III.7
4 Pillars for potential mitigation actions



(own elaboration)

As shown by Figure III.7, based on the above understanding and in accordance with article 4, paragraph 7, of the Convention, there are at least four pillars that need to be taken into consideration in the establishment of potential mitigation actions of each associated sectors, such as: (i) poverty eradication, (ii) job creation, (iii) sustainable economic growth and social development, and (iv) meeting the national emissions reduction target.

The UNFCCC Resource Guide Module 4 for developing National Communications, suggest that actions can be evaluated against more than just cost effectivenes: (i) consistency with national development goals, (ii) consistency with national environmental goals, (iii) data availability and quality, (iv) political and social feasibility, (v) replicability, e.g. adaptability to different geographical, socio-economic-cultural, legal, and regulatory settings, and (vi) macro-economic considerations, such as: the impact on GDP; the number of jobs created or lost; effects on inflation or interest rates; the implications for long-term development: sustainable economic growth & social development, and poverty eradication; foreign exchange and trade, etc.

Screening criteria should be consistent with the overall framing of proposed potential mitigation scenarios for each sector. Furthermore, the relative score on abatement costs and the other agreed criteria will determine the priority level of mitigation actions (national and per sector).

[5] This has been addressed in Indonesia under 2011 RPJM (Budget Execution Checklist) which are pro-growth, pro-jobs, pro-poor, and pro-environment, as stated by the President of Republic Indonesia on the 28th of December 2010.

The agreed criteria shall cover the four pillars above and some of the above proposed screening criteria shall be used to rank the implementability level of proposed potential mitigation actions of each sector in accordance with national and sub-national circumtances as shown by Figure III.8.

It should be noted that the above proposed screening criteria may vary among sectors, since imbedded system conditions of each sector at national and sub-national level may have own typical characteristics.

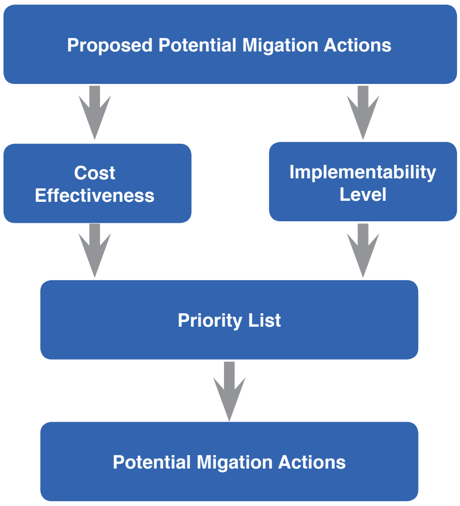


Figure III.8
Selection processes of proposed potential mitigation actions

(own elaboration)

NAMA CATEGORIES

Figure II.2 shows three types of NAMAs and the associated reduction relative to the baseline. The question is now, which mitigation actions will be chosen as unilateral NAMAs, and which mitigation actions require support (or can benefit from a future carbon market). As part of NAMA planning, the categories can be established as follows:

1. The first step is to establish a national BAU baseline (multi-sectoral, aggregated), identify mitigation actions, and construct mitigation scenarios.
2. The second step, is to classify mitigation actions into NAMAs categories: unilateral NAMAs which serve the national emission reduction target of 26%, or supported NAMAs that count towards the 41% below the national BAU baseline.
3. The third step is to identify which of the remaining mitigation actions (not selected under the two mentioned NAMAs categories) can be eligible as credited NAMAs.

FURTHER CONSIDERATIONS

In developing Indonesia's NAMAs, the National Integrated Processes should consider the following: (i) policies that require integration are not specific to climate change only, but are a general governance issue; (ii) embedded system conditions of each sector under national and sub-national levels circumtances may vary and have own characteristics, (iii) NAMA development has a cross-sectoral characteristic; (iv) The progress on meeting the target depends on the calculation of a national business as usual baseline; (v) NAMAs should be integrated into the national development programmes; (vi) NAMAs should be based on cost effectiveness and take into consideration feasibility, and (vii) linkages to UNFCCC mechanisms and procedures should be considered.

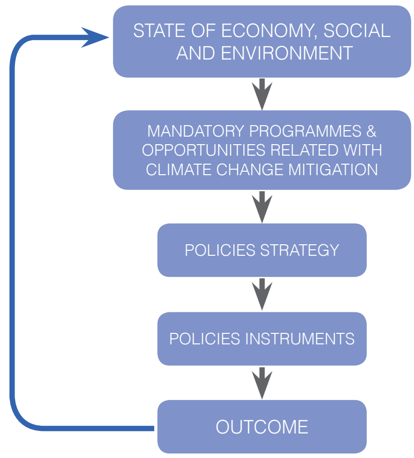
While this report can not clarify the borders between the three types of NAMAs, i.e., unilateral, supported and credited, in terms of exact legal and regulatory procedures in Indonesia, it can recommend to initiate a government led process in order to produce the specific legal documents, which are needed to translate the UNFCCC requirements for the three types of NAMAs into Indonesia specific guidelines for NAMA proponents and developers. This should address outstanding questions related to financing, MRV and potential split or combined implementation of the three types of NAMAs and might be produced upon adequate availability of information and maturity of the UNFCCC process.

III.4 NAMA DEVELOPMENT

POLICY INTEGRATION

Reducing emissions across all sectors requires a portfolio of policies, tailored to fit specific national/sub-national and sectoral circumstances and interests. Climate change goals (outcomes) are to be included into a wide variety of sectors.

Figure III.9
Flow of Climate Policy Integration



Development of climate policy should include the full integration into national, provincial and district levels as well as sectoral plans, budgetary frameworks and potential coordination mechanisms. Figure III.9 describes the logical flow of climate policy integration which constitutes the linkages of key elements to achieve a coherent action to meet the national emission reduction target.

According to the Convention article 3, paragraph 4, the “developing countries have a right to and should promote sustainable development”. Thus, the UNFCCC states that “policies and measures to protect the climate system against human-induced change should be appropriate for the specific conditions of each country and should be integrated with national development programmes, while taking into account that economic development is essential for adopting measures to address climate change” (UNFCCC 1992).

The question of consistency between climate objectives and other policy goals is rarely discussed in the development of national strategies. There is even a tendency to overlook inconsistencies between climate change issues and other issues, while potential synergies are highlighted. Too frequently, mitigation is seen in the context of just one level of governance or, if several levels are concerned they are viewed simply as a top-down control hierarchy. However, it is clear that mitigation concerns all levels from the local to the global level and that their interactions are complex and multidirectional.

Policy integration can be cross sectoral, or within and across government (see Figure III.10). Cross sectoral policy refers to measures and procedures to mainstream a comprehensive integration of climate change strategies, and the integration of climate change mitigation into public policies and regulations, and the annual national budget. Policy integration within and across government refers to the integration of climate policies into specific sectors by various (national sub-national) entities under the supervision of a ministry. It covers sector specific strategies and decisions made at ministerial level, as well as the integration of climate policy into strategies, measures and actions taken by sub-ministerial entities.

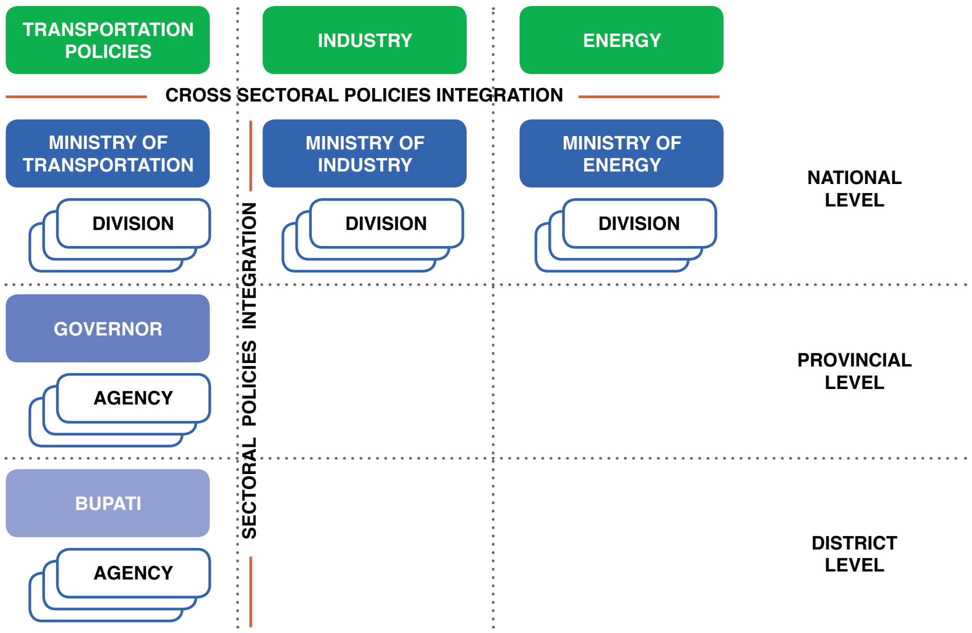


Figure III.10
Cross Sectoral and Sectoral Climate Policies Integration

Source: Mickwitz et al. 2009

After establishing the national BAU baseline, national aggregated mitigation actions of each sector can be derived and national carbon budget and sectoral carbon budget can be established in meeting national emission reduction targets (see Figure III.11).

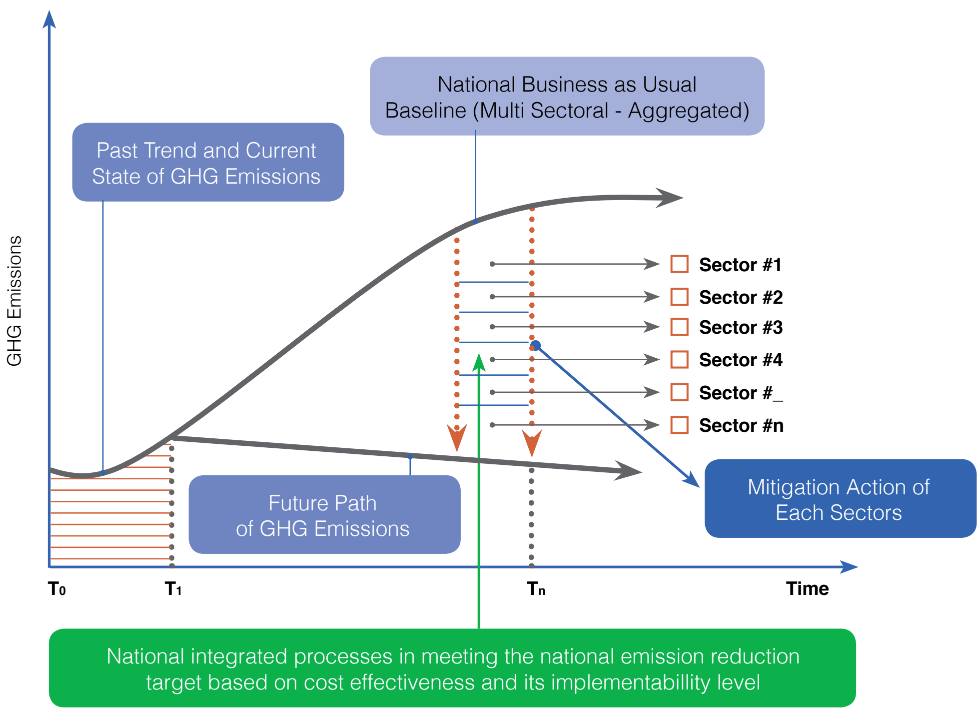


Figure III.11
National Aggregated Mitigation Actions of Multi Sectors

(own elaboration)

III.5 UNFCCC REPORTING

UNILATERAL AND SUPPORTED NAMAs

In order to realize the target of reducing the national emission in the amount of 26% below the national BAU baseline in 2020 Indonesia has to make several calculations and decisions. The resulting package of mitigation actions and the expected impacts can be summarized as illustrated by Table III.1. For unilateral NAMAs data will be recorded on the action, the sector, mitigation costs and potential, abatement costs and the timeframe. For supported NAMAs additional information might be needed such as required financing support, as shown by Table III.2.

As explained above, prioritisation and selection of supported NAMAs per sector are based on cost effectiveness and various criteria. A mitigation scenario is constructed by 'subtracting' all expected mitigation effects of the NAMAs from the sector or aggregate baseline. The list for unilateral NAMAs will consequently have to add up to 26%, and the list for supported NAMAs will have to cover the additional 15% (needed to reach 41%) deviation from the national business as usual baseline in 2020.

Tabel III.1

Proposed matrix for unilateral NAMAs. (Indonesia Case – 26% from BAU in 2020)

No	Sector	Mitigation Actions	Emission Reduction		Mitigation Cost	Abatement Cost	Time Frame	
			[Mt CO_2]	[%]	[US$]	[US$/T$CO_2$]	Required Completion Period [Year]	Operating Date
1	--aa--	---xxx---	xx,xxx,xx	-x-	x,xxx,xx	xx.xx	xx	---zz---
2	--bb--	---xxx---	xx,xxx,xx	-x-	x,xxx,xx	xx.xx	xx	---zz---
3	--aa--	---xxx---	xx,xxx,xx	-x-	x,xxx,xx	xx.xx	xx	---zz---
4	--cc--	---xxx---	xx,xxx,xx	-x-	x,xxx,xx	xx.xx	xx	---zz---
5	--aa--	---xxx---	xx,xxx,xx	-x-	x,xxx,xx	xx.xx	xx	---zz---
6	--dd--	---xxx---	xx,xxx,xx	-x-	x,xxx,xx	xx.xx	xx	---zz---
7	--ee--	---xxx---	xx,xxx,xx	-x-	x,xxx,xx	xx.xx	xx	---zz---
n-1	--bb--	---xxx---	xx,xxx,xx	-x-	x,xxx,xx	xx.xx	xx	---zz---
n	--aa--	---xxx---	xx,xxx,xx	-x-	x,xxx,xx	xx.xx	xx	---zz---
TOTAL			**xx,xxx,xx**	**-y-**	**x,xxx,xx**	**xx.xx**		

(own elaboration)

Whether the proposed supported actions actually be implemented will depend on the availability of financial support and associated support (under the UNFCCC). Therefore, the order in which the list of supported NAMAs is implemented, ultimately depends on for actions support is available.

No	Sector	Mitigation Actions	Emission Reduction		Mitigation Cost	Abatement Cost	Required Financing Support*	Time Frame	
			[Mt CO_2]	[%]	[US$]	[US$/T$CO_2$]	[US$]	Required Completion Period [Year]	Operating Date
1	--aa--	---xxx---	xx,xxx,xx	-x-	x,xxx,xx	xx.xx	x,xxx.xx	xx	---zz---
2	--bb--	---xxx---	xx,xxx,xx	-x-	x,xxx,xx	xx.xx	x,xxx.xx	xx	---zz---
3	--aa--	---xxx---	xx,xxx,xx	-x-	x,xxx,xx	xx.xx	x,xxx.xx	xx	---zz---
4	--cc--	---xxx---	xx,xxx,xx	-x-	x,xxx,xx	xx.xx	x,xxx.xx	xx	---zz---
5	--aa--	---xxx---	xx,xxx,xx	-x-	x,xxx,xx	xx.xx	x,xxx.xx	xx	---zz---
6	--dd--	---xxx---	xx,xxx,xx	-x-	x,xxx,xx	xx.xx	x,xxx.xx	xx	---zz---
7	--ee--	---xxx---	xx,xxx,xx	-x-	x,xxx,xx	xx.xx	x,xxx.xx	xx	---zz---
n-1	--bb--	---xxx---	xx,xxx,xx	-x-	x,xxx,xx	xx.xx	x,xxx.xx	xx	---zz---
n	--aa--	---xxx---	xx,xxx,xx	-x-	x,xxx,xx	xx.xx	x,xxx.xx	xx	---zz---
TOTAL			xx,xxx,xx	-y-	x,xxx,xx	xx.xx	x,xxx,xx		

Note:
1. 26% + -y-% = 41%, which is deviation from the baseline in 2020
2. *) Submit to the UNFCCC Secretariat (support by Developed Country Parties)

Tabel III.2
Proposed Matrix fot Internationally Supported NAMAs (Indonesia Case – reduction up to 41% from BAU in 2020)

(own elaboration)

FROM NATIONAL LEVEL TO UNFCCC REPORTING

The mechanisms to facilitate NAMAs under the Convention (such as a registry and matching process) are not yet available. Although not operational yet, the 2010 Cancun Agreements established a NAMA registry as: “a registry would be set-up to record NAMAs seeking international support, and to facilitate matching of finance, technology and capacity-building to these actions” (FCCC/CP/2010/7/Add.1/paragraph 53).

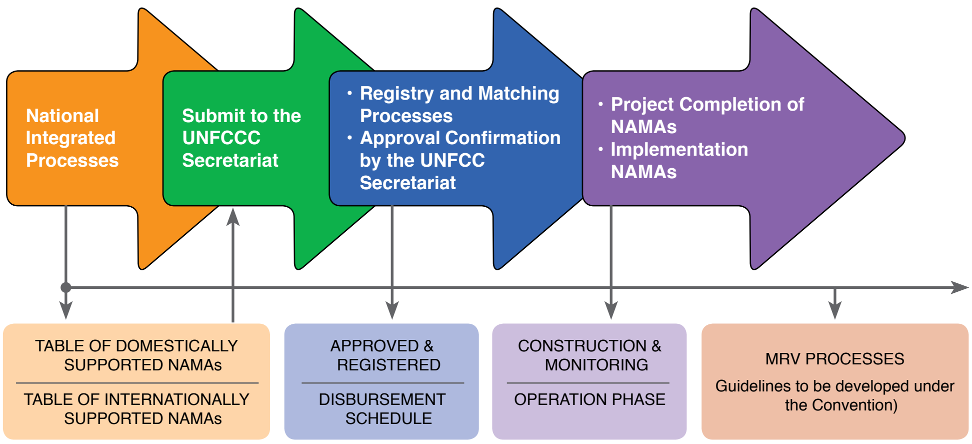


Figure III.12
Flow of required tasks for establishment of NAMAs Developing Country Parties

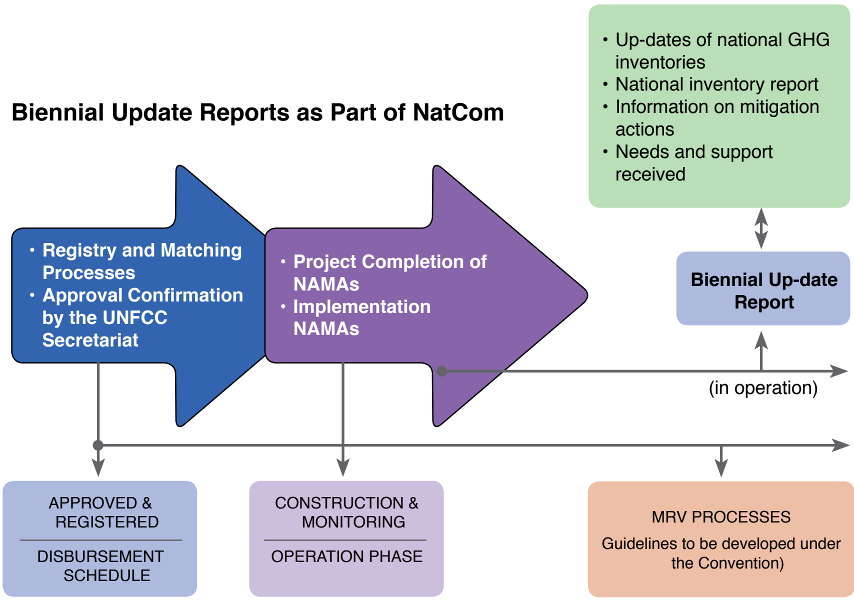
(own elaboration)

Parties may – in the future – need to submit their internationally supported NAMAs to the UNFCCC Secretariat, along with information on emission reduction, estimated mitigation costs, abatement cost, and required/realized level of (financing) support, and the anticipated time frame for implementation (such as lead time, life time and operating date).

The logical flow to establish this expected NAMAs reporting in developing countries, is (1) from national integrated processes to (2) the UNFCCC secretariat for (3) registry and matching process, and approval confirmation. When (4) the implementation starts, regular MRV reporting starts (as depicted in Figure III.13).

In accordance with Decision 1/CP.16, paragraph 60 (c), "biennial update reports containing updates of national GHG inventories including a national inventory report and information on mitigation actions, needs and support received should be submitted by developing countries, consistent with their capabilities and the level of support provided for reporting". Figure III.13 describes the linkages of the biennial reports as a part of the National Communication, and reporting on NAMAs already implemented (and for which emission level would be included).

Figure III.13
Linkages of biennial update reports with NAMAs



As mentioned in Chapter II, a process for International Consultations and Analysis (ICA) of biennial reports would be conducted under the Subsidiary Body for Implementation (SBI). This process may be done through: (i) analysis by technical experts in consultation with the Party concerned, and (ii) a facilitative sharing of views. The sequential process from biennial update reports to ICA is shown by Figure IV.14 that will result in a summary report. The contents of the summary report should include: (i) the national greenhouse gas inventory report, (ii) information on mitigation actions, including a description, analysis of the impacts and associated methodologies and assumptions, (iii) progress in implementation and information on domestic MRV, and (iv) support received.

To support developing countries in achieving the aims of the ICA, a guideline is required which provides and clarifies the scope of each key element of the content of the summary report, its level of detail, its proposed structure, and the reporting mechanism under the UNFCCC which needs to be established and endorsed further by the COP. Currently, such a guideline is not available.

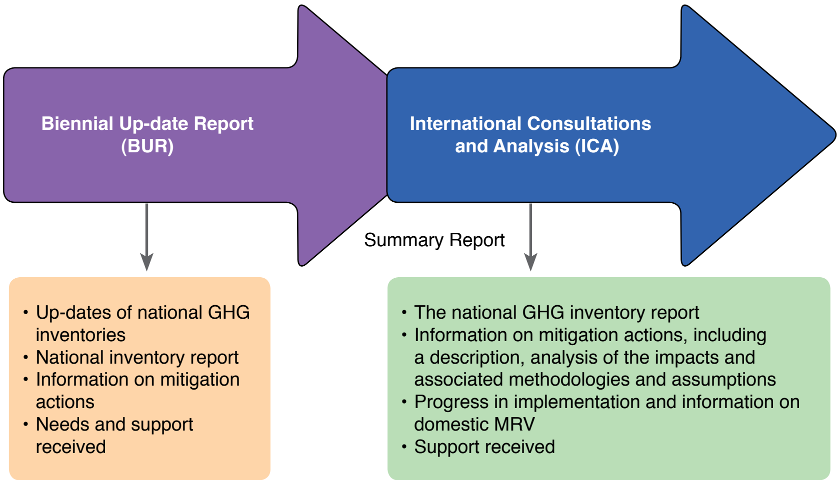


Figure III.14
The sequential process from biennial update reports to ICA

III.6 STAKEHOLDER INVOLVEMENT

This report suggests general principles on the one hand for combining a top down approach and a bottom up approch of developing and implementing NAMAs, and on the other hand integrating NAMAs as much as possible into the Indonesian system of development planning, including related legal and fiscal systems.

The appropriate involvement of stakeholders at all relevant levels and sectors is indespensable in order to assure ownership and strength of these processes.

Depending on the steps and parts of the process to develop and implement NAMAs, different stakeholders and actors are expected to play different roles and are involved to a different degree.

The role of BAPPENAS as the national integrator, as described in chapters III.3 (inter alia), will be major in identifying all relevant stakeholders, which in the early stages of NAMA conceptualization might involve the planning and structural bureaus of the line ministries and local government institutions as well as related institutions. BAPPENAS is expected to lead and coordinate the NAMA development process, which in terms of stakeholder involvement might mean to undertake intensive and regular consultation meetings about proposed concepts and strategies with related stakeholders, including private sector and civil society. This part of the NAMA development is expected to take a top down approach in the sense of providing a national framework and principles, in which sectors and local governments can develop NAMAs according to own development priorities.

A top down approach should not be mistaken for the exclusion of stakeholders, here it is understood as a coordination process to establish the national NAMA architecture by selected institutions with strong involvement of stakeholders, which could be differentiated according to which actor is regarded. Instead of providing a complete list, a few examples are the mentioned national ministries and institutions, including local governments as primary stakeholder during this stage of the process as well as the DNPI, national UNFCCC focal point, private sector (including state owned enterprises), NGOs and universities. The latter group of stakeholders could be regarded as secondary in this part of the NAMA process. Likewise, the bottom up approach does not imply stakeholder engagement without coordiation, but rather that sectoral and local government actors become primary stakeholders in the process.

Exact roles and responsibilities in the NAMA development and implementation process should be identyfied by the national NAMA coordinator and integrator in order to get the best results for the process in terms of substance, strategies, strength and ownership of the process.

IV. NAMA Development Per Sector

IV.1 ENERGY: INTEGRATED ASSESSMENT

IV.2 ENERGY: POWER SECTOR

IV.3 ENERGY: INDUSTRIAL SECTOR

IV.4 ENERGY: TRANSPORT SECTOR

IV.5 WASTE SECTOR

IV.6 LAND USE, LAND-USE CHANGE AND FORESTRY

This chapter provides initial guidance and input for sectoral NAMA development and implementation. It provides a detailed summary of each of the main sectors that contribute to Indonesian GHG emissions; namely power, industry, transport, waste and land-use, land-use change and forestry (LULUCF).

Each sector is structured similarly to:

i. introduce the key characteristics of that sector and the current outlook,
ii. describe the observed and anticipated trends in GHG emissions,
iii. introduce the concepts underpinning the estimation of a BAU baseline and a methodology to perform this task,
iv. propose a number of potential emission mitigation scenarios and actions and how their impact might be assessed,
v. list potential key indicators that could be used to gauge progress towards achieving any declared sectoral goals or possibly for MRV, and
vi. detail possible policies, measures and instruments that could be used to achieve the earlier described scenarios.

As energy use reaches across a number of sectors within the Indonesian economy, the energy system is first described more broadly in an opening section before each of the largest sectors – power, industry and transport – are treated in separate subsequent sections.

IV.1 ENERGY: INTEGRATED ASSESSMENT

The broad dimension of the energy system means that it plays a central role in achieving national sustainable development goals. The role of energy within sustainable development is to improve the energy system in Indonesia in relation to Accessibility, Availability, Acceptability and Accountability; the so-called four A's. This includes provision of sufficient, affordable and secure energy supply, promoting energy efficiency, promoting utilisation of low-carbon and renewable energy, and enhancing diffusion of low carbon energy technologies.

The long-term national energy plan must be able to answer the main challenges facing Indonesian society in achieving sustainable development in regard to energy – such as expansion of access to sufficient, secure and affordable supplies of energy – by taking into account the required energy infrastructure and environmental impacts associated with energy sector activities in maintaining economic growth and development.

A number of sectors exist within the broad heading of energy, including power generation, energy use in industrial processes and energy use for transport. Before going into detail on those individual sectors later in this chapter, this section introduces the Indonesian energy system and some of the challenges to integrate these different sectors into a coherent Indonesian energy plan that can be aligned with the NAMA framework.

BACKGROUND AND OUTLOOK

Indonesia's primary energy supply has grown steadily for the last five years, increasing from 1,166,488 thousand BOE in 2005 to 1,270,904 thousand BOE in 2009. Within this, coal consumption increased from 173,673 thousand BOE in 2005 to 231,351 thousand BOE in 2009 and natural gas grew from 191,189 thousand BOE in 2005 to 220,930 thousand BOE in 2009.

Based on the current trend of Indonesia energy use, as described in the National Energy Mix Target 2025, fossil fuels would remain the dominant source of energy; providing the largest share of Indonesia's energy supply. This has important implications for energy related GHG emissions that are discussed below, but hints at an opportunity to reduce the growth of fossil-energy demand in order to move towards a low-carbon development path in the Indonesian energy system.

GHG EMISSIONS TREND

Indonesia's emission profile shows that energy related CO2 emissions were 293.3 million tons in 2005 with average growth of around 6.6% per-year from 1990 to 2005 (Figure IV.1). The main contributors to those emissions, particularly in 2005, were power generation, industrial energy use and transportation.

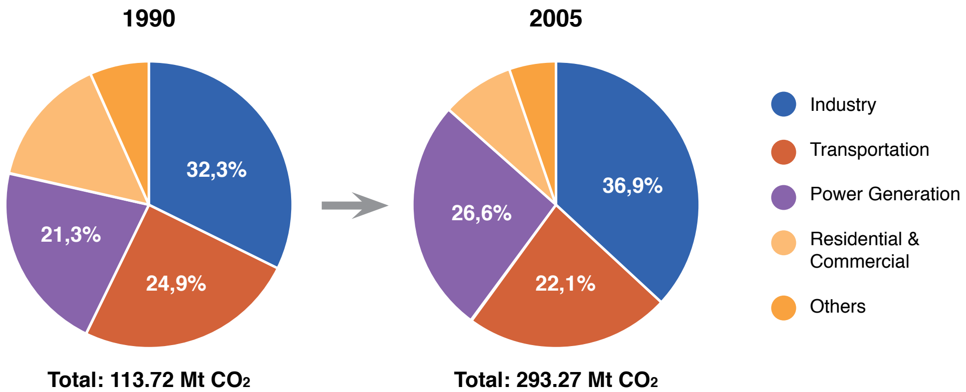
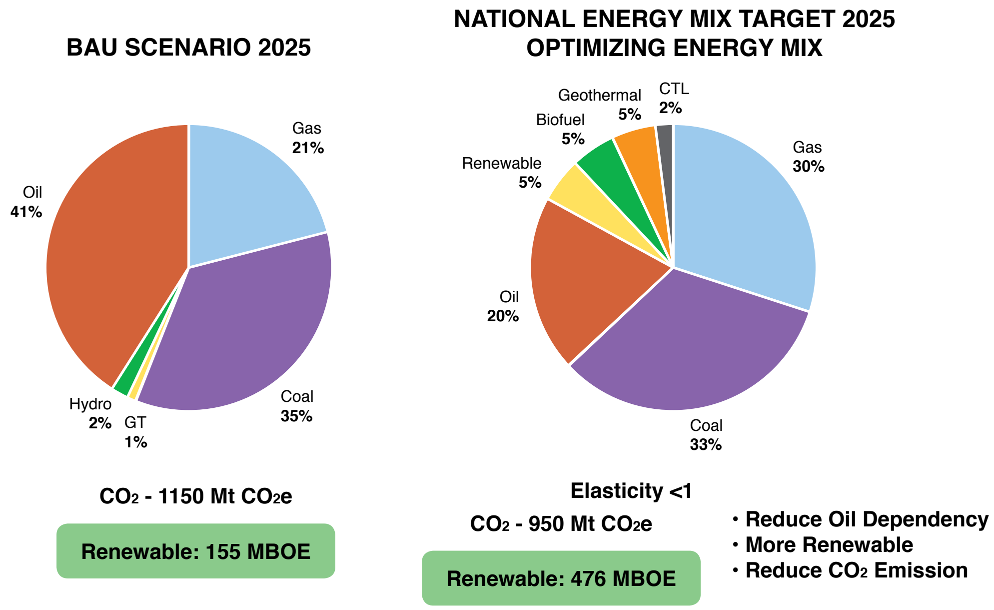


Figure IV.1
Energy related CO2 Emissions by sector in 1990 and 2005

Source: ESDM 2005

Emissions will continue to rise as Indonesia's population grows, increases its standard of living and, correspondingly, its demand for energy to support this economic growth. The BAU scenario of the national long-term energy simulation (Figure IV.2), indicates that energy related emissions could reach 1,150 Mt CO_{2eq} by 2025, an almost four-fold increase on 2005 levels. This anticipated trend suggests that a full range of mitigation approaches may be necessary if a significant portion of this emissions increase is to be avoided, including energy diversification and conservation programmes, as well as the use of low-carbon and carbon-free energy technologies.

Figure IV.2
Improvement of the National Energy Mix 2025



Source: ESDM 2010

The present national energy policy towards 2025 contains the following key elements:

1. Improving the national energy mix by reducing oil dependency
2. Increasing the role of renewable energy
3. Reduce the energy intensity of the Indonesian economy (ideally achieving an energy elasticity of less than one)

A scenario, that takes into account the above three initiatives, suggest that energy related GHG emissions in 2025 could be reduced to 950 million ton CO_{2eq} (Figure IV.2). However, this is still a significant increase on current levels, partly due to the inherent growth forecast within the economy and since low-carbon technologies are not considered to be widely deployed within this scenario in the 2025 timeframe.

Action on a number of fronts will be required to steer the national energy system onto a lower-carbon trajectory while supporting national economic growth and energy security. An improved energy mix will need to be achieved using alternative and low-carbon technology. Given this, technology improvements and knowledge transfer in the energy system become very important. Any energy technology development programme should be designed considering geographic position, population growth, economic growth, living pattern, standard of living and environmental impact along with other important aspects, which as a whole should be implemented within a framework of a long-term energy plan. In addition, the factor of social readiness will influence the willingness of energy consumers and suppliers to address climate change. Community readiness to change their pattern of energy consumption or methods of supply should be considered in energy policy design.

Modelling the emissions of the Indonesian energy sector is an important step in understanding possible levels of emissions in the future under BAU assumptions and different possible abatement scenarios. This understanding can, in turn, inform the design, implementation and/or revision of energy policy to achieve a certain future. An integrated model takes into account the contributions of the individual sectors within the energy system as well as their interactions with one another.

INTEGRATED MODELLING OF THE INDONESIAN ENERGY SYSTEM

Objective and Scope

This section outlines a proposed integrated modelling approach for the Indonesian energy system. The primary objectives of this integrated modelling are:

- To establish an aggregated BAU baseline for the energy sector in which long-term CO_2 emissions are estimated and a long-term CO_2 emissions trajectory, on a yearly basis, is determined.
- To establish aggregated mitigation actions for the Indonesian energy system which consist of potential mitigation actions for the power, industry and transport sector.
- To develop CO_2 mitigation scenarios for the aggregated potential mitigation actions along with the resulting impact on CO_2 emissions on a yearly basis.

There are many possible modelling approaches for estimating GHG mitigation within the energy system. Existing approaches can be broadly categorised into top-down or bottom-up approaches. As mentioned in the UNFCCC Resource Guide 2008, top-down models are most useful for studying broad macroeconomic and fiscal policies for mitigation, such as introducing a carbon value as an environmental instrument in the energy system or other environmental taxes within the economy as a whole.

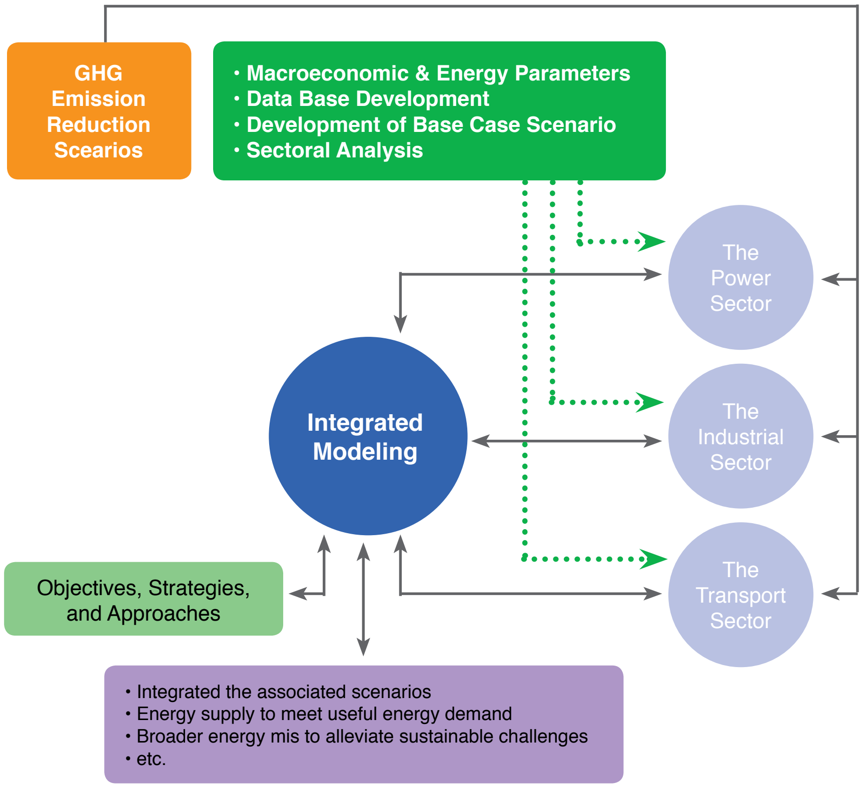
Bottom-up models are most useful for studying options that have specific sectoral and technological implications, and mostly physical indicators to reflect its potential mitigation actions. A form of bottom-up modelling is proposed for the integrated assessment of future emissions in Indonesia's energy system. As explained in the previous chapter, the bottom-up approach:

- reflects the imbedded system conditions at national and sub-national levels that influence specific sectoral conditions,
- reflects the utilization of energy resources at national or at sub-national levels,
- considers existing sectoral policies and instruments either at national or at sub-national levels, and
- focuses on available or emerging technology, including its characteristics and common practices.

The proposed bottom-up, scenario-based modelling can be used to integrate the power, industry and transport sectors – as the main sectors that constitute the energy system – to achieve these aspects above (Figure IV.3). In such a model, there are two levels of processes. The first level focuses on processes within each of the associated sectors (power, industry and transport sector), and the second level is dedicated to integrated processes.

Figure IV.3

Integrated Modelling of Energy Sector for mitigation assessments



(own elaboration)

Proposed tasks and processes

As mentioned above, there are 2 levels of processes imbedded in the integrated model. The following five steps are proposed under the first level, and it should be noted that each step should consider the same time frame with a minimum proposed horizon of 2020.

1. Definition of sector boundaries within the energy system in order to avoid overlap on the supply and demand side, as well as to avoid the possibility of double counting of GHG emission reductions when establishing aggregated potential mitigation actions,
2. The establishment of an BAU baseline for each sector; power, industry and transport. At this stage, particularly for the power sector, a mathematical model can be used to identify optimum configurations for each energy sector that minimise the total cost of its associated energy services. Later in this chapter, the specific power, industry and transport sector sections provide more detail on these long-term simulations.
3. Potential mitigation actions for each energy sub-sector are then based on the proposed scenarios of potential mitigation actions[6].
4. Potential CO_2 emission reduction scenarios for each energy sub-sector are determined from the above potential mitigation actions.
5. CO_2 emission reduction paths are determined for each emission reduction scenario within each energy sector sequentially according to a rank. The emission reduction should be provided both as an absolute value in total (over the period of the analysis) and on a yearly basis. To construct each CO_2 emissions reduction path,

[6] The proposed potential mitigation actions scenarios for each energy sub-sector are described in detail in each associated sub-chapter.

an assessment of the sectoral potential mitigation actions at different cost level is needed. This should also take into consideration its ability to be implemented through a ranking process. This ranking process is strongly recommended since the selection of NAMAs is largely based on cost effectiveness and their ability to be implemented.

The above steps should provide a number of important outputs, such as:

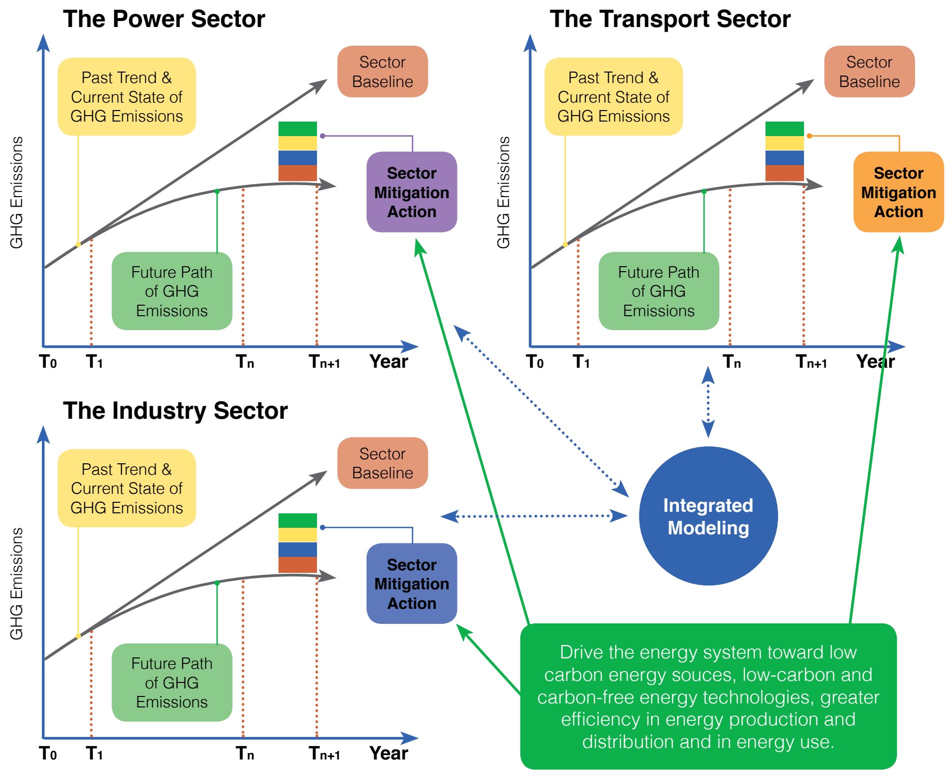
a) Energy-related features, such as total primary energy requirements, composition and energy intensities of each sector on a yearly basis,
b) Key associated cost features, such as total costs, investment costs, cost composition, fuel costs (by fuel type)in total and on a yearly basis. This cost information should be available for both the emission reduction scenarios and the BAU baseline assumptions.
c) Key CO_2 emission features, such as CO_2 projections: total and on a yearly basis, by fuel in absolute value (i.e. tonne CO_2), GHG intensities, (such as CO_2/unit production, CO_2/kWh, CO_2 per unit of equivalent primary energy use for each potential mitigation action), and BAU baseline scenarios for each sector, and
d) GHG emission reduction performance features: emission reductions in total and on a yearly basis, its determined rank and system abatement cost.

It is anticipated that at least four main additional steps are required at the second level of aggregated modelling as depicted in Figure IV.4):

1. Determine an aggregated BAU baseline for the Indonesian energy system,
2. Establish aggregated mitigation actions for the overall energy system – based on the potential mitigation actions of each energy sectors – to be used as a basis for the development of NAMAs,
3. Establish emission reduction scenarios for the overall energy system from the aggregated potential mitigation actions in step 2 above.
4. Construct a CO_2 emission reduction trajectory, or path, for each scenario , sequentially according to its rank, along with the associated total emission reductions as well as on a yearly basis.

Figure IV.4

Integrated Modelling of Energy Sector – Emission Reduction Scenarios



(own elaboration)

When establishing the aggregated BAU baseline of the energy sector, the total required primary energy supply and demand must achieve an equilibrium. In the instance where there is an imbalance, the modelling process must be iterated by adjusting prices and quantities (primary energy supply) in order to change the final configuration of the energy system.

POLICIES, MEASURES AND INSTRUMENTS

As noted earlier, an examination of Indonesia's energy mix for the next two decades shows that fossil fuels will remain the main energy driver to fulfil national energy demand growth. That said, there are opportunities to make changes within the energy mix in order to move Indonesia closer towards a low-carbon growth path. Key to this is the need to integrate new and improved programmes to decarbonise the energy system along with associated actions to preserve national energy security while supporting economic growth.

To establish a low-carbon energy path in the future, policies, measures and instruments are needed to align economic development with low carbon development in regard to the energy system. In particular they will need to provide the enabling framework to support the following key tasks:

1. Move the energy system towards using low carbon energy sources,
2. Develop and deploy low-carbon and carbon-free energy technologies,
3. Promote greater efficiency in energy production (supply side) and energy use (demand side),
4. Provide efficient transmission and distribution systems, and

5. Improve the associated policy and regulatory framework to attract greater private sector investment in the Indonesian energy system

Detailed assessments of the impact – both in regards to GHG mitigation and economic development – of implementing any proposed policies as well as their effectiveness will be required. To support the above key tasks a number of potential policies are proposed for each sector in the following sections of this chapter. However, it is acknowledged that their applicability depends on national and sector frameworks, national circumstances, their possible interactions at the national and/or international scale and whether the proposed policy instruments are in line with international frameworks to attract international support.

IV.2 ENERGY: POWER SECTOR

BACKGROUND

Electricity supply in Indonesia is mostly provided by the Indonesian state-owned Electricity Corporation – PT PLN (Persero). PLN's installed capacity makes up approximately 84% of the total installed capacity and the remaining part comes from a number of independent power producers (IPPs). The level of development of the different electricity systems (listed in Figure IV.5) across Indonesia vary greatly, from the mature Java-Bali power system, which is well interconnected, to small-scale isolated power systems scattered over many parts of the country.

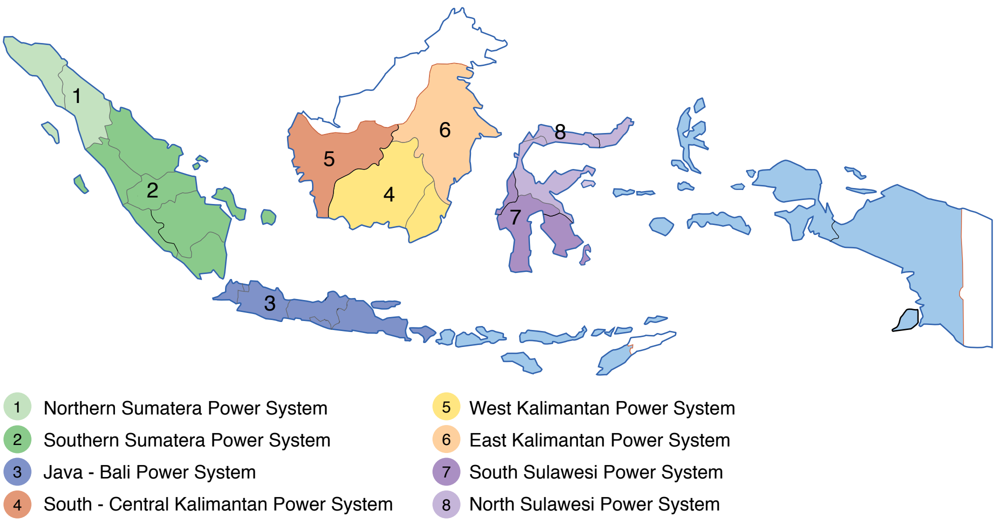


Figure IV.5
Indonesian Power Systems

PLN owns, operates, maintains and develops more than 600 isolated power systems and 7 interconnected power systems. These 7 interconnected power systems are located on 4 major islands namely, Java-Bali, Sumatera, Kalimantan and Sulawesi. The largest power system in Indonesia is the Java-Bali interconnected power system, which accounts for more than 77% of the total power production in the country. The second largest system is the Sumatera power system, which accounts for 13% of total power production. In line with the electrification ratio, only about 64% of the populations had access to electricity in 2009, which has been improved to about 67% in 2010.

In 2009 the total installed capacity in the Indonesian electricity sector was approximately 30.3 GW, of which the Java-Bali interconnected power system had an installed capacity of roughly 22.9 GW.

Within the Java-Bali system, steam coal power plants make up the largest share (34.4%) of the installed capacity and steam non-coal power plants make up another 4.9%. The second largest share of capacity (25.8%) comes from combined-cycle power plants. The installed share of open-cycle gas turbines and renewable power plants are about 10.3% and 15.8% respectively. Diesel power plants make up 8.9% of total installed capacity.

The growth of electricity demand in Indonesia is expected to remain strong in the medium to long-term future. Prior to the East Asian crisis of 1998, the demand growth had been very strong, in the range between 10% to 14% per year, and was only suppressed for one year in 1998. Soon afterward, the demand recovered rapidly and grew steadily at about 7% per year. It is believed that this growth could have been higher if there had been enough capacity available.

In recent times, a sharp decline of electricity demand has been observed since Q3 of 2008, especially in the high-voltage industrial sector, whilst the demand in business and residential sectors has been quite strong. However, it appears that this decline within the industrial sector has started to level out. Compensating this decline, PLN experienced an increase in demand for medium-voltage supply from commercial customers. A reported long waiting list of both residential and commercial customers in the last few years seems to make a convincing case that demand growth in Indonesia will be significant for at least the next ten years. Such an assertion is supported by an independent study (LPEM - Indonesia University) showing that in the future each 1% economic growth will need electricity consumption to grow by 1.5% to 2.0%. The average energy sales growth over the last 5 years has been about 6.1% (Table IV.1).

Table IV.1
5 Years Energy Sales 2005-2009

Region	2005	2006	2007	2008	2009	Average
Indonesia (TWh)	107.03	112.60	121.25	129.02	134.58	
Growth (%)	6.93	5.21	7.67	6.42	4.31	6.11
Jawa-Bali (TWh)	85.39	89.04	95.62	100.77	104.11	
Growth (%)	6.79	4.28	7.39	5.39	3.31	5.40
Sumatera (TWh)	13.28	14.58	15.80	17.68	18.92	
Growth (%)	7.23	9.81	8.32	11.89	7.03	8.86
Kalimantan (TWh)	3.60	3.80	4.09	4.40	4.82	
Growth (%)	6.61	5.64	7.55	7.61	9.48	7.38
Sulawesi (TWh)	3.31	3.57	3.93	4.22	4.59	
Growth (%)	6.65	7.64	10.21	7.30	8.77	8.10
Eastern Indonesia (TWh)	1.45	1.61	1.81	1.96	2.15	
Growth (%)	10.57	10.81	12.27	8.33	9.91	10.40

Source: PLN 2010

In 2009 PLN had almost 40 million consumers in which the biggest demand came from the residential sector (40.8%), followed by industry (34.3%), commercial sector (18.5%), social sector (2.5%), street lighting (2.2%) and government office buildings (1.7%). Energy consumption has mainly been for appliances such as AC and refrigerators, as well as lighting, in the residential sector. The evening peak demand is mostly influenced by the residential sector. Having said that, energy consumption in the commercial and public sectors more than doubled in 2009 from 2001 (Table IV.2).

Year	Residential	Industry	Commercial	Public			Total
				Social	Street Lighting	Government	
2001	33.3	35.6	11.4	1.8	1.1	1.3	4.2
2009	54.9	46.2	24.8	3.4	2.9	2.3	8.6

Table IV.2

PLN energy sales by customer type 2001 & 2009 (TWh)

Source: PLN 2010

Demand-side interventions, such as energy efficiency in the residential, commercial and public sectors, are valuable mitigation actions, but can also have other important benefits. For example, the application of energy efficiency measures within the public sector may provide considerable energy and cost savings to a city or district. For instance, by replacing conventional street lights with energy efficient street lights, along with an adequate metering system and demand-based payment system, city administrations could be able to more accurately measure energy consumption and reduce local budget expenditures. However, for this example, new technologies such as LED street lighting can require significant up-front investments which can pose a barrier for local governments to invest in energy efficient measures in the public sub-sector. Installed meters suitable for proper measurement of energy consumption, technical capacity to implement and maintain energy efficient technologies such as LED street lighting and accountable administrative processes are additional barriers that will need to be addressed to realise energy saving opportunities.

OUTLOOK

Indonesia's power sector is at a critical phase. It faces a large challenge, to meet the fast growing demand in order to sustain economic growth. At the same time, uncertainties remain in securing the necessary levels of investment to build this required capacity. With electricity demand growing at an average rate of 9% per year, Indonesia has to double its power generation capacity every 8 years. To satisfy this rate of growth, the required level of investment has been estimated at approximately 9.6 billion US dollar per-year, which suggests that private sector investment will be a key factor for success.

Participation of private investors in the power sector was significant before the East Asian economic crisis of 1998. However, encouraging more participation IPPs in the future could prove challenging, especially for larger power projects in which investors may require some sort of guarantee to reduce any perceived investment risks. The relatively low electricity tariff charged by the state electricity company PLN since 2003 could be seen to reduce new entrants to the power market.

The prevailing law in Indonesia's power sector is Law No. 30 of 2009. Under this law, the central government and the local government, in principle, hold the authority to provide electricity to the people. This authority is exercised through state-owned enterprises like PLN, or regional government owned enterprises under their jurisdictions. It seems likely that PLN will remain the dominant player in the national power sector over the coming years.

In 2007 the government assigned PLN to build 10,000 MW of coal power plants throughout the country dubbed the 'fast track program'. About 7,000 MW of the projects are located in Java and the remaining 3,000 MW are located in Sumatra, Kalimantan, Sulawesi and some other islands. In January 2010 the government assigned PLN to develop another 10,000 MW power projects, dubbed the 'fast track program II'. Unlike the 'fast track program I' that consisted of only coal power plant projects, the fast track program II contains also almost 4,000 MW of geothermal projects to be developed by private investors, and some sizeable coal power projects as well as large hydro power/ pumped storage projects.

The outlook for Indonesia's power sector is contained in two official publications: RUKN and RUPTL. RUKN (Rencana Umum Kelistrikan Nasional) is a 20 year general plan issued by the Ministry of Energy and Mineral Resources (MEMR). Its main contents are the general policy and guidance of the government for power sector development, high-level demand projections for each province, high-level generation capacity requirements, and projections of required power sector investments for the next 20 years. RUKN does not provide detailed information on power projects nor transmission projects.

Complementing the RUKN, RUPTL (Rencana Usaha Penyediaan Tenaga Listrik) – established by PLN – is a comprehensive and detailed 10 year planning document. It provides detailed demand forecasts for every province, on-going and planned power projects, and transmission/substation projects.

According to the RUPTL, electricity growth is anticipated to be 9.3% annually; from an energy demand of 147.8 TWh in 2010 increasing to 334.4 TWh in 2019. Additional capacity needed to meet this demand is 55 GW, of which about 11.5 GW is expected to come from renewable power plants. Electricity demand in Java-Bali, western Indonesia and eastern Indonesia is expected to grow by 9.0%, 10.2% and 11.9% per year, respectively. In line with this growth, the electrification ratio would increase from 64% in 2009 to approximately 94% in 2019. To meet the demand growth, Indonesia would require 55,000 MW of new generation capacity, over 43,000 km of new high voltage transmission lines, over 117,000 MVA of power transformers, 172,000 km of medium voltage lines, 237,000 km of low voltage lines and 33,000 MVA of distribution transformers supplying 26 million new customers. Coal will dominate the fuel mix, but natural gas and geothermal will make up greater roles by 2019 (Figure V.8) This projected fuel mix is a product of policy intervention in capacity expansion to promote more renewable energy.

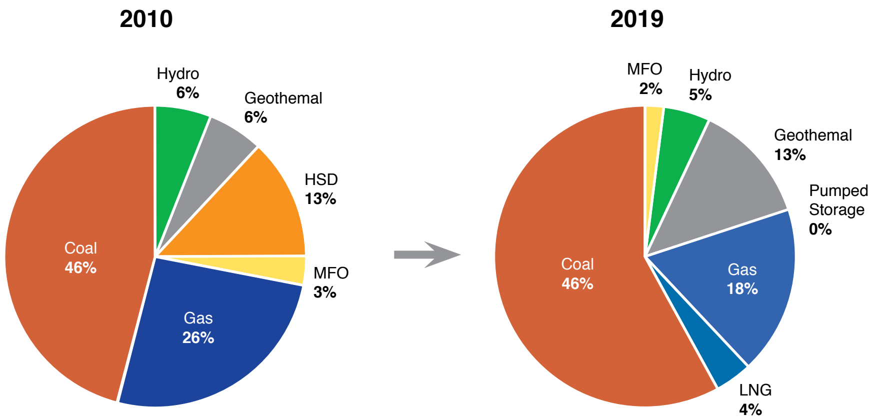


Figure IV.6

Power Plants Composition 2010 – 2019 Based on Use of Primary Energy

Source: RUPTL 2010 – 2019

GHG EMISSIONS TREND

It can be seen in the RUPTL that CO_2 emissions, particularly due to growth in the Java-Bali interconnected power system, will increase from 97 Mt in 2010 to 236 Mt by 2019. Within this 10 year development plan, the role of low-carbon and zero carbon technologies, in the form of renewable energy, is promoted. There are further opportunities to reduce CO_2 emissions to 189 Mt if wide spread geothermal power generation would be deployed.

In coming to these conclusions, CO_2 emissions from different power plants were calculated based on certain assumptions. The key assumptions have been taken from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. A nominal emission factor for each primary energy source was applied according to the type of power plants (Table IV.3).

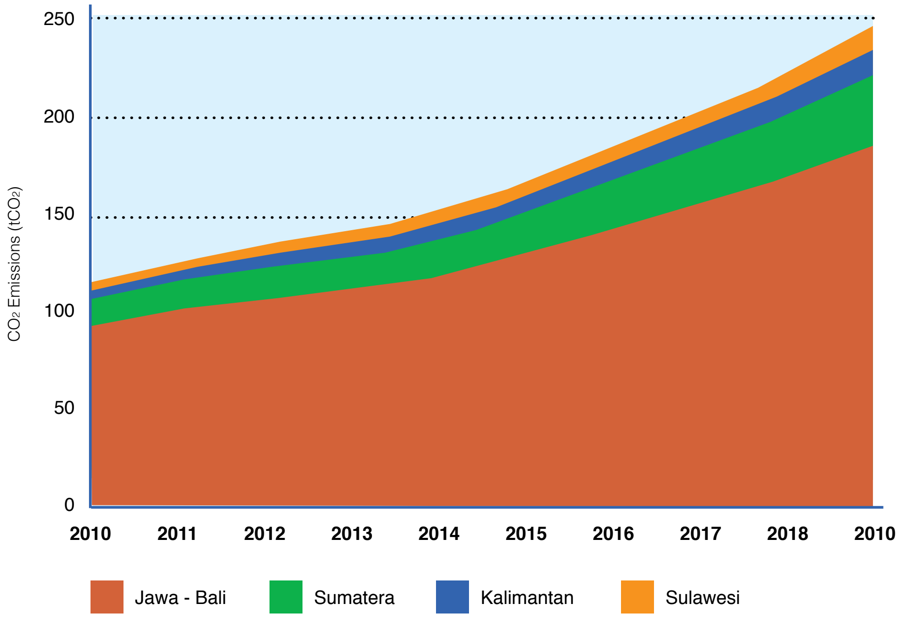
Fuel	NVC	E mission Factor	Oxidation Factor
MFO	40,766.7 KJ/liter	21.1 tC/TJ	100%
IDO	37,219.1 KJ/liter	20.2 tC/TJ	100%
HSD	36,757.9 KJ/liter	20.2 tC/TJ	100%
Coal	21,080.5 KJ/liter	25.8 tC/TJ	100%
Natural Gas	1,148.1 BTU/SCF	15.3 tC/TJ	100%

Tabel IV.3

Emission factors based on 2006b IPCC Guidelines for National Greenhouse Gas Inventories

A breakdown of the CO_2 emissions was calculated for the interconnected power systems in the main islands of Indonesia; Java-Bali, Sumatera, Kalimantan, and Sulawesi (Figure IV.7).

Figure IV.7
CO2 Emissions of Interconnection Power Systems



Source: RUPTL 2010 – 2019

Projected CO_2 emissions from 2010 up to 2019 for the 4 islands above are shown in Table IV.4. Total CO_2 emissions by power plants across these four power systems is estimated to be around 119.4 Mt in 2010 and would increase up to 245.9 Mt by 2019. Approximately 200 Mt, or 81% of the total interconnected power system emissions, is expected to come from coal combustion in this study.

Table IV.4
Projected CO2 emissions in 2019 (RUPTL 2010 – 2019)

No	Interconnection Power System	CO2 Emissions (Million Tones)
1	Jawa-Bali	188.8
2	Sumatera	35.8
3	Kalimantan	13.4
4	Sulawesi	7.9
	Total	**245.9**

Source: RUPTL 2010 – 2019

In line with the RUPTL, total national CO_2 emissions will increase from 123 Mt in 2010 to 256 Mt in 2019 if policies to develop extensive geothermal power generation are taken into account.

The average grid emission factor (GHG intensity) is forecast to improve from 0.725 $kgCO_2/kWh$ in 2010 to 0.675 $kgCO_2/kWh$ in 2019. This expected improvement of the grid emission factor can largely be attributed to the assumed development of geothermal power and adoption of efficient coal generation, especially in Java, such as super-critical and ultra-super-critical coal-fired power plants.

BASELINE CONCEPT AND METHODOLOGY

One method of determining a long-term CO_2 emission trajectory under BAU is to assume an optimal capacity expansion plan, which is based on the least-cost principle without climate change policy intervention. The most cost effective choices are made in expanding generation capacity without considering CO_2 mitigation. The CO_2 emissions contribution from each interconnected power system and all isolated power systems is first calculated (within the same timeframe and over the same time period). Later, in the next step, those sources are aggregated to construct the total power sector BAU baseline.

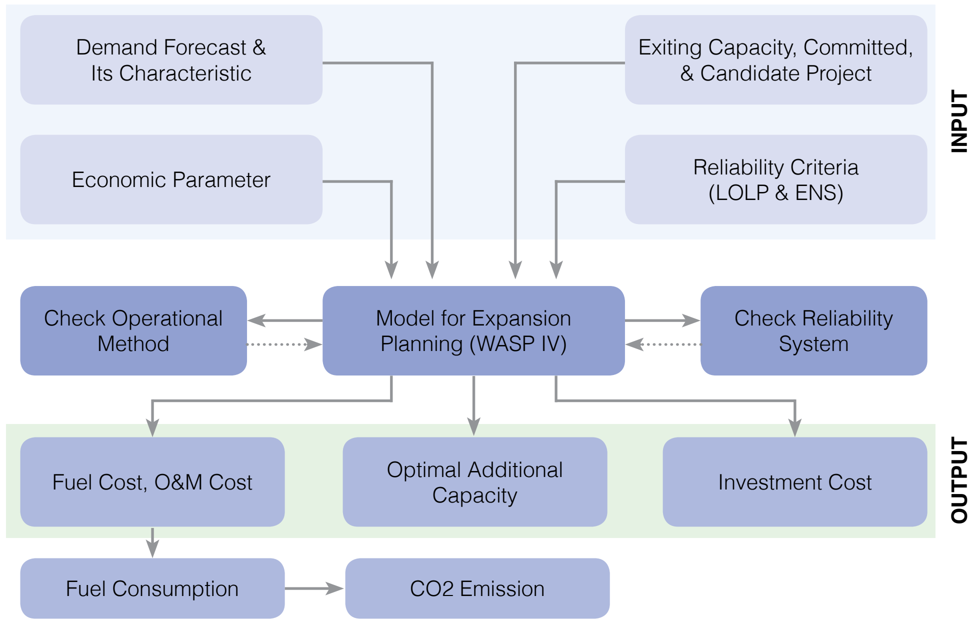
In calculating the BAU baseline for each interconnected power system, the optimal capacity expansion plan can be derived through a so-called “free optimization approach”. However, for isolated and small power systems, the capacity expansion plan is made using simpler methodology based on assumptions. For this approach the optimal capacity expansion plan should have the following features:

1. Technology, fuel, capacity and timing of new power plants used for capacity expansion are determined by using the least-cost principle (free optimisation process), without taking into account emission reduction measures;
2. Satisfies the long-term supply and demand balance;
3. Takes into account the probabilistic nature of power plants, represented by their availability factor, and the probabilistic nature of demand, which is time varying; and
4. Meets other key input constraints, such as expected system performance/reliability, e.g. measured LOLP (loss of load probability) and ENS (energy not served).

In reality, power system development planning by PLN is carried out in a systematic way that is not dissimilar to the above described approach. The objective of capacity expansion planning is to obtain the right mix of power plants (technology, fuel type, capacity, timing) which yields the minimum cost of power plants configuration as an ‘optimal plan’. The optimization process to obtain the optimal plan is made through simulation based on dynamic programming and probabilistic production costing. While the simulation would attempt to find the least cost solution, it must also meet a set of reliability criteria such as LOLP and reserve margin. A simplified description of the model for generation expansion planning is shown in Figure V.8 below. Its key inputs are: (i) Demand forecast and its characteristic, (ii) Existing capacity, committed and power plant candidates (project), (iii) Economic parameters, and (iv) Reliability criteria such as LOLP and ENS, and its outputs are: (i) Optimal additional capacity, (ii) Investment costs, (iii) Fuel and O&M costs, (iv) Fuel consumption, and (v) CO_2 emissions.

Figure IV.8

Input/Output Model for Generation Expansion Planning-WASP



The objective function that has to be minimized in the simulation, in order to obtain the minimum NPV, is given in equation 1. This objective function equation does not include emission reduction variables. Any calculation of CO_2 emissions is only performed after the long-term capacity development plan is determined.

The objective function will look like this:

$$\text{Obj. F} = \sum_{i=}^{n} (\text{Cap. Cost} + \text{O\& M Cost} + \text{Fuel Cost} + \text{ENS Cost} - \text{Salvage Value})$$

where:

- Objective Function : Total Cost of Power Plant Development
- i : Years
- n : Length of study period

Determining the BAU baseline emissions of the power sector, as proposed here, can be described as a two layer, or two tier approach. At the 2nd tier, baselines are determined for the individual power systems being studied. In the 1st tier these are aggregated into an overall baseline.

BASELINE AGGREGATION

The conceptual approach for constructing the aggregated BAU baseline CO2 emissions, or so-called 1st tier, for the Indonesian power sector is depicted in Figure IV.9. This is a bottom-up process which integrates the BAU baselines of all interconnected systems and isolated systems.

In this instance, determining an aggregated national BAU baseline CO_2 emission path is relatively straightforward, as it only requires the individual BAU baseline CO_2 emission paths to be summed. As described, determining the individual, or 2nd tier, emission paths is more complicated, as it involves optimization of the capacity expansion.

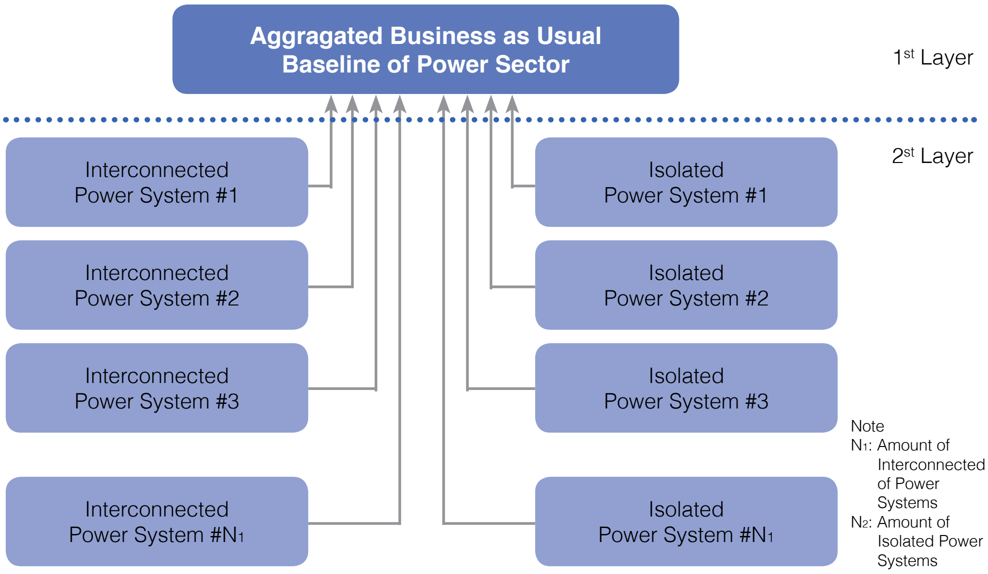


Figure IV.9

The Required Integrated Processes to Establish the Aggregated BAU Baseline of Indonesian Power Sector

(own elaboration)

INDIVIDUAL INTERCONNECTED AND ISOLATED POWER SYSTEMS

Before establishing an aggregated BAU baseline of the Indonesian power sector the 2nd tier individual baselines must be determined. There are three broad steps that should be taken into account for each interconnected and isolated power system at this 2nd tier:

1. Analysis of electricity system,
2. Database development, and
3. Long-term simulation of capacity expansion plan.

These are detailed further in Table IV.5, where each step lists the associated key activities that would be carried on.

Tabel IV.5

Required Steps for Establishment of BAU Baseline of each Interconnected and each Isolated Power Systems

No	Required Steps	Key Activities
1	Analysis of electricity system	• Electricity demand & supply and its structure • Collection of electricity statistics • Associated network analysis • Identification of system characteristics • Decision of scope analysis including future plan
2	Data base development	• Primary energy • Electricity demand and supply, including its associated composition • Existing power generations facilities including technical and economic data • Candidate of new power generations including technical and economic data
3	Long-term simulation of capacity expansion	• Description of system demand and its associated composition • Power generation capacity expansion and composition of additional generation capacity requirements, its capacity balance and its time frame • Electricity generated in total and yearly basis by fuel type in absolute value including its composition • Primary energy requirements: total and yearly basis by fuel type and its energy intensities • Associated costs features: total EPC cost (NPV least cost principle), investment costs, operation costs, its costs composition, fuel costs by fuel type in total and yearly basis • CO2 projections: total and yearly basis, by fuel type in absolute value • CO2 intensities: CO2/kWh-production (also in demand site), CO2/BOE (CO2 per unit equivalent of primary energy requirements) in total and yearly basis

POTENTIAL MITIGATION SCENARIOS

A thorough assessment of ways to reduce CO_2 emissions from a future Indonesian power sector needs to be conducted. Such an assessment should determine the impacts, including costs, of different emission reduction scenarios. Furthermore, assessment results can be used to provide advice on the formulation of long-term strategies, policies and instruments for establishing cost effective CO_2 emission reduction programs in the Indonesian power sector.

As a potential starting point, this report proposes four different mitigation scenarios - in addition to the BAU scenario - for the Indonesian power sector. The proposed scenarios are not only focused on the supply side, but also on the demand side, considering the residential, commercial, industrial and public sectors. As depicted in Table IV.6, each of the scenarios is based on a number of possible mitigation actions.

GHG emission reductions can only be realized on the supply side through a reduction in the amount of electricity generated or the amount of fossil fuels consumed per average unit of generated electricity. The latter of these can be achieved through efficiency improvements in existing plant or changing the mix of generation sources to use less carbon intensive fossil fuels or renewable sources.

The available options for mitigating GHG emissions which result from end-use interventions should be examined for each use sector; residential, commercial, industrial and public. Two broad classes of options are described here: (i) Reducing the amount of energy used per appliance by technology exchange. This requires an increase in overall energy efficiency by exchanging appliances or upgrading existing appliances (e.g. AC, lighting, refrigerators, industrial equipment), and (ii) reducing the amount of energy used per appliance by improving energy management. Energy audits in residential and commercial building could be conducted in order to identify opportunities to improve energy management.

Potential mitigation actions can be categorised according to their deployment potential and cost. The costs are based on technology and financing cost parameters. The mitigation potential is based on physical and technical constraints as well as on the size of the market. The reduction potential at sectoral level is estimated for a low and a high range representing the main uncertainties in the assumptions.

Tabel IV.6

4 Proposed Potential Mitigation Actions Scenarios

Scenarios	
Extension of RUPTL 2010-2019	• This scenario has the same pattern with RUPTL. The time period is extended up to the next two or three decades (in which 2020 is included).
Zero Carbon Technology & Greater Role of Renewable	• Increasing role of geothermal and other renewable power sources, based on mapping of national potential availability • Biomass combusted alone, or co-fired based on national potential availability mapping
Low Carbon Technology, Fuel Switching and Efficiency Efficiency Improvements	• Super critical and ultra super critical coal fired power plants; use of more advanced clean coal technologies, e.g., integrated gasification combined cycle (IGCC) • Revitalization and modernization of the existing thermal power plants to increase efficiency level, operation performances and capacities • Promote cleaner fuel in an effort to shift from fossil fuel with a high emissions factor to a fuel whose carbon emissions factor is low • Improvement of distributed generation system integration including distribution and transmission systems assets management • Incorporating high temperature superconductors into powerful electrical equipments which increase efficiency, system capacity & reliability and safety • End use-side interventions: energy efficiency measures for residential, commercial and public customers
New Technology	• Introduction of new power generation technologies, including CCS technology

As with the calculation of a BAU baseline, each mitigation scenario must be analysed to determine its impact and outcomes. Broadly speaking, step 3 from Table V.5 should be repeated for each of the different scenarios. This allows long-term CO_2 emission reduction trajectories for each mitigation scenario to be determined (Figure IV.10). These can be further assessed in order to rank the different scenarios based on aspects such as level of mitigation achieved, cost effectiveness, ease to implement and socio-economic outcomes,

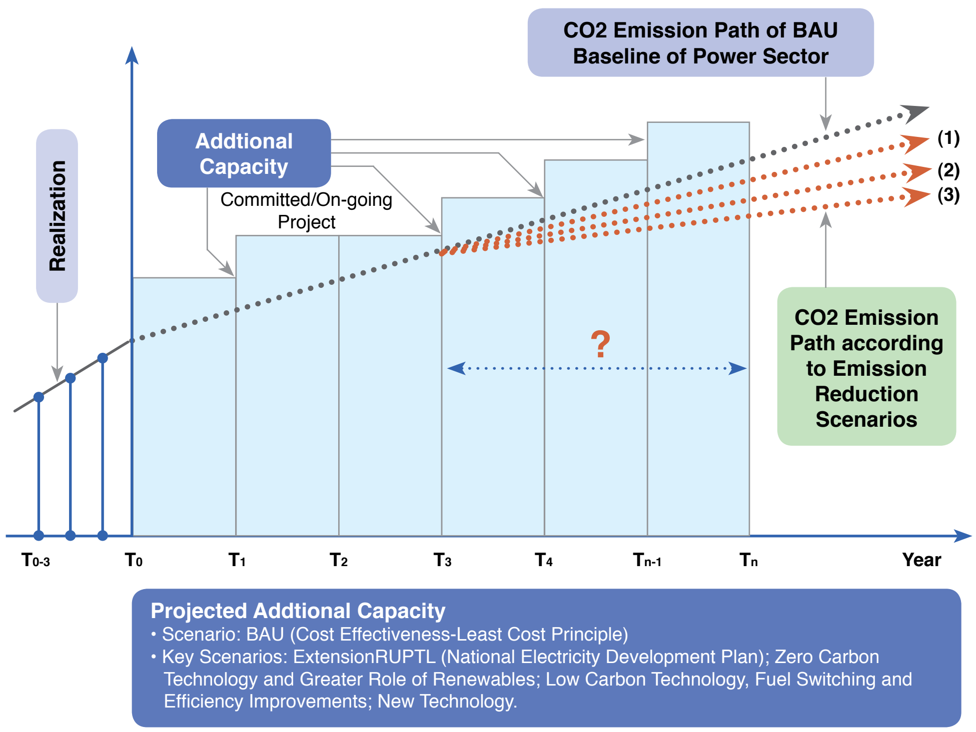


Figure IV.10

GHG Emissions Reduction Path of Potential Emissions Reduction Scenarios

(own elaboration)

POTENTIAL KEY INDICATORS

Potential key indicators – for MRV of both achieved mitigation and progress towards policy goals – can be provided at the: (i) power system level: interconnected, and isolated power systems, and (ii) aggregated level: aggregated BAU baseline and potential mitigation actions (Table IV.7).

In particular there are several key indicators that should be provided to describe the emission reduction performance of mitigation actions: (i) amount of electricity generated in total and on a yearly basis by zero-carbon power plants and renewable energies, (ii) mitigation costs, (iii) system abatement cost, (iv) CO_2 projections in total and on a yearly basis in absolute value, (v) CO_2 intensities: CO_2/kWh (also at demand side) and CO_2/BOE in total and on a yearly basis, and (vi) emission reductions in total and on a yearly basis versus the aggregated BAU baseline.

From these possible key indicators, some can be considered as suitable indicator for MRV activities, particularly those that relate to electricity generation and CO_2 emissions.

Tabel IV.7
Potential Key Indicators

Power Systems Level	Potential Indicators
• Interconnected power system • Isolated power system	• Power generation, capacity expansion and composition of additional generation capacity requirements, its capacity balance and its time frame • Electricity generated in total and on a yearly basis by fuel type and in absolute value including its composition • Primary energy requirements in total and on a yearly basis by fuel type and energy intensity • Associated costs features: total EPC cost (NPV least cost principle), investment costs, operation costs, its costs composition, and fuel costs by fuel type in total and on a yearly basis • CO_2 projections in total and on a yearly basis by fuel type and in absolute value • CO_2 intensities: CO_2/kWh-production (also in demand side), CO_2/ BOE (CO_2 per unit equivalent of primary energy requirements) in total and yearly basis
Aggregated Level	**Potential Indicators**
• Aggregated BAU baseline of Indonesian power sector	• Power generation capacity expansion and composition of additional generation capacity requirements, its capacity balance and its time frame • Electricity generated in total and on a yearly basis by fuel type and in absolute value including its composition • Primary energy requirements in total and on a yearly basis by fuel type and energy intensity • Associated costs features: investment costs, operation costs, its costs composition, and fuel costs by fuel type in total and on a yearly basis • CO_2 projections in total and on a yearly basis, by fuel type and in absolute value • CO_2 intensities: CO_2/kWh-production (also in demand side), CO_2/ BOE (CO_2 per unit equivalent of primary energy requirements) in total and yearly basis
• Potential mitigation actions of Indonesian power sector	• Power generation capacity expansion and composition of additional generation capacity requirements, its capacity balance and its time frame • Electricity generated in total and on a yearly basis by fuel type and in absolute value including its composition • Primary energy requirements in total and on a yearly basis by fuel type and energy intensity • Associated costs features: investment costs/mitigation costs, operation costs, its costs composition, and fuel costs by fuel type in total and on a yearly basis • CO_2 projections in total and on a yearly basis, by fuel type and in absolute value • CO_2 intensities: CO_2/kWh-production, CO_2/BOE (CO_2 per unit equivalent of primary energy requirements) in total and on a yearly basis • Emission reduction performance features: emissions reduction in total and on a yearly basis, its rank and system abatement cost • At the demand side: number of building built and related floor area according to minimum performance standards (building codes), number of appliances labelled, number of energy efficiency lighting installed (in street lighting and residential area), CO_2/kWh-consumption, CO_2/m2 floor

POLICIES, MEASURES AND INSTRUMENTS

Current forecasts show that over the next 10 years the Indonesian power sector will continue to be dominated by fossil fuel based generation. Mitigation actions and decarbonisation programmes should be considered in order to shift this anticipated trend and reduce long-term CO2 emissions.

To enable the necessary mitigation actions in the power sector, a number of different policies and instruments could be considered, including:

1. Reductions in any fossil fuel subsidies, or even imposition of taxes or carbon charges on fossil fuels,
2. Feed-in tariffs for renewable energy technologies or renewable energy obligations,
3. Financial incentives (for example grants, soft loans or loan guarantees) for zero and low carbon technologies investments in the areas of power generation, improving efficiency in supply and demand sides and in transmission and distribution, and
4. Regulations and standards, for example expansion of standards and labelling for minimum efficiency requirements for appliances.

Before making decisions on which policies to pursue, it is necessary to make a detailed assessment of the cost of implementing any proposed policies, how effective these policy instruments are in reducing carbon emissions from the power sector and what socio-economic impact they could have (for example a policy may lead to an increase in the average electricity price for consumers).

IV.3 ENERGY: INDUSTRIAL SECTOR

BACKGROUND AND OUTLOOK

Industrial activities are known contributors to greenhouse gas (GHG) emissions. In the industrial sector, sources of GHG emissions include energy consumption, industrial processes and industrial waste. Speaking generally, the industrial sector consumes energy for heat and electricity, but apart from energy consumption, many different GHGs can be released through industrial processes; for example during production processes that use chemical reactions or physically transform materials.

In Indonesia, there are more than 25,000 medium- and large-scale companies operating in different industry sub-sectors (Badan Pusat Statistik, 2008). The "Indonesian Second National Communication under the United Nations Framework Convention on Climate Change" (MoE, 2010) demonstrates that GHG emissions from manufacturing industries rank among the top ten sources of GHG emissions in the National GHG Emissions Inventory of Indonesia (w/o land use, land use change and forestry). The energy use of manufacturing industries alone was considered to be the 9th largest source of GHG emissions in the mentioned inventory (MoE, 2010)[7].

[7] In this context, energy use is defined as stationary fossil fuel combustion and does not include the use of grid-supplied electricity, fossil fuel combustion for transportation purposes or fossil fuels used as reductors and catalysts during industrial processes.

The GHG emissions from the industrial sector can be expected to increase along with the growth of the sector itself. Although the growth of some industrial sub-sectors has been slower in the past years, it is expected that industrial growth will be more than 7% in the coming years. The growth rate of each industrial sub-sectors in 2005 – 2009 can be seen in Table 13. Based on the National Industry Development Policy (Presidential Decree No. 28/2008) that aims to strengthen competitiveness of manufacturing industries and to enhance their production capacity, the target industrial growth is 8% in 2025. These levels of anticipated growth would significantly increase the GHG emissions from the industrial sector in 2025.

Tabel IV.8

Industry Sector – Annual Growth 2005 – 2009

Industry Sub-sectors	Growth Rate (%)
Food, beverages and tobacco	5.00
Textiles, Leather Products and Footwear	7.17
Wood products and Forest products	3.16
Paper and Printing Matter	7.80
Fertilizer, Chemical and Rubber Product	10.63
Cement and Non-Metal Mineral Products	10.13
Base Metal, Iron and Steel	6.56
Transport, Machinery and Equipment	12.03
Other products	10.20
Total	**8.56**

Source: Ministry of Industry, 2005

To reduce GHG emissions from energy consumption in the industry sector, the Government Regulation No. 70/2009 on Energy Conservation requires that industries with an annual energy consumption of more than 6000 TOE must conduct energy conservation through an energy management system. With this regulation, most large scale companies will need to conduct energy conservation measures in the coming years; however, what impact that regulation will have on GHG emissions still needs to be understood in more detail.

Considering that the industry sector has many different sub-sectors, there will need to be a selection process to decide which sub-sectors that would be in the scope of possible NAMAs development. The selection of these sub-sectors could be done based on a number of possible criteria including the potential of the sub-sector to reduce GHG emissions or based on its priority for Indonesia's development. The industry sub-sectors of cement, iron & steel, pulp & paper, textiles, and fertilizer are observed to be the main contributors to Indonesia's industrial sector GHG emissions (ICCSR, 2010).

During any possible development of NAMAs within the industrial sector, the balance of demand and supply of the industry sector would also have to be considered. The analysis should be based on factors such as the current and predicted output of production, the current and predicted future energy demand of the industry sub-sector (by type of fuel), current installed production capacity and predicted demand growth rate.

In regards to the development of NAMAs for the industrial sector, Indonesian industry will, in a sense, be analyzed as one sector of the broader energy system. It is, therefore, important to define sector boundaries within the energy system in order to avoid overlap and to reduce the possibility of double counting within the aggregated mitigation potential. Industry could then be analyzed within its defined boundaries for a chosen reference year.

GHG EMISSIONS TREND

Indonesia's Climate Change Sectoral Roadmap (ICCSR) has made a forecast of the GHG emissions under a BAU scenario from 2005 – 2030 due to energy consumption (ICCSR, 2010). The projection was made using a MARKAL model with an assumption of an average growth rate of 7% per annum for manufacturing industries after 2010. The industrial sub-sectors covered are non-metallic minerals (including cement), iron & steel, pulp & paper, textile, fertilizer, and others. In Figure IV.11, it can be seen that the non-metallic minerals (including cement) sub-sector contributes the highest proportion of GHG emissions.

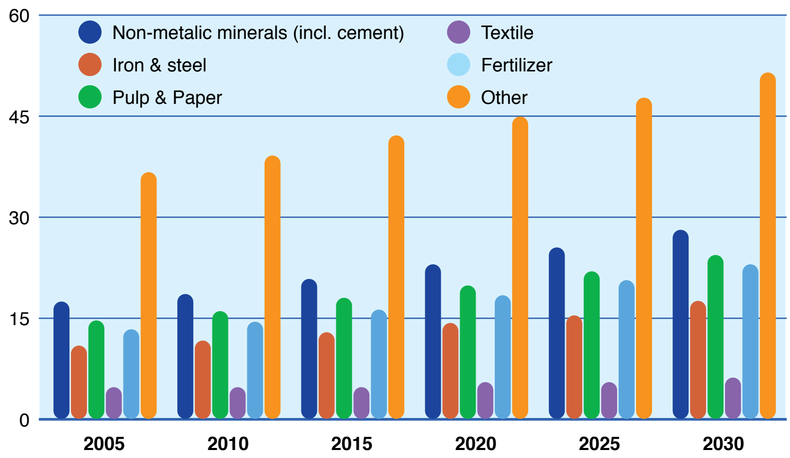


Figure IV.11
Industry Sector – GHG emissions from energy consumption under BAU Scenario 2005 – 2030

Source: MoE, 2010

Under a BAU scenario the overall GHG emissions from the industrial sector will rise from 97.49 Mt CO_{2eq} in 2005 to 150.87 Mt CO_{2eq} in 2030 (Figure V.15). Under one potential scenario that includes energy efficiency interventions, GHG emissions from the industry sector might rise from 97.49 Mt CO_{2eq} in 2005 to 104.93 Mt CO_{2eq} in 2030; a decrease of 30% versus the BAU scenario.

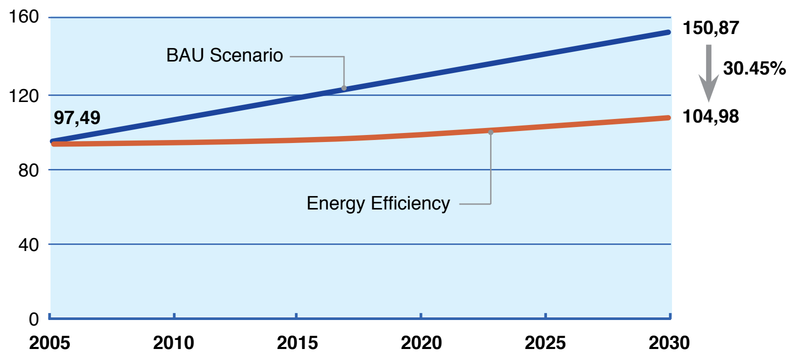


Figure IV.12
Industry Sector – Comparison of GHG emission scenarios 2005 – 2030

Source: MoE, 2010

BASELINE CONCEPT AND METHODOLOGY

Developing a BAU baseline provides a starting point for demonstrating the role industry could play in achieving Indonesia's climate change commitments. In establishing the baseline scenario for the industrial sector, GHG emissions have to be calculated based on the energy consumption and the industrial processes in the related sub-sectors. GHG emissions from industrial waste are proposed to be calculated within the waste sector.

Approach

In calculating a BAU baseline, two broad approaches can be differentiated; top-down and bottom-up. A top-down approach is commonly defined as the breaking down of a system to gain knowledge about its sub-systems. Assuming the industry to be such system, the GHG emissions level would first be formulated for the whole sector before examining in greater detail the contribution of each industry sub-sector.

A bottom-up approach is defined as the piecing together of systems (here industry sub-sectors) to form a larger system (here the industry sector). This means that first each industry sub-sector is specified in detail. Depending on the aggregation level that was used as a started point, the classes, groups and/or divisions are then, if relevant, aggregated to form industry sub-sectors, which then in turn are aggregated to provide a complete picture of the industrial sector as a whole.

The bottom-up approach lends itself more readily to the purpose of determining an aggregated BAU baseline for the industrial sector in the frame of NAMA development. A bottom-up approach is proposed due to the higher certainty of the calculation results. However, comprehensive datasets are required for this approach. Although some data may currently be available for important sub-sectors, such as cement, iron & steel, obtaining accurate data for the entire industrial sector remains an important challenge that will need to be overcome.

Once any aggregated BAU baseline calculation from the bottom-up approach is available, it is recommended to compare it, if possible, with the corresponding calculation using a top-down approach to check the results. The comparison can provide useful insights on accuracy, as the top-down approach uses datasets that are available in a more complete manner than for a bottom-up assessment, e.g. sales statistics of the state-owned energy companies PT. Pertamina and PT. PLN (Persero).

Industry Classification

Using a bottom-up approach, the industrial sector aggregated BAU baseline would be constructed by summing the BAU baselines from each industrial sub-sector. As a first step to achieve this, the industrial sector has to be divided into several sub-sectors using a classification scheme. Any calculations should start from the lowest chosen level of classification.

The classification scheme should ideally be aligned with the IPCC methodology to inventory GHG emissions. It is recommended to use International Standard Industrial

Classification (ISIC) (United Nations Statistics Division, 2010). Based on the ISIC Code, the Indonesian Central Statistics Bureau (Badan Pusat Statistik – BPS) has issued Head of BPS Regulation no. 57/2009 to classify the manufacturing industries in their database and it is widely known as Klasifikasi Baku Lapangan Usaha Indonesia (KBLI).

The classification can be made based on products, considering that the industrial landscape is highly diverse with thousands of companies producing tens of thousands of products in quantities varying from a few kilograms to thousands of tons. Based on the ISIC the industrial sector is divided into the following sub-sectors (see Figure IV.13).

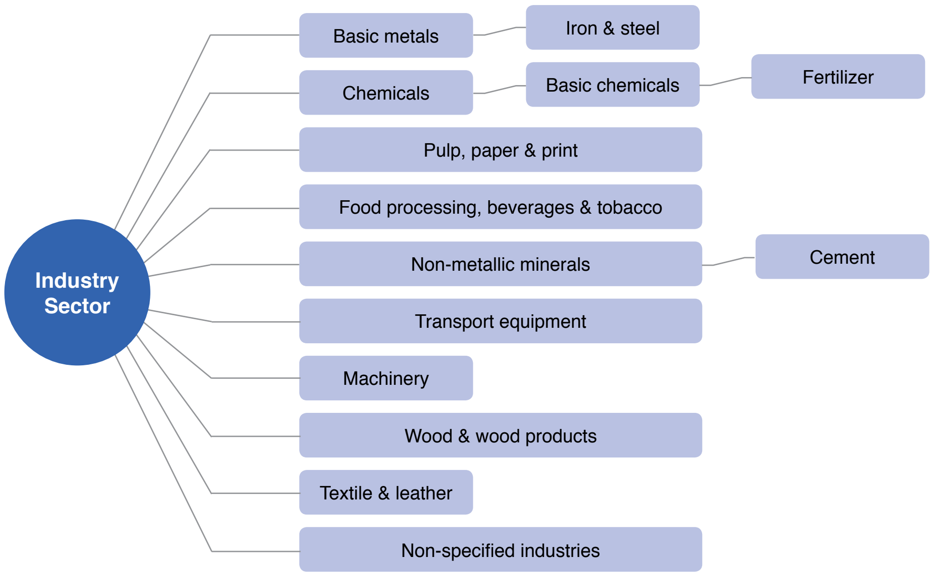


Figure IV.13
(Simplified) Industry Classification

Source:
ISIC 2010

Assumptions and Data Requirements

The necessary assumptions for calculations and projections then have to be developed. Given the overarching aim to model the entire energy system, a number of key assumptions will need to be agreed upon among the sectors. This includes basic assumptions like physical conversion factors, calorific values and emission factors for each type of fossil fuel for the actual estimation of GHG emissions. It also requires agreement on economic parameters like the inflation rate, business tax rate, exchange rates, fuel price development, etc., from which the costs for GHG emissions mitigation are derived.

In establishing the industrial sub-sector BAU baselines, calculations and projections should be based on the level of production, which is divided into current and expected level of production based on demand growth. In this case, existing installed capacity in the industry has to be considered and how it can accommodate the expected level of production in the coming years according to the production plan, ensuring that the demand and supply balance is met.

If the existing installed capacity can fulfil the production level in the coming years, then the GHG emission path up to 2020 would approximately grow in proportion to the demand growth. However, if the existing installed capacity cannot accommodate the production level in a certain year before 2020, the industry sub-sector would have to install new equipment and/or new technology. In this case, the GHG emission path up to this certain year will be proportional to the demand growth, but after this year emissions must be calculated taking into account the new equipment/technology. In the BAU scenario, the installation of new equipment and/or new technology is proposed to be based on the least-cost principle.

The data required for the calculation of BAU baseline in the bottom-up approach includes the following:

- details on factories; classification, name, location, age, current/future production capacity by product type (t product/yr), current/future average annual capacity utilization (%) or production (t product/yr);
- details on expansion plans; location of future factory, expansion/new production unit, size, etc;
- details on energy utilization; amount of conventional and alternative fuels consumed - in total and/or separated by important production steps - in (t) or (GJ) per fuel type;
- electricity obtained from the grid; in total and/ or separated by important production steps - in (MWh);
- quantities of raw material used by type of raw material in (t/yr)
- expected annual growth rates in (%)

The data can be collected from different sources e.g. BPS and/or the private sector for each required industry sub-sector/-division/-group/-class.

Establishment of Aggregated BAU Baseline of Indonesia Industry Sector

The BAU baseline scenario for each industrial sub-sector will be calculated based on the assumptions made and the above data. This baseline gives the projected GHG emissions, in total and on a yearly basis, for each of the industrial sub-sectors until at least 2020. The studied industrial sub-sectors should be based on the industrial classification. Summing these individual sub-sector baselines will allow the aggregated BAU baseline of the industrial sector to be calculated.

POTENTIAL MITIGATION SCENARIOS

The industrial sector has many options to mitigate GHG emissions, either through changing energy use patterns or changing its industrial processes. Based on changing energy use patterns, the options can be categorized as:

- Reduce the amount of energy used per product: this option decreases the energy used via an increase in energy efficiency, and
- Change energy-sources/energy-mix used for production: the option involves a substitution of the current sources of energy by alternative fuels (fuel switching) – such as biomass, municipal solid waste, etc. – which have a lower emission intensity than original fuel.

Besides the options mentioned above, the industry sector has the option to make process modifications. GHG emissions from industrial processes could be reduced by changing the product, feedstock or increasing material efficiency; e.g. recycling.

Some selected examples of industrial technology available for reducing GHG emissions can be seen in Table IV.9.

Table IV.9

Selected Examples of Industrial Technology Available for Reducing GHG Emissions

Industrial Sub-sectors	Energy Efficiency	Fuel Switching	Major Process Modifications
Cement	waste heat recovery, ASD/VSD, energy management system, process control, reciprocating grate cooler, lighting efficiencies, motor efficiencies, air-conditioning and fuel in machinery	utilization of agricultural biomass, municipal solid waste, hazardous waste	blended cement
Iron and steel	smelt reduction, optimized electrical furnace, improvement of preheating process	product gas combine cycle, biomass and biogas utilization	recycling of product and its waste
Pulp and paper	boiler efficiency, efficiency on drying process, shoe press usage, condebelt drying	biogas utilization, gasification process (natural gas) with black liquor	recycling of product and its waste, use of raw materials from plantation and non-raw wood
Fertilizer	Boiler efficiency, replacing dryer, decreasing air compression		
Textile	energy-efficient RF dryer, transformers, pump, motors	utilization of natural gas	

Source:
ICCSR (2010), TNA-MoE (2010), AFD (2010)

Development of mitigation scenarios

By building up sets of different potential mitigation actions, it is possible to develop mitigation scenarios for each industry sub-sector. In this instance, three broad scenarios are described along with potential corresponding mitigation actions (see Table IV.10).

Table IV.10
Proposed mitigation scenarios

Approach	Target	Special Data Requirements	Difficulties for Potential Assessment/Questions	Recommendation
Energy Efficiency				
• Use efficient lighting, compressed air, steam & process heating systems, pumps, fans, industrial motors, • Combined heat and power, • Process optimization	• Reduce energy intensity (%)	• Currently used technology: type, age, energy use of certain fuel (t) or (GJ) • Energy conservation potential of new technology in (t) or (GJ) or (%) of fuel savings	• Potential for energy efficiency improvement commonly given in (%) only (w/o considering factory or technology details), which leads to inaccuracy • Combination of several efficiency improvements might not result in the sum of their single potentials	• Calculation based on energy intensity • Apply sophisticated model for combining different measures
Fuel Switching				
Substitute …% of the "fossil fuel demand per unit of product" by non-conventional, advanced fuels such as biodiesel, biomass, etc.	• Reduce carbon intensity (%) under assumption of constant energy intensity	• Physical conversion factors per alternative fuel type e.g. calorific value (GJ/ t fuel), emission factor (t CO2/ GJ fuel)	• Quantity of alternative fuels, which will be (made) available to AL has to be estimated conservatively considering the future growth of demand, price development and regulations e.g., chemical industry is prioritized by government over other industry sub-sectors	• Calculation based on carbon intensity • Study quantity and location of alternative fuels and draw special attention to food-, energy security, etc. • Analyze technology requirements for fuel switch on AL
Major Process Modifications				
• Change of product e.g. by changing its composition • Change of feedstock • Material efficiency e.g. by substituting (%) of raw materials by recycled products	• Reduce energy intensity (%)	• Fuel savings from changing product in (t) or (GJ) or (%) • Requirements on datasets and calculation have to be analyzed on AL	• Marketability of changed products might be different from that of other countries • Some product options lead to a reduction of GHGe from energy use, others to a reduction of GHGe from industrial processes (latter is of less interest for IEM) • Demonstration of additionality difficult and might become an obstacle for claiming the achievement of 26 - 41% due to climate change action	• Calculation based on energy intensity • Since approach is well-studied for some products, lean on these case studies • For IEM strictly disconnect GHGe from energy use from GHGe from industrial processes • Analyze technology requirements on AL

Note: Abbreviation: GHGe – GHG emissions, AL – Aggregation level of the data analysis e.g. per industrial sub-sector, -division, -group or – class (see Industry Classification)

Assessing the impacts of such mitigation scenarios is a significant challenge. Production processes have to be analyzed in detail sector-wise to find out what impact a feedstock change, or the substitution of raw materials by recycled input, have on the energy use of a certain production process[8] and how much the energy intensity of each product could potentially be decreased. International best practices might therefore serve as examples or approximations for the assessment in Indonesia.

[8] Calculation example: Steel production can be differentiated into 3 routes either being counted to primary steel production (1st route) blast furnace (BF) – basic oxygen furnace (BOF) or open hearth furnace (OHF) utilizing 19.8 – 41.6 GJ/t steel, (2nd route) direct reduction (DR) – electric arc furnace (EAF) utilizing 28.3 – 30.9 GJ/t steel or secondary steel production (3rd route) using recycled steel - electric arc furnace (EAF) utilizing 9.1 –12.5 GJ/t steel. From an environmental point of view, steel recycling has an enormous impact on the reduction of GHG emissions. If 4.5 t hot rolled steel were produced from 100% scrap rather than new materials, the total GHG savings would be approximately 8.1 t/year (Worldsteel, 2008)

In a similar way by which the BAU baseline is developed, mitigation scenarios have to be calculated based on the demand and supply balance. Therefore, expected production levels have to consider the existing installed capacity versus the production plan.

If the existing installed capacity can fulfil the production level in the coming years, then the scenarios to reduce GHG emission could be based on mitigation actions such as energy efficiency. However, if the existing installed capacity cannot accommodate the anticipated production requirements in a certain year (year X) before 2020, then it means that the industry sub-sector has to install new equipment and/or new technology to meet the required production output. In this case, the GHG emission path up to year X will be based on a certain set of potential mitigation actions. However, after this year, the calculation of emissions has to consider those same potential mitigation actions but also the installation of new equipment and/or new technology. In a GHG mitigation scenario, the installation of new equipment and/or new technology would typically assume the use of improved low-carbon technology.

Assessment of mitigation scenarios

Integrated modelling is an approach that could be used for the assessment to rank the proposed mitigation scenarios and to establish which potential mitigation actions are most appropriate in the industrial sector. It can assist in an assessment of the feasibility, barriers and impacts of different scenarios as well as inform the design of necessary strategies and policies.

To assess the proposed mitigation scenarios, a so-called incremental cost approximation can be used. Observations from other countries that have used such a cost approximation suggest two complementary levels of economic analysis: (i) a microeconomic assessment of the options considered from both social and private sector perspectives, and (ii) a macroeconomic assessment of the impacts of these options, either individually or collectively, on the national economy (World Bank, 2010).

A parallel assessment of a scenario's feasibility and barriers is also crucial for ranking the scenarios. Even though a broad range of cost-effective GHG emissions mitigation technologies exist, a variety of economic barriers can prevent their full realization. These barriers include the effective cost of capital, technology reliability, resource constraints, high initial capital costs, low rate of technology transfer, lack of technical skills/capacity, inadequate enforcement of policy, legal limitations and public perception (IPCC, 2007).

In general, the assessment of proposed mitigation scenarios should draw conclusions of the expected cost effectiveness and develop a number of screening criteria that can be used to indicate the impact of implementation of the proposed mitigation actions; including:

- Total emissions reduction potential;
- Cost effectiveness of mitigation defined by the cost per tonne of CO_2 reduced;
- Ease of implementation (considering aspects such as institutional capacity, social

acceptance, existing government/industry policies, technical knowledge/skills and other potential barriers);
- Political and commercial acceptability (attractiveness of each policy in the current Indonesian context);
- Technological opportunity (transferability; potential for market transformation);
- Cross sectoral implications;
- Access to finance;
- Ease of measurement, reporting and verification (MRV);
- Technical risks (including vulnerability to climate change impacts and tectonic activity);
- Future export potential and opportunities;
- Impact on balance of payments and other economic considerations; and
- Compatibility with development goals (energy security, economic growth, environmental protection)

The selection of mitigation actions to pursue in the industrial sector can then be based on their cost effectiveness and impact of implementation. The assessment of which potential mitigation actions are feasible at different cost levels is important for the construction of CO_2 emissions reduction paths. Each potential mitigation action can be ordered sequentially starting from the lowest cost. However, as described above, cost alone may not be the only reason for pursuing a certain mitigation action.

POTENTIAL KEY INDICATORS

Closely aligned to the idea of key indicators, each industry has its own metrics for measuring performance. For the Indonesian industry, such indicators might include total GHG emissions, carbon intensity or energy intensity, amongst others. Such indicators can be derived from an analysis and projection of the current and future energy demand of the industry.

Potential quantitative key indicators for the industrial sector include:
1. Key data, such as energy intensity or carbon intensity. Energy intensity considers energy consumption (including electricity) per tonne product (GJ/t product). Carbon intensity considers CO_2 emissions from process and energy consumption in emissions per tonne product (tCO_2 /t product)
2. Key cost features; such as its total mitigation costs and system abatement costs

Indicators such as these, when appropriately defined in terms of measurement approach and reporting periods, could be used for MRV requirements.

POLICIES, MEASURES AND INSTRUMENTS

The successful implementation of an industry NAMA is not only dependent on the identification and acquisition of appropriate technology. Market driven implementation of a NAMA requires a wider, coherent framework of policies and instruments to create the appropriate enabling environment aligned to sustainable economic development.

Such policies and instruments include regulations, standards, technology penetration programmes, economic instruments, R&D support, technology demonstration projects, sustainable development programmes, capacity building and data-gathering activities.

A blend of policy approaches is typically required to achieve both short and longer-term emission reductions. Some policies may not directly influence behavioural or technological changes that reduce emissions, but instead improve the chance that other associated policies reduce emissions. Certain other policies may be too slow to achieve emission reductions in the short-term, but could contribute to achieving a shift to a low-carbon industrial sector in the longer-term (ICCSR, 2010). Related to this, a commitment period will need to be agreed on for the implementation of policy actions that relate to NAMAs. A first outlook regarding future MRV requirements should also be sketched.

NAMA development is expected to require the involvement of all relevant stakeholders. In addition to the NAMA development work that is occurring in the National Development Planning Agency (BAPPENAS), there could be added value in building another working group, specifically for industry NAMA development, coordinated by the Ministry of Industry, that would complement the efforts currently going on within BAPPENAS. Such a working group could focus on technical issues within the industrial sector, such as BAU baseline development and estimating GHG emissions mitigation potentials.

An industry specific working group on NAMA development would also require the input of experts in policy frameworks and financial instrument development. There would need to be close coordination between any industry focused working group and other efforts on NAMAs within Indonesia – such as those coordinated by BAPPENAS – to ensure that common approaches and assumptions are adopted where appropriate, in order to allow the aggregation of scenarios and sectors. At the same time, the elaboration of any possible financial incentives should happen in close cooperation with the Ministry of Finance (MoF).

Involvement of the private sector and industry is also deemed to be crucial for the successful development of NAMAs, as much of the practical implementation will come from private parties and industry. Therefore, representatives from relevant industry sub-sectors should be involved during BAU baseline and mitigation scenario development, as well as during the analysis and choice of the final applicable actions.

To support the implementation of mitigation actions in the industry sector, a number of possible national policies, measures and instruments could be adopted, including changes to (ICCSR, 2010):

- Planning: to ensure that long-term strategies for the industry, energy, transportation and waste sectors are in line with low-carbon industrial objectives;
- Regulations and standards: to create a "level playing-field", to provide certainty for industry and to require the consuming public to change their behaviours. This can be particularly applicable in improving industry-wide MRV capabilities and performance. Regulations and standards may be preferable to other instruments when information or other barriers prevent producers and consumers from responding to price signals.

- Economic instruments: to create financial incentives for industry to change its behaviour. Financial incentives (e.g., taxes, subsidies, tradable permits) are often used by governments to stimulate the development and diffusion of new technologies and measures. While direct public costs may be higher than for the other instruments listed here, they are often important to overcome barriers related to technology costs, financial risk or up-front investment requirements;
- Information and marketing: to complement the delivery of other policy options and to assist with the delivery of new products and services. Information instruments (e.g. awareness campaigns) may positively affect environmental quality by promoting informed choices and contributing to behavioural change. However, their impact on emissions is difficult to determine and attribute; and
- Technology transfer and promotion: including alternative fuels, new kiln systems, high efficiency motors, new products and services.

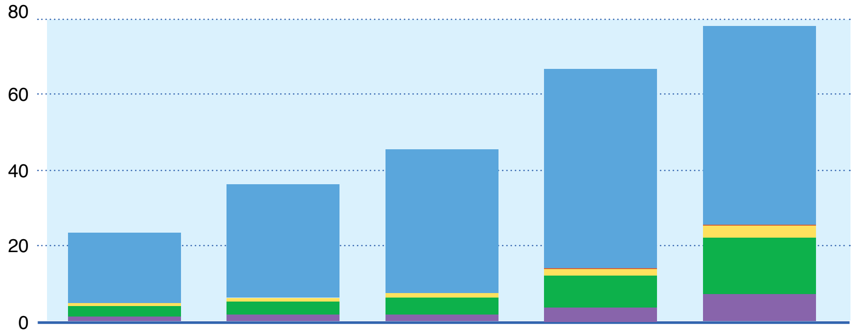
Before moving towards any particular policy, it is first necessary to make a detailed assessment of the efficiency and effectiveness of implementing the policy instrument in terms of achieving emission reductions and supporting sustainable development. The socio-economic impacts – for example, from potentially increasing prices of industrial productions – need to be examined, both locally and in terms of trade balances. Such assessments are best performed with cross-cutting cooperation within the Government of Indonesia, and should involve the Ministry of Industry, Ministry of Energy and Mineral Resources and Ministry of Finance, amongst others.

IV.4 ENERGY: TRANSPORT SECTOR

BACKGROUND AND OUTLOOK

An efficient, clean and affordable transport system is essential for the sustainable development of Indonesia. Yet, the current patterns of development in the transport sector, characterized by a rapid growth in motorized transport, pose fundamental risks to achieving this aim.

Based on one study by ADB (2006), vehicles in Indonesia are predicted to grow more than two-fold between 2010 and 2035 (Figure IV.14), with the growth expected to be largest in two wheelers and light duty vehicles (cars).



Population	2005	2010	2015	2025	2035
2-W	18.8	30.0	38.0	52.9	52.7
3-W	0.0	0.0	0.0	0.1	0.1
HCV	0.8	1.0	1.2	1.9	3.0
LCV	2.9	3.6	4.4	8.4	15.1
Car. SUV	1.2	1.4	1.8	3.6	7.0
Grand Total	**23.7**	**36.0**	**45.5**	**66.9**	**77.8**

Figure IV.14
Vehicle Growth Trends in Indonesia

Source: ADB (2006)

This rapid growth in motorized vehicles is leading to acute congestion, particularly in the peak periods in major cities. For example in Jakarta, it is estimated that the cost of traffic congestion (based on time value, fuel consumption and health costs) is up to Rp12.8 trillion per year (approximately USD 1.4 billion). Local air quality is also degraded, to the extent that 60 to 80% of air pollutants in metropolitan cities are thought to be caused by transportation. Furthermore, large levels of noise and vibration are observed. The dominance of private vehicles also reduces the safety of vulnerable road users, especially pedestrians and cyclists. The heavy reliance on fossil fuels by the sector (which continues to be subsidized) puts strains on the country's finances.

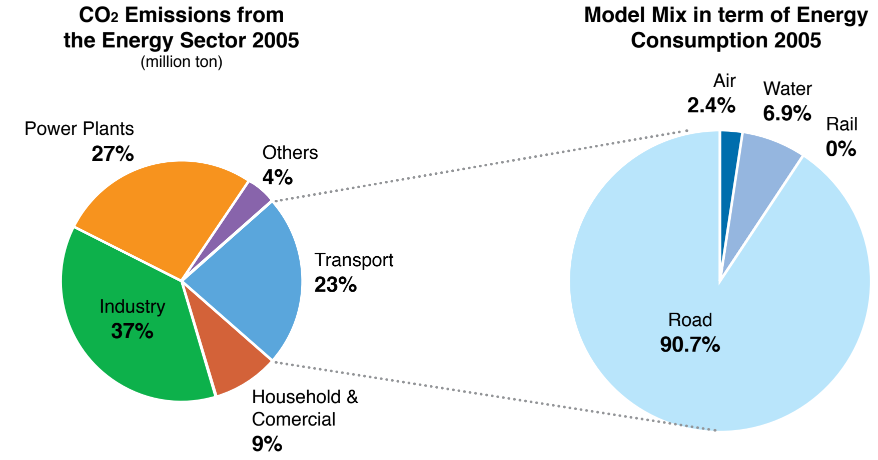
GHG EMISSIONS TREND

Due to the growth in transport activity and vehicles, Indonesia faces a major challenge in taking mitigation measures in the transport sector. Transport made up 23% of the total CO_2 emissions of the energy sector in 2005 (Figure V.18), or 20.7% of the country's overall CO_2 emissions (with annual emissions of 67.68 million tons CO_2 equivalent)[9]. Transport was the third largest contributor to energy-sector emissions, surpassed only by emissions from industrial sources and power generation. Road transport is by far the largest component of transport emissions, representing around 89% of CO_2 emissions and 91% of energy consumption from the sector (Figure IV.15).

[9] Another estimate by DNPI (2010) notes that emissions from the Indonesian transport sector are expected to rise from 60 Mt CO_{2e} in 2005 to 443 Mt CO_{2e} by 2030.

Figure IV.15

CO_2 Emissions from the Transport Sector (Modified from ICCSR, 2010)



Estimates of future emissions vary among different studies. A study in 2010 by KEMENHUB predicted that emissions from land transport will nearly triple between 2008 and 2030 (see section on Baseline and Emission Reduction Scenarios)

BASELINE CONCEPT AND METHODOLOGY

For actions (including those identified through the RAN-GRK) to become recognised as NAMAs, the CO_2 emission reduction from such actions will need to initially be estimated versus a BAU baseline. At the stage of implementation, actions will be measured, reported and verified (MRV) against this baseline.

Within the framework of MRV, measuring CO_2 emissions in the transport sector involves:

- The establishment of an aggregated BAU baseline for transport emissions, and
- The estimation of emission reductions from the business as usual baseline as a result of any proposed mitigation actions.

There are principally two ways of measuring changes in emissions from transport; top-down and bottom-up. Under a top-down approach, emissions are estimated simply from the aggregate fuel sales for transport vehicles, multiplied by the emission factors for each type of fuel. This involves using national level energy balances, taking the fuel consumed in the transport sector and assuming that all of the carbon in the fuel is released as CO_2.

This method provides a relatively reliable national level estimate of CO_2 emissions from different types of transport such as road transport, rail, shipping and aviation. However, it does not provide enough detail to assess the likely impacts of most mitigation measures. For example, if a BRT system was introduced, then the impact on CO_2 emissions requires the estimation of the emissions from the buses, and the emission savings from reduced private cars. This is not possible using the top-down approach because emissions from these modes are not individually identified, and even if they were, more information would be needed to assess the change in emissions.

Therefore, a different approach is needed to compile an emissions inventory that can estimate the change in CO_2 emissions caused by the introduction of mitigation actions. This is a bottom-up approach.

Under a bottom-up approach, emissions are estimated as a product of
- Transport activity (A),
- Structure of the sector in terms of modal split (S),
- Intensity of fuel consumption (I) and
- CO_2 intensity of each fuel (F).

These could be considered the key indicators with regards to the transport sector. In practice, and as noted in Schipper et al. (2010), this requires knowledge on:
- The stock of motor vehicles by fuel type and vehicle type (e.g., car, two-wheeler, three-wheeler, trucks and buses) on an annual basis.
- The average annual number of km each vehicle type travelled
- The passenger or ton-km produced by each mode

The fuel use/km for each vehicle and fuel combination can then be derived from these three types of data.

Generally, in order to measure the impacts of transport policies (and particularly those associated with the Avoid and Shift strategies), a bottom-up methodology is required, as a top-down approach cannot indicate the reason why fuel consumption in the transport sector has come down. Only by measuring travel activity, one can estimate the direct impacts of the transport measure being put in place.

Ideally, all of the aforementioned indicators would be disaggregated to the local level, so that the impacts of measures implemented at the local level (i.e. by municipal authorities) can also be quantified.

Aggregated BAU baseline

The development of a business as usual baseline for the entire transport sector using a bottom-up approach requires (Figure IV.16):

1. Establishment of business as usual baselines for each subsector of transport, e.g. road, rail, water and air transport. For each sector, ASIF (The activity – structure – intensity – fuel) is generally used as a method of carrying out the “bottom-up” approach. GHG emissions in the transport sectorcan be derived from transport activity (A), modal share (S), fuel intensity of each mode (I) and emission factor (F) as described in the following equation.

   Where:

   G : CO_2 emissions from transport (ton CO2)

   A : Transport activity (person-km travelled, vehicle-km travelled, ton-km transported for freight)

S : Structure in terms of modal share or modal split
I : Fuel intensity (liter/person-km traveled)
F : Carbon content of fuel or emission factor (ton C or ton CO_2 per liter)
i : Transport mode
j : Fuel type

Note that further disaggregation is also possible and can be beneficial, especially for the road transport sector, e.g. by:

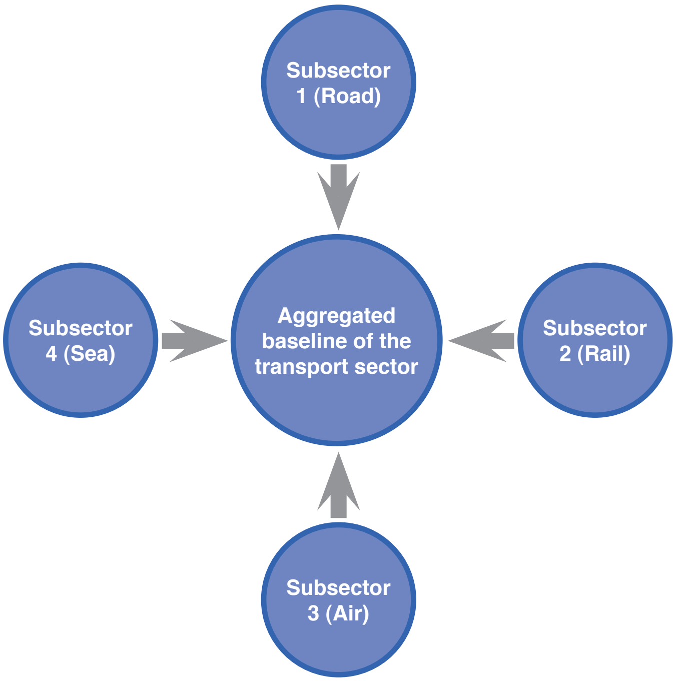
- Type of vehicle (engine type)
- Geographical region
- Urban vs. non-urban

The ability for such disaggregation is dependent on the availability of data (see next section on data gaps).

2. Establishment of an aggregated BAU baseline that sums up the emissions from each subsector.

This process is shown by.

Figure IV.16
Integrated Process to Establish the Aggregated Baseline for the Transport Sector



(own elaboration)

The benefits of a bottom-up approach to estimating CO_2 have been described earlier. However, for some sub-sectors, data may be insufficient for a full disaggregation along the ASIF parameters. In this case, a top-down estimation can be conducted for specific sub-sectors (e.g. based on fuel sales data) and aggregated with other sub-sectors. For example, the air and water transport sub-sectors use a separate “bunker” of fuels to road transport. Hence, data on such bunker fuels can be used as a direct surrogate for emissions from those sub-sectors.

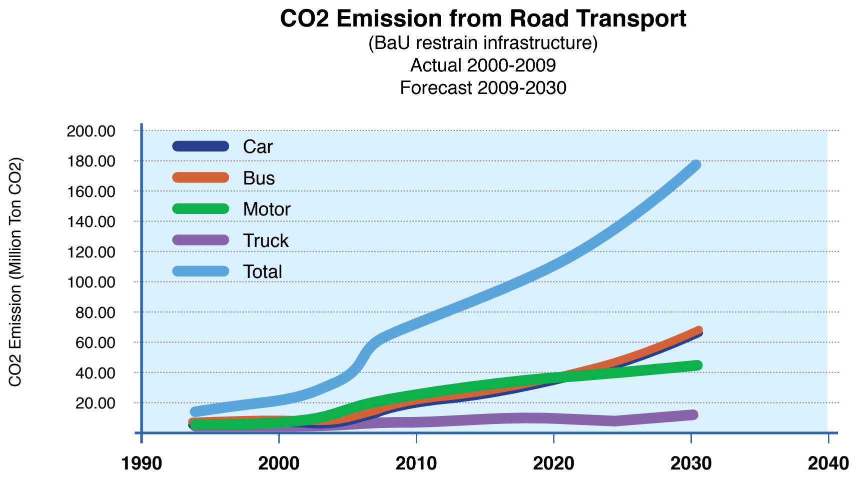


Figure IV.17

Baseline for Road Transport Subsector Developed in KEMENHUB (2010)

This bottom-up aggregation process could build on existing efforts. For example, attempts have been made by KEMENHUB (2010) to develop a BAU baseline for the road transport sector (Figure IV.17). That report includes various assumptions on traffic growth, modal split, vehicle efficiency, fuel split and infrastructure constraints. It also identified the key challenges associated with setting the BAU baseline – especially with regards to data availability on travel activity – which is a key requirement for measuring emissions via a bottom-up process[10].

Data availability

Existing studies show that a fundamental barrier for a full bottom-up emissions estimate is data availability. Data relevant to estimating CO_2 emissions from the transport sector is, and has historically been, collected by several ministries and projects. However, there are some significant gaps in the data that is required to compiling a reliable BAU baseline using a bottom-up approach. If these data gaps are to be addressed, it will be important to clearly identify who is responsible for collecting the data, in what format, and to ensure that the data collection is undertaken on a regular basis.

To enable the bottom-up approach for estimating CO_2 emissions, a number of priority datasets are considered to be important, including:

- Private Vehicle Numbers by Type: The number of vehicles registered each year can be obtained from National and Regional Police. However, this dataset is not thought to be an accurate reflection of the national vehicle fleet, because it can include double counting of second-hand vehicles bought and sold. It would be beneficial to be able to more accurately quantify the national fleet by vehicle type on an annual basis.
- Road Transport Activity by Vehicle Type: There is no information at the national level which provides average annual vehicle kilometre or fuel consumption data by vehicle type. This can be considered a key dataset to develop.

[10] This study only covered the road transport sector as it is the largest subsector in terms of CO2 emissions. To develop an aggregated baseline for the whole of the transport sector, this would need to be complimented with further analysis of the remaining sub-sectors, such as rail, water and air transport. Furthermore, the baseline development would benefit from disaggregating the data by region and locality, so that local policies and their contributions to the overall mitigation target could be made more explicit.

- Road Transport Fleet Age Profiles: Currently sales data can be obtained for private vehicles (e.g. based on data from GAIKINDO). But there is no easily accessible data which provides information on the age profiles of the vehicles. Having this data will allow more representative fuel efficiency figures to be attributed to vehicles of different ages.
- Road Transport Speed Profiles: Vehicles operate with different fuel efficiencies at different speeds. Consequently, a bottom-up approach to estimating emissions needs data on speed. Traffic count data which also logs speed information can be used to characterise typical speeds on different road types. The time spent on different road types, and therefore at different speeds can then be estimated for use in the bottom-up calculation of CO_2 emissions.
- Projected activity data: For road transport, some projections have been made, but this has been part of individual projects (such as the transport master plan for Jakarta), and is not a dataset that is generated on a regular basis. In addition, a significant amount of the projected data lacks sufficient transparency on assumptions and inputs.

Annual activity data for non-road transport modes (shipping[11], aviation and rail), in the form of fuel consumption and electricity use, are thought to be readily available from national fuel balances. As a result, these modes are relatively well characterised in terms of CO_2 emissions.

POTENTIAL MITIGATION ACTIONS

The anticipated growth in transport related GHG emissions will require efforts from a wide range of stakeholders in Indonesia if there is to be a move towards a sustainable transport system that mitigates CO_2 emissions and delivers wider co-benefits; including improvements in safety, air quality, noise, vibration and congestion.

As noted in ICCSR (2010), there are three primary strategies in the transport sector that can be pursued to bring about such improvements – Avoid, Shift and Improve. The principles behind these three strategies, as well as the practical steps for their implementation are described by Table IV.11.

Table IV.11
The Avoid, Shift, Improve strategy

Strategy	Principle	Practical steps
Avoid	Avoid or reduce travel by reducing the need to travel	Avoid unnecessary generation of VKM through integration of land use and transport planning. Develop new urban areas around transit corridors (Transit Oriented Development)
Shift	Shift to more environmentally friendly modes of transport	Enable conditions for the lowest-emitting modes (both freight and passenger) Prevent shift from NMT (such as walking and cycling) and public transport (such as buses, rickshaws etc) to private vehicles via improving the quality of public transport including paratransit.
Improve	Improve the energy efficiency of transport modes and vehicle technology	Ensure future vehicles/fuels are cleaner, encouraging small efficient vehicles (including 2 wheelers which are used frequently in Asian countries). Design innovations for traditional NMT such as cycle rickshaws.

Source: Dalkmann and Sakamoto, 2011

[11] Some leakage may be expected for small craft, which are sometimes supplied with fuel from conventional petrol stations (for surface transport).

The Figure IV.18 illustrates some possible measures and how they relate to the strategies of Avoid, Shift and Improve. Note that some measures influence more than one strategy; for example a fuel tax can help to reduce the volume of traffic, shift passengers to public transport and incentivise vehicle manufacturers to improve the fuel efficiency of cars they sell.

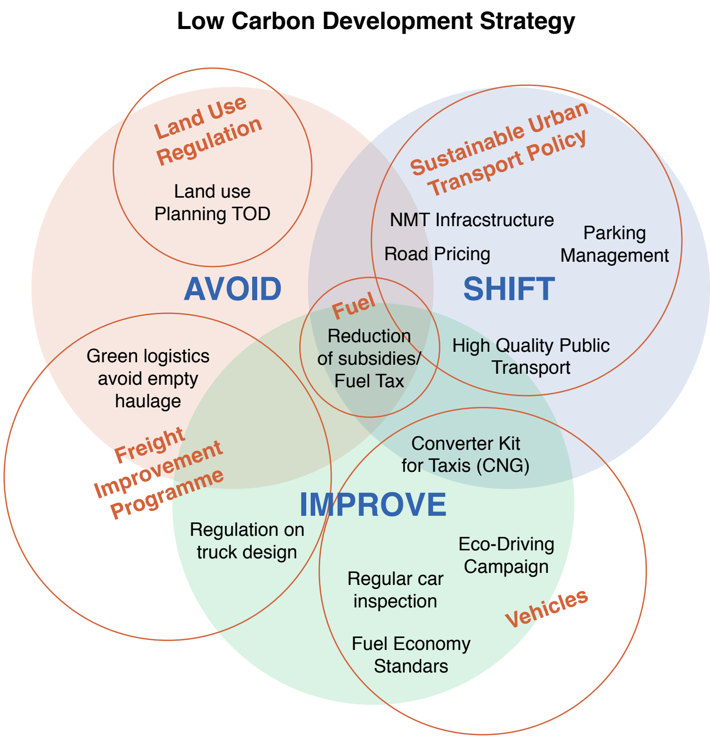


Figure IV.18

Example Measures for Mitigation in the Transport Sector

Such measures can be thought of as potential NAMAs in the transport sector. In fact, the Indonesian Government in its submission to the UNFCCC in early 2010 has already submitted a number of potential NAMAs, including "shifting to low-emission modes of transport"[12].

The ICCSR (2010) provides a list of possible mitigation actions in the transport sector. A further list was developed for the RAN-GRK, including a suite of measures that have the potential to mitigate transport emissions. These contain a mixture of measures at both national and local level, as well as under each of the Avoid, Shift and Improve strategies. However, as described later in this section, it will be important that the impacts of these actions and measures are estimated, in terms of both mitigation potential and sustainable development.

Aligning mitigation actions with the NAMA process

Based on these initial efforts to describe potential mitigation actions in the transport sector, the following steps may prove useful in aligning the development of sustainable, low carbon transport policy in Indonesia with the International NAMA process:

[12] In association with the Copenhagen Accord. Based on the outcomes of subsequent UNFCCC negotiations there are likely to be further opportunities to make additional (more detailed) proposals on NAMAs relating to Indonesia's transport sector.

1. Conduct a screening exercise of existing transport measures within the country, and see which of these could contribute (either currently or in the future) to CO_2 mitigation. The screening should ideally extend to the local level (e.g. municipal governments) as many interventions in the transport sector are conducted at this level.
2. Based on the first step, revisit the current list of proposed mitigation actions, and compare them against published lists of international best practice[13]. Based on this comparison, consider further actions that could be taken in Indonesia.
3. Estimate, quantitatively, the CO_2 emissions from the transport sector under BAU assumptions, as well as the impact of the identified mitigation actions on CO_2 emissions (see next section).
4. Combine the information on CO_2 mitigation impacts with other criteria related to sustainable development (for example traffic safety, energy security, health benefits or environmental impact) and prioritise/rank the measures[14].
5. Identify a combination of actions that would allow the transport sector to mitigate CO_2 emissions up to or even beyond a given target[15].
6. Identify the key barriers for the implementation of these actions, and identify the need for international support (e.g. capacity building, technology transfer and financing).

Estimating emission reductions

With suitably detailed bottom-up emission projections for different transport modes, it is possible to investigate the impacts of potential mitigation actions, noting that additional data may be required for actions that are taken locally/regionally.

For Avoid and Shift measures it is usually necessary to understand and quantify the behavioural response to particular measures. It is therefore generally more difficult to estimate the impact of these measures with a high degree of certainty.

For example, if a BRT was introduced, then it is not difficult to estimate the emissions from the new scheme by using the methods outlined above, combined with information on the details of the scheme (how many buses are expected to run, and how many kilometres etc). But it is also necessary to calculate the emission savings from reducing the number of private car kilometres. This is easy if the number of kilometres saved is known. However, estimating the number of kilometres of private cars saved is difficult. This kind of information would need input from local sources to improve reliability.

To date, there have been initial attempts by KEMENHUB and SUTIP to estimate the emission reduction potential of the measures listed in the RAN-GRK and ICCSR. However, largely due to a lack of data to accurately implement a bottom-up methodology, these estimations have so far relied on approximations and general

[13] For example Dalkmann and Brannigan (2007), see http://www.sutp.org/

[14] One basic approach when ranking measures would be to prioritise an action's CO2 mitigation potential or abatement cost. However, this could ignore other important priorities such as traffic safety or congestion relief. In general, measures to mitigate CO2 can benefit these other goals, but it is important that other sustainable development priorities are formally accounted for in any NAMA selection process. A multi-criteria analysis is one approach to balancing and weighing these different criteria.

[15] There is currently no formal target for the transport sector's contribution to the national mitigation ambitions. Whether and how such a target is set will depend on the overall framework for target setting.

estimates from existing literature and data sources, which may not be accurate enough for the purposes of prioritising mitigation actions.

PROPOSED KEY INDICATORS

To judge the effectiveness of policies at reducing CO_2, a number of indicators may prove useful in monitoring. These come directly from the bottom-up estimation process, as they are also the key inputs to the estimation process. The proposed key indicators exist alongside the ASIF parameters shown earlier, and are summarised in Table IV.12 below.

Table IV.12
Proposed Key Indicators

Activity (A)	Structure (S)	Intensity (I)	Fuel intensity (F)
• Vehicle kilometres travelled (vkm) per annum, person-km travelled (pkm) for each type of mode and vehicle type and ton-km transported for freight	• Modal split (which can be derived from the aforementioned activity data by mode	• Km/litre of fuel for each type of mode of transport, and further by vehicle type	• CO2/litre of fuel, for each fuel type

Secondary indicators may be desirable for specific emission reduction scenarios. Table IV.13 gives examples of secondary indicators for a hypothetical smart growth strategy.

Table IV.13
Proposed Secondary Indicators

Strategy	Indicator
"Avoid Strategy", example: Smart growth	• Reduce of vehicle km travel per person over time at the metropolitan and national levels • Number of units developed in purpose-built mixed-use projects • Number of public transport corridors achieveing an TOD (transit oriented development) around stations • Reduction in average freight trip distance regionally and nationally

Current levels of data availability and methodological developments may already allow some transport NAMAs in Indonesia to be subject to MRV, especially those that relate to the Improve strategy. However, challenges remain in conducting MRV activities for actions associated with the Shift and Avoid strategies (Table IV.14).

Table IV.14
Overview of current MRVability in the transport sector

Strategy	Avoid/Shift	Improve
Local measures	• Requires bespoke studies, but substantial levels of data already available. • Challenges exist in incorporating impacts into assessment at the national scale.	• Can rely on a top-down approach. Some NAMAs can be MRVd where localised data is available.
National measures	• Requires substantial collection of new data to characterise vehicle activity by mode.	• Can rely on a top-down approach Some NAMAs can be MRVd with currently available data.

Observing the current limitations in data and forecasts, a number of recommendations can be made with regards to improving MRV in the transport sector. Each of the aspects proposed below would need to cover all sub-sectors of transport (road, rail, water and air) to allow an aggregated BAU baseline for the entire transport sector to be developed.

1. National Data Collection Framework: A comprehensive screening of the currently available data in the transport sector would allow datasets to be identified which need improvement or need to be developed. A framework could then be agreed which assigns responsibility for the collection of each dataset, the details of that dataset, to whom it should be reported and the timeframes for reporting. An initial assessment of the current data gaps, especially for road transport, was provided earlier in this chapter.
2. Projections: A similar exercise should then be undertaken with regards to collecting data relevant for calculating projections, including for example data on: infrastructure projections, macroeconomic factors (population, GDP etc.), projected vehicle ownership rates, amongst others.
3. Develop a consensus on assumptions: The assumptions behind these datasets need to be clearly presented, and importantly these data need to be fully endorsed by the different Ministries contributing to their calculation. In this way, a single set of national projections can be made using consistent data across the different source sectors.
4. Supporting tools: There are a range of tools that could be considered for use as part of the national framework for estimating CO_2 emissions. At the local level, such tools may take the form of urban transport models that allow for the modelling of local traffic flows and speeds, with CO_2 as a key output. At the national level, a national transport model could be used to determine the CO_2 emission profiles for each mode of transport.

Assessing the impacts of NAMAs acting at the local level will require similar datasets, but for a specific region or location. However, many of the local level NAMAs are likely to be related to modal shifts, and the necessary data is highly dependent on the specifics of the NAMA that is introduced. As a result, bespoke modelling at the local level may be needed to obtain an accurate estimate of the reduction in CO2 emissions that can be achieved.

Last but not least, a strong coordination process across the transport sub-sectors, between national and local levels of government, and between the various ministries relevant to the transport sector (e.g. Ministry of Transport, Ministry of Public Works, Ministry of Industry and Ministry of Energy) will be required to build consensus on transport NAMA options and the ways to MRV them.

POLICIES, MEASURES AND INSTRUMENTS

Within the three broad mitigation strategies of avoid, shift and improve, a number of types of transport measures and policies can be identified. Often, a combination of these measures is used in the transport sector to mitigate CO2 emissions. Types of transport measures include:

- Planning measures, that include land use planning and transit oriented development;
- Regulatory measures, including emission standards, traffic rules/regulations such as on speed, parking, road space allocation, as well as on production processes for vehicles;
- Economic measures, including fuel/vehicle taxes, congestion/road pricing, subsidies for public transport etc;
- Information measures, including public awareness campaigns for public transport, mobility management and marketing schemes and eco-driving schemes; and
- Technological measures, including improvements to fuel, vehicles, and infrastructure.

When defined in more detail, individual measures or combinations of them provide a starting point for developing potential NAMAs. Evaluation of the reduction potential from different NAMAs, and their associated costs are two of the most easily quantified criteria for the prioritisation of NAMAs in order to achieve emission reductions in the transport sector. However, in assessing priorities, a number of other aspects should also be considered:

1. National appropriateness: what is the contribution of the proposed mitigation actions to sustainable development? For example the impact on other issues such as air quality, congestion and road safety.
2. Sectoral appropriateness: the MRV process and methodology to be applied to the transport sector needs to take into account the current situation in terms of data availability, the anticipated time and effort needed to collect new data, as well as the priorities of the Ministry of Transport. The MRV process should encourage, and not hinder the development of NAMAs in the transport sector.
3. Ease of implementation: what barriers are there for implementing the proposed mitigation actions or policies? These could include the level of political/public acceptance, technical practicalities (example land acquisition, availability of technology, and disruption to existing infrastructure) and the ability to define a workable and effective MRV approach.
4. Timescale: the benefits that result from implementing a NAMA may be spread across a long period of time, or can be delivered more immediately. The need to achieve short term emission reduction targets may need to be balanced with the longer term benefits provided by a certain action or policy.

IV.5 WASTE SECTOR

BACKGROUND AND OUTLOOK

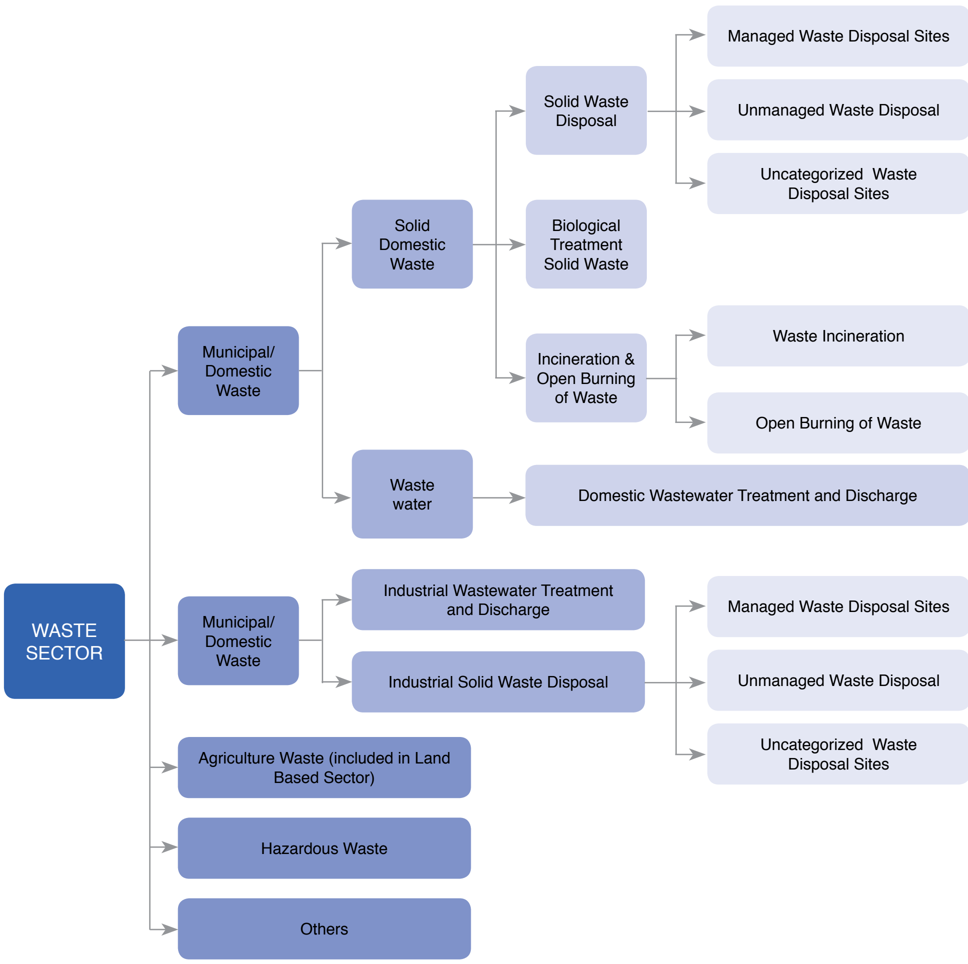
The waste sector contributes to GHG emissions through activities such incineration and open burning of waste, wastewater treatment and discharge, biological treatment of solid waste, and from decomposition of organic waste in solid waste disposal (IPCC, 2006a). Waste is also a potential resource, much of which can be recycled and reused.

Waste can be divided into several main categories according to its type and character, how it is regulated and the way in which it is handled. These are municipal/domestic waste, industrial waste, agriculture waste, hazardous waste and others (Figure IV.19). In this report, the overall waste sector is considered to include municipal/domestic waste and industrial waste; agriculture waste is included in the land based sector.

Waste streams begin at the point of generation, flow through collection and transportation, separation for resource recovery, treatment for volume reduction, detoxification, stabilization, recycling and/or energy recovery and terminate at solid waste disposal sites (SWDS).

Figure IV.19

Structure of Categories within the Waste Sector (modified from IPCC 2006a)



In Indonesia the waste sector contributes around 11% of total national GHG emissions and is the fourth largest emitting sector (SNC, 2011). In addition to offering opportunities for GHG mitigation, the sound management of waste is of high importance to local governments because of environmental and health related aspects. The potential for GHG mitigation alongside sustainable development goals make the waste sector relevant for the design of the Indonesian NAMAs.

Municipal solid waste

Currently there are about 400 landfills in Indonesia and almost all are using the open dump method; only a small portion are sanitary landfill (ICCSR, 2010). The solid waste management services in Indonesia are authorized and supervised by local governments including collection, transportation, treatment and final disposal of the waste.

In 2005, about 50% of domestic solid waste in urban areas and 20% of domestic solid waste in rural areas was collected by government authorities and transported to final disposal areas. Of this waste that is collected by government authorities in urban areas, 45% was processed in open dump sites, and the rest was recovered, composted, burned or processed at sanitary landfills. From the solid waste collected by government authorities in rural areas, 10% was burned at the polling stations and landfills and the rest was left at open dump sites, composted or other treatments. The remaining solid waste in urban areas and rural areas was not managed by the government, but by communities (Table IV.15).

Year 2005	Unit	Urban	Rural
Domestic Solid Waste generated	Kg/capita/day	0.6	0.3
Increase of domestic solid waste generated per year	%	2.5	1
Domestic Solid waste transported collectively	%	50	20
Increase of collectively transported domestic solid waste per year	%	2.5	1
Domestic Solid waste managed collectively in 2005			
• Inorganic recovered	%	3	0.5
• Organic composted	%	1	5.5
• Burned at polling stations and landfills	%	0.5	10
• Covering open dumping	%	45	4
• Covering sanitary landfill + Biogas capture	%	0.5	0
Total		**50**	**20**
Domestic Solid waste managed by community in 2005			
Inorganic recovered	%	3	5
Organic composted	%	1	40
Burned	%	5	20
Discharged into rivers channels	%	1	5
Hide anywhere	%	40	10
Total		**50**	**80**

Table IV.15

Municipal Solid Waste Management Condition in Indonesia in 2005

Source:

ICCSR, 2010

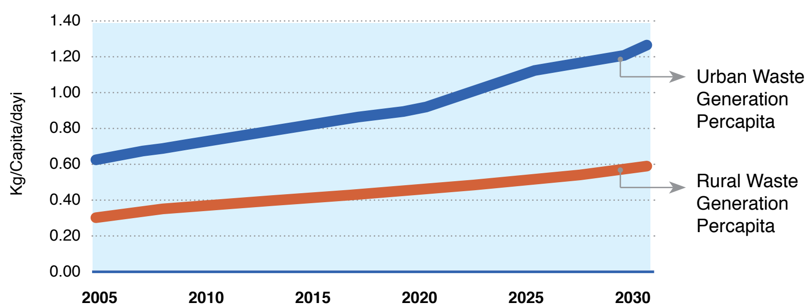


Figure IV.20

Prediction of Urban and Rural Solid Waste in Indonesia until 2030

Source:

ICCSR, 2010

Incomplete data for Municipal/Domestic Solid Waste (MSW) in Indonesia makes it difficult to accurately determine GHG emissions from the waste sector. The available MSW data is from several big cities only. The exact volumes of MSW generated from other cities and rural areas of Indonesia are not available. Therefore, the volumes of

MSW from the cities where the data is not available are estimated from the population and default value of average MSW generation per capita (SNC, 2011). For example, IPCC 2006a provides default values of average MSW generation per capita by country. For Indonesia, the default value is 0.28 tonne/capita/year (IPCC, 2006a).

The Indonesia Climate Change Sectoral Roadmap (ICCSR, 2010) differentiated the default value for urban and rural areas. Based on the analysis (Figure V.23), it was estimated that in 2005, urban activities generate 0.6 kg/capita/day of urban solid waste and this is expected to increase to 1.2 kg/capita/day in 2030. While in rural areas, the solid waste generation was estimated to increase from 0.3 kg/capita/day in 2005 to 0.55 kg/capita/day in 2030 (ICCSR, 2010).

From the projected population data and default factor of MSW generation rate, the total amount of solid waste generated can be estimated (Table IV.16). This total MSW is then converted into GHG emission estimates based on the use of default DOC (degradable organic content) factors provided by the IPCC.

Table IV.16

Estimated MSW in Indonesia for the years 2000-2005

Year	Population	MSW Generation Rate (Ton/cap/year)	Waste Generation (Mega Ton/year)
2000	205,132,458	0.28	57.44
2001	208,647,000	0.28	58.42
2002	212,003,000	0.28	59.36
2003	215,276,000	0.28	60.28
2004	217,854,000	0.28	61
2005	220,923,000	0.28	61.86

Source: SNC, 2011

Waste management in Indonesia is currently implemented to improve public health, prevent environmental pollution, and protect clean water resources as stated in Act No. 32/2009 on Environmental Management. Waste management is specifically regulated in Act No. 18/2008 on Waste Management and prior to this act, regulation (PP) No.16/2005 had focussed on protecting water resources from pollution due to landfill. However, none of this legislation has been designed to address climate change.

Domestic and industrial wastewater

In Indonesia, domestic wastewater constitutes a large portion (approximately 80%) of total wastewater. A smaller part (5%) derives from the public and commercial sectors and the remainder (15%) from industry (SNC, 2011). When considering GHG emissions from wastewater, it can be a source of methane (CH_4) when treated or disposed of un-aerobically. It can also be a source of nitrous oxide (N_2O) emissions. Carbon dioxide (CO_2) emissions from wastewater are not considered because there are of biogenic origin and should, therefore, not be included in the total emissions of the waste sector (IPCC, 2006a).

Based on existing available data from the Department of Public Works, 12% of total domestic wastewater in urban areas is treated through off site sanitation (sewerage system) and 54% with septic tanks (individual and communal). In rural areas, on site sanitation using private and communal septic tanks is around 54% and offsite sanitation is not yet implemented (SNC, 2011).

The National Water Resources Management Act No. 7/2004 makes it clear that wastewater management is very important for freshwater resource conservation. The water resource management system and, in particular, the drinking water supply is controlled by Regulation No. 16/2005. Government Regulation (PP) No. 82/2001 requires industry to achieve certain quality standards for industrial wastewater before it is discharged into rivers or water bodies (TNA, 2010).

GHG EMISSIONS TREND

GHG emissions from Indonesia's waste sector in the year 2000 were approximately 157,328 Gg CO_{2eq}. The vast majority (97%) of these emissions were in the form of CH4 and the remainder was CO_2 and N_2O (SNC, 2011) (Table IV.17). However, a lack of data industrial and commercial activities means that the GHG emissions from industrial wastewater are estimated using the assumption that the wastewater from industrial activities is 15% of the total wastewater. The main source of GHG emission from the overall sector is industrial waste water treatment (WWT) and discharge. CH_4 and N_2O emissions are mainly from domestic and industrial WWT and discharge, while CO_2 emissions are mainly from open burning of MSW.

Table IV.17

Estimated GHG emissions from the waste sector in 2000

Sources	Emission (Gg)		
	CO2	CH4	N2O
Managed Waste Disposal Sites	-	-	-
Unmanaged Waste Disposal Sites	-	589.23	-
Uncagegorized Waste Disposal Sites	-	-	-
Biological Treatment of Solid Waste	-	4.22	0.32
Waste Incineration	-	-	-
Open Burning Waste	1662	62.34	1.44
Domestic Waste Water Treatment and Discharge		459.59	6.3
Industrial Waste Water Treatment and Discharge		5904	
Total	**1662**	**7020**	**8.05**
Total CO2eq	**1662**	**153164**	**2501**
Total CO2eq from waste sector		**157328**	

Source: SNC, 2011

There are several projections and estimates of future GHG emissions from the Indonesian waste sector. Some of these projections could provide a starting point for developing BAU emission baselines or estimating emissions from mitigation scenarios. The following sections describe the estimated waste sector developments and resulting GHG emissions over coming years, based on the available studies.

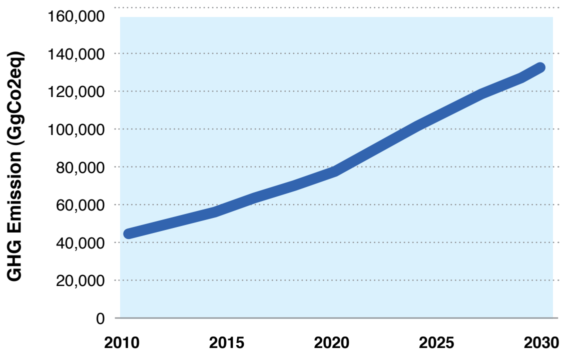
Municipal Solid Waste

In the ICCSR (2010), the GHG emissions trend for MSW in Indonesia has been calculated based on a projection of population growth in urban and rural areas. This projection was converted into an estimated volume of MSW. Assumptions relating to emission factors, activity data and sector development were used in developing the final MSW projection. The assumptions used for estimating the GHG emission trend in solid waste sector in urban area include (ICCSR, 2010):

1. Final disposal areas (SWDS) predominantly use open dumping; only a small percentage are sanitary landfill (the percentage of total collected waste treated in sanitary landfills is assumed to grow from 0.5% to 0.9% from 2005 to 2030).
2. The solid waste collected and transported by government authorities is assumed to increase from 50% to 80% to 90% in 2005, 2020 and 2030 respectively.
3. Solid waste combustion or open burning at SWDS is assumed to increase from 0.5% to 0.8% to 0.9% in 2005, 2020 and 2030 respectively.
4. The small portion of waste (1%) that is biologically treated/composted in SWDS or by communities in 2005 is estimated to remain the same in 2030.

Figure IV.21

GHG Emissions projection for MSW in urban areas

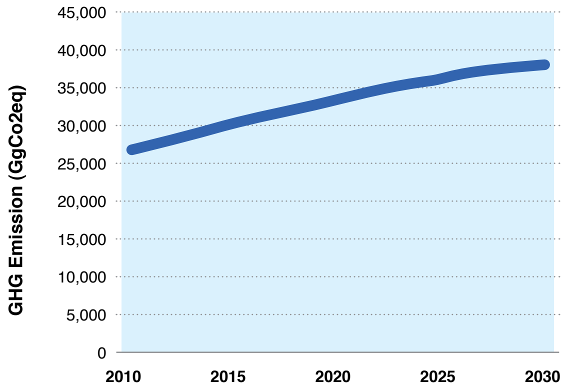


Source: ICCSR, 2010

The resulting GHG emission trend for MSW in urban areas can be seen in Figure IV.21. When the same assumptions are applied for rural area they give the trend shown in Figure IV.22.

Figure IV.22

GHG emissions projection for MSW in rural areas



Source: ICCSR, 2010

Domestic and Industrial Wastewater

The projected emissions from domestic wastewater (Figure IV.23) can be determined from population growth and the corresponding treatment services. One of the factors that was considered in the domestic wastewater projection in Figure V.26 is a target from the Millennium Development Goals, which states that 80% of the community should receive wastewater treatment services by the year 2015 (TNA, 2010).

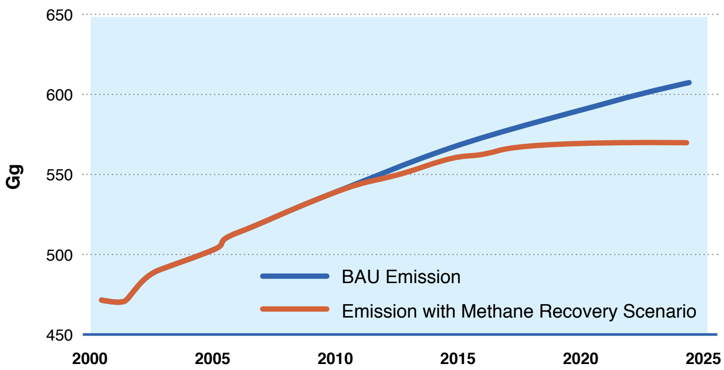


Figure IV.23
Domestic wastewater CH4 emissions

Source: TNA 2010

An emissions projection for industrial wastewater it not yet available. Further data collection and analysis is required in order to allow an assessment of future BAU emissions and the corresponding mitigation potential.

There are large uncertainties with respect to direct emissions, indirect emissions and associated mitigation potentials for the waste sector. This represents a barrier for the design of NAMAs in the sense that it is difficult to determine the efficacy and cost of a certain mitigation action. These uncertainties could be reduced by consistent national definitions for characterising waste, coordinated local and national data collection, standardized data analysis and field validation of models. At present there is no national inventory covering annual emissions and its methods for the waste sector, so these emissions are often not well understood. Future efforts to improve this situation will be important in developing the necessary underlying data in support of a reliable BAU baseline. Efforts may need to go beyond traditional considerations of GHG emissions in the waste sector, to include aspects such as anaerobic biodegradation of chlorofluorocarbons (CFCs) and hydro chlorofluorocarbons (HCFCs) in landfill settings.

BASELINE CONCEPT AND METHODOLOGY

Setting a BAU baseline for GHG emissions from the waste sector is an essential step for assessing GHG mitigation scenarios and actions. One possible approach would see the BAU baseline developed based on projections of historical data and population growth, as well as estimates of future waste management habits, such as MDG targets for domestic wastewater treatment or implementation of Act No. 18/2008 for MSW.

Using a bottom-up approach, the BAU baselines of the individual MSW and industrial/ domestic wastewater sub-sectors – as well as estimates for the remaining waste sub-sectors – would be aggregated in order to determine the overall baseline for the waste sector.

Municipal solid waste

When determining the BAU baseline for the MSW sub-sector (MSW) it is important to consider:

- Total waste generated and its composition, or population data and waste generation rates,

- Existing waste management practices and future plans for waste management including: (i) transportation of waste; (ii) processing of waste; (iii) and practices such as combustion of waste or biological treatment of waste,
- The current and future split fraction of waste transported to landfill and type of landfill,
- The current and future split between collectively waste managed and self- or community-managed waste.

The IPCC (2006a) provides a so-called First Order Decay (FOD) methodology for calculating the actual GHG emissions in the waste sector from the above information. This approach was used in developing the emissions estimates presented earlier in this sub-chapter; the ICCSR emission factors for each solid waste management activity were used to calculate the overall emissions from solid waste.

The national BAU baseline for MSW sub-sector can be aggregated from sub-national (local government) level estimates. However, since the availability of data related to waste varies greatly across Indonesia, a mixed approach – using some elements of a top-down approach – can be useful in providing emissions estimates where sufficient data is not available. The suggested steps to develop a BAU baseline for the MSW sub-sector include:

1. Calculation of the total amount of municipal solid waste based on the historical population data and solid waste generation rate;
2. Development of projected emissions based on an assumed waste management scenario including, waste collection, transportation, processing, and disposal.

Domestic and Industrial Wastewater

A similar approach can be taken for developing a BAU baseline for domestic wastewater emissions. One key difference is that domestic wastewater management is addressed at the national level. Activity data that needs to be identified to develop the BAU baseline include:

- Population data and projections;
- Current and future domestic wastewater management practices, in particular the percentage of onsite and offsite wastewater treatment.

To determine a BAU baseline for industrial wastewater, the current emission characteristics from the major industrial wastewater sources should be identified along with their future development. According to IPCC (2006a), the major industrial wastewater sources with high CH_4 generation potential include:

- Pulp and paper manufacturers
- Meat and poultry processing (slaughterhouses)
- Alcohol, beer, starch production
- Organic chemicals production
- Other food and drink processing (dairy products, vegetable oil, fruits and vegetables, canneries, juice making, etc)

For industrial wastewater, close coordination with the industrial sector will be required in order to improve data quality and availability. The process to determine a BAU baseline for industrial wastewater should mirror the approach used in developing a baseline for the industrial sector, whereby future demand and supply should be balanced, possibly through the assumption of additional production capacity.

Figure IV.24 illustrates the process establishing an aggregated BAU baseline for the waste sector.

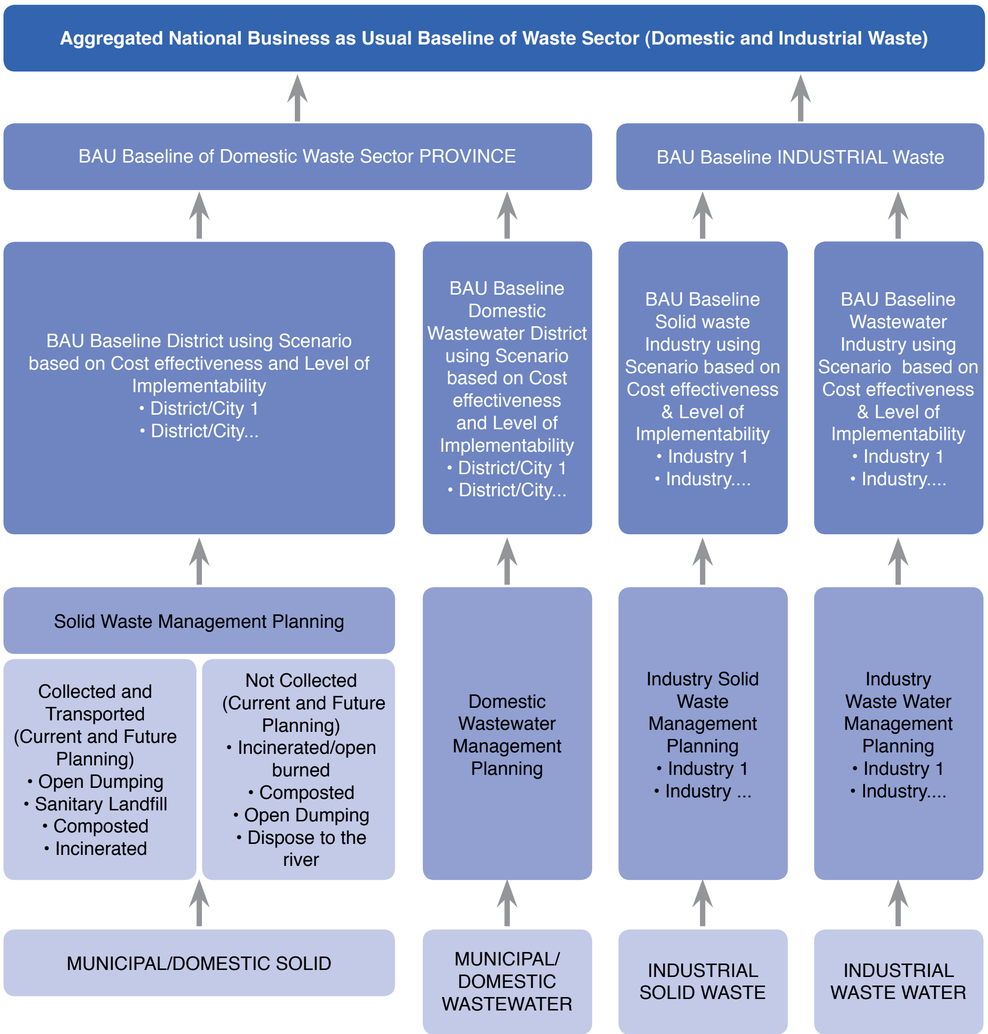


Figure IV.24
Process in Establishing the Aggregated BAU Baseline of Waste Sector

POTENTIAL MITIGATION SCENARIOS

Emission reduction efforts in the waste sector should be embedded in a broader approach to sustainable waste management. Local involvement is particularly important in the waste sector for implementing the mitigation actions as many of the potential interventions or measures are implemented at this level. MSW can also be considered as a potentially valuable resource that is largely unused. This suggests that there are potential economic savings that could come from realizing increased value from waste through enhancing recycling and energy recovery. Such actions would also act to reduce GHG emissions.

Any potential mitigation scenarios can incorporate a number of possible actions and measures including, amongst others:

1. Strengthening and encouraging efforts to de-link economic growth and waste generation.
2. Accelerate a shift to sustainable consumption patterns (SCP). Any waste reduction scenario should ideally address the whole life cycle, beginning with minimization of waste – including through eco-efficient product design – and continuing through to recycling and reuse, with disposal only of those residuals that are not recyclable or reusable at acceptable cost and then only in an environmentally and socially sound manner. Closed loop systems based on industrial ecology – where one firm's or industry's waste becomes other firms' or industries' raw materials – are a useful model to which to aspire.
3. Provide basic infrastructure and services for waste collection and disposal.
4. Encourage waste reduction through composting of organic waste; which is a sizeable portion.

More specifically, in urban areas, potential mitigation actions can include:

- MSW reduction at the source;
- Creating incentives for waste reduction which make waste minimization financially rewarding ;
- Apply the principles of the 3Rs (reduce, reuse, recycle) along with composting at the solid waste collection station and at the final processing station;
- Reprocess waste plastics into similar or different plastic products without modifying its initial chemical structure;
- Recycle waste plastic as raw materials, fuel oil and industrial feedstock by altering the chemical structure;
- Recycle metal waste to reduce mineral extraction from primary sources and processing;
- Convert open landfill to sanitary and controlled landfill; and
- Collect landfill gas (LFG or methane; $CH4$) from sanitary landfills to usable energy.

In addition, in rural areas, potential mitigation actions can include:

- Using biomass waste as soil improvement by method of soil cover (instead of burning crop residues after harvest) to inhibit the germination of weeds, protect soil microorganisms and help build up organic matter;
- Enabling composting for application to the soil as a fertilizing resource;
- The use of agricultural residues (biomass) as a source of material/energy

A mitigation scenario would then be built up from a number of potential mitigation actions. For any scenario it is important to understand the system abatement cost, considering the level of investment required and the projected operational and maintenance costs. The abatement cost gives a sense of the economic efficiency of the scenario in reducing GHG emissions. The abatement cost of the Emissions Reduction Scenario (ERS) can be calculated using the following equation, where the NPV is the net present value (at some assumed discount rate for costs).

$$\frac{[NPV\ (Total\ Cost\ of\ BAU) - NPV\ (Total\ Costs\ of\ ERS)]}{[NPV\ (Total\ Emission\ of\ BAU) - NPV\ (Total\ Emission\ of\ ERS)]}$$

It is important to note that abatement costs are not the only consideration when comparing and prioritising different mitigation scenarios. It will generally also be necessary to consider aspects such as: the impact of a scenario on sustainable development goals, the ease of implementation and timeframe for implementation. Different actions can have varying socio-economic, distributional, health, environmental and other impacts, higher or lower barriers to implementation and may lead to results (be these in terms of mitigation or development) in shorter or longer timeframes.

POTENTIAL KEY INDICATORS

Municipal Solid Waste

Potential key indicators are identified for five main aspects associated with the MSW sub-sector, namely: (1) waste source, (2) waste transportation, (3) waste processing, (4) reduce, reuse, recycle (3R) implementation, and (5) policies and laws. Key indicators in these categories could be used to evaluate and analyze the status of the municipal solid waste sector for a certain scenario. The key indicators should indicate the changes and effect of the mitigation actions in the MSM sector as well as provide a starting point for conducting MRV in support of NAMAs. Table IV.18 shows potential key indicators for the MSW sub-sector.

Quantitative	Qualitative
MSW Source Condition	
• Number of waste generated/reduced • Number of waste recycled and reused from the source point • Number of waste composted in the source point	• Policy on source reduction that is being implemented • Policy on 3R that is adopted and implemented • Responsible institution appointed • Capacity building on waste management in the community conducted
MSW Transportation Condition	
• Number of waste collected and transported to the final disposal area	
MSW Processing	
• Number of open dumping area has been closed and changed into sanitary landfill • Number of waste centrally composted • Number of waste incinerated	• Policy on open dumping closing adopted and implemented
GHG Mitigation Outcome	
• GHG emission reduction in tCO2/capita or tCO2/ton of waste	• Local decision for proposing local mitigation action in waste sector

Table IV.18
Potential Key Indicators for MSW Subsector

Domestic and industrial wastewater

The key indicators for domestic and industrial wastewater would have similar characteristics as MSW. Quantitative indicators would include volume of wastewater generated, wastewater treatment performance, and GHG mitigation outcomes (absolute GHG reduction as well as tCO2eq/capita for domestic wastewater and tCO2eq/ton production for industrial wastewater). Further work should be done to identify specific key indicators for domestic and industrial wastewater management.

POLICIES, MEASURES AND INSTRUMENTS FOR WASTE SECTOR

Mitigation of GHG from the waste sector represents a significant challenge for Indonesia with its growing economy, rising incomes, industrialization, rapid urbanization, and shift to more consumptive lifestyles all leading to rising waste volumes and changing the type of waste generated. For dynamic, urbanizing economies, defining a long-term mitigation strategy of waste sector for the coming decades is critical to fostering long-term mitigation efforts and sustainable waste management. An effective long-term GHG mitigation strategy should work alongside the operationalization of integrated sustainable waste management systems. Implementing waste management strategies requires coordinated efforts from local governments, national governments, civil society, the informal waste sector and the private sector. Understanding the scale of generation of various categories of waste – i.e. the availability of reliable data – is fundamental to formulating appropriate policies. Furthermore, conventional waste management systems and legislation were not designed for the mitigation of GHG and so will typically need to be modified.

Priorities, policy and regulatory frameworks, institutional capacities and “maturity” of the waste business are at different levels across Indonesia. It is important therefore that the right enabling framework is established on a timely and comprehensive basis to address local circumstances. To develop and implement potential mitigation actions in the waste sector, it is important to consider the following elements:

1. Defining a mitigation goal in the long-term waste management strategy within the broader contexts of sustainable waste management and development,
2. Improving waste management systems, infrastructure and technology, with GHG mitigation as a consideration,
3. Promoting the 3R’s of waste reduction, reuse and recycle,
4. Targeted management of specific wastes driven by GHG mitigation goals;
5. Capacity building and technology transfer for effective mitigation efforts,
6. Financing and investing in mitigation efforts within the context of sustainable waste management, and
7. Building partnerships with stakeholders to effectively implement mitigation efforts.

The conventional priority objectives in the policy field of waste management are to formulate and implement policies that promote waste prevention, minimization and good environmental status. However, in the future it will be important to integrate the goal of GHG mitigation in the waste sector as an important consideration for waste management.

IV.6 LAND USE, LAND-USE CHANGE AND FORESTRY

BACKGROUND AND OUTLOOK

The share of emissions from land-based sectors (Land Use, Land Use Change and Forestry – LULUCF, including peat fires and agriculture) is approximately 67% of total national emission (Figure IV.25), the largest of any sector (MoE, 2010). The land-based sub-sectors (including agriculture and estate, livestock, fishery and forestry) play an important role in the national economy, contributing 15% of total national gross domestic product (BPS, 2010). The sector also provided important growth after the 1997/98 crisis through a substantial increase in exports and employment opportunities.

However, it is argued that although land-based resources contribute considerably to country's total wealth, they are being depleted without significant proportional corresponding investment in human or tangible capital. Therefore, reducing emissions from the land-based sector through sustainable land management practices could offer important benefits for Indonesia, not only in terms of meeting climate change targets, but also by promoting more efficient use of land-based resources.

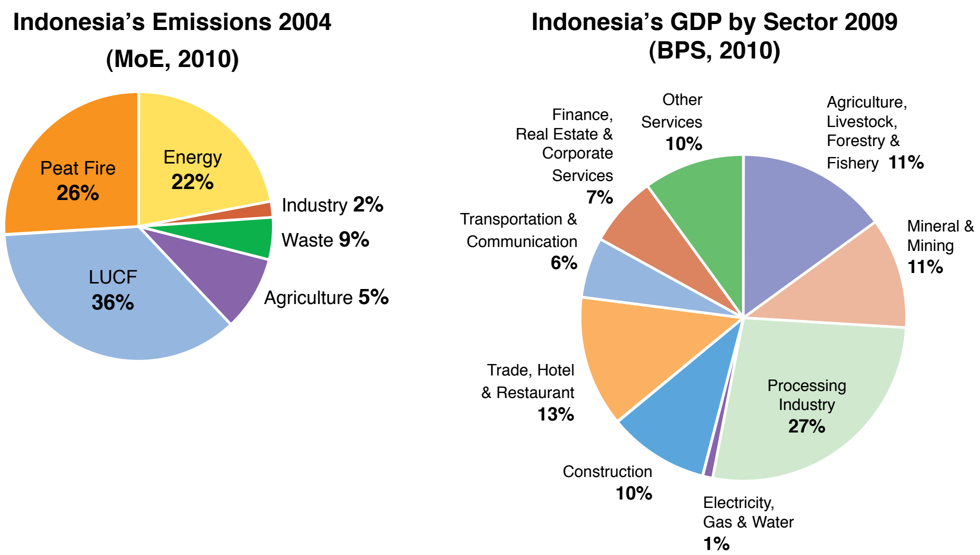


Figure IV.25
Indonesia's emission and GDP by sector

Source:

MoE, BPS 2010

Indonesia's land-based resources

Indonesia holds the third largest tropical rainforest worldwide (FAO, 2010), extensive peatlands, agroforest and agro-plantations. As a result, the land-based sectors also generate livelihood for local community and employment opportunities for rural populations. A study indicated that about 80 million people, or 38% of the total population in Indonesia, depend on forests and forest resources (Poffenberger, 2006).

The largest part of land-based resources, which represents about 70% of national territory falls under forestry sector authority (both at central government and local government level). The 'forest zone' can be defined by two main categories 'permanent forest' (including conservation, protection, and production forest) and 'convertible forest' (about 17% of the total forest zone) which is devoted to development and may be converted for other land uses such as agriculture, mining, settlements and roads. For agriculture areas, the land ownership status can be private rights (Hak Milik) or state owned (Hak Guna Usaha[16]/HGU).

Most of the forest zone was demarcated during the mid-1980s based on vegetation maps generated from remote sensing imagery and supported by biophysical data. According to the 1960 Basic Agrarian Law, any areas without legal titles issued by the National Land Agency (Badan Pertanahan Nasional – BPN) – including most areas with customary claims (tanah adat) – are included as forest zone. In the past, timber concessions, timber forest plantation and estate plantation were granted in areas occupied by rural or adat communities. Some of these areas also overlap with mining concessions and transmigration areas. Fay et al. (2000) shows that adat forests overlap with some 65 million hectares of timber industry areas, 15 million hectares of plantations, and with 48 million hectares of conservation and protected areas, including national parks.

Further, with the decentralization process, there are also disagreements about spatial planning across different level of governments or conflicts with local communities. In the last ten years, the Government of Indonesia has taken critical steps to deal with these political and governance problems. However, local governments still lack considerable capacity (human resources, institutional and financial capacity) to wield greater authority.

Although all forestland are managed under government authorities, its policy implementation differs under local governments, national government, concession holders, PERHUTANI[17], and private institutions. Conservation forests are managed under national government agencies, which have special units in charge of managing forests; the protection forest is managed under provincial government within Provincial Forestry Agency (Dinas Kehutanan) and its subordinates (Bagian Kehutanan Daerah). Production forest is managed under National Government with Provincial Forest Agency as the implementing institution. District/Kabupaten Governments are mostly in charge of community forest development and in some cases of protection forests; so far they don't have a large role over state forest management.

As few foresters are actually restricted from forests, forest management and forest control is currently weak. A new policy on forest management units (KPH), which aims at intensifying forest management, could provide a means to improve this situation.

Policies related to agricultural lands (such as policies related to food security, plantation expansion, prices for agricultural commodities, fertilizers and chemicals) are mostly under the responsibility of national government. Additionally, policies from other sectors and institutions (such as local governments, public works and mining) would also influence the utilisation and management of land-based resources and consequently emissions from land-based sectors.

[16] This is a right to cultivate on state land for agriculture and farming enterprises. The duration is maximally 25 years, extendable for 35 years, and should be registered at the Land Register at the National Land Agency (Badan Pertanahan Nasional/BPN). This area could be managed by state enterprise or private company, mainly as large scale plantation.

[17] Perum Perhutani is a State owned enterprise managing State Forests in Java and Madura on a commercial basis

The land-based emissions result from deforestation, forest and peatland degradation and other land-use activities through burning, decomposition of waste forest matter and soil degradation in cleared land, rice fields, and the use of fertilizer and chemicals in agricultural lands.

So far, land issues combined with the weak system of forest management in Indonesia over the last four decades has produced a large regression of natural forests from 145 million ha of primary forest[18] to currently about 75 million ha of secondary and primary natural forest in permanent forests. During the same period, forest lands area under "critical conditions" have grown; degraded forest lands now cover 59 million ha, including 32 million ha with no forest cover at all (MoFor, 2009).

A main driver of land change dynamics in Indonesia is wood extraction and expansion of agriculture. Forest fires, especially in peat-lands, are also important issues for Indonesia's land resources management and GHG emissions. The extent of peat areas is between 16.5 million to 27 million hectares (depend on peat definition used; usually related to the thickness). About 20 million hectares of peatland are covered by forest: 20% on convertible forest, 3% on protected forest, 7% on conservation forest, 32% on production forest, and 38% on forest outside of national forest estate (Areal Penggunaan Lain; APL). Agricultural activities have also used some peatland for food crops and estate development (such as rubber, oil palm and coffee).

Effective policy development involving all relevant stakeholders in the land-based sector is essential for the success of any land-based GHG mitigation strategy in Indonesia.

BASELINE CONCEPT AND ITS METHODOLOGY

In meeting national emission reduction target, it is likely that the largest fraction of the mitigation efforts will come from land-use based activities. However, a final baseline and allocation of GHG reductions for each sector have not yet been determined. The baseline[19] here is understood to be the BAU scenario, which is based on projections of what would happen without land-based mitigation policies and actions.

The baseline for land-base sector could, in principle, be determined at the national or sub-national level (province/district or region), following a bottom-up approach. Establishing a baseline at sub-national level would be more accurate, especially for a country such as Indonesia which covers large areas with diverse characteristics. The difficulty consists in ensuring consistency across sub-national levels and to link these sub-national baselines into a national multi-sectoral baseline. Many local governments lack the institutional, technical and human resources capacity to perform this type of anaylsis. The other concern would be also on how integrate 'leakage' issues from certain policies. For example, if the government of Kalimantan introduced actions to conserve forest area, how can the impact of these policies on the neighbouring provinces (such as market or population pressure) be calculated.

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[18] According to FWI/GFW (2002).

[19] The terms 'reference level' and 'baseline' are frequently used interchangeably in the REDD+ debate, but they can mean different things (see Angelsen, 2009; REDDnet, 2010). For the purpose of the land-based NAMAs concept in this report, (BAU) baseline has the same meaning as reference level.

A national approach is more suitable for minimizing the impacts of leakage issues on different sub-national baselines. For these reasons, namely to provide a national framework, to ensure consistency among local governments and to minimize leakage, it is proposed that the baseline for the land-based sector would be aggregated at the national level in Indonesia, composed of the different sub-national province/district baselines.

For Indonesia, the land-based sector baseline should be established on a historical baseline and be adjusted with other “national circumstances” such as outlooks for economic growth, and demography. Furthermore, any model would ideally also take into account both planned and unplanned drivers of land dynamics (such as forest fire). Table IV.19 illustrates three different approaches to establish national baseline for land-based sector.

Table IV.19
Different approach to establish land-based baseline

Approach	Advantages	Disadvantages
Historical: taking an average of past emission over an agreed time frame Example of model: SiHA, SpHA	• The simplest approach • Easier to address transparency	• Land use dynamics are not linear, the outcome could be hazardous as it depends on the reference period chosen • The situation would be different across regions (fairness – leakage)
Planned: Modelling based on planned activities to meet development goals over a specified time frame (for instance solely based on RPJM/RPJP/RTWP)	• Takes into account development objectives and economic analysis.	• Projections would depend on whether the drivers of deforestation/land degradation are planned or unplanned. Dynamics of these drivers are different across regions in Indonesia. • Such approach would reflect only a fraction of reality for BAU scenario in Indonesia
Mixed modelling: based on planned activities and taking into account unplanned activities as happen in the past considering also forest transition dynamics or distribution of remaining forest resources Example of model: GEOMOD, CLUEs, ICEE	• Takes into account both planned and unplanned drivers of deforestation and land degradation • Recognize variation among regions • It could allow optimum scenarios to be found. • Recommended by MoFor (2008)	• Complex model, • Requires precise information in regards to land use changes, carbon dynamics and its drivers in specific regions.

Source: MoFor, 2008

A wide range of models to establish BAU baselines are available, but only a few are appropriate for setting up a national baseline for the land-based sector. In the historical approach, the baseline is determined by calculating the mean relative rate of deforestation over a past reference period. For instance, some models using this approach are Simple Historical Approach (SiHA), Spatial Historical Approach (SpHA) and Joint Research Centre Approach (JRCS). However, the simple historical approach has been rejected by most countries; mainly by the Coalition of Rainforest Nations who proposed that the historical baseline should be adjusted by ‘development factors’. UNFCCC negotiations have agreed that the baseline should be based on historical data adjusted by ‘national circumstances’, so-called mixed modelling.

The approach that has been preferred is to use 'prospective methods' which combine information of past trends (e.g. ten years average) with anticipation about the future behaviour of land use change to predict the rate and location of changes (Huettner et al. 2009). The prospective methods can be grouped into two main categories:

1. Dynamic spatial land-use modeling, such as the Geographical Modeling (GEOMOD), the Land Change Modeler (LCM), the Conversion of Land use and Its Effect Model (CLUEs), etc.
2. Economic regression modeling, such as the Integrated Carbon Ecology and Economics model (ICEE). The model is able to stimulate the effect of policy scenarios on carbon fluxes from land use and to assess the benefit of predicting land use and measuring carbon. This model has been applied for Costa Rica.

GEOMOD and ICEE are arguably the most sophisticated models and offer the potential for more detailed assessment of a BAU baseline. However, there is a trade-off with employing increasingly complex models for the purposes of deriving national baselines: as model complexity increases and as inputs other than actual emissions are used, so increases opportunities for errors to be introduced.

There remains a significant challenge to coordinate the many different ministries that have an interest in the land-based sector to ensure that common understandings, definitions, parameters and assumptions are used. This will be necessary if a national aggregated BAU baseline is to be successfully determined for such a complex sector. Further information and research will be needed to improve data on historical land use change and the drivers of those changes.

Table IV.20 proposes steps and activities, as well as possible responsible institutions, that for establishing a BAU Baseline for the land-based sector.

Table IV.20
Steps to establish land-based baseline

Required Steps	Key Activities	Potential Key Actors
1. Review of historical land cover change	• Identify the current state of land use mapping	National & Local: MoFor, MoA, Bakosurtanal, BPN, Bappenas, PU, Bappeda
	• Review national land use classification framework consistent with carbon density (also refers to IPCC classification guideline) and on-ground economic activities - aggregated at provincial levels	National & Local: MoFor, MoA, Bakosurtanal, BPN, Bappenas, PU, MoE, Bappeda
	• Multi-period analysis on wall-to-wall system based on satellite remote sensing data, with sampling approach	National: MoFor, MoA, LAPAN, then communicated to local level
2. Analysis of historical trends and locations of deforestation; including the identification of the agents, drivers and conditional factors for deforestation	• Construct a matrix of land use change associated with deforestation rates, agents/drivers of the changes and economic activities in a landscape (e.g. NPV for each land class) - aggregated at province level	National & Local: MoFor, MoA, Bappeda, Universities, Research/ International Organisation (FAO, CIFOR, ICRAF)
	• Integrating information from steps 1 & 2	National: MoFor, Bappenas
3. Modelling future emissions	Projecting land use change based on various assumptions:	National & Local: Bappenas, Bappeda
	• Forest Spatial Planning (Forest Land Use by Consensus - Tata Guna Hutan Kesepakatan/TGHK) & National Forestry Planning (Rencana Kehutanan Tingkat Nasional/RKTN)	Ministry of Forestry
	• Spatial Land Use Planning (Rencana Tata Ruang Wilayah - RTRWP/RTRWN)	Ministry of Public Work, Bappenas, Ministry of Home Affairs, Bappeda
	• Development Planning (Renstra, RPJMN/D)	Sectors (MoFor, MoA, ESDM, PU, Ekuin, Transmigrasi, Bappenas, Local Governments)
	• Demography Data (population growth, rural employment, rural poverty)	BPS, UNDP
	• Macroeconomic Data (e.g. target economic growth per sector, GDP, inflation rate, discount rate, exchange rate, wage rate)	Ministry of Finance, Central Bank, Ministry of Coordinating Economic, BPS
	• Data on Forestry and Agricultural Products (Supply, Demand, Prices)	Ministry of Trade, Chamber of Commerce and Industry (Kadin)

The land-based emissions at provincial level should also be identified and spatially disaggregated in the process of setting up a national baseline and then building mitigation scenarios for the land-based sectors. Regional information is important to formulate the guidelines for local action plans (RAD GRK) and to indicate mitigation strategies at the national and provincial levels.

After establishing the national BAU and various mitigation scenarios for the land-based sectors as part of the national emission reduction scenario (Figure IV.26), the national government will need to communicate and consult on these results with local governments to get inputs for the guidelines for the local action plans (RAD GRK).

One study found that – for changes of above ground carbon stock between period 1990-2005 – more than 79% of Indonesia's emissions were produced by less than a third of the provinces of Indonesia (10 out of 33 provinces). The largest share of emissions came from Central Kalimantan (16%), Riau (14%) and East Kalimantan

(12%); while provinces such as Papua only contributed about 5% of the total national land-based emissions (Ekadinata and Dewi, 2011). In the future the share of emissions from Riau is likely to be lower again as less forest can be converted into other land-uses and infrastructure has been relatively well-established; while Papua's land-based emissions are likely to increase significantly as more forested area will be converted to establish infrastructure and agricultural/plantation areas.

Therefore, when moving from the national level to the regional level, emission reduction targets would need to be allocated based on not only historical deforestation in each province but also projections of future land-use change. Further detail on building up mitigation scenarios both at national and local levels is discussed in the next section.

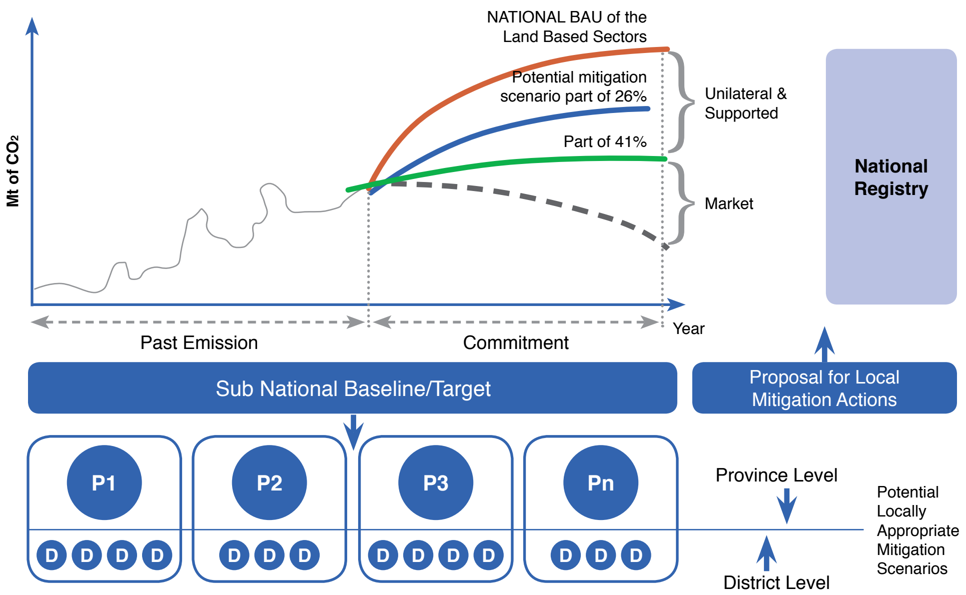


Figure IV.26

Link national baseline to sub national actions: it is suggested the national level allocate the national baseline shares to Provinces. By contrast, mitigation actions will be designed by local government levels

(own elaboration)

In regards to a baseline for the Indonesian land-based sector, there are several key issues that should be addressed, which are:

1. Defining the historical baseline (reference period). This paper proposes 2000-2010 as a reference period for Indonesia;
2. Confirming the Indonesian voluntary commitment period, which could be 2010-2020 according to RAN-GRK (2011);
3. Identifying gases that would be measured for the land-based sector (for example, whether land-based NAMAs would focus on direct CO_2 emissions or also include other gases such as CH_4, N_2O);
4. Describe the link between national BAU baseline and sub-national baseline in more details, as well as mitigation scenarios at national level versus local mitigation action plan at the provincial level;
5. Periodically analyze the deviation between the BAU and actual emissions to differentiate the actual performance of mitigation actions versus miscalculations in the BAU baseline due to issues such as data deficiencies. This paper suggests that such analysis can be done every two years on the basis of new information and data availability, as well as in accordance with the period of biennial GHG accounting and MRV processes indicated by the UNFCCC.

POTENTIAL MITIGATION SCENARIOS

Reducing land based GHG emissions is important in Indonesia as part of the national mitigation efforts as well as in the context of sustainable development, biodiversity and maintaining environmental support systems (such as watershed function). Reducing land-based emissions is seen as being among the most economical mitigation options[20]. Mitigation scenarios can be built up from potential mitigation actions, which can be thought of as NAMAs. In this sense, land-based NAMAs could be used for the implementation of the RAN-GRK, which has a forestry and peatland chapter and an agriculture chapter. The NAMA concept could provide a conceptual framework in order to safeguard the proper integration of all land based mitigation actions into national strategy and Indonesia's contribution to international mitigation efforts. To ensure consistency within this approach, land-based NAMAs should have a common approach to baseline setting, emissions accounting and registering as well as MRV system.

This proposed approach means that land-based NAMAs consider emissions from all land uses. Defining NAMAs with this broad scope also means that, effectively, they include the existing REDD+ national strategy. This is open to some confusion, so to better articulate the difference between REDD+ and NAMAs, a proposed scope of activities is defined in Table IV.21. This is only one possible approach to treating REDD+ within the broader scope of NAMAs, selected in an attempt to improve financing, implementation and MRV prospects.

Table IV.21
Proposed scope of land-based NAMAs and link to REDD+

	Land Use Type	REDD+ Scope	Land-based NAMAs Scope
Dry Land and Peatland	Primary Forest (on permanent/convertible forest area)	Included	Included
	Secondary forest (on permanent/convertible forest area)	Included	Included
	Logged over forest (HPH/IUPHHK) on production forest area	Included	Included
	Timber plantation (HTI/HTR) on forest zone	Included	Included
	Private timber plantation (Hutan Rakyat) on APL	Excluded	Included
	Crop plantation (eg. rubber, coffee, cocoa) on APL	Excluded	Included
	Agroforest on APL	Excluded	Included
	Oil Palm on APL	Excluded	Included
	Open field food crops	Excluded	Included
	Rice field	Excluded	Included
	Settlements/road	Excluded	Included

In Indonesia to date, the main objectives for managing land-based resources have been to support economic development, to improve rural livelihoods and reduce poverty, and to maintain environmental support systems; including carbon stocks and carbon sequestration. Therefore, to develop mitigation scenarios for the land-based sector, these objectives should continue to be considered. Mitigation scenarios of land-based NAMAs can also be based around future governance environments; for example scenarios with a strong institutional environment could allow different or more effective policy options to be deployed.

[20] although firm information on the actual costs, which include the opportunity cost, investment costs for enabling conditions and transaction costs still requires further research

Table IV.22 illustrates four possible types of scenario for the land-based sector. The optimum scenario for reducing land-based emissions would have a balance of mitigation impacts, sustainable development outcomes and create the necessary enabling conditions. Enabling conditions can be described in terms of strong institutional structures and legislation (such as clarity in land tenure, clear responsibilities and consistent policy across different stakeholders) and high resource capacity (technical, human resource, and financial capacity).

Strong Institutions	**Mitigation focus**: focuses on reducing land-based emissions with slow economic growth (e.g. stop licenses for logging concessions, little expansion of crop plantations, little forest conversion)	**Balance**: achieves targets for both mitigation efforts and sustainable development
Week Institutions	**BAU**: no mitigation action, focus on economic development, unsustainable use of land-based resources	Rapid Economic Development: intense exploitation of land-based resources, weak mitigation policies and action (except for A/R projects)
	Low resource capacity	**High resource capacity**

Table IV.22

Possible framework for land-based mitigation scenarios

The BAU baseline and any mitigation scenarios should be established through participatory/stakeholder and multi-level processes. The mitigation scenarios that are built by the national government, would serve as a framework for local government to set up their local mitigation scenarios. Ultimately, the national mitigation scenarios could be used as reference for merging and selecting local actions into NAMAs which would be submitted to UNFCCC. Possible mitigation activities for the peatland, forestry and agriculture sectors can be seen in Table IV.23.

Although the BAU baseline is ultimately set up at the national level, action plans should be formulated in terms of local on-the-ground activities and aligned with local development plans. At the local level, a province may call on districts to propose their local mitigation action plans. Then, each provincial government (through BAPPEDA and related 'Dinas') could select and merge the activities based on the sub-national baseline and target that have been assigned.

Table IV.23

Potential mitigation actions for the land-based sector

Activity	Land status	Potential emission reduction (tCO_2/ha)*	Abatement Cost (USD/tCO_2)*	Practicality	Co-benefits	Possible financing source
Avoiding Deforestation						
Avoiding planned deforestation on peat (e.g. land-swap)	Conversion Forest, APL	●●●	●●	●●	●●●	International support (such as REDD+)
Avoiding planned deforestation on dry land (e.g. land-swap)	Conversion Forest, APL	●	●	●●	●●●	International support (such as REDD+)
Avoiding unplanned deforestation (eg. fire mngnt)	All land	●●	●	●●	●●●	International support (such as REDD+)
Sustainable Forest Management						
Improve peat mgmt in forest land	All forest zone	●●●	●●	●●●	●●	International support
Improve mgmt logging Concession (HPH) eg. RIL	Production Forest	●	●●	●●●	●	Private
Improve mgmt DOC /HTR	Production Forest	●	●●	●●	●	APBN/Private
Improve mgmt national park, conservation and protected forest	Conservation/ Protection Forest	●	●	●●●	●●●	APBN/APBD
Carbon Enhancement: A/R/R						
Afforestation	Forest zone/ APL	●●	●●●	●●	●●●	International support
Reforestation	Forest zone, esp. protection forest	●●	●●●	●●	●●●	APBN
Revegetation (e.g. smallholder rubber plantation)	APL	●	●●	●	●●●	APBN/APBD and Internationa support
Conservation of Forest Carbon Stock						
Law enforcement in existing conservation and protected areas	Permanent forest areas	●●●	●●	●●	●●	APBN/APBD
Establishing conservation area such as national park	Conservation Forest/ Permanent forest	●●	●●	●●	●●●	International support
Reducing Emissions from Agricultural Activities						
Improve peat management on existing agriculture areas	APL (HGU/ private land)	●●	●●	●	●●	International support
Improve management of estate crops (e.g. oil palm, rubber)	APL (HGU/ private land)	●●	●●	●●●	●●●	Private
Improve agroforestry	APL (HGU/ private land)	●●	●●	●●●	●●●	APBN
Improve private smallholder forest (Hutan Rakyat)	Private land	●●	●●	●●●	●●●	Private/APBN/APBD

*Based on current available data

ESTIMATING ABATEMENT COSTS

The land-based sector is one of the most complicated sectors for which to estimate abatement costs, as baselines (opportunity costs) and mitigation costs are not as clearly defined as in other sectors. Hence, this topic deserves special attention.

Information on abatement costs will be needed to guide decisions on land-based mitigation strategies as well as financing scheme design (with domestic or international support). The abatement cost, which includes opportunity cost, implementation and transaction costs, indicates whether a particular mitigation option would be more financially attractive (or more financially feasible) compared to alternatives.

Several models have been developed to estimate abatement costs. The approaches to estimating the abatement costs to mitigate GHG emissions from land-based activities can be categorized into three types: local-empirical models; global-empirical approaches; and global simulation models (Table IV.24).

Local-empirical models	Global simulation models	Global-empirical approaches
• Boener and Wunder (2008) – 2 states of the Brazilian Amazons • Swallow et al. (2007)[21] – 3 sites in Indonesia, 1 in Peru and 1 in Cameroon • Nepstad et al. (2007) – Brazilian Amazon region	• Dynamic Integrated Model of Forestry and Alternative Land Use (DIMA) • The generalized Comprehensive Mitigation Assessment Process Model (GCOMAP) • The Global Timber Model (GTM)	Grieg-Gran (2006) for the Stern Review – 8 main tropical forest nations (Brazil, Bolivia, Cameroon, Democratic Republic of Congo, Ghana, Indonesia, Malaysia and PNG), cumulatively account for 46% of global deforestation

Table IV.24

Different models to estimate abatement cost related to land-based mitigation actions

Source:

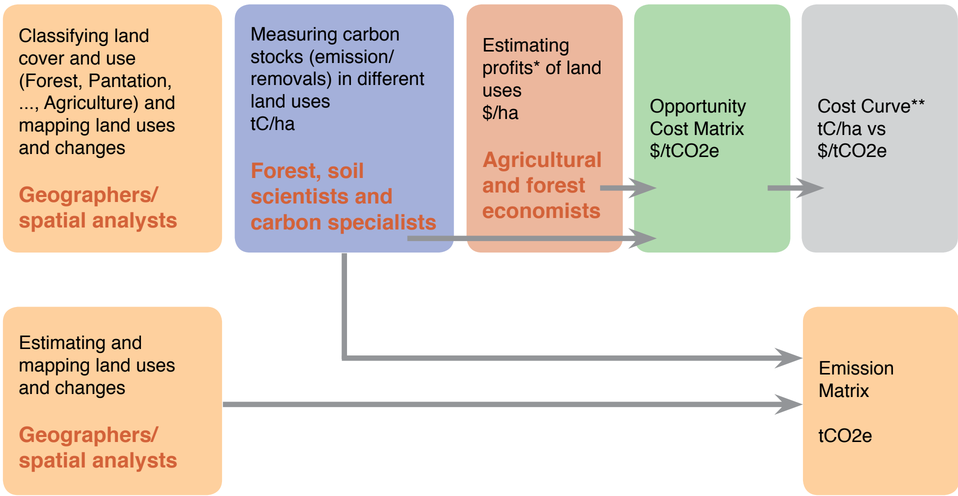
Adapted from Boucher, 2008; Kindermann et al.(2008; Myers, 2008 and Wertz-Kanounnikoff, 2008)

In general, global simulation models indicate significantly higher abatement costs than empirical studies. The true value most likely lies between these values (Wertz-Kanounnikoff; 2008). For countries such as Indonesia, a local empirical model would be most appropriate for estimating the abatement cost since it can capture local variations of physical characteristics (such as carbon density) as well as economic distinctiveness. In general, estimating the abatement cost for the land-based sector would require several steps by a skilled expert (Figure IV.27).

[21] The ASB Partnership and The World Bank Institute has further developed this model (ABACUS) (see White and Minang, 2011)

Figure IV.27

Steps for Estimating the Abatement Costs Related to Reducing Land-based Emissions



* hydrologists and biodiversity specialists would also be needed to estimate possible co-benefits
** in addtion to Opp.Cost, transaction costs, implementation and monitoring costs also need to be integrated

Current estimates suggest that the average opportunity cost of land-based emission reductions in Indonesia is about USD 5/tCO2 (Swallow et al., 2007; Grieg-Gran, 2006). A BAPPENAS (2010) study further estimated that implementing improved forest management would be the cheapest option for reducing land-based emission, with a relatively high potential emission reduction (Table IV.25). However, these numbers do not take into account transaction and implementation costs, including monitoring costs.

Table IV.25

Estimated land-based abatement costs up to 202

Sector / Scenario	Total mitigation cost (billion IDR)	Abatement cost (US$ / tCO2)
Peat	266	4.2
SFM	53	1.0
RED Dry Land	55	2.0
Plantation	241	19.0
Total	**615**	**3.9**

Source: Bappenas, 2010

At the moment, information on transaction costs remain inadequately estimated and there is little consistency in how data on transaction costs are collected (Wertz-Kanounnikoff, 2008). Grieg-Gran (2006) indicated that administrative costs for a scheme to control deforestation would range from USD 4 to 15 per ha annually (or USD 0.01 to 0.03/tCO2) based on case studies of existing payments for environmental services in Central and South America. Cacho et al. (2005) reported that transaction cost from various carbon projects in six tropical countries ranged between USD 0.14 to 1.07/tCO2. Further, experience from agroforestry projects designed for carbon sequestration in Indonesia showed that the highest element of transaction costs results from the activities of searching for project sites and negotiation; including gathering information, establishing groups and lobbying (Cacho and Wise, 2005). A comparative study of 15 Payment for Environmental Services (PES) schemes in various countries suggested that PES schemes generally face relatively high start-up costs, and moderately low recurrent costs (Wunder et al., 2008).

Looking at current available or applicable data for Indonesia and existing methods, it can be concluded that further research is needed, particularly in regards to the potential emission reductions per activity and the abatement costs associated with land-based mitigation actions.

POTENTIAL KEY INDICATORS

Any MRV system for the land-based sector will chiefly rely on robust and transparent national and sub-national terrestrial carbon monitoring systems. A common approach is to combine remote sensing and ground-based forest carbon inventory methods to estimate: i) anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks,ii) forest carbon stocks and iii) forest area changes (Table IV.28).

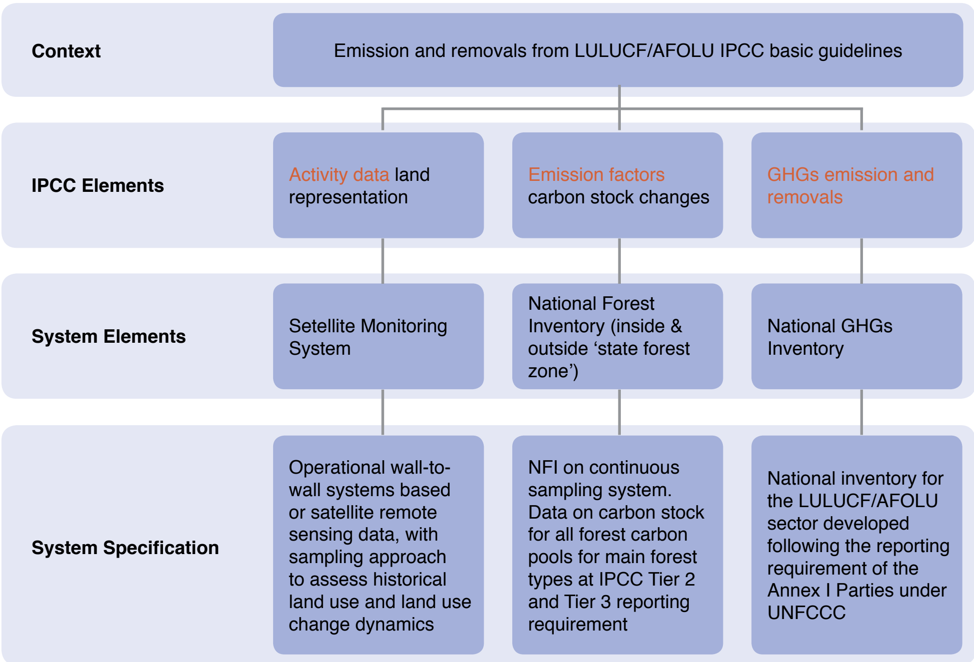


Figure IV.28
Monitoring GHGs emissions related to land-based sector
(Modified from FAO, 2010)

During the process of calculating baselines, indicators for future MRV should be developed since these will later be used for measuring the actual emissions reductions relative to the BAU scenario. REDD+ MRV should ideally be closely aligned with any NAMA MRV requirements to avoid leakage or double counting. Additionally, the MRV system for land-based NAMAs could also take into account other aspects that can indicate the progress in implementation, such as finance, technology and capacity building. Table IV.26 presents potential key MRV indicators for Indonesia's land-based NAMAs.

Table IV.26
Possible MRV Indicators for Land based NAMAs

Measured Component	Indicators
Emission reduction	Type of activity (ha) Emission reduction/removal GHG per unit (tCO2/ha) or (tCO2eq/ha)
Abatement cost	Opportunity cost: investment cost & operational cost of different land-based activities ($/ha or $/tCO2) Transaction costs
Development indicators	Rural poverty reduction Job creation in rural areas (job/ha) Human Development Index Indicators representing distributional effects
Finance	Amount ($) Flow ($/institution) How it is used ($/activity)
Technologies	Improved fertilizer applied Hectares with improved tillage practices implemented Hectares with improved forest harvesting methods Hectares with improved methods of peat management
Capacity building	Institutional setting and capacity strengthening Human resource development
Co-benefits	Biodiversity preservation, watershed protection

Decisions on mitigation actions should, as far as possible be taken at the local level to find a balance amongst different local specific objectives relating to aspects such as GHG mitigation, poverty reduction, economic growth, adaptation, biodiversity conservation and human rights. Criteria for land-based NAMA prioritization should take into account these different objectives as well as barriers to implementation, such as local capacity (human, institutional and financial).

With regard to mitigation, there are four main criteria which can be used: potential emissions reduction, applicability, equity and cost effectiveness. Based on current studies for Indonesia, reducing emissions from land-based activity can provide some of the most effective and cost-efficient approaches, compared to reducing emissions in other sectors.

POLICIES, MEASURES AND INSTRUMENTS

To meet national GHG mitigation targets, Indonesia will need to take wide ranging policy approaches, particularly in reducing land-based emissions. A strategy to reduce land-based emissions could include broad policy reform, informed by an understanding of the drivers and agents of land use change and terrestrial carbon dynamics.

For Indonesia a mix of policies will be necessary to tackle land-based emissions. This can include:

1. Specific policies related to land-based sectors (such as policies that directly regulate restrictions on land use, sustainable forest management (SFM), export taxes for agricultural commodities, community based forest management, and compensation such as a PES system).

2. Transformational reforms (such as land tenure and governance reform, and decentralization)

Specific policies for reducing land-based emissions may use a mix of policies from command-control approaches (e.g. regulation) and market based approaches (e.g. payments from a carbon market). Future market based approaches to offer compensation for forest conservation will only be able to be implemented in a well functioning market economy and under certain conditions such as clear tenure arrangements. In such cases, for instance, illegal logging and other unaccounted activities that release land-based emissions would require effective regulation and law enforcement. Currently, some regulations that could influence emissions reduction from land-based sectors have been established, such as in relation to illegal logging and a moratorium on peatland conversion. However, these need to be effectively enforced.

Specific policies can be effective in reducing emissions and may be technically simpler. However, they can have perverse side effects on rural development and poverty alleviation. For example a heavy tax on the export of palm oil and restrictions on road construction in rural areas could overly hinder local development.

Policies to intensify agriculture such as credit programs, subsidized fertilizer and planting materials, assistance in marketing and technical support might help to reduce deforestation, however, they should be coupled with good spatial planning.

Sustainable forestry management can also offer a way to reduce land-based emissions. This can be done by promoting eco-labelling for timber and forest products from sustainable sources, or introducing environmentally sound technologies for harvesting process like Reduced-Impact-Logging (RIL).

Implementing PES systems for carbon sequestration/storage in forested areas requires a comlex set of enabling conditions such as tenure clarity, regulations, administrative capacity, MRV system and good governance (Angelsen, 2008). This acts as a significant barrier to this approach.

The land-use planning process is potentially a strong tool for tackling land-based emissions. However, this depends on priorities at local and national levels. Therefore, public perception on the importance of GHG mitigation is a strategic factor that should be developed to enhance broader public participation in reducing emissions from deforestation and land degradation.

To address emissions from land-based sector, cross-sector policies that underpin the drivers of the land use change are needed. A study found that broad societal forces and policies outside forestry sector play a critical role in driving land use change (Kanninen et al., 2007). Inter-sectoral policies to reduce land-based emissions should be developed in an integrated manner, taking into account aspects such as economics, population dynamics, technology requirements, institutional barriers, and public perception.

In general, transformational reform can be politically charged, may be costly, and can only be implemented over a relatively long period. However, this may prove necessary for the long-term success of land-based NAMAs. Depending on the approach taken, it can also have positive effects on equity and rural poverty alleviation (Wertz-Kanounnikoff and Angelsen, 2010). Table IV.27 presents various policies options to reduce land-based emission.

Table IV.27

Potential policies to reduce GHG emissions from land-based sector

Potential Policy	Effectiveness to reduce land-based emissions	Cost efficiency of policy	Political viability equality	Effect on poverty and
1. Agricultural and Food Security Policies				
• Intervention on agricultural prices (assume demand at international market for agricultural prices is inelastic)	High	Negative	Low	Negative
• Create off-farm opportunity	High	Medium-High	High	Positive
• Support intensive agriculture system (e.g. technology)	Moderate	High	Moderate	Uncertain
• Support extensive agriculture (e.g. low fertilizer used)	Low – moderate	Medium	Low-moderate	Positive
2. Forestry Policies				
• High prices of forest product	High	Low	Moderate	Positive-uncertain
• SFM	Moderate	High-medium	Moderate – High	Positive
• Community forestry	Moderate	Low-medium	Moderate	Positive
• Eco-labelling	Low	Medium	Moderate	Uncertain
• Payment for Environmental Services (e.g. carbon market)	Potentially high	Medium-High	Moderate-High	Uncertain-positive
3. Energy and Mining Policies				
• Open pit mining in protection/ forested area	High	High	Low	Uncertain
4. Demography Policy				
• Restrict the development of transmigration area	Moderate – High	Moderate	Moderate	Negative-uncertain
• Controlling population growth	High	High	Moderate	Positive
5. Spatial Planning Policies				
• Protection area to conserve terrestrial carbon	Moderate	Medium	Moderate	Neutral
• Allocation of land for production areas (e.g. degradation area for plantation)	Moderate	Medium	Moderate	Positive
• Regulate development of infrastructure (e.g. restrict road and infrastructure construction in rural/remote area)	High	High	Moderate	Positive
6. Cross Cutting Policies				
• Good governance	High	High	High	Positive
• Decentralization	Low – moderate	Moderate	Moderate	Uncertain
• Tenure reform	Uncertain	High	Low-moderate	Uncertain
• Acknowledging local rights/ knowledge in land-based resources management	Moderate	Moderate	Low	Positive

In order to formulate effective mitigation policies and strategies that will be recognized by the international community, a number of initial political process and consensus building steps are proposed, including:

1. Clarifying and validating the scope of land based NAMAs with relevant stakeholders
2. Reviewing and establishing national policies and legal systems related to sustainable land-based resources both at national and sub national level (province/districts) as well as reviewing national/sectoral strategic planning (RPJM & RPJP) and spatial and land use planning (RTRWN, RTRWP and TGHK)
3. National Data Collection Framework - A comprehensive screening of the currently available data in the land based sectors would allow datasets to be identified which require improvement or development. A framework could then be constructed, indicating responsibilities for data collection, the details of that dataset, who will be responsible for reporting and for what timeframes.
4. Establish a land-based BAU (national and/or sub national) baseline and mitigation scenarios. This should include consensus building on scenario assumptions and allocated emission reduction targets at the provincial level.
5. Establish a land based MRV system (technical capacity and institutions).
6. Calculate land-based actions' abatement costs (include opportunity cost, implementation and transaction cost) and evaluate co-benefits.
7. Formulate financial strategies and benefit-cost sharing mechanisms (national government, local government and local community or 'forest dependant people').

V. Summary

SUMMARY

To achieve the ultimate objective of the UNFCCC, the Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities.

According to the Bali Action Plan, the negotiations on the future climate regime include consideration of “nationally appropriate mitigation actions” by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner to contribute to a global mitigation effort in achieveing the ultimate objective of the Convention.

COP 16 in Cancun again emphasizes the need for deep cuts in global GHG emissions and early and urgent undertakings to accelerate and enhance the implementation of the Convention by all Parties. COP 16 agrees that developing country Parties will take nationally appropriate mitigation actions in the context of sustainable development, supported and enabled by technology, financing and capacity building, aimed at achieving a deviation in emissions relative to “business as usual” emissions in 2020. In accordance with this framework, the need of developing country Parties to continue their developments and their needs for support on some condition is recognized.

Furthermore, the decision 1/CP.16 of COP 16 reaffirmed the existence of two categories of NAMAs by developing country Parties, namely: (i) domestically supported mitigation actions as unilateral or voluntarily NAMAs, and (ii) internationally supported mitigation actions as supported NAMAs.

However, there are a lot of questions still lingering about NAMAs. In general, NAMAs’ framework still needs to be established as the basis for derivation of its key elements particularly at national level. The understandings regarding its associated issues need to be enhanced further since some issues are not yet clearly established. Therefore, there is an urgent need of information such as the deviation from business as usual baseline, the establishment of aggregated business as usual baseline of sectors, the establishment of potential mitigation actions of sectors, the establishment of national business as usual baseline and aggregated mitigation actions, and the way to select NAMAs from a selection of aggregated mitigation actions in meeting the national emission reduction target, etc. Thus, a clear NAMAs’ framework is a key and of paramount important in providing consistency action across a vast difference of national and global situations and needs

To address this condition this report provides guideline information on the status, the related important issues and the content of NAMAs. Most importantly, this report proposes NAMAs development framework to give directions and guidelines on how to establish NAMAs, as well as its requirements and processes.

This framework covers principles in establishing components of NAMAs such as the conceptual baseline scenario to establish national business as usual (BAU) baseline,

conceptual national carbon budget, cost effectiveness and its implementability level, priority list of potential mitigation actions, cross sectoral and sectoral climate policies, measures and instruments for enabling action of NAMAs and its link to measuring, reporting and verification (MRV).

Moreover this report also discusses the issue on the level for implementation for several main sectors namely the energy sector that consists of power, transportation, industry sectors and for the waste and land based sectors. For each sector the report describes the sector condition, its relation to the development, its CO_2 emission trend, the proposed integrated modeling scenario for CO_2 emission assessment, associated required tasks and processes as well as the requirements to establish its business as usual baseline, proposes potential mitigation action scenarios, CO_2 emission reduction path, key indicators and conceptual policies, measures and instruments for sectors.

This document discusses development of national integrated process in order to obtain NAMAs which covers requirements of national policy integration, the main task of national integrated process, Indonesian NAMAs and linkages to UNFCCC level.

In summary, there are some important issues to be addressed in establishing NAMAs as follows:

1. Establish an aggregated business as usual baseline of sectors by using sector's development plan and future evolution of activities without explicit new climate change policy intervention and action,
2. Propose a list of potential mitigation emission reduction actions of sectors in the order according to sector's cost effectiveness and level of implementability,
3. Integrate sector's aggregated business as usual baseline to establish national business as usual baseline (aggregated),
4. Construct a list of national aggregated mitigation emission reduction actions based on national cost effectiveness and level of implementability,
5. Establish NAMAs from the national aggregated mitigation emission reduction actions in meeting the national emission reduction target, and
6. Linkage NAMAs to the UNFCCC level.

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