



Low Carbon Development Options
f o r I n d o n e s i a

Phase 1:

Status Report and Findings

November 2008

Acknowledgements. During the second half of 2007, the Ministry of Finance convened an inter-ministerial working group to guide efforts and studies toward the High Level Event on Climate Change held in conjunction with the 13th Conference of the Parties to the UNFCCC in Bali. The working group included senior policy makers and researchers from the Fiscal Policy Office, reporting to the Minister. The group was informally constituted and included representatives from the Coordinating Ministry for Economic Affairs, the National Planning Commission (Bappenas), the Ministry of Environment, the Ministry of Foreign Affairs, and the President's office (senior advisor). The working group oversaw and guided the several studies and results that are reported in this paper. The working group was led by Anggito Abimanyu of the Fiscal Policy Office of the Ministry of Finance, with the regular participation of Anny Ratnawati, M. Chatib Basri, Herwidayatmo, Achmad Askolani, Irfa Ampri, Makhiani, Amnu Fuady, Herfan Brillianto, Purwoko, and Teguh Suwondo of the Ministry of Finance. Mr. Agus Purnomo, Ms. Masnellyarti Hillman, , Laksmi Dhewanthi, Ms. Damayanti Ratunanda, Listyowati, and Upik S. Aslia of the Ministry of Environment participated regularly and provided important inputs. From Bappenas, Edi Effendi, Medrilzam and other colleagues participated and provided inputs. Representatives from the Coordinating Ministry for Economic Affairs, the Ministry of Foreign Affairs, and the President's Council of Advisors (Professor Emil Salim) also attended. The Ministry of Finance would like to thank these officials for their contributions during the working group process. The GOI would also like to thank the World Bank, AusAID and the Netherlands Embassy for their support to this process. World Bank staff and consultants, including William Wallace, Timothy Brown, Kurnya Roesad, Josef Leitmann, Budy Resosudarmo, Frank Jotzo, Arief Anshory Yusuf, Emile Jurgens and Mario Boccucci contributed to the dialogue process and the technical studies and results reported here.

Disclaimer. This document summarizes technical analyses conducted by consultants and academics in consultation with the World Bank and the sponsoring GOI agencies. The views and statements expressed do not necessarily reflect the official positions of the Government of Indonesia. The Ministry of Finance makes no claims about the accuracy of data or estimates presented here to stimulate discussion of appropriate options for pursuing lower carbon development paths in Indonesia.



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Foreword

In December 2007, Indonesia hosted the 13th Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) in Bali, and with it a High Level Event on Climate Change for Ministers of Finance. During these events, the President of Indonesia launched the National Action Plan for Climate Change. Ministers of Finance also agreed that it is in the global interest to improve international financing mechanisms and develop innovative approaches for climate financing. As a result, it is now widely understood that climate change is a development issue.

In 2008, Indonesia published its blueprint for integrating climate change mitigation and adaptation into the national planning and budgeting process. The President also formed the National Council on Climate Change as the focal point on climate change and a focus for intra-governmental coordination, and other areas of technical assistance, outreach and capacity building. The National Council has engaged with external partners and key stakeholders, including the Ministry of Finance, on climate change adaptation and mitigation issues, including low carbon development.

Mitigating and adapting to climate change requires macro-economic management, fiscal policy plans, revenue raising alternatives, insurance markets, and long term investment options. The Ministry of Finance recognizes the need to manage these challenges by adopting budget priorities, pricing policies, and financial market rules. To do this, the Fiscal Policy Office appointed a working group to study and map out fiscal issues for climate change. This report covers the discussions and findings of technical assistance and analytical studies conducted under the first phase of a low carbon options study.

The GOI is collaborating with the World Bank and other donors to conduct the technical studies needed to inform the low carbon development strategy. The Governments of Netherlands and Australia have also contributed resources and expertise to this effort. The low carbon work begins with the premise that sound environmental management, reduction of emissions, economic efficiency and growth are compatible goals, important to the sustainability of Indonesia's development path.

These results can serve as an input to the Government's discussions of appropriate fiscal policy instruments to promote low carbon development, carbon markets, and climate finance opportunities.

Head of Fiscal Policy Office
Jakarta, November 2008

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Abbreviations and Acronyms

| | | | |
|-------------------|---|---------------------|--|
| Bappenas | National Development Planning Agency | IFCA | Indonesian Forest Climate Alliance |
| CDM | Clean Development Mechanism | IFI | International Financial Institution |
| CEIF | Clean Energy Investment Framework | IPCC | Intergovernmental Panel on Climate Change |
| CER | Certified Emission Reductions | ktCO ₂ e | Thousand Tons of Carbon Dioxide equivalent |
| CF | Carbon Finance | MDB | Multilateral Development Bank |
| CH ₄ | Methane | MDG | Millennium Development Goals |
| CIF | Climate Investment Funds | Menko Econ | Coordinating Ministry for Economic Affairs |
| CO ₂ | carbon dioxide | MOF | Ministry of Finance |
| CO ₂ e | carbon dioxide equivalent | MOFr | Ministry of Forestry |
| COP | Conference of the Parties | mtCO ₂ e | Million Tons of Carbon Dioxide equivalent |
| CPF | Carbon Partnership Facility | NGO | Non-governmental Organizations |
| DFID | UK Department for International Development | ODA | Overseas Development Administration |
| DNA | Designated National Authority for CDM | OECD | Organisation for Economic Co-operation and Development |
| EE | Energy Efficiency | PPP | Purchasing Power Parity |
| FCPF | Forest Carbon Partnership Facility | REDD | Reducing Emissions from Deforestation and Degradation |
| FLEG | Forest Law Enforcement and Governance | RE | Renewable Energy |
| GDP | Gross Domestic Product | tCO ₂ e | Tons of Carbon Dioxide equivalent |
| GEF | Global Environment Facility | UK | United Kingdom |
| GHG | Greenhouse gas | UNDP | United Nations Development Programme |
| IBRD | International Bank for Reconstruction and Development | UNEP | United Nations Environment Programme |
| IDA | International Development Association | UNFCCC | United Nations Framework Convention on Climate Change |
| IEA | International Energy Agency | USAID | United States Agency for International Development |
| IFC | International Finance Corporation | WB | World Bank |
| | | WRI | World Resources Institute |

Executive Summary

Climate change is a strategic and development challenge facing Indonesia. Climate change will create threats for Indonesia — sea level rise, changing weather patterns, floods and famines, increased uncertainty — but also opportunities in terms of incentives, financing, efficiency, and competitiveness. The Government of Indonesia (GOI) recognizes climate change as a key economic development and planning issue. The GOI also acknowledges that early action to address mitigation and adaptation concerns will be strategically and economically beneficial for Indonesia, and the rest of the world.

Indonesia emits significant levels of greenhouse gases (GHG) and is highly vulnerable to climate change. The largest share of current emissions comes from land use (peat land degradation, fires, and deforestation), but Indonesia's fossil fuel emissions are growing rapidly (faster than GDP and energy consumption) and represent the larger concern for the long term.¹

Political commitment for successful climate change actions is high; global visibility is also high. The President of Indonesia has expressed commitment to climate change action at international venues in 2007 and 2008, including forestry measures and low carbon development planning. Indonesia has also achieved global visibility as the President of the UNFCCC COP process in 2008, as a leader of the *troika* countries (Indonesia, Poland and Denmark) in the negotiating process up to 2012, as a founder of the Forest-11, and as a leader in the global Finance Ministers' dialogue process. This has created political and institutional entry points for discussing options for both mitigation and adaptation.

Emerging from the successes of COP 13 in Bali, the UNFCCC Parties are negotiating the post 2012 framework, which could lead to future commitment periods for GHG reductions, to expanded carbon markets, to innovative payment mechanisms. Indonesia has a strategic role in the negotiations as a large developing country with a significant stake in the future framework outcomes.

¹ Recent estimates of Indonesia's forest and land emissions are high, and currently under study and refinement. Remote sensing evidence indicates progress in reducing the rate of deforestation, which would lower the estimated level of emissions. Indonesia has one of the fastest growing energy demands and fastest growing greenhouse gas emissions of developing countries (IEA, 2006). Indonesia's emissions intensity is actually rising with growth. Plans to increase dependence on coal (and decrease dependence on oil), and quadruple the use of bio-fuels over 20 years could further adversely affect land use and forest cover, contributing to emissions.

Indonesia understands the strong economic rationale to address climate change issues.

Both the forestry and energy sectors have long-standing and well-studied policy distortions and governance issues. Weak governance impedes investment, raises costs, and hinders international competitiveness and market access (for forestry and other products). These distortions are an expensive burden on the budget and the economy.

The government significantly reduced subsidies in 2008 and 2005 to better target assistance to the poor.

The GOI understand more needs to be done but must allow for social and well as economic considerations, and is working to address this issue. It also understands the pressing need to do more in this area. The Indonesian Government is also working to improve policy consistency, reduce distortions, and improve management to become more efficient and competitive, encourage energy security, improve environmental services/quality of life, and free up budgetary resources for priority needs for investment and job creation.

The Indonesian government also acknowledges the pressing need to ensure efforts to address climate change are not at the expense of the poor.

Climate change efforts should also be pro-growth and pro-job creating.

At the same time, Indonesia has significant alternative and renewable energy resources,

including geothermal, hydro, solar, biomass and biofuel. Indonesia also has substantial economically viable opportunities to save energy through improved efficiency. However, the investment climate remains an issue, impeding private sector development of alternative energy resources.

Carbon markets can provide a financial incentive for addressing some mitigation needs, off-setting the potential cost of some actions.

The Kyoto protocol and emissions reductions objectives for developed countries have helped to generate a global market for 'carbon credits.' This market has doubled in size annually in recent years and reached \$5 Billion in 2006. This market is a strategic opportunity for developing countries like Indonesia to gain access to carbon finance.

Carbon markets recognize that the most cost effective sources of emissions reductions can often be found in developing countries,

particularly in the forestry sector. Growing global carbon markets and payment schemes offer new financial incentives — or provide some compensation — where difficult choices are needed. The potential for carbon market payments through the Clean Development Mechanism (CDM) in Indonesia is explored in Annex A. Potential carbon payments through a mechanism for Reducing Emissions from Deforestation and Degradation (REDD, under negotiation) may provide the incentives needed to continue and expand forest sector reforms and improvements.

The current global climate context is creating an historic opportunity for an integrated approach

to climate issues without compromising growth and development. After Bali COP 13, billions of dollars are being mobilized across the globe to help countries with mitigation and adaptation needs. Innovative financing opportunities such as the Climate Investment Funds under development through Multilateral Development Banks, The Forest Carbon Partnership Facility, global carbon markets, the Adaptation Fund, bilateral donor programs, and private sector participation may offer sufficient incentives for change. There is a competitive international 'market' for these resources, just as with investment resources.

Indonesia understands that accessing this kind of innovative financing presents a strategic opportunity. Indonesia also understands that in return for actions that benefit the globe, it has the potential to gain financial support through a successful REDD effort.

Indonesia also has significant potential to control carbon intensity while continuing to develop and grow (including energy efficiency and renewable energy sources), opening the door to carbon market payments and other innovative financing alternatives. To access these resources, credible policies, programs and institutional arrangements must be in place. Initial planning and strategy documents have been produced, but are works in progress and institutional responsibilities for implementation are still under discussion and formalization.

Indonesia's development planning cycle is ready for integration of climate change actions and policy reforms. Indonesia's political, planning, and budgeting calendars are creating the right conditions to deepen engagement and scale up policy dialogue on climate change related issues. Bappenas will develop the Medium Term Development Plan over 2008 and 2009 to guide GOI activities and budgeting during the period 2010-2015, corresponding to the term of the next elected government. Indonesia's policy dialogue and planning process will benefit from better information on the options and policies relevant for reducing GHG emissions from forest and land use, as well as energy.

The GOI is developing a strategic, multi-year policy reform program, as outlined in the *National Climate Change Action Plan* (2007) and the *Development Planning Response to Climate Change* (2008). This high-level focus will help Indonesia to improve energy and forestry sector management, prepare for the post-2012 climate change regime, and establish a sound framework for coordination and implementation of adaptation activities. Strategic choices about energy sector investments, policy reforms, and inter-ministerial coordination could yield development benefits in terms of new private sector investments, greater energy efficiency, energy security, additional fiscal resources, and potentially revenues from GHG emissions reductions.

The GOI also acknowledge that addressing climate change and energy issues will also generate secondary development benefits and improve quality of life, such as cleaner air, enhanced public health, reduced congestion, better waste management, and greater efficiency. Energy diversification will also help to meet growing future demand while reducing dependence on expensive imported fuels.

A low carbon options study is an opportunity to evaluate and develop strategic options to address mitigation issues without compromising development objectives. Indonesia has good potential to use the results to take advantage of alternative energy options (geothermal, hydropower), reduce the emissions intensity of energy sector development, access existing carbon markets for energy efficiency improvements, develop carbon credits for REDD (under negotiation for the post 2012 period), facilitate additional investments and transfer of technology, and access innovative sources of financing that are now emerging.

This report outlines the results of Phase 1 investigations of greenhouse gas emissions, as well as economic policy instruments available for addressing climate change mitigation and adaptation needs.

1. Introduction

Indonesia has requested the development of a low carbon options study as an opportunity to evaluate and develop strategic options to address climate change mitigation issues without compromising development objectives. Indonesia has good potential to use the results to take advantage of alternative energy options (geothermal, hydropower), reduce the emissions intensity of energy sector development, tap existing carbon markets for energy efficiency improvements, develop carbon credits for Reduced Emissions from Deforestation and Degradation (REDD, under negotiation for the post-2012 period), facilitate additional investments and transfer of technology, and tap into innovative sources of global financing that are now emerging.

1.1. Purpose and Scope

This first phase of work on a low carbon options analysis for Indonesia was undertaken at the request of the Ministry of Finance (MOF). This report aims to contribute to understanding of the structure of Indonesia's greenhouse gas (GHG) emissions and the issues, opportunities, and constraints this creates. The report also lays the foundation for additional analyses and options that can be considered in a second phase of analytical work.

The work supported the Government of Indonesia's (GOI) preparations for the Bali COP 13 Climate Change Conference through three main areas of activity: Technical assistance, capacity building and awareness raising, and specific analyses. This series of activities focused on three main areas:

- **Engagement/discussion, capacity building.** This task involved close working engagement with an inter-Ministerial working group preparing technical material and documentation in advance of the UNFCCC COP 13 meeting in Bali. Specific training opportunities were pursued along with capacity development through engagement on global climate change issues in the context of international conferences. This engagement process provided opportunities to share experience with Indonesian think tanks, universities, and other donor efforts and to refine products in conjunction with key government stakeholders. This process of engagement and learning is described in section 2 of this report.
- **Technical baseline study of GHG emissions.** This analysis provided a base of information needed to plan and develop a more comprehensive Low Carbon Options study. This analysis was a key output of an interactive working process that informed the Ministry of Finance and

the wider GOI on the current emissions situation and the potential areas for further study and action. The results are reported in section 3 of this report.

- **Assessment of fiscal and financial policy instruments to address climate change.** This document was designed to assist the Minister of Finance to understand and explain the policy instruments available to help Indonesia mitigate and adapt to climate change. This was delivered as a key input from the GOI to the High Level Event on Climate Change for Ministers of Finance in parallel with the Bali COP 13 in December 2007. This document is summarized in section 4 of this report.

Finally, this process of engagement, technical studies, and interactive discussion provided the basis for design of a second phase of work on a Low Carbon Options Study. The broad outlines of the proposed study are described in section 5 of this report. The Low Carbon Options Study will be designed to help inform the GOI about the main GHG emissions by source and category of use, to estimate the potential costs and benefits associated with movements toward alternative development paths, and to build consensus toward a national low carbon strategy.

1.2. Rationale for Addressing Climate and Low Carbon Issues

Phase 1 work represented an initial step on the way to understanding the issues and options involved in preparing an Indonesian low carbon development strategy. Low carbon strategy and actions would influence energy and forest sector investments, fiscal policy responses, adaptive development and overall GHG emissions from a growing middle income country with abundant coal, oil and gas resources, as well as forests and peat lands. Indonesia's efforts in this area will also contribute to the international climate framework dialogue by increasing the country's stature and capacity to articulate the position of a developing country and set an example for others.

Low-Carbon Country Case Studies

Low-Carbon Country Case Studies have been initiated for the G8+5 countries (Mexico, China, India, South Africa and Brazil) to help these countries identify: the carbon emission-reduction potential, as well as the incremental costs and benefits, of "lower-carbon" growth strategies; the policy support requirements; and projects and programs that contribute to their respective growth and development objectives while lowering increases in GHG emissions. These country studies are establishing a framework for deepening the analysis of mitigation interventions and costs at the country level, complementing both the global analyses undertaken by IPCC and IEA and the efforts of individual countries. It is expected that in the course of developing a low carbon strategy, specific interventions – both policies and projects – would be identified and that quick wins could be developed. Although the studies focus at a strategic level, the work is also designed to be sufficiently detailed to enable the implementation of low carbon interventions to be accelerated. The World Bank is assisting in the development of these studies.

This work begins with the premise that sound environmental management, reduction of greenhouse gas emissions, and economic efficiency and growth are compatible goals – and important to the sustainability of Indonesia's development path. Indonesia has many opportunities to take steps that improve its climate change position – in terms of both mitigation and adaptation, and in both policy and practice. The package of policies or interventions employed may entail

different levels of trade-offs depending on the goals espoused: protecting the poor, promoting efficiency, mitigating environmental concerns – at local or global level.

There are economic and environmental arguments for actions that improve outcomes in the energy and forestry sectors. These benefits in the domestic economy and development path are the key reasons to implement changes. Climate change and low carbon financing sources may provide an additional incentive or compensation to encourage movement in this direction. This section briefly summarizes the main areas of domestic benefits from addressing energy and forestry issues.

The economic rationale. Indonesia's energy sector remains highly subsidized and regulated, though there was a successful effort to reduce the fuel subsidy in 2005 and another approaching in mid-2008. This creates a substantial drain on GOI budget resources – which could otherwise be spent on development, infrastructure or poverty alleviation. Subsidized energy pricing also contributes to inefficient public spending and impedes investment to modernize the sector. As well, Indonesia remains vulnerable to world energy price shocks, because price changes affect the level of subsidy provided from the state budget. Rapidly growing energy demand coupled with an increasing shift to coal-based power generation are important issues for both investment and environmental outcomes. Future energy and carbon intensities are likely to grow as the economy grows and as better-off people move to more energy- and carbon-intensive products and lifestyles. The investment climate remains an issue also, impeding private sector development of alternative energy resources, such as geothermal, wind and solar.

Indonesia's forest resources are not contributing as they could to poverty reduction, economic and social development, and environmental sustainability. The forest sector has contributed substantially to the economy, but now is in a state of decline. Most forest sector analysts agree that over-exploitation, inefficiency and weak governance in the forest sector have contributed to illegal logging and trade, forest degradation and loss, underperforming plantation lands, losses in GOI tax earnings, and indebted firms. Industrial output, employment, and competitiveness are declining. Environmental problems and conflict are increasing, putting pressure on state assets and budgets. Official statistics do not measure the billions of dollars in illegal forest earnings, which are not only unsustainable, but also create high costs of environmental degradation. A more diversified, efficient, competitive and sustainable future is feasible, based on more plantation-grown timber, less degradation and encroachment, alternative timber sources, retooled mills and higher value added processing, with more small scale enterprises and employment. It makes economic sense in the long run to strive toward these objectives – independent of the climate regime.

The environmental rationale. The existing energy pricing and subsidy policies lead to excessive consumption of fossil fuels. Excess and inefficient use of energy resources causes emissions and pollution that damage the environment and impose health costs. Key pollutant levels in Indonesia are high compared with other Asian countries, and the excessive use of petroleum fuels has been identified as one of the key reasons. Deteriorating environmental conditions impose significant economic costs, as noted in a Bappenas (2007) report on sustainability. National energy sector policies propose a large scale up in the use of coal to reduce Indonesia's dependence on oil imports. At the same time, the GOI plans to increase reliance on renewable energy sources, including bio-fuel, geothermal, and hydropower. Increased coal use would lead to significant negative environmental impacts associated with high sulfur content and potential impacts on forests from land clearing. Expanding use and export of coal has the potential to lead to more extensive strip mining – affecting already-threatened forests in Kalimantan and Sumatra – and direct pollution

impacts due to acid drainage from mines and air pollution from coal-fired generation. Transport and use of coal in vastly greater quantities also has the potential to overwhelm shipping and port facilities, risking pollution in transit as well. A major expansion of production of bio-fuels could lead to more conversion of forest area into oil palm plantations.

Forests produce environmental services that contribute to quality of life, both directly and indirectly. Direct benefits include water supply, soil fertility, pest control, and seed stocks that support local livelihoods. Indirect benefits include watershed protection for downstream users or biodiversity protection. When markets do not exist and forest resources are undervalued, these essential services are undersupplied. When forest resources are undervalued and laws are not enforced, the upstream sources of environmental services can be degraded, imposing costs (externalities) on downstream users. Forest degradation contributes to decreasing water quality, soil fertility, and land productivity as well as increasing water shortages, fires and haze, health impacts, downstream siltation and flooding. All of these impose costs on the people and the economy. Managing and avoiding these costs makes sense independent of the climate regime, though carbon payments may provide an incentive for improvement.

1.3. Summary of Main Findings

Phase 1 work represented an initial step on the way to understanding the issues and options involved in preparing an Indonesian low carbon development strategy. Phase 1 analytical work, technical assistance and process of dialogue will inform the second phase of work.

Engagement and capacity development process

Since May 2007, the Ministry of Finance has led an inter-ministerial working group that developed analyses and capacity on climate change and low carbon issues. Technical inputs and engagement across a wide range of agencies stimulated interest in MOF and GOI in policies and instruments that can be used to deal with climate change issues. This dialogue process has advanced the work on low carbon options by increasing demand, interest, and capacity for conducting the analysis, interpreting the results, and shaping effective policies. The products of this work contributed to the preparedness and capacity that supported the GOI's participation in a range of international events over the last year.

Analysis of policy instruments. Work on an analysis of fiscal policy instruments highlighted the main categories of instruments that Finance Ministers can use to address climate change issues: domestic financial and investment sector policies, fiscal policy instruments (taxes and subsidies), expenditure and budget policies, and direct regulation. Policies generally need to be used together in integrated reform packages aimed at particular outcomes.

The Indonesian Ministry of Finance has become increasingly aware of the international financing mechanisms and sources that can be used for investments, preparatory analyses, and incentives or seed money for innovations. The GOI has begun to consider the institutional and regulatory framework needed to benefit from international flows to create sound incentives, provide resources for programs, and protect the poor.

The High Level Event on Climate Change for Finance Ministers in Bali in December 2007 was an historic platform for finance and development minister to engage more deeply on climate change issues. Participants agreed that more knowledge is needed on economic impacts and the

application of particular policy instruments. They agreed on the need to encourage international collaboration on financing for climate change. They supported the need for International Financial Institutions to explore development of a diversified set of financing instruments, in particular for low-carbon technologies and private sector involvement. Indonesia, Poland and Denmark agreed to collaborate in planning for future climate change meetings for Finance Ministers.

Through the High Level Event and subsequent international meetings, including the WB-IMF, ADB, G-20, ASEAN and APEC, it appears that Ministers of Finance have begun to play a more active role in responding to climate change issues, both domestically and internationally. Representatives from Indonesia are considered valuable contributors in many of these global dialogue processes.

Greenhouse gas emissions assessment

Indonesia is among the top 25 GHG emitters from fossil fuel combustion, or ranked 16th when counting the European Union as one country. However, if emissions due to deforestation and land use change are included, estimated emissions become much higher.

Emissions from deforestation and land use change, including conversion by fire and especially on peat lands, are currently greater than those from fossil fuel combustion. The GOI (Ministry of Forestry) recognizes this issue and is developing a Reducing Emission from Deforestation and Forest Degradation (REDD) initiative in collaboration with the Indonesia Forest Carbon Alliance, a coalition of donors, NGOs, and scientists working on supporting technical studies. Emissions estimates will be revised and updated as part of this process.

Remote sensing data show that Indonesia's deforestation rate is now much lower (perhaps two-thirds lower) than estimates from the period of economic crisis and decentralization. Reductions in deforestation will reduce the estimated level of emissions. Most deforestation (and hence another large share of emissions) occurs on production forest land (designated for sustainable harvest) and on land slated for conversion to other uses, mainly agriculture and plantations. Deforestation on forest areas designated for conservation or watershed protection has been relatively minor in recent years.

Substantial deforestation is occurring on peat swamp areas (*lahan gambut*).² Because peat lands are the most intensive sources of emissions per hectare, even a smaller area deforested can contribute to a larger amount of GHG emissions. Prior estimates based on secondary data indicate that a large share of Indonesia's emissions comes from burning, draining, and degradation of peat swamp areas. Timber estates and oil palm plantations have been among the fastest growing land uses in recent years, and have contributed to deforestation both on mineral soils and peat swamps. Both are important to regional economies. Emissions from deforestation for pulp timber and palm oil plantations are especially high when fire is used and when plantations are situated on peat land.

Considerable deforestation is also occurring outside state forest areas. Forested land outside the state forest may be in large blocks, or in smaller areas controlled by small holders (mixed agroforestry areas), private operators or local governments. Actions to reduce deforestation in these areas would have to be based on the legal authorities and incentives appropriate to lands under local and private control.

2 Indonesia has extensive areas of peat soil, which are particularly rich in carbon, which is emitted when these areas are cleared, drained or burned.

Emissions from fossil fuel combustion are not as large as emissions from forests and land use, but are growing very rapidly, at 6 percent per year, faster than gross domestic product (GDP). Overall emissions are growing even faster than energy use, implying inefficient use of energy and a shift to fuels with higher emissions.

Among fossil fuels, oil is currently the main contributor of emissions. However, emissions from use of coal have been the fastest growing for the last decade. The fast rise of coal (which produces more GHG emissions per unit than oil or gas) is attributed to its increasing use in electric power generation.

Among the consuming sectors, industrial activities have been the main source of emissions, but electricity generation is the fastest increasing. This is mainly due to the increases in electricity demand, being fed by expansion of coal-fired generating capacity in recent decades. Emissions from the transportation sector grew steadily but less so than the industrial sector. Residential sector emissions are relatively smaller and come mainly from the combustion of kerosene for home cooking.

Emissions intensity and international comparison. Emissions from fossil fuel combustion grew faster than GDP during the decade 1994 to 2004, so emissions intensity³ increased. In the period 1994-2004, energy intensity increased, but the rate of increase declined, which is progress in the right direction

In most countries, GDP has been growing faster than fossil fuel emissions, so emissions intensity declines over time. Indonesia's emissions intensity is similar to that of the world average, and still below the average for non-OECD (developing) countries.

Indonesia's GHG emissions per capita are still low in comparison with other countries, but are rising faster than energy use per capita. From 1994 till 2004, Indonesia's CO₂ emission per capita from fossil fuels grew faster than China's and India's.

Future scenario comparisons. Although forest loss, fire, and land use change are currently the largest share of emissions, there is no reason to expect a major increase over time. As forests are depleted, or controls on deforestation and fire are implemented, emissions from these sources would decline. As noted, deforestation does appear to be declining in recent years.

In contrast, GHG emissions from fossil fuel combustion are expected to grow rapidly, doubling every 12 years. By 2030 these emissions would be four times higher, thus potentially off-setting any gains made through controlling Indonesia's forest and peat land destruction.

Energy and fossil fuel use issues in Indonesia have been analyzed for some time. There are governance challenges and underlying policy issues in both sectors that contribute to Indonesia's current greenhouse gas emissions profile. Climate change considerations – and potential access to carbon markets – provide a new angle for examining these issues, but not fundamentally different options than have been offered in the past.

3 Intensity is a measure of the level of emissions per unit of economic activity (as measured by GDP).

2. Consultation and Engagement Process

This section describes how the low carbon and climate change technical assistance work program was undertaken under the leadership of the Ministry of Finance and how the technical contributions and analytical work contributed to the development and advancement of Indonesia's climate change position and consideration of low carbon development options.

2.1. Government Leadership

During the second half of 2007, the Ministry of Finance (MOF) convened an inter-ministerial working group⁴ at least monthly to guide efforts and studies toward the High Level Event on Climate Change held in conjunction with the 13th Conference of Parties of the UNFCCC in Bali, including the low carbon options study. The working group includes senior policy makers and researchers from the Fiscal Policy Office, reporting to the Minister. The group is informally constituted and includes representatives from the Coordinating Ministry for Economic Affairs, the National Development Planning Agency (Bappenas), the Ministry of Environment, the Ministry of Foreign Affairs, and the President's office (senior advisor). The working group will adapt its membership and reporting structure as the GOI solidifies institutional relationships and mandates for climate change planning and implementation (In particular, representation needs to be expanded to include the Ministry of Mining and Energy Resources, Ministry of Public Works, Ministry of Forestry and other sectoral ministries. Key academics or public opinion leaders may be invited to join or advise the Working Group).

During the process of developing working papers and briefings, regular meetings provided a venue for presentation of results and sharing of technical information. The group sponsored technical meetings, developed analytical pieces, commented on technical reports, and contributed to planning of work and specific studies. Technical inputs and engagement across a wide range of agencies stimulated interest in MOF and Government of Indonesia (GOI) in policies and instruments that can be used to deal with climate change issues. This dialogue process has advanced the work on low carbon options by increasing demand, interest, and capacity for conducting the analysis,

⁴ See acknowledgements for structure and function of working group, which was led by the Fiscal Policy Office of the Ministry of Finance.

interpreting the results, and shaping effective policies. The products of this work contributed to the preparedness and capacity that supported the GOI's participation in a range of international events over the last year. Some outreach and constituency building activities have been conducted in Phase 1 and these need to be expanded in later phases to ensure that the results and options are widely understood.

2.2. Capacity Building Process

The High Level Event on Climate Change for Finance Ministers in Bali in December 2007 was an historic platform for finance and development minister to engage more deeply on climate change issues. Through the High Level Event and subsequent international meetings, including the WB-IMF, ADB, G-20, ASEAN and APEC, it appears that Ministers of Finance have begun to play a more active role in responding to climate change issues, both domestically and internationally. Representatives from Indonesia are considered valuable contributors in many of these global dialogue processes. The Ministry of Finance has become increasingly aware of the international financing mechanisms and sources that can be used for investments, preparatory analyses, and incentives or seed money for innovations. The GOI has begun to consider the institutional and regulatory framework needed to benefit from international flows to create sound incentives, provide resources for programs, and protect the poor.

The Ministry of Finance engaged a program of technical assistance from the World Bank in the lead-up to the Bali Climate Change Conference (UNFCCC COP 13) in December 2007. A working group on climate change has been set up under the auspices of the MOF, which was tasked to provide technical assistance on basic environmental economics, carbon finance and international climate change policy to the Minister.

Learning by doing. The working group involved regular meetings and discussions that contributed to a process of staff capacity development. Participants in the working group reviewed literature and technical reports, contributed to the discussion of key climate change issues facing Indonesia, and jointly developed a matrix of fiscal and financial policy instruments with relevance to climate change (see Section 4 of this report, as this was incorporated into the Policy Instruments Working Paper reviewed there). The inter-ministerial working group prepared substance materials used to brief the Minister on key issues of concern, milestones in the development process, and the politics of country positions on climate change issues. Senior Indonesian experts were invited into the working group and into the private briefings as needed to ensure technical representation of issues of importance to Indonesia's overall position. Key briefings for the Minister were held each month and focused on climate change issues and opportunities, UNFCCC history and process, evolution and workings of Carbon markets⁵, fiscal and financial policy instruments to address climate change, and GOI positions on key climate change issues. Planning and executing Ministerial briefings provide a very focused and rapid method of getting staff up to speed on an issue.

⁵ As an example of a technical contribution to capacity building, Annex B of the report includes an overview of CDM activity in Indonesia produced for the GOI in run up to Bali COP 13.

| MOF Participation in Global Venues 2007 | | |
|---|--------------------------------|-----------------------|
| Date | Subject | Place |
| 1-2 Aug | APEC | Queensland, Australia |
| 20-Oct | ASEAN Finance Minister Meeting | Washington, DC, USA |
| 6-7 Nov | ASEM Workshop | Jakarta, Indonesia |
| 7-Oct | G20 Deputies. | Durban, South Africa |
| October | WB/IMF Annual Meeting | Washington, DC, USA |
| 7-Nov | G20 Ministers | Cape Town, S Africa |

Learning by engaging internationally. Though the group was formed primarily to prepare for the High Level Event on Climate Change hosted by the Minister of Finance in parallel to the UNFCCC COP 13 in Bali, the group also contributed to preparations for a number of international gatherings in the run up to the Bali Meeting during 2007 (see table). Preparation for these international meetings provided key staff with the motivation and deadline to learn the issues, develop the materials, brief the Minister, and interact with the counterparts in international venues. Success in presenting at international venues is also a substantial reward to continue performing at a high level on climate change issues.

| MOF Participation in Global Venues 2008 | | |
|---|----------------------------|--------------------|
| Date | Subject | Place |
| Feb-08 | Scheduled Meeting WB | Washington DC, USA |
| Apr-08 | WB-IMF Spring Meeting | Washington DC, USA |
| Apr-08 | Troika Process Planning | Washington DC, USA |
| May-08 | ADB Annual Meeting | Madrid, Spain |
| May-08 | G-20 Clean Energy Program. | London, UK |

In 2008, the Ministry and working group on climate change has been faced with the success and visibility arising from the successful Bali HLECC meeting (see Section 2.3), which has resulted in increasing demand for representation from MOF at global events. Continuing the efforts to develop capacity, learn by doing, and provide technical assistance, the working group and supporting team contributed to the Ministry of Finance's preparation for presentations and participation at international venues, as noted in the table.

Learning through technical collaborations. The Ministry of Finance has already allocated counterpart resources to ensure full engagement with the study team and appropriate representation at international meetings during 2008. The Ministry has assigned senior staff and designated researchers to lead the working group and interact with donor funding consultants and studies. During Phase 1, the technical team pursued many opportunities for close collaboration with GOI agencies, donors, projects, academics and others doing related work. For example:

- The Ministry of Environment and UNDP are working now to develop a national Adaptation Strategy and Indonesia's 2nd National Communication on Climate Change. This report will provide valuable data and analysis that can complement this work.
- The Ministry of Forestry is conducting baseline studies and developing pilot studies to develop the framework and mechanism for carbon payments from Reduced Emissions from Deforestation and Degradation. These studies are being supported by WB (PROFOR

and CF), AusAID, DFID, GTZ and others and will generate useful data and analyses that can complement this work.

- JICA is supporting the Ministry of Finance to develop technical studies and a research program in support of climate change and low carbon issues, which will be planned in collaboration with the working group and research team mentioned above.
- CSIRO and ANU are working on a study of pathways to sustainability in partnership with Bappenas. This work will produce results on carbon intensity and employment absorption of industrial sectors; a CGE model that can be used to look at regional impacts of energy reform scenarios; and region-specific information that can be used to understand the impacts of macro policy change on land and resource use at the local level.
- Bappenas, funded by the DANIDA Environmental Support Project, is engaging local consultants and universities on a Country Natural Resources and Environmental Analysis, which provides data and analysis looking at sustainability issues.
- ADB is commencing with UK funding a Regional Review of the Economics of Climate Change in Southeast Asia (RETA 6427) and will schedule a consultation in Jakarta during May 2008.
- The World Bank is supporting country case studies for the G+5 in China, India, Brazil, Mexico and South Africa. This study can draw on expertise and methods already available within the World Bank.

The team actively sought collaboration and sharing of data, analysis and expertise with these other efforts.

Learning through environmental economics course. During the collaboration, there was an effort to improve the GOI's analytical capacity to engage on environmental and climate change issues. The regular annual WBI – ADB course on “Environmental Economics for Development Policy” (EEDP) was identified as an ideal option to increase capacity-building within MoF and the Coordinating Ministry for Economic Affairs and to provide the latest findings in these policy areas to GOI staff. The course and the participants' findings from it are described in Annex C.

As a supplement to the regular learning by doing activities, the Environmental Economics Course provided a week's introduction to the principles and theories behind environmental economic policy making. A second week emphasized case studies on environmental cost-benefit analysis from all over the world. The practical examples provided valuable comparative insights on how best-practice environmental valuation estimates of policy choices can be done. The balanced mix of theory and practical examples provided the GOI participants a practical “toolkit” to bring back as a resource material for the respective ministries.

An additional benefit for the participants is the access to a wide network of practitioners in the field, among colleagues from neighboring countries, and in the MDBs. By bringing the material home to share with colleagues, the participants have contributed to creating awareness among a critical mass of staff within the key economics ministries on environmental economics issues. This is manifested in the formation of a research team dedicated to Climate Change within the Ministry of Finance and a seminar series on climate change issues being sponsored by the Coordinating Ministry for Economic Affairs.

2.3. Initiation of Finance Ministry International Climate Change Policy Dialogue

In December in Bali, finance ministers and officials from 36 countries and 13 international financial institutions and multilateral organizations gathered to focus their attention exclusively on climate change. The President of Indonesia opened the event. Indonesia's Ministry of Finance organized and hosted the event, which was held in parallel with the UN Climate Change Conference also being held in Bali. Minister Sri Mulyani Indrawati was very pleased at the positive responses from colleagues and the technical assistance and capacity building efforts that preceded the event. She said, "Both Finance and Development ministers were eager to contribute to this discussion in very thoughtful and substantive ways. Ministers also proposed to carry this discussion forward into our other meetings in 2008. We expect that this dialogue will be sustained at a high level through the next year and beyond."



December 12, 2007 - World Bank Group President, Robert B Zoellick and Indonesian President Susilo Bambang Yudhoyono at the UN climate change conference. Photo: © World Bank

The main purpose of this Ministers of Finance meeting was to initiate a discussion process through discussion on three main topics: raising awareness about the size and severity of the development challenge, stimulating discussion about national policy instruments that Minister of Finance can use to promote mitigation or adaptation, and stimulating discussion about collective actions or instruments that Minister of Finance can use to respond to this global challenge.

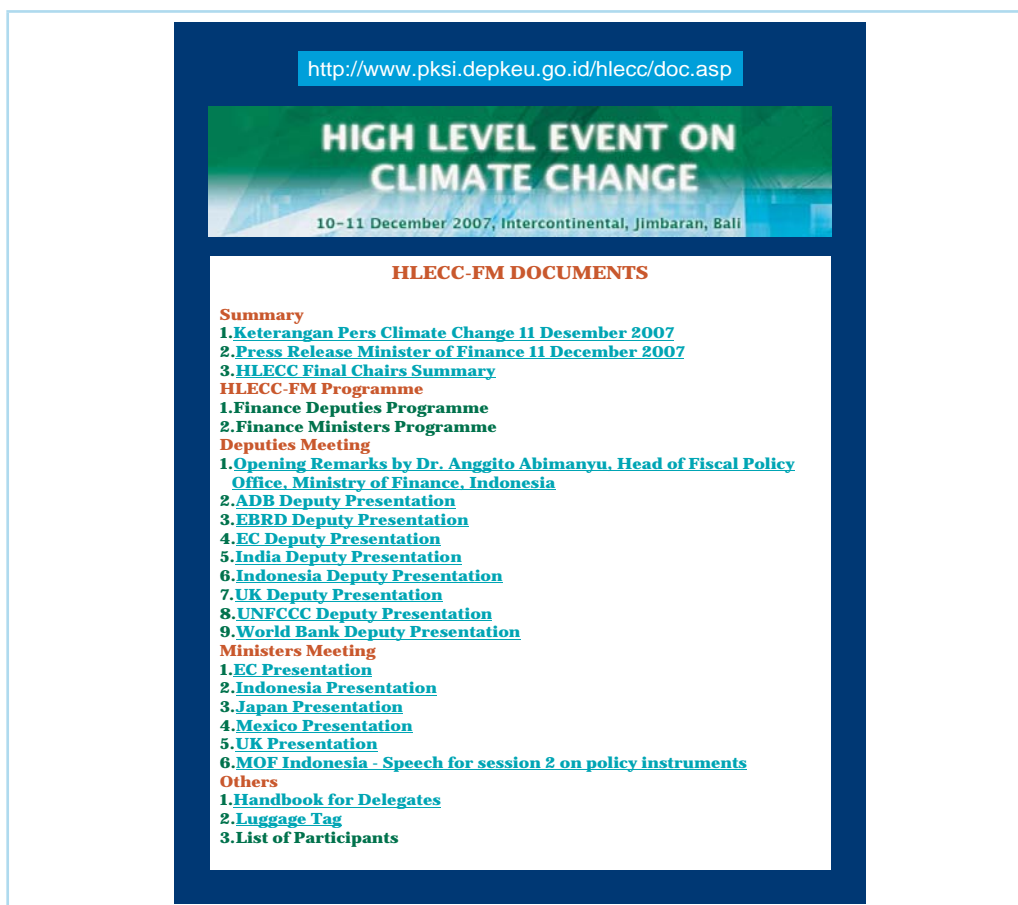
Participants focused on why Finance Ministers need to care about climate change. Climate change is a very costly global development challenge – according to the UNFCCC, USD200 billion more investment will be needed each year. Finance Ministers manage the levers of the economy and the flows of investment. They establish the long term, stable investment climate and economic signals that encourage public, private, and individual efforts to deal with the consequences of climate change. Finance Ministers are responsible for maintaining the investment climate and creating the incentives that are needed to address the long term challenge of climate change.

This was an historic platform for finance and development ministries to engage more deeply in the ongoing process to tackle this most serious globally-shared problem. Climate change is an economic, development and investment challenge, not just an environmental challenge. Participants agreed that it is important for Ministers of Finance to take a more active role and

integrate climate change issues into development planning and economic policies. They agreed that future Finance Ministers meetings will include climate change sessions.

Developing countries were clear that their development agendas and poverty alleviation goals are a key priority. They agreed that additional resources are needed to address climate change, and this view was supported by developed countries and international financial institutions. The participants recognized that Finance Ministers can play a role in accessing important opportunities related to the carbon market, technological innovation and transfer. Developing countries, like Indonesia, India and Mexico, outlined climate change responses that are compatible with their development goals, including helping the poor to adapt and reducing emissions intensity.

Participants noted that collective effort to generate additional investment and financial flows will be needed to implement effective mitigation and adaptation approaches. They also agreed that more knowledge is needed on economic impacts and the application of particular policy instruments on climate change outcomes. They agreed on the need to encourage international collaboration to explore climate change issues between developed and developing countries, as well as with International Financial Institutions. They supported the need for International Financial Institutions to explore development of a diversified set of financing instruments, including instruments to facilitate the deployment of low-carbon technologies and private sector involvement in addressing climate change.



<http://www.pksi.depkeu.go.id/hlecc/doc.asp>

HIGH LEVEL EVENT ON CLIMATE CHANGE
10-11 December 2007, Intercontinental, Jimbaran, Bali

HLECC-FM DOCUMENTS

Summary

- [1. Keterangan Pers Climate Change 11 Desember 2007](#)
- [2. Press Release Minister of Finance 11 December 2007](#)
- [3. HLECC Final Chairs Summary](#)

HLECC-FM Programme

- 1. Finance Deputies Programme**
- 2. Finance Ministers Programme**

Deputies Meeting

- [1. Opening Remarks by Dr. Anggito Abimanyu, Head of Fiscal Policy Office, Ministry of Finance, Indonesia](#)
- [2. ADB Deputy Presentation](#)
- [3. EBRD Deputy Presentation](#)
- [4. EC Deputy Presentation](#)
- [5. India Deputy Presentation](#)
- [6. Indonesia Deputy Presentation](#)
- [7. UK Deputy Presentation](#)
- [8. UNFCCC Deputy Presentation](#)
- [9. World Bank Deputy Presentation](#)

Ministers Meeting

- [1. EC Presentation](#)
- [2. Indonesia Presentation](#)
- [3. Japan Presentation](#)
- [4. Mexico Presentation](#)
- [5. UK Presentation](#)
- [6. MOF Indonesia - Speech for session 2 on policy instruments](#)

Others

- [1. Handbook for Delegates](#)
- [2. Luggage Tag](#)
- [3. List of Participants](#)

The Government of Indonesia committed to integrate the climate change policy program into national development planning and state budget policy and mobilize resources. Indonesia, Poland and Denmark also agreed to collaborate in planning for future climate change meetings and maintaining the momentum of the Minister of Finance High Level Event through continuing discussions at the WB-IMF Spring and Fall meetings. Materials from the meeting can be found on the web site noted in the box.

2.4. Consultation Process on the Low Carbon Study

In preparation for implementation of the low carbon study, the technical team supporting the Ministry Working Group has undertaken a series of consultations. The results of the Phase 1 analysis (the subject of this report) and plans for the Phase 2 work (the subject of a Project Concept Note dated March 24, 2008) have been presented at the following kinds of consultation events (all during 2008):

- March 11. Reviewed the progress report and plan with Ministry of Finance working group at Echelon 1 level. Received general approval of the approach, recommendation to discuss with other GOI agencies.
- March 18. Reviewed progress report and plan with Ministry of Environment at Echelon 1 level. General acceptance and understanding of the approach.
- April. Informally provided and discussed results with Bappenas/Directors for Environment and Director for Forest and Water Conservation, as well as key staff and consultants.
- March 11-24. Informally discussed Phase 2 plans with potential partner and collaborator agencies in Jakarta, including NGOs and think tanks.
- March 26. Reviewed progress report and plan with Coordinating Ministry for Economic Affairs at Advisor level. General interest and offer to schedule additional meetings and briefings for a wider audience.
- April 14. Met with Director for Forest and Water Conservation of Bappenas and reviewed the Phase 1 status report and Phase 2 plan informally.
- April 17. Presented low carbon phase 1 status report to about 60 senior GOI officials, at the invitation of the Deputy of the Coordinating Minister for Economic Affairs, who also chaired the meeting.

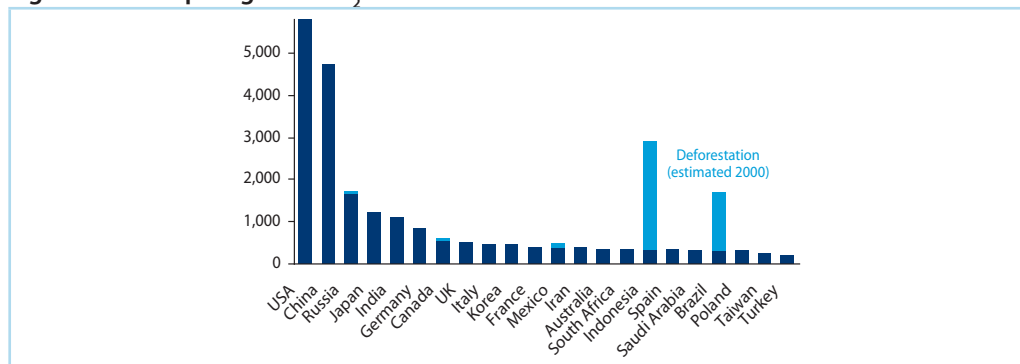
The result of this work program and process of engagement is that currently the Ministry of Finance and representatives from Indonesia are considered important and valuable contributors and participants in a wide range of global venues, many of which have a greater focus or special sessions devoted to climate change issues.

3. Greenhouse Gas Emissions Assessment⁶

3.1. Emissions Overview and International Comparisons

Overall emissions. When considering only fossil fuel combustion, since 2004, Indonesia is among the top 25 CO₂ emitters, or ranked 16th when counting EU as one country. Many countries in this range have only a slightly higher or lower level of emissions than Indonesia, making Indonesia’s position (rank) sensitive to small changes. However, if CO₂ emissions due to deforestation and land use change are included, Indonesia then rises to among the top emitters. It is important to note that there are questions on the reliability of emissions data from deforestation and land use change due to different methods of estimation. More recent estimates of deforestation provided by the Government of Indonesia (GOI) indicate a substantial decline in deforestation. The estimates in the figure are from 2000 and will be updated based on newer estimates when available. See section 3.2 for a fuller discussion.

Figure 3.1. Top 25 global CO₂ emitters in 2004

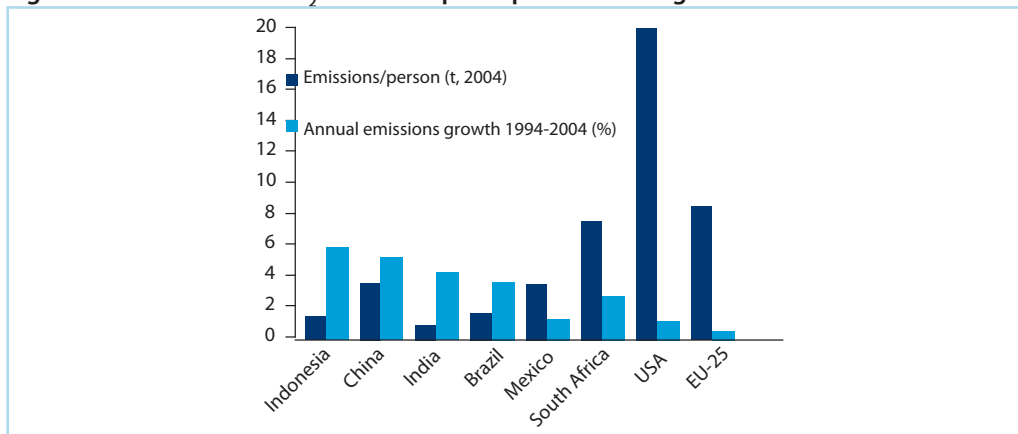


Source: International Energy Agency (2007) [www.iea.org]

⁶ The fossil fuel discussion in this section is based primarily on “Decomposing CO₂ Emission from Fossil Fuel Combustions in Indonesia to Understand the Options for Mitigation.” A draft report prepared by Budy P. Resosudarmo and Frank Jotzo, with assistance from Arief A. Yusuf and Ditya A. Nurdianto, all from the Research School of Pacific and Asian Studies at the Australian National University. Emile Jurgens and Mario Boccucci made contributions related to forestry and land use emissions, summarized in Section 3.3.

Emissions from deforestation and land use are now greater than that from fossil fuel combustion, but in the future there should be a tendency for slower deforestation emissions as the rate of deforestation will be slower due to decreasing available forest areas. Meanwhile, energy use and fossil fuel emissions will keep growing as gross domestic product (GDP) grows unless mitigating actions are taken. In the long run, CO₂ emissions from fossil fuel combustion will most likely be much more important than that caused by deforestation and land use change. This comparison is taken up in section 3.2.

Figure 3.2. Fossil fuel CO₂ emissions per capita and their growth rates

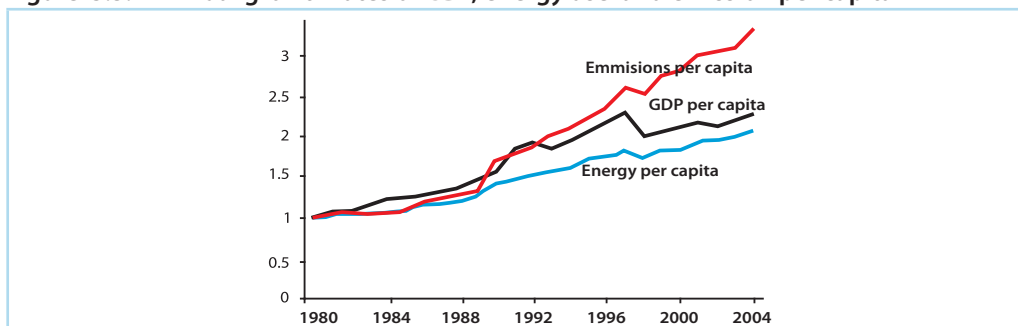


Source: International Energy Agency (2007)

Emissions per capita. Indonesia's green house gas (GHG) emissions per capita are still low in comparison with other countries. However, as can be seen in the figure to the right (for energy only, not forestry), it is growing relatively fast. From 1994 until 2004, Indonesia's CO₂ emissions per capita from fossil fuel combustion grew faster than China's and India's.

From 1980 to 2004, annual growth rates of energy consumption per person have increased slightly less than those of GDP per person. Comparing 1980 to 2004, the growth rate of GDP/person has increased by 2.3 times and energy/person by 2.1 times. In the meantime, CO₂ emissions growth varied with changes in the energy structure and technology. In Indonesia, annual growth rate of CO₂ emissions per capita has risen faster than those of energy use per capita; indicating carbon intensity of energy has increased as well. Comparing 1980 to 2004, the growth rate of energy use/person has increased 2.1 times and CO₂/person by 3.3 times.

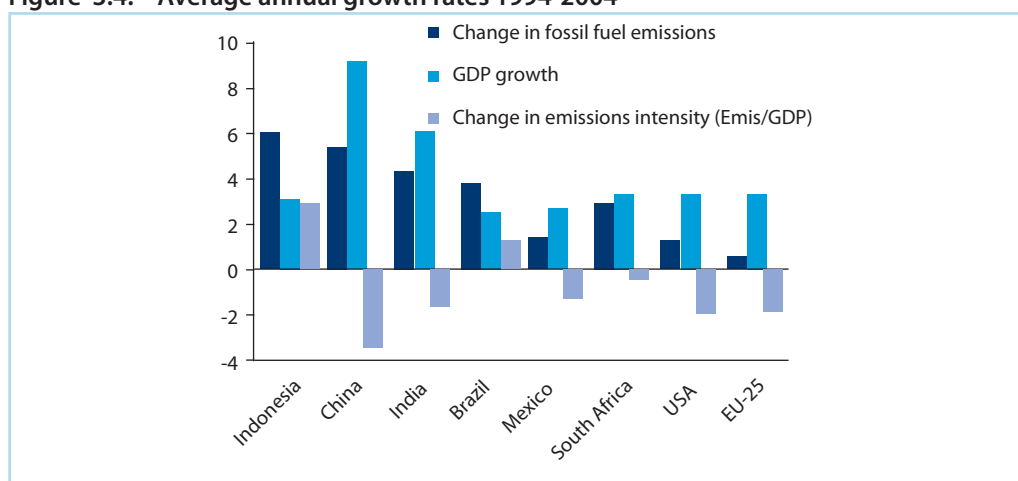
Figure 3.3. Annual growth rates of GDP, energy use and emission per capita



Source: International Energy Agency (2007) [<http://www.iea.org/>]

Emissions intensity. Intensity is a measure of the level of emissions per unit of economic activity (as measured by GDP). The figure to the right compares changes in fossil fuel emissions, GDP, and emissions intensity for several countries and regions. Developing countries like India and China have high GDP growth rates (first, grey bar) and developing countries generally have faster growing emissions (second, yellow bar) than the developed nations of Europe. In most countries, GDP has been growing faster than fossil fuel emissions, so emissions intensity declines over time (third, brown bar). In Indonesia, by contrast, emissions from fossil combustion grew faster than GDP during the decade 1994 to 2004, so emissions intensity increased. The 1997/98 financial crisis which reduced GDP but did not change energy consumption much had a role to play. But Indonesia's emissions intensity also increased strongly from 1999-2004 – at nearly 2 percent per year.

Figure 3.4. Average annual growth rates 1994-2004

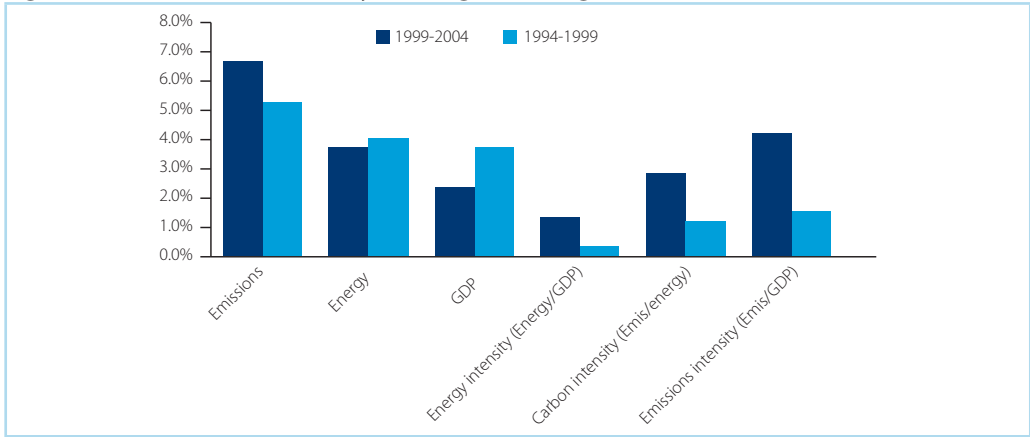


Source: International Energy Agency (2007) [<http://www.iea.org/>]

Internationally, increasing emissions intensity is uncommon. However, many fast-growing developing and industrializing countries are shifting increasingly to coal, which will tend to increase emissions intensity. The level of Indonesia's emissions intensity ($\text{kgCO}_2/\text{\$GDPppp}$) is similar to that of the world average, and still below the non-OECD average.

Emissions intensity over time. To understand better what happened during the 1994-2004 period, it is possible to look separately at the pre- and post-crisis periods: 1994-1999 and 1999-2004. The figure below shows that CO_2 emissions grew faster during the earlier 1994-1999 period than during the later 1999-2004 period, though energy use grew faster. So although energy intensity increased from 1994-2004, the rates of increase declined, which indicates progress. Carbon intensity has progressed as well: the increasing rates of carbon intensity declined. It is, hence, not surprising to see that the rate of increase of emissions intensity was lower in the later period than the earlier one. Thus, although the situation related to energy use and CO_2 emissions intensity in Indonesia had been increasing during the 1994-2004, the rates of these increases have been declining.

Figure 3.5. Emissions intensity: Average annual growth rates 1994-2004



Source: International Energy Agency (2007) [<http://www.iea.org/>]

Carbon emissions decomposition. The following figure presents the average annual change of population, GDP per capita, energy intensity, and carbon intensity for Indonesia and several other countries. From this figure, comparing with other countries, it can be seen that the main long-term driver for increasing CO₂ emissions in Indonesia is the increasing carbon intensity. The average annual growth of carbon intensity in Indonesia is much higher than those in other countries. Long term annual change of energy intensity in Indonesia is in the right direction, albeit less progressive than in Vietnam and China.

To understand why carbon intensity in Indonesia has increased significantly, we need to observe the level of emissions for each type of fossil fuel combustion (or by energy sources), as taken up in section 3.4. The role of coal in the electric generating sector emerges as a prominent factor in the increase in emissions intensity over time. The next section compares forestry and fossil fuel emissions.

3.2. Overview Comparison of Emissions from Fossil Fuels and Forests/Land Use

This Phase 1 analysis aimed to inform the Ministry of Finance and its partners of the main issues, targets and financing options for reducing emissions and shifting toward lower carbon development options. This section provides an overview of greenhouse gas (GHG) emissions from both deforestation/land use and fossil fuel consumption. The size and growth rates of GHG emissions sources are reviewed to give a sense of overall importance in the economy. This is a summary from secondary sources to give some perspective on the challenges, opportunities and potential entry points for action, particularly from the point of view of economic management, incentives and budget targeting.

Indonesia’s forest and land use emissions are still being tabulated through official consultative processes. The Ministry of Environment is developing Indonesia’s Second National Communication to UNFCCC on GHG emissions, while the Ministry of Forestry is developing a plan and baseline estimates for a national initiative on Reducing Emissions from Deforestation and Degradation (REDD). The Ministry of Forestry is also developing a Forest Resource Information System and

a National Carbon Accounting System. A global REDD framework, under negotiation through UNFCCC, holds the potential to provide payments through markets for GHG emissions reductions from forest lands.

Indonesia and Reducing Emissions from Deforestation and Degradation (REDD)

IPCC (2007) and Stern (2006) have noted that reducing deforestation is one of the most cost-effective approaches to reduce GHG emissions in the short run. The UNFCCC is discussing how to create markets for forest carbon by instituting a REDD scheme (as recommended by the Bali Roadmap adopted at COP 13). A mechanism to encourage payments for carbon emissions reductions from forest land would provide a powerful incentive to improve forest management. If an ambitious mechanism is established after 2012, Indonesia could potentially gain USD 1 billion or more in annual payments, assuming successful and verifiable efforts to reduce deforestation and degradation. Forest carbon emissions reductions are produced through sound forest governance and management activities that reduce forest loss. Indonesia has already committed to combat deforestation and illegal logging and is developing a REDD initiative (MOFr, 2008). REDD payments for forest carbon (avoided deforestation) could provide resources and incentives for sound forest management, as well as compensation for those who must forego benefits to prevent deforestation.

However, considerable consensus has emerged on the importance of forestry and land use emissions in Indonesia's overall profile (National Action Plan on Climate Change, 2007; National Development Planning Response to Climate Change, 2008, MOFr/IFCA, 2007)⁷. Land use change and forest loss are key mitigation issues and the GOI is placing a high priority on this issue and working toward preparation and implementation of a national REDD Initiative (REDDI). Because this detailed sectoral work is ongoing, this low carbon study incorporated available results and for comparison with fossil fuel and energy sector results. These forestry and land use data are preliminary and will be improved as the MOFr-IFCA analysis on emissions inventory from forest and land use is completed in the first half of 2009. The energy and fossil fuel use data are from the International Energy Agency.

Emissions from forests and land use change. A range of estimates of emissions from deforestation and land use change, including conversion by fire, are summarized in the Table below. The wide range of estimates is because estimates are based on different periods of activity and different methods and focus. In particular, the 1997-98 El Niño-Southern Oscillation period was especially severe and caused widespread drought and fires that have been estimated to have caused a global spike in GHG emissions (Page, et al., 2002). Even efforts to look carefully at deforestation and land use change may not capture all emissions from peat land degradation and drying. Indonesia has extensive areas of peat soil (*lahan gambut*), which are particularly rich in carbon and a key contributor to Indonesia's overall emissions profile.

⁷ Indonesia Forest Climate Alliance (IFCA) is a coalition of donors (WB, AusAID, DFID, GTZ), NGOs, and scientists working with the Ministry of Forestry on technical studies in support of the REDD initiative.

Table 3.1. Indonesia: Forest and land use change emissions range of estimates from literature, annualized, converted to MtCO₂e

| Period of Estimation | Deforestation | Swamp Forest / Peatland Degradation | Forest and Peat Fires | Sources |
|----------------------|---------------|-------------------------------------|-----------------------|--|
| 2000-2005 | 317 | 179 | | IFCA/MOF 2008, tentative, unpublished; Fire estimates to be developed |
| Annual | 1138 | | 1425 | WRI CAIT, 2005, quoted in PEACE, 2007, based on earlier sources |
| 2000-2006 | | | 469 | van der Werf, et al, PNAS, 2008; modeling calibrated to direct measurement of CO emissions |
| 1997-98 | | | 3,190 | van der Werf, et al, PNAS, 2008; modeling calibrated to direct measurement of CO emissions |
| 1997-98 | | | 2,970 | Page, et al, Nature 2002 |
| Annual | | 600 | 1400 | Hooijer, et al. 2006 |

There is an important caveat on forestry and land use data. As noted in the table, several reputable, internationally journals have reported different emissions estimates; some including fires, some including peat land loss. However, it must be noted that data on land use changes are subject to some uncertainty and the total estimated emission level depends on a number of assumptions about land area and emissions per hectare. Estimates that include peaks in emissions from years with fires (1997-1998) may over-estimate Indonesia's average annual emissions contribution, especially if forest loss due to fire and degradation is being reduced in recent years. Formal reporting on GHGs is done through the National Communications to the UN Framework Convention on Climate Change (UNFCCC). The latest such reporting from Indonesia is from 1999 with data from 1994. Estimates of forest, peat and fire GHG emissions will continue to be refined through ongoing processes (MOFr development of REDD Initiative, Min Environment development of Second National Communication). It is clear, however, that all estimates of emissions from forests and land use are larger – potentially much larger – than the total emissions from the combustion of fossil fuels (336 MtCO₂e, as reported in the table below).

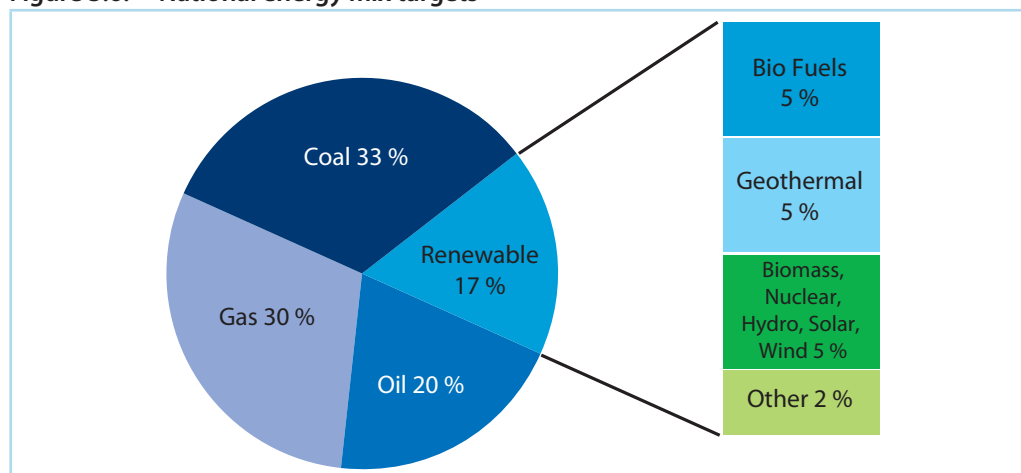
Emissions from fossil fuel combustion are not as large as emissions from forests and land use, but this category of emissions is growing very rapidly, at 6 percent per year, faster than GDP, in fact. In most countries, GDP has grown faster than fossil fuel emission, so the intensity of emissions has declined over time. In Indonesia by contrast, emissions from fossil fuel combustion has grown faster than GDP during the last decade, so emissions intensity has increased. Overall emissions are growing even faster than energy use (carbon intensity increases because of shift from oil to coal). Internationally, increasing emissions intensity is uncommon. However, many fast-growing developing and industrializing countries are shifting increasingly to coal, which will tend to increase emissions intensity.

Table 3.2. Indonesia: Fossil fuel emissions

| By Consumption Group | Emissions by Fossil Fuel Source | | | | Total Emissions | Share of Fossil Fuel Emissions | Emissions growth '94-'04 |
|----------------------|---------------------------------|--------------|-------------|--|-----------------|--------------------------------|--------------------------|
| | Coal | Oil | Gas | | | | |
| Industry | 31.9 | 35.4 | 50.7 | | 118.0 | 35% | 48% |
| Electricity | 54.9 | 25.2 | 9.9 | | 90.0 | 27% | 170% |
| Transport | - | 78.0 | - | | 78.0 | 23% | 74% |
| Residential | - | 41.0 | 9.0 | | 50.0 | 15% | 71% |
| Total | 86.8 | 179.6 | 69.6 | | 336.0 | 100% | 80% |

Data Source: IEA 2004, measured in MtCO₂ in 2004

Comparative trends. It is important to note that this static comparison is only the beginning of the story. Although forest, fire, and land use change dominate emissions currently, there is no reason to expect a major increase over time. As forests are depleted, or controls on deforestation and fire are implemented, emissions from these sources would decline. Land conversion and deforestation emissions should slow and level off over time, at least due to depletion of forest lands, if not due to better control and changed practices. It is important, however, to differentiate peat land emissions and forest loss emissions. Total emissions appear to be dominated by peat land emissions (sources sited in table above). Peat land emissions are dominated by emissions from burning and drainage. If fires are indeed successfully controlled, emissions will decrease substantially (though underground peat fires are a continuing issue). However, emissions from peat degradation following drainage is a long term problem that needs further study. It takes many years for peat to completely degrade and effects will be cumulative, adding to existing areas – again, unless mitigation actions (raising the water table) are undertaken.

Figure 3.6. National energy mix targets

Source: Presidential Decree No. 5, 2006

In contrast, GHG emissions from fossil fuel combustion are currently low relative to land use and forest emissions. Emissions from fossil fuel use, however, are growing quite rapidly at 6 percent per year, faster than GDP growth in most years. With current investment plans and the long lock in periods for some kinds of fossil fuel consumption (e.g., power plants), this level of growth could

continue for some time. At this rate of growth, fossil fuel emissions will double every 12 years, so that by 2030 these emissions would be four times higher, comparable to or higher than today's forest and land use emissions. Thus, fossil fuel emissions growth has the potential to offset any gains made through controlling Indonesia's forest and peat land destruction. Looking at all sources of GHG emissions allows consideration of this kind of trade-off.

In addition, Indonesia's proposed energy growth path has the potential to adversely affect land use and forest cover. GOI energy plans and documents explicitly state the desire to increase dependence on coal (and decrease dependence on oil). Based on a recent Presidential decree (Perpres No 5/2006) on National Energy Management, there is an intention to increase use of coal from 24 percent of overall energy use to 33 percent of energy use over 20 years (almost a 40 percent increase) and to quadruple the use of "biofuels" from 1.3 to 5 percent of total energy use (a 400 percent increase) in the same period. These goals have been advanced at high government levels in response to concerns about the price of imported fuels (higher in 2008 than in 2009) and the level of consumer fuel subsidies. Land conversion from forest to palm oil and timber plantations is already proceeding rapidly (as noted below in graphs). A major expansion of production of biofuels could lead to even more conversion of forest area into oil palm plantations. Expanding use and export of coal has the potential to lead to much more extensive strip mining – affecting already threatened forests in Kalimantan and Sumatra – as well as contributing to direct pollution impacts.

Within a reasonable planning horizon for climate change decisions, and with no changes in practices or regulation, emissions from the Indonesia's energy sector could be a major area of concern. The actual trajectory of emissions will depend on 'business as usual' assumptions, regulatory changes, actions in the forestry and land use sector, and investment decisions made in the next 5 to 10 years. For this reason, the low carbon options analysis takes a forward looking approach, recognizing that growth in energy emissions will one day be the dominant issue in Indonesia's emissions profile. This means that efforts to control emissions in the energy sector must not be forgotten, while shorter term efforts focus on control of deforestation, and especially peat fires.

3.3. Deforestation as a Source of Emissions

3.3.1. Overview⁸

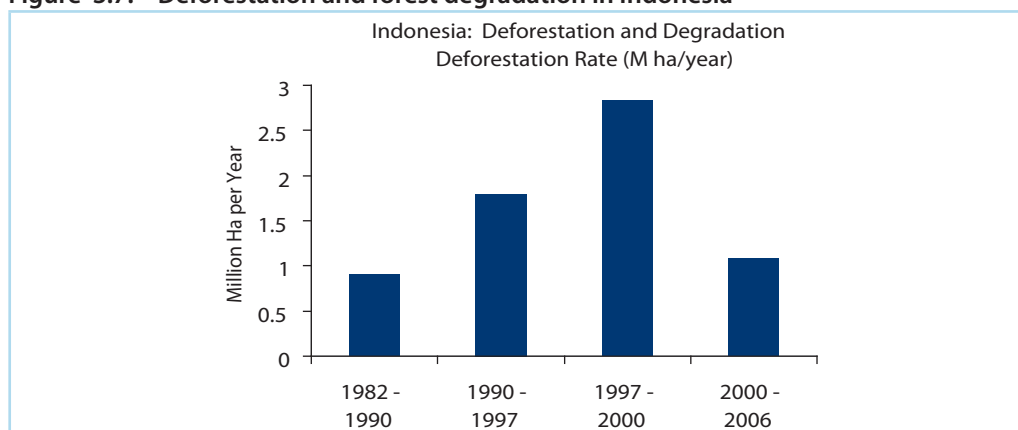
In recent decades, Indonesia has been known for high rates of deforestation, illegal logging, forest fires, and peat land conversion. All of these contribute to high rates of greenhouse gas emissions. The exact emissions figures are uncertain and disputed because of the many factors that must be measured or estimated to develop sound estimates (e.g., timing/severity of fires, depth/subsidence of peat, deforestation vs. degradation, carbons stocks in different kinds of forests).

Greenhouse gas emissions estimates have focused renewed attention on Indonesia's forests in the context of the global climate change debate. However, sustainable forest management and governance has long been a topic of concern in Indonesia, as well as the rate of conversion of forest and peat land into plantations and other uses. These issues have been the subject of study and debate for many years (see World Bank, et al., 2006 for an overview of forest sector issues). Climate

⁸ Because emissions data are still under review, this section focuses on land use change and deforestation for an overview of the size and location of the issue.

change and the focus on carbon emissions provide another rationale for raising the level of policy and management attention to this set of issues, especially as it has the potential to unlock up to a billion dollars of payments for the preservation of standing forests. Green house gas emissions are just another symptom/indicator of the underlying issues of forest management for improved equity, economic growth, and environmental projection, as reflected in the national development focus on “pro-poor, pro-jobs, pro-growth.”

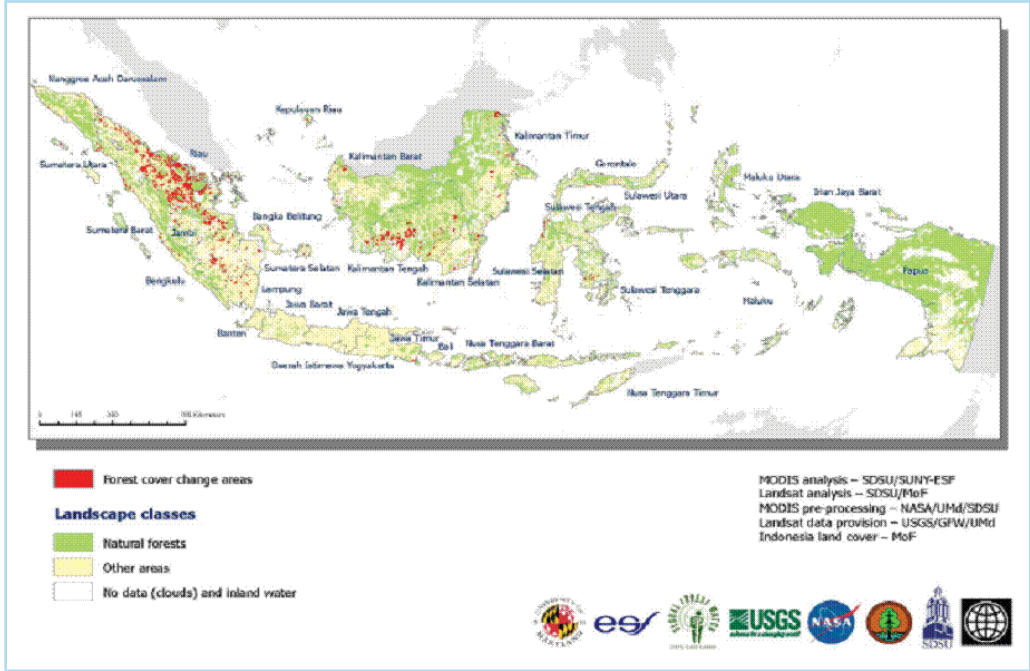
Figure 3.7. Deforestation and forest degradation in Indonesia



Source: MoFr/IFCA, 2008

Forest loss is declining. More recently, data and analysis (cited in MOFr, 2008) show an improvement in the rate of deforestation. The figure to the right compares average areas deforested during different periods based on when satellite information was gathered by different organizations. The most recent period, since 2000, shows a clear indication that deforestation is declining. The current rate may be only a third of average rates estimated in the 1990s. These data from mapping analyses (and see figure below) have been developed using more sophisticated and detailed images and analysis from new satellite systems (Hansen, et al., 2007). These results depend on definition of forest and interpretation of land cover, but there is a clear indication that deforestation is going down in more recent years. During the period of the monetary crisis and decentralization (1997-2000) in Indonesia, most analysts believed that deforestation was increasing (World Bank, et al., 2006). These data confirm that judgment, but also show that in more recent years, the rate of deforestation may be only a third or less than the average rates in the late 1990s.

Figure 3.8. Decrease of forest cover in Indonesia 2000-2005: Forest cover change areas



Reported by Mr. Hermawan Indrabudi Min Forestry’s Center for Forest Inventory and Mapping National workshop on Forestry and Climate Change in Indonesia. Jakarta Aug 27-28, 2007. GTZ & GOI.

The Ministry of Forestry is currently working on a consolidated report and plan for reducing emissions from Indonesia’s forestry sector. As part of that work, there will be an effort to translate the latest information on forest cover loss into estimates of GHG emissions and rates of change. Since emissions are based on land use change and deforestation can be shown to be declining (to perhaps a third of prior estimated levels), it can be expected that lower estimates of Indonesia’s forest-based emissions will emerge.

Peat swamps and fires. Though this section focuses on area deforested because of the relative availability of data, this not a perfect guide to overall emissions. Many estimates of emissions (see table above) show that peat drainage and fires have been a more important source of emissions than deforestation. Fires do not happen every year with same severity, so estimates of this source may vary by methodology and which years are taken into account. These emissions also create costs in terms of air pollution and health risks to the local population and in neighboring countries (Bappenas-ADB, 1999). Reducing the use of fire in peat conversion would have multiple benefits⁹, and could perhaps be achieved at negative cost (that is, overall, society would gain through this change, even after the implementation cost is considered). However, peat fires and peat land drainage on land without trees are not currently considered part of the REDD incentive scheme being negotiated under UNFCCC.

⁹ Use of fire for land clearing for planting is not legal in Indonesia and can be reduced and contained through a number of well-understood practices (Bappenas-ADB, 1999). Some hold that alternative practices are more expensive, would undermine profits, and hurt poor small holders. Evidence shows that most fire activity is found on large estates, not smallholdings, however (WWF/Eyes on Forest 2008). Further, there are clear societal and global gains in terms of health and greenhouse gas emissions from changing these practices. Priority should be placed policies, incentives, regulations, or law enforcement approaches that can effect a shift toward less destructive and emissions-producing practices.

Comparison of emissions estimates. Emissions estimates from forest loss and land use change are subject to a wider range of assumptions and uncertainties than those coming from fossil fuels. Since a range of assumptions are employed at various points in the analysis, it is relatively more difficult to elaborate a specific range in the final analysis. Forest cover information was developed from satellite analysis conducted by Ministry of Forest in collaboration with South Dakota State University (MOFr, 2008; Hansen, et al., 2007). This analysis for a more recent period indicates that forest loss during 2000-2005 was about one third of prior estimates (0.7 million ha/yr vs. 1.3-1.9 million ha/yr in FAO 2007 and other sources). Estimates vary due to the definition of forest and methods used (e.g., resolution of images). In general, though, lower deforestation estimates in the newer period would lead to lower estimates of overall emissions than previous estimates in international publications, cited in the table above. Several other considerations and assumptions also contribute to overall emissions estimates, including estimates of the carbon stock (which can be disaggregated for different types of soils and forests). Assumptions about the depth of peat and the rate of burning also have a substantial effect on the emissions estimates. The period before 2000 not only included more deforestation, but also more forest fires and hot spots. More recent analysis shows that the number of hot spots and range of forest fires has been lower than in 1997-98 period. The approach for incorporating these findings into an overall country estimate and a baseline for future projections is at the heart of analytical concerns and discussions going on now among Indonesia's forest carbon analysts inside and outside of government.

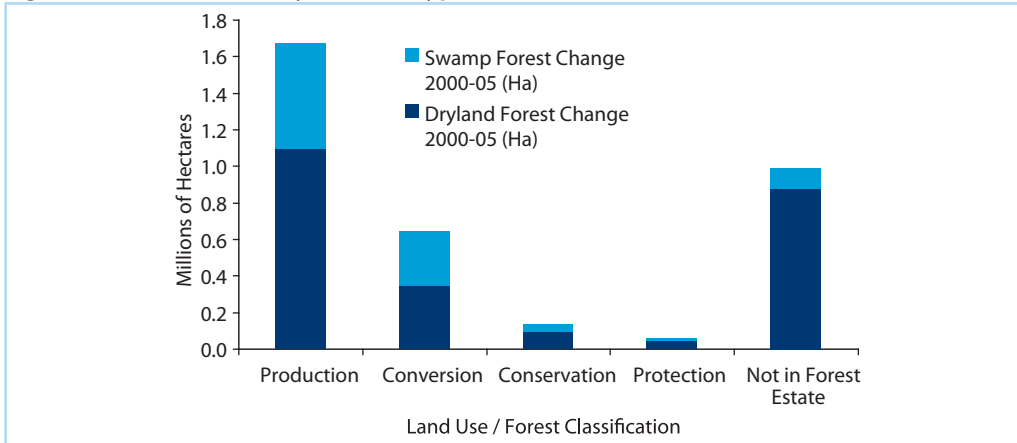
3.3.2. Decomposition of Deforestation Findings

A more disaggregated analysis of deforestation locations and trends can reveal much about how and where Indonesia can make efforts to reduce emissions. Following deforestation is a reasonable approach, because deforestation is clearly linked to emissions. Emissions will not track deforestation areas exactly, because of differences in the carbon content of different forests and soils, as well as the method of deforestation. For example, deforestation through burning contributes emissions more directly and quicker. Deforestation and further drainage of peat land (mainly swamps, or *lahan gambut* in Indonesian) creates more emissions per unit area due to the high carbon storage ability of these soils. An analysis of emissions, however, would be subject to much uncertainty, given the ongoing debate over the level of emissions from peat lands and burned areas, as well as the rate and frequency of burning. Indonesia is in the process of compiling its Second National Communication, as well as a 'readiness' submission to the Forest Carbon Partnership Facility. These processes should lead to more consensus on the forest sector emissions levels, as well as a baseline for judging future reductions.

Deforestation by land use. The data available on deforestation are informative on a number of issues, such as the locations and types of land where deforestation is most prevalent. These would be the most likely targets for an effort to reduce deforestation, hence emissions, and achieve some level of international compensatory payments. Although total emissions from deforestation are still under study, the deforestation figures are more widely accepted (since they can be read relatively directly from satellite imagery) and the basic trends and relative values are reasonably clear.

As the figure to the right shows, most forest losses in recent years occurred on production and conversion forest land. These areas have been allocated for economic exploitation through selective harvesting or through liquidation and conversion to agricultural or plantation uses. In contrast, protection and conservation forests are relatively less damaged, better protected.

Figure 3.9. Forest loss by land use type, 2000-2005



Source: Modis Analysis by MOFr and SDSU (2008)

The figure also shows that both “dry land forests” (i.e., most forest areas in Indonesia) and “swamp forests” (forests on wetlands, often peat, or *lahan gambut*) are facing heavy deforestation pressure. This is critically important for emissions because peat swamp forests contribute several times more GHG emissions than dry land forest areas. Thus, even though a smaller area is affected, overall emissions from this area could well be higher.¹⁰ Note that production and conversion areas accounted for almost all of the forest loss on swamp/peat land in this analysis.

Production forests are allocated for permanent production through selective harvesting, such that the timber can grow back and be harvested again over some long period. However, note that the highest level of deforestation is occurring on these production forest lands. This is unauthorized deforestation, resulting from poor forest management practices, illegal behavior, and insufficient or ineffective law enforcement. Reducing emissions on these lands would mean addressing the underlying drivers of deforestation that have been analyzed at length in other sources (World Bank, et al., 2006; and see figure in Section 3.3.3).

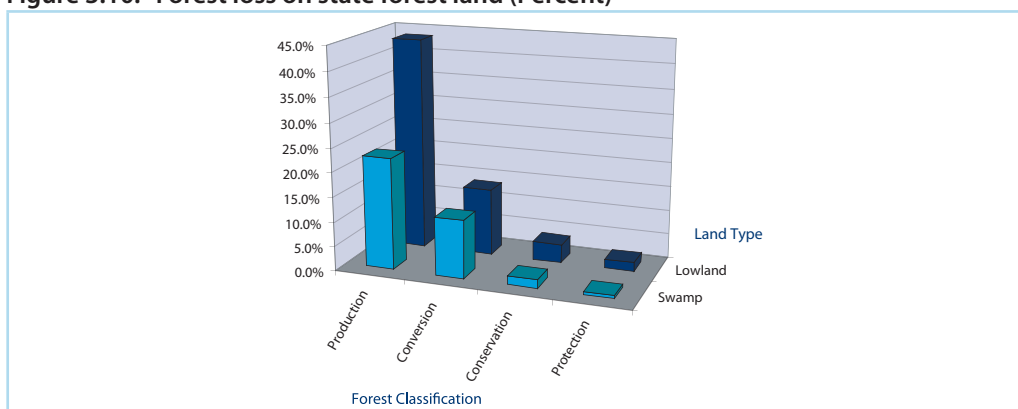
Conversion forests are allocated for liquidation to non-forest uses. This means these are planned losses within Indonesia’s forest management framework. These planned losses contributed 25 percent of overall deforestation on state-claimed land. Converted lands are used for agriculture and plantation crops, and a high proportion is converted to timber (pulp) and oil palm plantations, which are some of the fastest growing land uses in Indonesia. Other analysis shows also that pulp plantations and oil palm plantations are important to regional economies. Some of this converted forest is swamp land on peat soil (*lahan gambut*). These categories represent only 5-8 million ha of land, but are likely among the most intensive sources of emissions per hectare. Because of high carbon concentrations in peat soil, smaller areas may lead to higher emissions than deforestation on mineral soil, or “dry land”. If the Government wanted to reduce deforestation here, it would have to reconsider the policy of authorized forest clearance for economic purposes.

Conservation and protection forests have not suffered the large and rapid deforestation on other classes of forest land – though any deforestation is too much in areas set aside to preserve

¹⁰ MOFr/IFCA (2008) indicates that emissions from deforestation on peat soil can be ten times higher than emissions from deforestation on mineral soil, though emissions vary by forest, soil, and fire type.

Indonesia's heritage and biodiversity. Looking only at the state-claimed forest areas, in the figure to the right, it can be seen that only 8 percent of deforestation on state lands (the four left most bars in the figure) occurs in protected and protection areas, while two-thirds occurs on lands managed under the concession system of allowable harvesting. Another 25 percent occurs on land slated for liquidation, conversion to non-forest uses.). These are areas allocated for protection of watershed services and conservation of biodiversity and landscapes.

Figure 3.10. Forest loss on state forest land (Percent)



Source: MoFr/IFCA, 2008

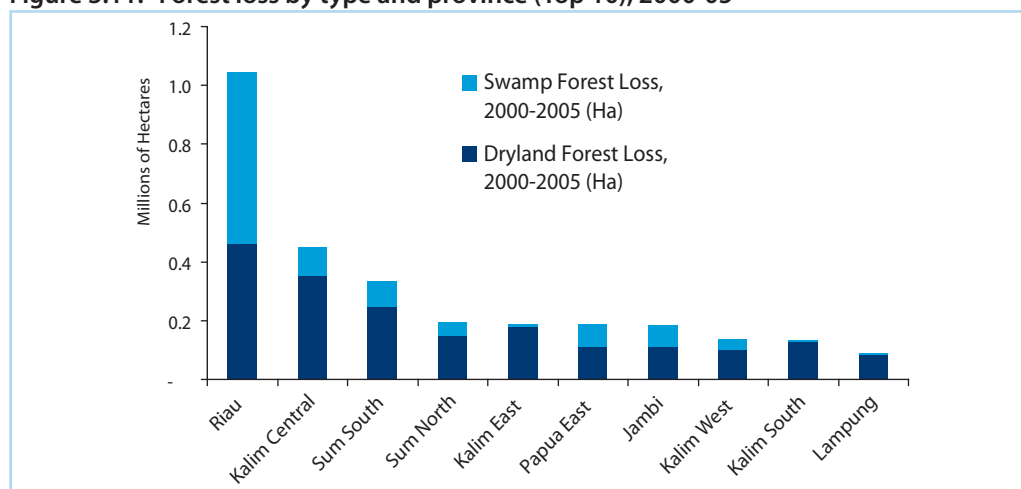
The IFCA process and report on REDD readiness provide extensive analysis of the issues and options for controlling emissions from deforestation and land use (MOFr/IFCA, 2007). A few key points are worth summarizing, however. Substantial emissions come from deforestation in the forest estate. These emissions can be reduced by focusing on forest management practices and the drivers of deforestation. However, the figures in this section also show that substantial deforestation (and emissions) are coming from planned land conversion to plantations and the continued operation of those plantations, on both mineral and peat soil. To address this source of emissions, a different suite of policy interventions may become more important. For example, the role of land use licensing and the role of local governments in allocating and creating incentives for land conversion would have to be considered – as opposed to improvements in forest management or traditional law enforcement methods.

Outside state forest considerable deforestation is also occurring. The figure above (right-most bar) indicates that a million hectares of forest were lost there (with associated emissions) during the study period 2000-2005. Note that land categories are also subject to change. After clearing and permitting for other uses, such as plantations or agriculture, conversion forests are removed from the state forest area and become non-forest area. During the early decentralization period, large areas were removed from the state forest area, even though a large portion still had good forest cover. Forested land outside the state forest may be in large blocks, or in smaller areas controlled by small holders (mixed agroforestry areas), private operators or local governments. The remote sensing behind this analysis indicates less swamp area in this category of land use; these swamp forests may be under greater threat of clearing and conversion, however. Plantation crop expansion is the main driver of deforestation on non state forest areas, with permits granted by local governments (Casson, 2002; World Bank, 2006). The GOI exercises less central control in these areas, which include private lands. Actions to reduce deforestation in these areas would have to be based on the legal authorities and incentives appropriate to lands under local and private control.

As noted above, payments through a forest carbon market (REDD) could provide a source of revenue that would allow the Government to address underlying deforestation drivers. Under some combination of carbon and land values, REDD payments would be sufficient to displace certain other kinds of economic activities, beginning with those of lower value.

Deforestation by province. Looking at deforestation at the island and province level, reveals that deforestation is most prevalent in a few places, mainly on Sumatra and Kalimantan. Ten provinces account for 78 percent dry forest loss and 96 percent of swamp forest loss in the 2000-2005 period. As noted, GHG emissions flow from forest loss and swamp land disturbance (with higher emissions per unit of peat land and for burning). Thus, these 10 provinces are also the largest emitters of GHG from forest loss and land use change. Of these, Riau, Central Kalimantan, and South Sumatra account for well over half of overall losses during the period, including most of the swamp forest areas degraded. As forests become scarcer in the west, Papua will become increasingly a focus for forest harvesting, and hence a center for deforestation in the future. This highlights the important role that specific provincial and local governments have in contributing to efforts to reduce deforestation. A cost-effective, efficient and well-targeted REDD initiative should focus most attention on the largest sources of deforestation (and emissions).

Figure 3.11. Forest loss by type and province (Top 10), 2000-05



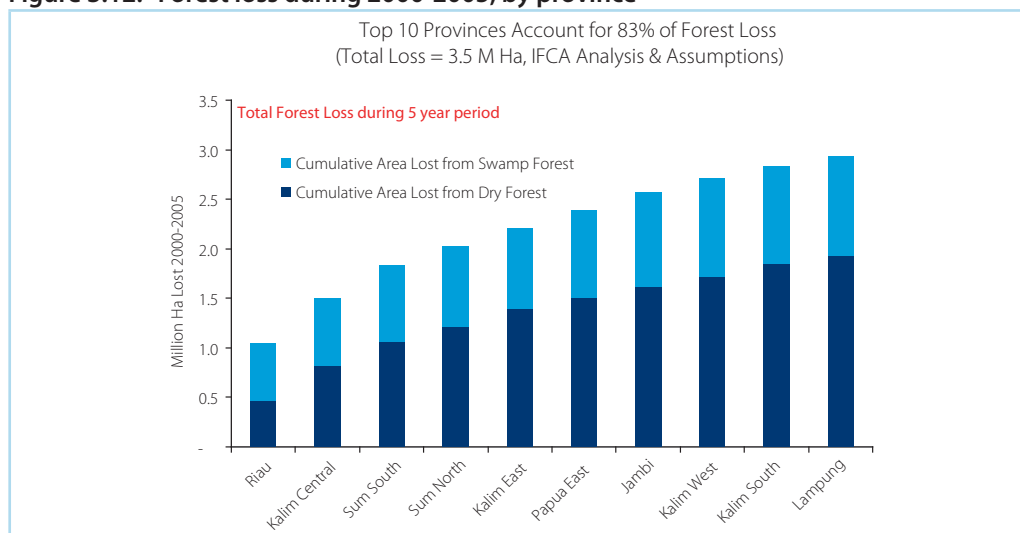
Source: Modis Analysis by MOFr and SDSU (2008)

This concentrated geographic distribution of forest loss means that efforts to reduce it can be targeted to a few places, where the drivers and trends are well known. Targeting of actions and interventions can lead to more effective resource deployment and more cost-effective approaches to reducing deforestation. However, it must also be realized that forest law enforcement and governance remains a challenge. These are the same provinces that have, in recent times, produced the most timber harvesting, timber processing and illegal logging, based on past estimates and other studies (World Bank, et al., 2006).

A few changes in a few places have the potential to create financial benefits for Indonesia and emissions reduction benefits for the whole globe. The converse is also true: continued inaction in these few provinces puts at risk the opportunity for benefits on a large scale. In terms of REDD payments, the places where deforestation is highest have the most to gain from efforts to reduce

forest loss. These few provinces have the potential to contribute the most to Indonesia's forest sector GHG emissions, which could potentially yield up to a billion dollars in payments annually, if successful.

Figure 3.12. Forest loss during 2000-2005, by province



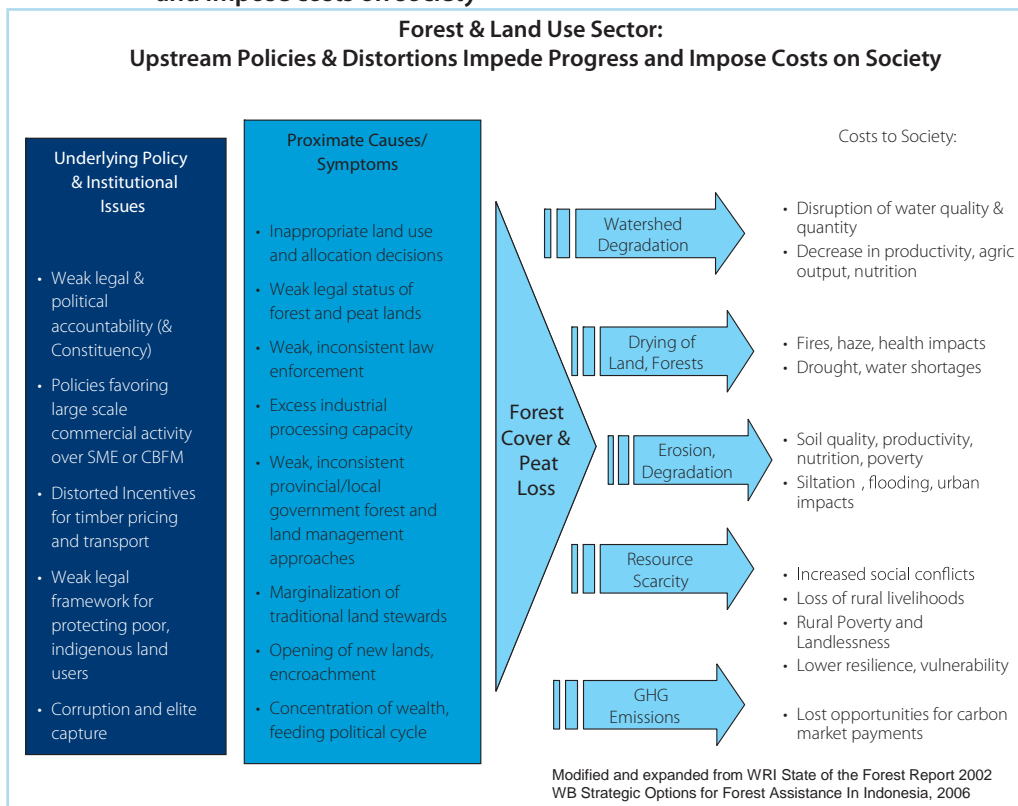
Source: MoFr/IFCA, 2008

3.3.3. Forest Governance Issues and Next Steps

This review of emissions sources indicates that forestry, peat land, fires and land use change need to be considered in any low carbon options study and strategy. The GOI REDD development process is well resourced and will yield more detailed and accurate forest emissions results soon (MOFr/IFCA, 2007). This section provides a brief overview of the forest governance and policy issues that are being addressed as part of the REDD discussion.

Forestry and land use issues in Indonesia have been analyzed for many years. The figure below summarizes some of the key issues and drivers contributing to deforestation in Indonesia. It is a complex story of underlying policy and institutional issues, as well as a range of more proximate causes that give rise to visible effects on the landscape. To address GHG emissions from forestry and land use, Indonesia will have to address the fundamental issues of management and governance that have existed for some time. Climate change and greenhouse gas considerations add a new lens, but not different fundamental options or solutions than have been offered in the past. The climate change angle, especially the potential for payments for reduced emissions from deforestation and degradation, may help to create new political will and financial incentives for implementing changes. The figure illustrates some of the challenges that will be faced on the road to reducing emissions from deforestation.

Figure 3.13. Forest & land use sector: upstream policies & distortions impede progress and impose costs on society



Forestry ‘no regrets’ options. REDD offers new financial incentives for improvement of forest management practices, but payment is only based on performance, or outcomes, not plans or projected improvements. To improve performance in the forest sector, both GOI sources and independent analysts have concluded (Min Forestry, 2006 and 2007; World Bank, 2006) that there is a need for:

- Improved forest law enforcement, management and governance to improve asset management and revenue collection within the sector.
- Realigned incentives for timber harvesting and processing firms, to improve competitiveness and economic returns
- Restructuring and revitalization of forest sector industries to balance demand with supply, capture and keep international markets, and improve competitiveness.
- Forest and land fire control to reduce smoke and haze that cause high health costs
- Equity and transparency in forest/land use decisions (also fundamental for any financing and distribution mechanism)
- Independent monitors of legal compliance and participation standards.

Under any climate scenario, these policy and governance actions make sense to improve management and financial returns from an important national asset. Thus, these could be seen as “no regrets” options.

3.3.4. International Forest Carbon Financing Opportunities

REDD is a large opportunity and incentive for Indonesia, which is a strong advocate in international negotiations. An international forest carbon market is expected to be established in the post-2012 framework, under negotiation now. Estimates of the potential gains to Indonesia through a REDD scheme range from USD 0.5 - 2 billion per year, depending on the area covered and overall performance, as well as the stock of carbon in the different types of forests. These payments for REDD can benefit Indonesia by creating an incentive and a revenue stream that offsets the costs of making needed changes. Many donors are now engaged in assisting the GOI to develop the REDD program through pilot demonstrations and development of policy frameworks. Also, many private sector agents and NGOs are pursuing REDD schemes through voluntary markets (WB, 2008).

Forestry Sector Management Issues

Much has been written about Indonesia's forest sector. Forests are a national asset that provides economic benefits in terms of jobs, production, and trade, as well as livelihoods for millions of the poorest Indonesians. Forest loss hurts rural livelihoods and ecosystem services, such as water regulation and soil fertility that provide benefits far beyond forest boundaries. Weak forest governance damages the investment climate, rural economic potential and Indonesia's competitiveness. Forest crime robs the state and diverts public revenues that could be better spent on development goals. Forest resource management affects equity, development and decentralization and is an essential issue of governance.

Forest management and incentive mechanisms (forest fiscal policies) affect outcomes, including revenue, forest cover, exports, and employment. The forest sector employs inefficient fiscal mechanisms, with poor incentive structures and low revenue recovery. Illegal logging, under-reporting of harvest and underpayment of tax/non tax obligations have all been identified as important fundamental issues of forest management and governance. As a result of past policies, practices, and performance in the sector, industrial output, employment, and competitiveness are declining. Over-exploitation, inefficiency and weak governance contribute to under-performing firms, plantations, tax losses, and indebtedness. In recent years, GOI has been allocating large sums to reforestation and rehabilitation of lands that have been deforested and degraded as a result of poor forest exploitation practices. In other words, public funds are being used to correct private misbehavior that damaged state assets.

Forest fiscal policies are highly relevant to the REDD discussion. Fiscal incentives, properly designed, can improve forest management, decrease deforestation (and associated emissions) and promote sustainable management.

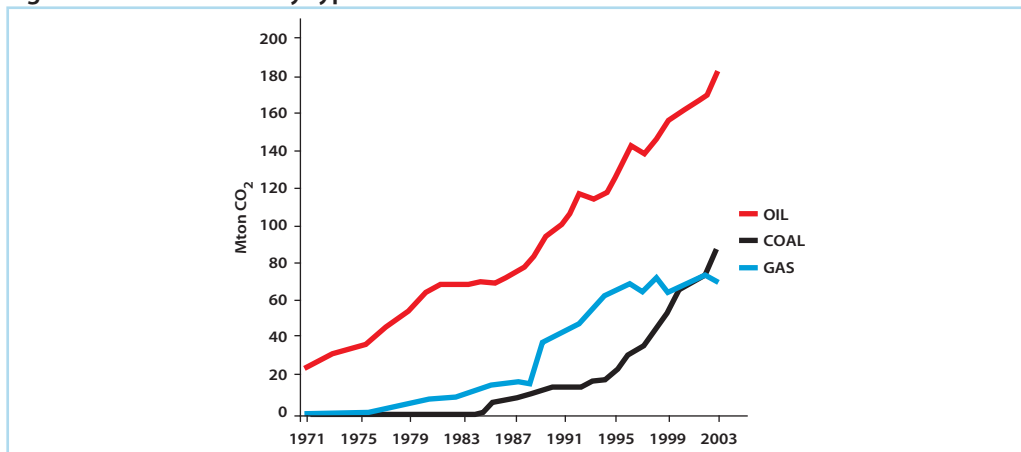
In fact, producing solid, verifiable emissions reductions for sale on an international is an investment process with risks. For this reason, the involvement of the Ministry of Finance is necessary and important. Reducing deforestation (and emissions) verifiably costs time and money: sites have to be selected and surveyed, actions have to be taken in the field to change incentives or replace behaviors, monitoring and verification are needed to assure carbon buyers that the emissions have indeed been reduced, with some permanence and minimal leakage in other areas. Willing buyers also have to be found and deals negotiated with appropriate sharing of both financial benefits and risks. Reducing deforestation means addressing the drivers of deforestation: governance, enforcement, rent-seeking. This remains a challenge, though recent forest monitoring data indicate that Indonesia has had some success in recent years.

3.4. Emissions by Type of Fossil Fuel Combustion

3.4.1. Overview

The figure below presents the level of CO₂ emissions by the type of fossil fuel used. Note that the numbers shown are for the amount of emissions, not the amount of energy consumed. Coal is the most emissions intensive fossil fuel, followed by oil, then gas. Coal releases roughly twice the amount of CO₂ per unit of energy than gas, depending on the quality of fuel and combustion technology. From this figure, it can be seen that emissions for each type of fossil fuel combustion have increased with time. However, emissions from gas and coal combustion grew faster than that from oil combustion. Since 1995, emissions from coal combustion grew fastest.

Figure 3.14. Emissions by type of fossil fuel combustion

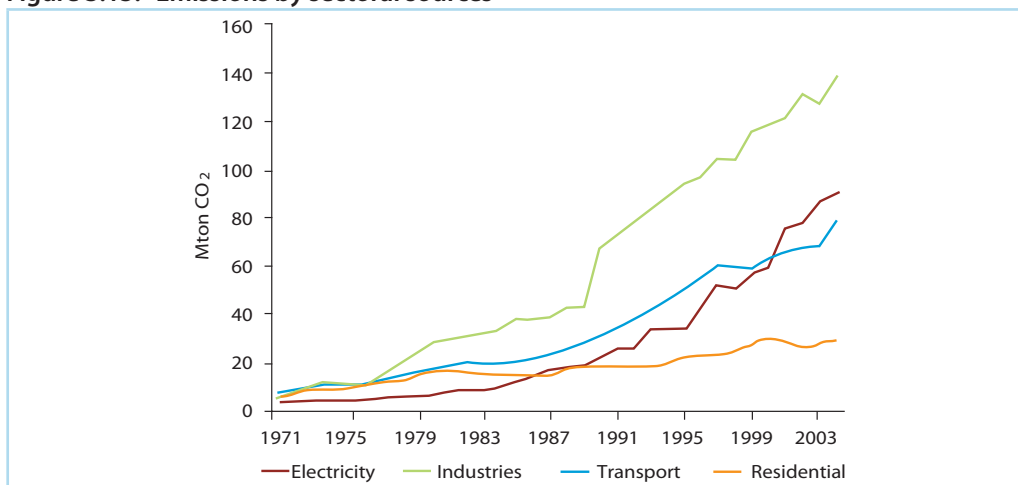


Source: International Energy Agency (2007) [<http://www.iea.org/>]

Comparing the shares of CO₂ emissions by type of energy use in 1984 and 2004 (not shown), one finds that the contribution from oil combustion has been declining from contributing 85 percent of total CO₂ emissions in 1984 to 53 percent in 2004. Meanwhile, the contributions of coal increased from 1 percent in 1984 to 26 percent in 2004, while the contribution of gas moved from 14 to 21 percent in the same period.

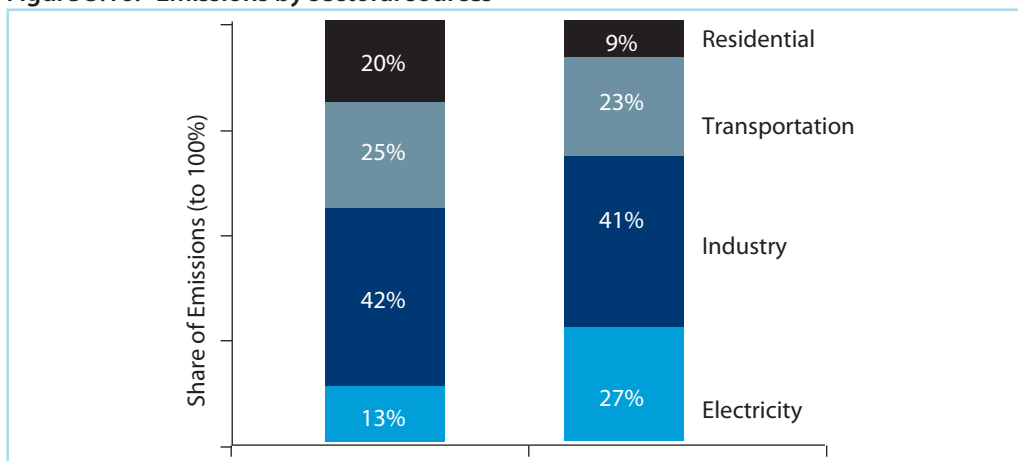
The broad trend in Indonesia's energy system basically shows that although oil is still the main contributor of CO₂ emission, the share of oil is decreasing as domestic reserves are exhausted and oil price rises. In the meantime, the share of coal is increasing and replacing the role of oil in the stationary energy sector, whereas the share of gas roughly remains constant as there are significant gas exports.

Looking at CO₂ emissions by sector, the figure below shows that industrial activities have been the main source of CO₂ emission. One of the reasons is that a significant number of firms have their own electric power generators. The types of energy that they use and the determinants of industrial fossil fuel use will be investigated more thoroughly in a second phase of work.

Figure 3.15. Emissions by sectoral sources

Source: International Energy Agency (2007) [<http://www.iea.org/>]

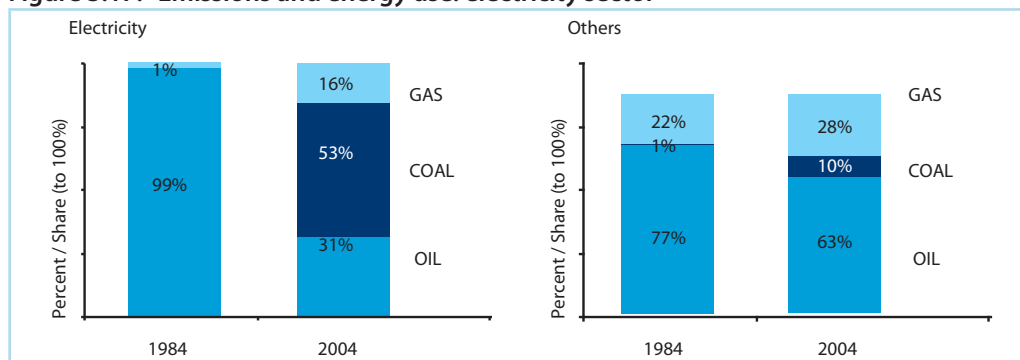
CO₂ emissions from the transportation sector grew steadily but less so than the industrial sector. It is interesting that emissions from the electricity sector grew the fastest (steepest slope) since the mid 1990s. CO₂ emissions from residential sector grew the slowest, perhaps reflecting increasing levels of household electrification. The household sector is not a primary issue in itself, but should be considered in how it relates to the overall growth in electricity demand, and how that electricity is supplied (e.g., coal-fired power plants). Efforts to improve efficiency and manage demand at the household level will have some effect on the need for generating capacity.

Figure 3.16. Emissions by sectoral sources

Source: International Energy Agency (2007) [<http://www.iea.org/>]

The next figure shows emissions shares by sector. This conveys the same points: industry is largest, electricity is fastest growing. While total emissions have been growing by around 7.5 percent annually, the emissions from electricity grew by around 11 percent in the last two decades.

Figure 3.17. Emissions and energy use: electricity sector



Source: International Energy Agency (2007) (<http://www.iea.org>)

This figure focuses on shares of emissions in the electricity sector. This shows that coal use in electricity has grown much faster than in other energy sources. Hence, by 2004, proportion of coal use in electricity sector was much higher than that in other sectors. This is the main reason that the proportion of CO₂ from electricity sector grew faster than the proportion of CO₂ from other sectors. It also highlights the important of looking carefully at power generation development plans, taking into account the costs, economic impacts and implications on resource endowments.

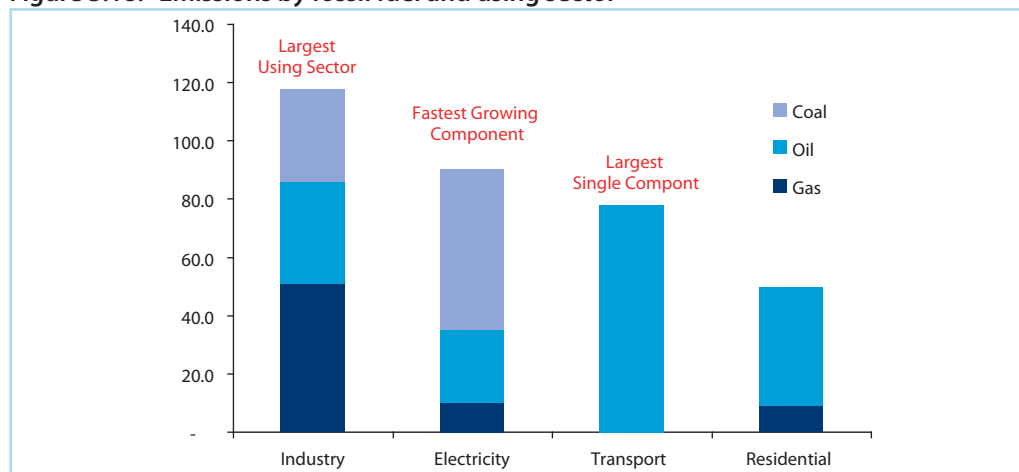
3.4.2. Fossil Fuel Emissions Decomposition

The figure below summarizes GHG emissions for the main product categories (coal, oil and gas) and for the main consumption categories (Industry, Electricity, Transport, and Residential). The figure is simplified from more detailed information that appears in the table below (based on IEA, 2004).

Industry is currently the largest source of emissions, but further analysis is needed to determine which subsectors are most responsible or fastest growing over time.

Electricity is the fastest increasing major component. This is mainly due to the increases in electricity demand, being fed by expansion of coal-fired generating capacity in recent decades and the increasing effort to replace oil-fired power generation for energy security and price reasons. There has been almost a 5-fold increase in coal use since 1994.

Transport is the largest user of liquid fuel, due to growth in vehicle fleet and the low price of liquid fuel products for transportation. Low fuel prices (due to subsidies) mask improvements in vehicle efficiency that may be taking place over time. The residential sector is not a large user of coal or gas. Emissions come mainly from the combustion of kerosene for home cooking.

Figure 3.18. Emissions by fossil fuel and using sector

Source: IEA (2004) in MtCO₂e

Preliminary sub-sectoral results. Phase 1 analyses focused on overall GHG emissions, rather than on detailed analysis of individual subsectors. Using the IEA database for 2004 and Indonesian sources, such as the Survey of Manufacturers, it is possible to provide a more detailed overview of emissions in the various subsectors. This analysis is being conducted as a component of Phase 2. Early analysis indicates that a dozen sub-sectors account for about half of emissions. Preliminary figures and findings suggest that non-metallic minerals (cement), textiles, steel making and rolling, pulp, food and beverage and fertilizer are high emitting segments of the manufacturing/industrial sector. These need further investigation of the kinds of cost effective interventions that can be pursued in these specific industries. These may be good targets for policy & actions to increase efficiency, reduce emissions – assuming that these actions are also compatible with the economic and development needs of the country and the benefits of action exceed the costs.

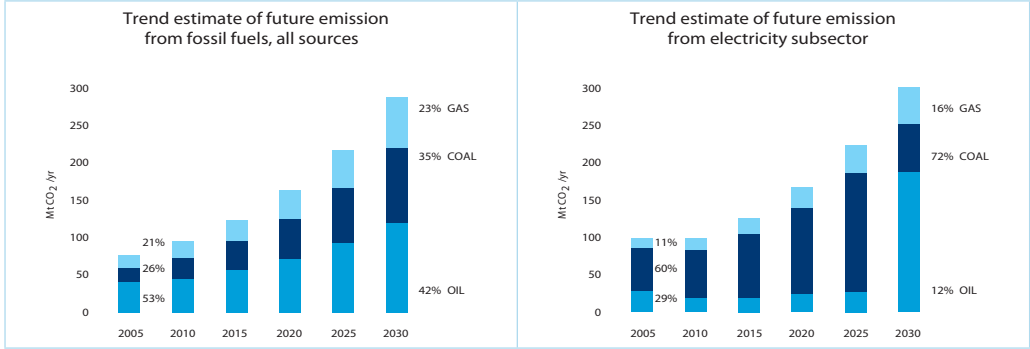
In the Transport Category, it is clear that Road Transport is the largest user and nearly the only one of consequence. Emissions are roughly split between use of Motor Gasoline and Gas/Diesel. In the Residential and Other category, residential emissions are almost entirely from kerosene use (mainly for cooking), with minor emissions from use of liquefied petroleum gas (LPG). Commercial and Public Services generate emissions mainly from use of Natural Gas. Agriculture and Fishing are relatively small emissions from fossil fuel use (and dwarfed by land use emissions)

3.4.3. Future Emissions Trend and Scenario

If the trend from the 1971-2004 period continues, by 2030 total CO₂ emissions will be around four times the level in 2005 as can be seen below. Total CO₂ emissions grow by about 5 percent annually, while CO₂ emissions from coal grow by about 7 percent annually.

There are many assumptions imposed on this trend, such as future proportion of energy used in the electricity sector and composition of energy use among renewables, oil, coal, and gas, which are the same as those predicted by the International Energy Agency (IEA) with the exception of energy intensity. IEA predicts a reduction in the rate of energy intensity by around 2.5 percent annually, which is very high compared internationally and much higher than the historical rate in Indonesia where energy intensity has actually increased over the last decade. For the projection here, energy intensity declines by around 1 percent annually, which is roughly in line with the global average reduction rate of energy intensity in the past.

Figure 3.19. Trend estimate of future emissions



Source: International Energy Agency (2007) (<http://www.iea.org>)

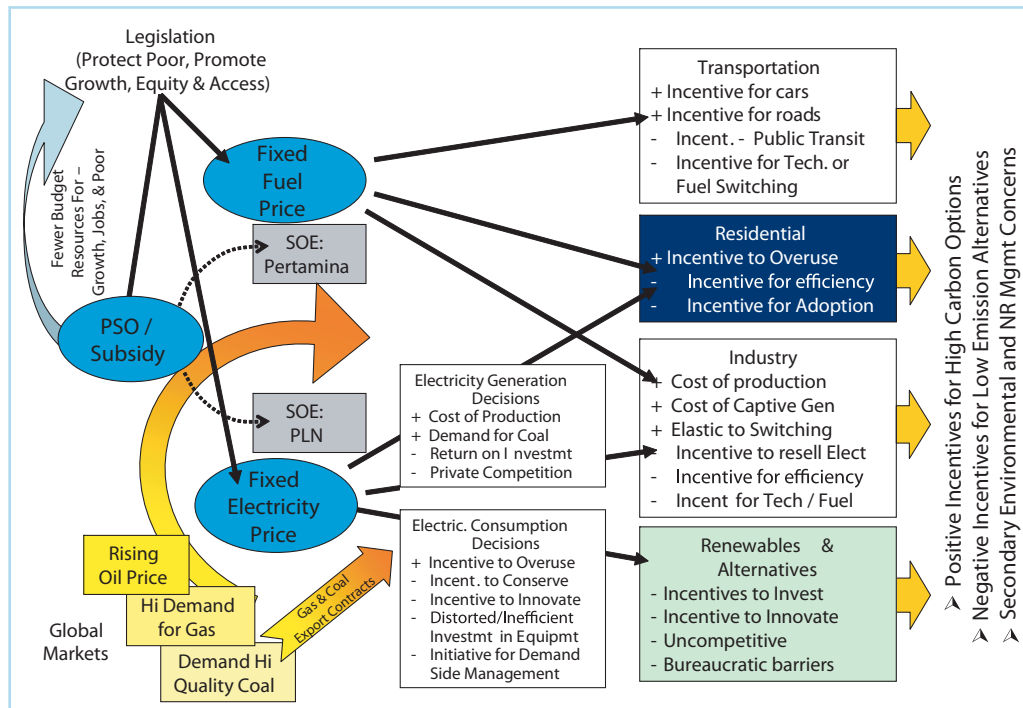
Even assuming a decrease in energy intensity, it can be expected that emissions from energy consumption will triple in the period to 2030. It is important to note that CO₂ emissions from fossil fuel combustion under this projection roughly double every 15 years. CO₂ emissions from energy use increase as Indonesia’s GDP grows and the proportion of households with medium and high levels of income increases. In the electricity sector, by 2030, total emissions will be around 3 times the level in 2005. The main driver of increasing emissions from electricity is emissions from coal combustion.

3.4.4. Issues and Next Steps for Energy/Fossil Fuels

Energy and fossil fuel use issues in Indonesia have been analyzed for some time. The following figure summarizes some of the upstream issues and policy distortions that contribute to Indonesia’s consumption of fossil fuels, and hence emissions of greenhouse gases. Policy and institutional issues complicate the story and the potential path toward reducing emissions. Climate change and greenhouse gas considerations – and potential access to carbon markets – provide a new angle for examining these issues, but not fundamentally different options than have been offered in the past. The figure illustrates some of the challenges for developing and implementing low carbon options in the energy and fossil fuel sector.

For the main fossil fuel using sectors of the economy, Phase 1 work identified the largest GHG emitter (the broad category of “industry”), focused on the fastest growing source of GHG emissions (coal-fired power generation), and found that emissions from oil use in transport are a third significant source. Upstream policies on pricing and incentives influence downstream investment and environmental outcomes, as illustrated in the figure below. Issues of concern include inefficient use of energy resources, over-consumption, compromised GOI fiscal position, unpredictable budget outlays, ineffective targeting of subsidies towards poor consumers, under-development of alternative energy subsectors, leakage and smuggling, and adverse environmental and health effects.

Figure 3.20 Key policy distortions impede potential for low carbon options in energy sector



These complexities and inter-linkages illustrate the challenges ahead in making progress on environmental and climate change issues at the downstream end of the policy distortions. Analysts have suggested some parallel actions that would help with a transition to a more sustainable fuel sector policy framework. For example, the GOI could move toward petroleum pricing aligned with international benchmarks, better targeted poor protection efforts, and more widely available alternative energy sources.

4. Fiscal and Financial Policy Instruments Analysis

In preparation for the High-Level on Climate Change (HLECC) for Finance Ministers, Bali, November 10-11, 2007, a Ministry of Finance (MOF) team, assisted by consultants, in concert with other Ministries developed a summary analysis of fiscal and financial policy instruments for influencing climate change mitigation and adaptation. This became a key background paper¹¹ presented by the Minister of National Development Planning and key deputies at the High Level Meeting chaired by the Minister of Finance. The paper is a survey of literature and preliminary categorization of policy instruments prepared through the efforts of an inter-departmental working group, assisted by consultants. Development of the policy instruments paper, with inputs and discussion across a wide range of agencies stimulated interest in MOF and Government of Indonesia (GOI) in policies and instruments that can be used to deal with climate change issues. In this way, the dialogue process has advanced the work on low carbon options by increasing demand, interest, and capacity for conducting the analysis, interpreting the results, and shaping ideas into effective policies. This section provides a summary of the key points in the background paper. Section 2 mentioned the HLECC and the results arising from that meeting.

4.1. Overview

The policy instruments paper argued that climate change is a challenge for economic development and for development financing and advocated that Ministers of Finance join in the effort to promote mitigation and adaptation measures. Climate change will affect macro-economic management approaches, fiscal policy choices, revenue raising alternatives, insurance markets, long term investment options, and the incentives that individuals face. Both developed and developing countries can do more to address climate change through innovative fiscal, financial, and investment policies managed by Finance Ministries. The paper provided some background

¹¹ The working group was led by Anggito Abimanyu of the Fiscal Policy Office of the Ministry of Finance. Inputs to the policy instruments paper were derived from intensive meetings in July to September 2007, with active participation from Anny Ratnawati, M. Chatib Basri, Herwidayatmo, Askolani, Irfa Ampri, Makhani, Amnu Fuady, Herfan Brillianto of the Ministry of Finance, Ms. Damayanti Ratunanda, Laksmi Dhewanthi, Listyowati, and Upik S. Aslia of the Ministry of Environment, and Medrilzam of the Ministry of National Development Planning. Kurnya Roesad, Timothy Brown, and Frank Jotzo provided inputs as consultants. The paper can be downloaded from www.pksi.depkeu.go.id/hlecc/doc.asp.

on the size of the climate change issue in terms of potential economic impacts and associated financial needs. The bulk of the paper focused on the range of economic policy instruments that Finance Ministers can use to address mitigation and adaptation issues, both domestically and internationally. Specific examples from Indonesia are provided. Many have concluded that the financial resources need to be mobilized from private, public and international sources. Finance Ministers have a crucial role to play in devising and implementing policies to support climate change objectives. Their instruments include policies for the financial and investment sector, including those that affect the investment climate; fiscal policies such as taxes and subsidies that can be used to put a price on emissions; budget and expenditure policies, including strategic priorities for direct government investment; sectoral regulation, where Ministers of Finance can have important indirect influence; and international finance flows, which can be crucial for the provision of large-scale financing for low-carbon investments. In developing countries such as Indonesia, all of these options need to be seen in the context of development objectives. The paper argued that continued exchange between Finance Ministers could make an important contribution to the ongoing international dialogue on climate change instruments and mechanisms.

Development of the paper was an entry point for a wider review, discussion and capacity building exercise on policy instruments that can be pursued by Finance Ministers, and specifically in Indonesia. The paper highlighted the power and scope of economic policy instruments, especially when deployed in concert with sectoral policies and regulations. The paper provided examples of policy instruments that can be applied toward climate change objectives. This approach encouraged a wide discussion of alternative approaches and policies that might be undertaken to address key issues within Indonesia. The process also helped Indonesia to understand where its existing fiscal and financial instruments can be applied more effectively in the area of climate change, which has significant overlap with energy, forestry, fuel and pricing policies. More analysis of effectiveness and implications would be needed to propose any of these as concrete options for a specific country.

The paper also highlighted some of Indonesia's ongoing steps and future plans to facilitate adaptation, to reduce emissions from deforestation and to promote cleaner future energy paths. Indonesia has already substantially raised the cost of fossil fuels, affecting energy choices across the economy and freeing up resources for other development efforts. Further policy options could be available, especially in the context of future international climate policies and agreements.

Through the HLECC and subsequent meetings of Finance Ministers at international venues, including the WB, ADB, G20, it appears that Ministers of Finance have already begun to play a much larger and more active role in responding to climate change, both domestically and internationally. Ministers of Finance manage national economic policies, relative prices for goods and services, and the long term development agenda that affects both greenhouse gas emissions and economic systems' responses to climate change impacts. Finance Ministers and Treasurers help to develop and execute strategic budget priorities. Finance Ministers manage the investment climate, pricing (fiscal) policies, direct spending, risk and financial markets, and influence sectoral rules and laws. Through these instruments, they can influence incentives, investments, insurance markets, industrial development, and the distributional impacts on the poor. Finance Ministers also have to think long term about adaptation issues: creating the markets, incentives, investments and flexibility that allow economies and citizens to adjust in the long run. Finally, Finance Ministers have some influence on international investment and development aid flows, international debt management regimes, and the policies and priorities of the multilateral development banks.

4.2. The Potential Size of the Problem is Beyond Current Means

The UN Framework Convention on Climate Change Secretariat (UNFCCC, 2007) estimated the size of investments and financial flows needed to address climate change.¹² The report found that:

- Significant additional investment and shifts in investment patterns would be needed, especially in developing countries, both for reducing emissions, and for adaptation.
- The required additional flows are large relative to funding currently available under the Kyoto Protocol but small relative to gross domestic product (GDP) and total investment.
- Private sector investment will need to be mobilised, and additional external funding will be needed, especially for developing countries.

The report presents a mitigation scenario where global net emissions are reduced by around 25 percent below year 2000 emissions (gross global emissions are stabilized, forests in aggregate change from net emitter to net sink). In 2030, the additional annual global investment needs for *mitigation* (reducing greenhouse gas emissions) would be over USD 200 billion. Of the total in this scenario, developing countries would account for about half of investments, but two-thirds of global emissions reductions compared to the baseline. This indicates that low-cost mitigation options are significantly greater in developing countries and need to be tapped for a cost-effective global response. However, in developing countries sources of funding are generally scarcer, public budgets very constrained and competing priorities for development paramount. Thus, much of the incremental cost of mitigation investment in developing countries will need to come from developed countries.

The UNFCCC notes that though these estimated costs are large, the “value of the impacts that those expenditures would avoid could be larger.” The notion that the global cost of mitigation action are much lower than the economic costs from unmitigated impacts from climate change has also been reported in the Stern Review on the economics of climate change (Stern 2006). Though figures vary, it is widely expected that developing countries will experience higher costs (damages) as a percentage of GDP than developed countries – and that adaptation costs would likely increase over the next century (IPCC Working Group II, 2007).

In thinking about where the funding will come from for these future challenges, it is clear that government-to-government financing is not large enough, and that private capital markets need to be tapped. Official Development Assistance accounts for less than 1 percent of investment and financial flows. Financing currently available directly under the Framework Convention on Climate Change relies mainly on voluntary contributions and would not be enough to address future estimated needs, if it remains in its current form, as pointed out by the UNFCCC. From the point of view of developing countries, it is clear that there are currently not enough public resources or investments available to meet these additional needs on top of the basic challenges of health, education, infrastructure, and poverty alleviation.

In comparison, private-sector sources account for 86 percent of current global investment and financial flows. Thus, with appropriate policies or incentives, much of the needed additional

¹² The report defines ‘investment flow’ as the initial (capital) spending for a physical asset. A ‘financial flow’ is an ongoing expenditure related to mitigation or adaptation that does not involve investment in physical assets.

financing could be covered by existing and available sources of investment. To mobilize the necessary investment and financial flows to address climate change, however, a combination of mechanisms and sources need to be paired with consistent and integrated national policies that create the right enabling framework and incentives over the long term.

4.3. The Role of Finance Ministers – Domestically and Internationally

Ministers of Finance have a wide range of policy instruments that can help in the effort to cope with climate change impacts, help to mitigate emissions, and help economies and societies adapt to the impacts that will arise from the emissions of the past. These issues must be factored into development planning policies and approaches.

Finance Ministers manage the investment climate, pricing (fiscal) policies, direct spending, risk and financial markets, and influence sectoral rules and laws. There are five main categories of instruments that Finance Ministers can use to influence things that matter for climate change:

- Domestic Financial and Investment Sector Policies
- Fiscal Policy Instruments (Taxes, subsidies and related instruments)
- Expenditure and Budget Policies
- Direct Regulation
- International Flows of Funds and Investment

Some are more relevant for mitigation, some for adaptation, some for managing risk. These basic categories of policy instruments are illustrated in the following diagram. In practice, these policy instruments would likely be used together in complementary packages of interventions. Policies from these various categories most likely need to be used together in integrated reform packages aimed at particular outcomes. Finance Ministers well know that any primary policy needs to be implemented in conjunction with a range of supporting policies, and harmonized with existing sectoral regulations. For example, a policy to promote renewable energy sources or adoption of cleaner technologies, through tax breaks for example, could be accompanied by direct sectoral regulations, minimum efficiency standards, or reduced import tariffs.

4.4. Ministry of Finance Role in Managing International Flows of Funds and Investment

There are a number of international financing mechanisms that Ministers of Finance, especially in developing countries, need to be aware of and involved with. These sources of financing can be used to finance investments, fund preparatory analyses, provide incentives or seed money for innovations, or supplement own country development spending. Following are some of the main sources of financing (not exhaustive) that are likely to be available for climate change mitigation or adaptation in the medium term.

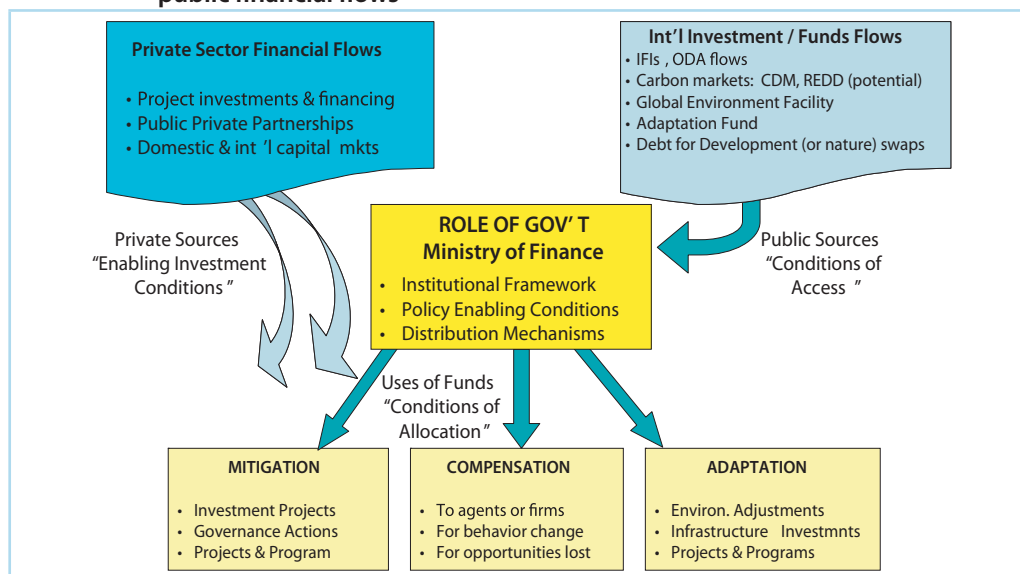
- International Financial Institutions, multilateral development banks, and Official Development Assistance are increasing and targeting financial flows toward climate change actions.
- Carbon Markets: Private companies and governments can provide payments for

greenhouse gas emissions reductions. Proposals are currently being discussed to expand the scope of the CDM after the first commitment period of the Kyoto Protocol expires in 2012. By 2030, annual demand for emissions reductions could range from USD 25 billion (low estimate based on current flow of projects) to USD 100 billion (high estimate assuming more stringent global compliance standards). Annex C provides a preliminary analysis of the potential in Indonesia for expanding the use of CDM. In the future, payments could potentially also be available for Reduced Emissions from Deforestation and Degradation.

- Specialized funds to support or advance carbon markets. The Multilateral Development Banks are operating and developing several funds that facilitate or promote carbon markets, for example, the Climate Investment Funds, the Carbon Partnership Facility and the Forest Carbon Partnership Facility.
- Private sector investment flows, as well as funds or financing that accompany corporate social responsibility programs, are driven by (non-Kyoto) government emissions reduction programs, or by voluntary emissions reduction purchases for the retail market (e.g. carbon-neutral events).
- Global Environment Facility provides grant resources for climate change projects and is now managing the Adaptation Fund proposed under the UN framework for activities (in vulnerable countries) that increase resilience to climate change (land use, agriculture, etc.)

These funds and sources will not be sufficient to meet every climate-related need of every developing country. Finance Ministries also may have an important role to play in designing country systems or proposals for collaborating with international finance institutions to facilitate access to cheaper or longer maturity loans for climate-friendly investments. Finance Ministers also have a hand in creating the domestic institutional framework that allows the country to take better advantage of these opportunities.

Figure 4.1. Role for ministers of finance in climate change capitalizing on private and public financial flows



The diagram summarizes how a country's institutional and economic policy framework influences the conditions for private sector investment, the conditions of access to international financing, and the conditions of allocation of funds within the country. Domestically, Finance Ministries need to develop sound institutional approaches for distributing the resources from international flows to create sound incentives, pay for programs, protect the poor, and potentially, to compensate individuals or groups that are being asked to change behavior or forego investments. More analysis of effectiveness and implications would be needed to propose any of these as concrete options in a real case.

5. Implications and Opportunities

In recent planning and analytical documents, the Government of Indonesia (GOI) has been considering the efficiency and sustainability of its energy and natural resource management policies. Financial sustainability is a well-understood risk, since holding domestic energy prices below global levels creates a budgetary drain of billions of dollars per year – and the gap grows as oil prices rise. But sustainability also refers to environmental and social appropriateness. Bappenas (2007) describes the importance of fossil fuels and minerals in Indonesia's development, while also noting risks to the sustainability of the country's growth. "Relatively low energy consumption per capita and high energy intensity, indicates both Indonesia's relatively low welfare and inefficient use of energy."

Over-reliance on natural resources negatively impacts the environment and disrupts quality of life and livelihoods of both poor and well-off Indonesians (Bappenas, 2007). There are negative externalities from inappropriate or inadequate environmental management and over-utilization of natural resources, particularly including fossil fuel and forestry resources. These negative externalities can undermine future growth prospects by degrading air and water quality, increasing competition for water quantity, and contributions to greenhouse gas emissions and climate change. Bappenas' report calls for "a more balanced composition of the energy resource (energy mix) to correspond to the supply capacity and consumption pattern."

Bappenas (2007) has identified several policy options that may help Indonesia "to reduce energy-related emissions and to remain internationally competitive ...[including] efficient energy use to conserve the low cost energy source; fossil fuel substitution to adopt eco-friendly fuel, the use of renewable energy technology, and application of emissions standards, a carbon tax and other incentives to support reforestation and sustainable forest management." Bappenas also highlights the need to "identify new resources, increase production, limit exports, and find/develop new and alternative renewable resources, including water power, geothermal, biomass (organic waste), solar energy, ocean energy, and wind energy."

A low carbon options study can benefit Indonesia by providing an analytical framework to inform strategic considerations for achieving high pro-poor economic growth with low carbon emissions.

5.1. Summary of Main Findings

Indonesia has good potential to develop alternative energy options (geothermal, hydropower), reduce the emissions intensity of energy sector development, tap existing carbon markets for energy efficiency improvements, develop carbon credits for Reducing Emissions from Deforestation and Degradation (REDD) (under negotiation for the post 2012 period), facilitate additional investments and transfer of technology, and tap into innovative sources of financing that are now emerging.

Phase 1 work represented an initial step on the way to understanding the issues and options involved in preparing an Indonesian low carbon development strategy. Phase 1 analytical work, technical assistance and process of dialogue will inform the second phase of work.

Engagement and capacity development process

Since May 2007, the Ministry of Finance (MOF) has led an inter-ministerial working group that developed analyses and capacity on climate change and low carbon issues. Technical inputs and engagement across a wide range of agencies stimulated interest in MOF and GOI in policies and instruments that can be used to deal with climate change issues. This dialogue process has advanced the work on low carbon options by increasing demand, interest, and capacity for conducting the analysis, interpreting the results, and shaping ideas into effective policies. The products of this work contributed to the preparedness and capacity that supported the GOI's participation in a range of international events over the last year.

Analysis of policy instruments. Work on an analysis of fiscal policy instruments highlighted the main categories of instruments that Finance Ministers can use to address climate change issues: domestic financial and investment sector policies, fiscal policy instruments (taxes and subsidies), expenditure and budget policies, and direct regulation. Policies generally need to be used together in integrated reform packages aimed at particular outcomes.

The Indonesian Ministry of Finance has become increasingly aware of the international financing mechanisms and sources that can be used for investments, preparatory analyses, and incentives or seed money for innovations. The GOI has begun to consider the institutional and regulatory framework needed to benefit from international flows to create sound incentives, provide resources for programs, and protect the poor.

The High Level Event on Climate Change for Finance Ministers in Bali in December 2007 was an historic platform for finance and development minister to engage more deeply on climate change issues. Participants agreed that more knowledge is needed on economic impacts and the application of particular policy instruments. They agreed on the need to encourage international collaboration on financing for climate change. They supported the need for International Financial Institutions to explore development of a diversified set of financing instruments, in particular for low-carbon technologies and private sector involvement. Indonesia, Poland and Denmark agreed to collaborate in planning for future climate change meetings for Finance Ministers.

Through the High Level Event and subsequent international meetings, including the WB-IMF, ADB, G-20, ASEAN and APEC, it appears that Ministers of Finance have begun to play a more active role in responding to climate change issues. Representatives from Indonesia have become important contributors in these global dialogue processes.

Greenhouse gas emissions assessment

Indonesia is among the top 25 greenhouse gas (GHG) emitters from fossil fuel combustion, or ranked 16th when counting the European Union as one country. However, if emissions due to deforestation and land use change are included, estimated emissions become much higher.

Emissions from deforestation and land use change, including conversion by fire and especially on peat lands, are currently greater than those from fossil fuel combustion. The GOI (Ministry of Forestry) recognizes this issue and is developing a REDD initiative in collaboration with the Indonesia Forest Carbon Alliance, a coalition of donors, NGOs, and scientists working on supporting technical studies. Emissions estimates will be revised and updated as part of this process.

Remote sensing data show that Indonesia's deforestation rate is now much lower (perhaps two-thirds lower) than estimates from the period of economic crisis and decentralization. Reductions in deforestation will reduce the estimated level of emissions. Most deforestation (and hence another large share of emissions) occurs on production forest land (designated for sustainable harvest) and on land slated for conversion to other uses, mainly agriculture and plantations. Deforestation on forest areas designated for conservation or watershed protection has been relatively minor in recent years.

Substantial deforestation is occurring on peat swamp areas (*lahan gambut*). Because peat lands are the most intensive sources of emissions per hectare, even a smaller area deforested can contribute to a larger amount of GHG emissions. Prior estimates based on secondary data indicate that a large share of Indonesia's emissions comes from burning, draining, and degradation of peat swamp areas. Timber estates and oil palm plantations have been among the fastest growing land uses in recent years, and have contributed to deforestation both on mineral soils and peat swamps. Both are important to regional economies. Emissions from deforestation for pulp timber and palm oil plantations are especially high when fire is used and when plantations are situated on peat land.

Considerable deforestation is also occurring outside state forest areas. Forested land outside the state forest may be in large blocks, or in smaller areas controlled by small holders (mixed agroforestry areas), private operators or local governments. Actions to reduce deforestation in these areas would have to be based on the legal authorities and incentives appropriate to lands under local and private control.

Emissions from fossil fuel combustion are not as large as emissions from forests and land use, but are growing very rapidly, at 6 percent per year, faster than gross domestic product (GDP). Overall emissions are growing even faster than energy use, implying inefficient use of energy and a shift to fuels with higher emissions.

Among fossil fuels, oil is currently the main contributor of emissions. However, emissions from use of coal have been the fastest growing for the last decade. The fast rise of coal (which produces more GHG emissions per unit than oil or gas) is attributed to its increasing use in electric power generation.

Among the consuming sectors, industrial activities have been the main source of emissions, but electricity generation is the fastest increasing. This is mainly due to the increases in electricity demand, being fed by expansion of coal-fired generating capacity in recent decades. Emissions from the transportation sector grew steadily but less so than the industrial sector. Residential

sector emissions are relatively smaller and come mainly from the combustion of kerosene for home cooking.

Emissions intensity and international comparison. Emissions from fossil fuel combustion grew faster than GDP during the decade 1994 to 2004, so emissions intensity¹³ increased. In the period 1994-2004, energy intensity increased, but the rate of increase declined, which is progress in the right direction

In most countries, GDP has been growing faster than fossil fuel emissions, so emissions intensity declines over time. Indonesia's emissions intensity is similar to that of the world average, and still below the average for non-OECD (developing) countries.

Indonesia's GHG emissions per capita are still low in comparison with other countries, but are rising faster than energy use per capita. From 1994 till 2004, Indonesia's CO₂ emission per capita from fossil fuels grew faster than China's and India's.

Future scenario comparisons. Although forest loss, fire, and land use change are currently the largest share of emissions, there is no reason to expect a major increase over time. As forests are depleted, or controls on deforestation and fire are implemented, emissions from these sources would decline. As noted, deforestation does appear to be declining in recent years.

In contrast, GHG emissions from fossil fuel combustion are expected to grow rapidly, doubling every 12 years. By 2030 these emissions would be four times higher, thus potentially off-setting any gains made through controlling Indonesia's forest and peat land destruction.

5.2. Implications for How to Proceed

For both of the main sets of issues – Forests and Land Use and Fossil Fuels and Energy – analysis and planning have been ongoing for many years. The key issues and challenges are reasonably well understood. Climate change and greenhouse gas considerations add a new lens, but not different fundamental options or solutions than have been offered in the past. The climate change angle, along with carbon markets and innovative financing becoming available, are creating new incentives for improvements at the margin, plus political will.

In both the forestry and the fossil fuel areas, the actions that Indonesia should undertake first will be those that make economic sense already. For example, land conversion by fire may benefit a private holder, but it imposes well-documented health costs on Indonesians and may undermine Indonesia's ability to access larger sources of global financing. Another example, forest management practices that degrade state-owned assets or result in underpayment of taxes or royalties should be curtailed, with or without climate benefits. Economic logic suggests that there is some price or value exchange scenario that would induce the private operator to change behavior to benefit the public good.

Similar examples can be developed for gas flaring, fuel subsidies, energy efficiency investments, and alternative energy sources. It makes sense for Indonesia to address policy distortions and barriers to make the economy more efficient, productive and competitive in the future. Climate or

¹³ Intensity is a measure of the level of emissions per unit of economic activity (as measured by GDP).

carbon benefits would provide some additional compensation or incentives that could enhance the argument or reduce the cost of making changes.

Climate change does offer an entry point, as well as increasing political visibility. Climate and low carbon issues may offer a rationale – or provide some resource support – for addressing policies or practices that should be corrected for basic economic reasons. Some illustrative examples of actions that make economic sense are listed in the table below.

| Examples of Policies or Practices that Can Help to Reduce GHG Emissions (and Improve Potential and Access to Innovative Financing) | |
|---|---|
| Forestry and Land Use: | Energy: |
| <ul style="list-style-type: none"> • Law enforcement, management and governance needed for any REDD scheme • Low/no cost opportunities: forest and peat fires, new licensing, law enforcement • Land use allocation/licensing, local government roles, financial incentives are critical for large areas & sources of emissions (e.g., peat and oil palm) • Equity and transparency are needed for financing and distribution mechanism. • Independent monitors are needed to ensure the rights and access of the poor | <ul style="list-style-type: none"> • Emissions growth also has negative implications for competitiveness & efficiency • Low/no cost opportunities: energy efficiency, transport options, gas flaring, abundant renewable options • Incentives for new investment, conservation, or renewable energy resources are distorted due to pricing and subsidy issues • Fuel pricing reform to improve incentives for both efficiency and investment. |

5.3. Opportunities Arising from Climate Change Engagement

In 1992, the UN Framework Convention on Climate Change affirmed the need for country actions to address climate change with “common but differentiated responsibilities” between developed and developing countries. In 1997, climate change negotiations culminated in the Kyoto Protocol, which focused on setting emissions targets for the developed countries and creating the Clean Development Mechanism (CDM) that allows payments for GHG emissions reductions in developing countries. These climate change agreements created a commitment period for reductions and CDM markets in the period to 2012. Now, the post 2012 framework is being formulated and negotiated and the Bali COP was a milestone event toward this future framework. Indonesia has a strategic role in the negotiations as a large developing country host with a significant stake in the future framework outcomes. The global context on climate change – new scientific findings, new approaches to development assistance and carbon financing, and new negotiations toward a post 2012 framework -- present Indonesia with historic opportunities to evaluate and develop strategic options that address a major global and national concern about changing climate without compromising growth and development objectives, by facilitating additional investments and transfer of technology.

Expanding global carbon market. The Kyoto protocol provides an opportunity for projects and programs which are registered by the CDM Executive Board to generate emissions reductions and to earn carbon revenues for the project or program. This is a new and additional source of potential funding for eligible projects and programs. This market has grown from a very low base and in 2007 reached USD 8 Billion for clean development mechanism projects. While Indonesia is well placed to make better use of the CDM, it is expected that the number of CDM projects being

developed will begin to decline until certainty is reached on post 2012 Kyoto framework. In this regard the World Bank is developing the Carbon Partnership Facility to support the purchase of emission reductions past 2012 through larger scaled up programs.

Recently, the CDM Executive Board approved more streamlined procedures for the registration of CDM activities through the approval of programmatic CDM procedures. This will allow program management entities to register a program of activities in a particular sector and for a particular technology, such as the geothermal sector or for the replacement of incandescent lamps with Compact Fluorescent Lamps. It is expected that CDM procedures will further evolve over time which will assist to better support low carbon growth in particular sectors.

Innovative low carbon financing opportunities. In 2005, at the Gleneagles Summit, the G-8 countries advocated greater attention toward helping developing countries reduce GHG emissions and requested the creation of a Clean Energy for Development Investment Framework (CEIF). This action plan aimed to support the transition to a low carbon economy, especially in growing middle income countries, by scaling up analytical, knowledge and investment support, to strengthen enabling conditions for private sector participation by decreasing market risk, and to develop knowledge and methods to address energy efficiency, renewables and transportation and strategic partnerships to support continued growth in the low carbon portfolio. Conducting a low carbon study will help to position Indonesia with plans and priorities for use of innovative financing sources as they become available. More recently, developed country donors, working with the World Bank, have established several Climate Investment Funds (worldbank.org/cif). The Clean Technology Fund would invest in energy and industry areas to mitigate emissions. The Strategic Climate Fund is a more flexible instrument that may open several 'windows' for assistance to developing countries, on forestry and resilience, for example. These funds became operational in 2008. These and other international mechanisms offer Indonesia the opportunity to tap into low cost or grant funds to finance low carbon activities or other mitigation efforts.

Indonesia's sectoral opportunities. Indonesia has significant opportunities for growth while controlling the carbon intensity of development. Opportunities include developing the potential of geothermal, hydropower and renewables, addressing policy distortions that affect energy consumption and investment, developing biofuels responsibly, improving power generation efficiency, enhancing end-use energy efficiency in various sectors, considering alternative urban transport options, and accelerating the adoption of new technologies. Addressing climate change and energy issues will also generate secondary development benefits and improve quality of life, such as cleaner air in cities and homes, reduced congestion, better waste management, and greater efficiency. Indonesia can also take advantage of opportunities for low-carbon development because it has substantial renewable energy resources (geothermal, hydropower), good potential to tap existing carbon markets through CDM and energy efficiency improvements, and prospects for carbon credits for Reduced Emissions from Deforestation and Degradation (under negotiation for the post 2012 period). Energy diversification through renewable energy and energy efficiency coupled with policies to increase domestic fuel production, and improve efficiency (such as reducing gas flaring), would help to meet growing demand in Indonesia and reduce dependence on expensive imported fuels.

Development planning context. Currently, Indonesia's political, planning, and budgeting calendars are creating the right conditions to deepen engagement, scale up policy dialogue, and integrate low carbon options into near and medium term plans going forward. The GOI will be developing a new strategic plan for the period 2009-2014, corresponding to the term of the next

elected government. Strategic choices about energy sector investments, policy reforms, and inter-ministerial coordination could yield development benefits in terms of new private sector investments, greater energy efficiency, energy security, additional fiscal resources, and potentially revenues from GHG emissions reductions.

5.4. Plans for Phase 2 Low Carbon Analysis

Further analysis of climate change issues, capacity building and development of low carbon options for development could support the GOI to:

- Develop a strategy for further lowering the carbon intensity of its development path while maintaining acceptable levels of macro and sectoral growth
- Identify opportunities (and potential trade-offs) for climate change mitigation and adaptation through appropriate financial and economic policy initiatives
- Raise awareness and facilitate informed consensus on Indonesia's efforts to address climate change through policy actions aimed at mitigation, adaptation, and financing.

Analytical work on climate change issues and specifically on low carbon options for development can also support the GOI in preparation of its Medium Term Development Plan (RPJM). Based on the findings of Phase 1, it is suggested that Phase 2 analyses consist of three main components to be developed in parallel.

- Macro Economic Modeling and Scenario Development to provide an overview of the main economic implications of alternative paths, as well as more detailed analysis of sectoral choices and scenarios
- Sectoral Technical Studies/Syntheses to provide more technically detailed options and scenarios, building on ongoing analyses on forestry/land use, fossil fuel using sectors, energy efficiency improvements, and renewable energy sources, as well as evaluations of financing needs and potential)
- Outreach and Constituency Building to ensure wide and systematic communication of results within the Government and the policy/research community.

The products of the work could be a series of economic analyses and papers, disseminated through policy notes, seminars and website. Ensuring leadership and ownership, the GOI could lead an inter-ministerial working group including the key economic, planning and environmental ministries. The studies would be conducted in collaboration with Indonesian institutions (GOI, think tanks and universities) as part of a process to build consensus toward a national low carbon strategy and action plan.

The macro-economic work will be the umbrella of the Indonesia low carbon analysis to give a big picture overview of the issues and economic implications of alternative energy development paths. The sectoral studies will analyze more refined and technically detailed options and scenarios to provide an avenue for engaging with sectoral ministries. The work will aim to develop a baseline and projection of GHG emissions, investigate emissions reduction wedges, cost-effective implementation paths, and identify actions, policies and investments needed to achieve these potential reductions. Well structured and resourced outreach and communication efforts will ensure that the results of each stage are communicated widely and systematically, within the Government and the policy/research community.

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Annexes

Annex A Potential of CDM in Indonesia

CDM in Indonesia: Prospects and Barriers¹⁴

The United Nations Framework Convention on Climate Change (UNFCCC) sets an overall framework for intergovernmental efforts to tackle the challenges posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases (GHGs). Indonesia ratified the UNFCCC in 1994 through the Act on Ratification of Climate Change Framework Convention No. 6/1994. As part of the Indonesia's growing response to climate change, the country signed the Kyoto Protocol of the UNFCCC in 1997 and ratified it in 2004 through Law No. 17/2004.

The following year, the Kyoto Protocol entered into force on February 16, 2005, committing Annex I (industrialized) countries to reduce their collective GHG emissions by about 5 percent below their 1990 levels on average during the period from 2008-2012. Non-Annex I (developing) countries that signed and ratified the Kyoto Protocol are not required to reduce their emissions during the 2008-2012 period. In fulfilling these commitments, the Annex I countries can achieve their emission reductions through several means including the Clean Development Mechanism (CDM) which allows companies or entities in Non-Annex I countries to develop projects leading to reductions of GHG emissions, verify and certify these emission reductions, and transfer the Certified Emission Reductions (CERs) to other entities or governments in Annex I countries at a price. Thus, project sponsors in developing countries can “cash in” on their carbon reduction assets. As a Non-Annex I Party to the Kyoto Protocol, Indonesia can participate in the CDM and has strong interest in meaningful participation in the market for CERs. This Annex provides an overview of the potential for CDM in non-forestry related sectors¹⁵ and the main barriers that are keeping Indonesia from realizing its full CDM potential.

14 This analysis was developed by Nick Bowden and Ina Pranoto of the World Bank as a contribution to the dialogue and capacity development work in advance of the UNFCCC Bali COP 13.

15 Carbon sequestration projects have been one of the most contentious activities debated within the Kyoto Protocol. The potential for CDM for forestry including afforestation, reforestation, and avoided deforestation are being assessed in separate reports.

CDM Potential

Indonesia and CDM Potential

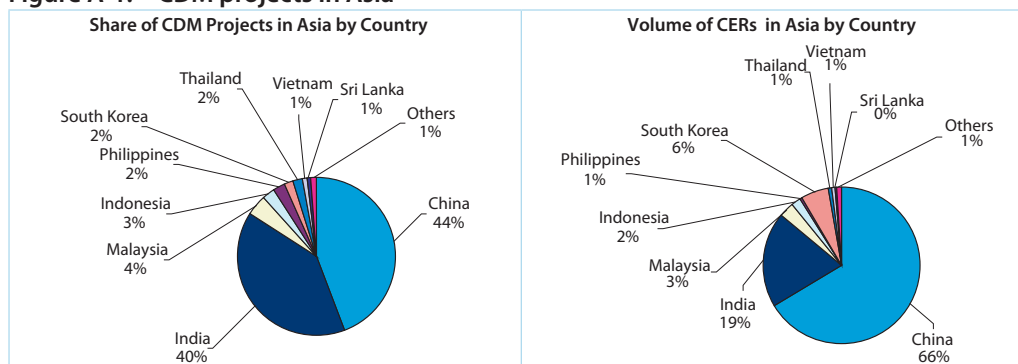
Indonesia's National Strategy Study indicated that the potential CDM volume in the energy sector is about 2.1 percent of the overall emissions of 1,200 million tonnes of CO₂ each year. A review of potential projects in 7 sectors could yield 24 million tonnes of CO₂ emissions reductions. If these projects could be realized and turned into carbon payments at USD 10 per tonne, CDM would be worth nearly a quarter billion dollars for the period to 2012. Realizing this potential has been a challenge for Indonesia, due to regulatory, capacity, and investment climate constraints, as well as fuel pricing. Reducing these barriers could stimulate development of even more projects.

Source: <http://www.cd4cdm.org/publications.htm> Date: 09/24/07 and World Bank estimates.

One of the country's first initiatives to assess CDM potential was the *National Strategy Study for Indonesia 2001* which estimated that the total volume of CERs from CDM projects from the energy sector in Indonesia could reach 125 million tons of carbon dioxide equivalent (MtCO₂e) in the first commitment period of the Kyoto Protocol ending in 2012, representing about 2 percent of the total global CDM market. Realizing this potential has been a challenge for the Indonesian market, especially compared to other countries in Asia (see Figure A-1). As of November 1, 2007 1,943 projects had either been approved or were under development in Asia for an estimated total of 1.8 billion tCO₂e.¹⁶

Although Indonesia lags behind India and China, several CDM projects have been successfully developed and approved by the Indonesian Designated National Authority (DNA). The DNA is an office, ministry, or other official entity appointed to review and give national approval of voluntary participation in projects proposed under the CDM. In Indonesia, the DNA is the National Commission on CDM, managed by the Ministry of Environment with multi-sectoral participation. As of October 31, 2007, the Indonesian government has approved 24 carbon projects. Nine of these projects are awaiting approval by the CDM Executive Board (EB).

Figure A-1. CDM projects in Asia



Source: <http://www.cd4cdm.org/publications.htm> Date: 11/1/2007

¹⁶ UNFCCC data available from <http://cd4cdm.org/>.

Table A-1. CDM Potential for Selected Sectors in Indonesia

| Sector | ktCO ₂ e |
|---------------------------------|---------------------|
| Agriculture | 32,800 |
| Biomass energy | 23,000 |
| Geothermal* | 15,000 |
| Landfill gas | 11,305 |
| Electricity generation from LFG | 5,400 |
| Hydro | 15,000 |
| Gas flaring | 7,500 |
| Total | 110,005 |

Sources: Pelangi-NEDO (2007) and World Bank internal estimates

*Based on known potential on Java only

Indonesia continues to depend on its considerable fossil fuel reserves to meet most of its energy demand. In addition to these large reserves of fossil fuels, Indonesia has vast potential resources of renewable energy, of which only a small portion has been exploited primarily limited to biomass, biogas, hydro, and geothermal. These renewables could represent more than 100 million tons of emission reductions (see Table A-1). Considering that the 2007 price for certified emission reductions was approximately USD 10, there is significant financial incentive for Indonesia to fully exploit its CDM potential and reanalyze its potential since prices have increased significantly since the 2001 study.

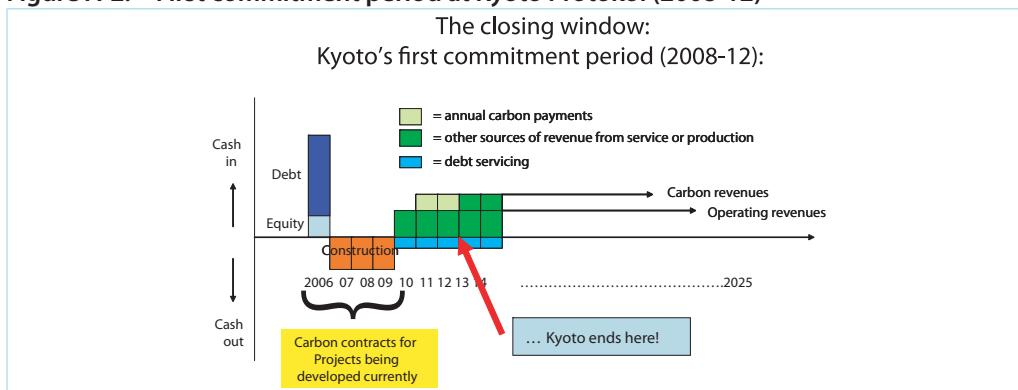
| SUMMARY SENSITIVITY ANALYSIS | | | | | |
|--|--|--------------|--------------|--------------|---------------------|
| INCREMENTAL IRR RESULTS - CONTRIBUTION OF CARBON FINANCE | | | | | |
| Sector | Impact (%) @ price = \$6.5/ton CO ₂ e | | | | CF impact (% range) |
| | Purchase 7y | Purchase 10y | Purchase 14y | Purchase 21y | |
| Landfill | 5.5 - 46.8% | 13.9 - 48.8% | 17.6 - 49.3% | 20.3 - 49.3% | 5.5 - 50 |
| CH ₄ from coal | 7.6% | 9.7% | 10.8% | 11.5% | 7 - 12 |
| Biomass | 1.9 - 3.5% | 2.3 - 5.1% | 2.6 - 6.3% | 2.9 - 7.1% | 2 - 8 |
| Forestry | 0.4 - 4.6% | 0.9 - 5.7% | 1.7 - 6.3% | 2.6 - 6.8% | 0.5 - 7 |
| Renewable energy | 0.2 - 1.7% | 0.3 - 2.2% | 0.5 - 2.6% | 0.6 - 2.9% | 0.2 - 3 |
| District Heating | 0.5% | 0.6% | 0.6% | 0.7% | 0.5 - 1 |

For example, higher prices for CERs have a significant effect on the internal rates of return and may make some sectors more attractive than previously assumed (see Figure below). In addition, more up-to-date analysis is needed to assess what is realistically possible given the closing window for the first Kyoto commitment period which ends in 2012 as well as the potential for different post-Kyoto regimes and the uncertainties regarding what may qualify as an emission reduction in the future, how they will be quantified, and their potential market value.

According to a number of recent studies, the mitigation options most feasible in Indonesia are geothermal energy, the utilization of flared gas, integrated combined cycle fuel switching, and cogeneration and heating systems. For example, the *National Strategy Study for Indonesia 2001* found that gas flaring may constitute that largest share of emission reductions from low-cost

abatement options and could account for up to half of emission credits generated in Indonesia.¹⁷ As the price of CERs has increased, other opportunities such as geothermal have become more viable and represent a significant share of the current and potential CDM portfolio in Indonesia. However, long lead times for project identification and preparation (in some cases more than five years) mean that not all potential projects can be competed in time to qualify for the first commitment period under the Kyoto Protocol (See Figure A-2 below).

Figure A-2. First commitment period at Kyoto Protocol (2008-12)



The need to diversify energy sources, rising environmental concern, and declining non-renewable energy resources have slowly led to increased interest in renewable energy, especially geothermal, biomass, and hydropower. The National Committee on Climate Change has recommended a shift from coal and oil to renewable energy to reduce GHG emissions. In addition, diversification has been advocated in government policies.

The nearly 200 volcanoes and 100 geothermal fields distributed throughout Indonesia make it a promising area for geothermal power generation. Geothermal resources were managed by Pertamina until 2000, when they were transferred to regional authorities. Prior to the 1997 economic crisis, the Indonesian government awarded contracts for 11 geothermal projects that would have had a generating capacity of 3,400 MW. The government is now attempting to resuscitate seven of the contracts. As of 2005, Indonesia had developed 802 MW out of an estimated potential of 30,000 MW (USAID, 2006).

¹⁷ The share of credits from gas flaring was based on the assumption that CER prices would remain fairly low, making other higher cost projects less feasible. At the time of publication in 2001, the price of a tCO₂e was USD 1.83. In 2007, the price was over USD 10. Therefore, other CDM opportunities that have higher up-front development costs have become more economically viable.

Table A-2. Indonesia CDM projects by sector

| Sector | No. of Projects | ktCO ₂ e thru 2012 |
|-----------------------|-----------------|-------------------------------|
| Afforestation | 0 | 0 |
| Agriculture | 1 | 1,065 |
| Biogas | 2 | 1,647 |
| Biomass energy | 12 | 6,246 |
| Cement | 1 | 3,329 |
| Coal bed/mine methane | 0 | 0 |
| Energy distribution | 0 | 0 |
| EE households | 1 | 257 |
| EE industry | 1 | 115 |
| EE own generation | 1 | 176 |
| EE service | 0 | 0 |
| EE supply side | 1 | 314 |
| Fossil fuel switch | 0 | 0 |
| Fugitive | 2 | 2,759 |
| Geothermal | 2 | 4,275 |
| HFCs | 0 | 0 |
| Hydro | 2 | 153 |
| Landfill gas | 6 | 3,645 |
| N ₂ O | 2 | 632 |
| Others | 0 | 0 |
| PFCs | 0 | 0 |
| Reforestation | 0 | 0 |
| Solar | 1 | 25 |
| Tidal | 0 | 0 |
| Transport | 0 | 0 |
| Wind | 0 | 0 |
| Total | 35 | 24,638 |

Sources: www.cd4cdm.org/publications.htm - 09/24/07

Note: EE, Energy efficiency

Given the domestic potential, maturity of the technology and impact on the environment, geothermal energy has many advantages. At least 9 geothermal CDM projects with a total of capacity of 1200 MW are under preparation in Indonesia. Expected annual emission reductions are over 5 Mt, making up 37 percent of the CDM volume in Indonesia.¹⁸ Geothermal projects are on average the largest of all CDM projects in Indonesia in terms of CERs. For example, a proven reserve of 2600 MW is estimated to be available in Java, with the biggest reserves found in Gunung Salak and Wayang Windhu. Deploying this potential would deliver 15 Mt of reductions in CO₂ emissions.¹⁹

18 Pelangi-NEDO. CDM Development in Indonesia -Enabling Policies, Institutions and Programmes, Issues and Challenges 2006 (Second Edition) <http://www.nedojakarta.org/nedo/html/docs/cdm.pdf>

19 Assuming the average capacity factor of current plants and that geothermal replaces average electricity production. Figures from ESDM 2004: Statistik Ekonomi Energi Indonesia 2004, <http://www.esdm.go.id/statistikenergi.php?stat=48&action=detail>

Current State of the CDM Market in Indonesia

While a small, but growing portfolio of CDM projects exists in Indonesia, before the Bali COP 13, no CERs from CDM projects in Indonesia had been issued.²⁰ Table A-2 provides a breakdown of current CDM projects by sector and estimated CERs. To date, the largest number of projects and highest volume of estimated CERs have come from biomass energy projects that use readily available agricultural wastes such as palm oil, rice husks, and cassava residues. The CDM has been a powerful tool in expanding the development of geothermal and landfill gas flaring projects which also account for a significant number of projects and estimated CERs.

Barriers to CDM and Sector Potential

While the CDM has been a major incentive to develop a small, but growing number of projects in the landfill gas flaring and geothermal sectors, many barriers continue to exist that hinder the scaling-up of the CDM in Indonesia. Many of the key barriers to CDM development in Indonesia have been identified and Table A-3 summarizes them.

Table A-3. Summary of key barriers to CDM development in Indonesia

| General barriers |
|---|
| <ul style="list-style-type: none"> • CDM is still a largely unknown or little understood concept in Indonesia. • Subsidy policies for fossil fuels limit switching to renewable sources of energy. • Few examples fully demonstrate the potential of CDM as a revenue stream. • Since the project preparation cycle is often long many companies find it difficult to plan that far in advance and assume that long preparation schedules increase risks and uncertainty. • Obstacles in processing legal documents relating licenses (too long chain of procedure) • Attracting investment remains a huge challenge as many investors view renewable energy and GHG projects as compounding risk – combining risky sectors with risky markets with a risky commodity. |
| Internal company/organization barriers |
| <ul style="list-style-type: none"> • Many companies lack the internal capacity to conduct project analysis or assist in project development. • High transaction costs place small projects at a disadvantage. Transaction costs in Indonesia are estimated to range from USD 50,000 up to USD 300,000, depending on the complexity of the project and revenues from CDM may not justify the transaction costs |
| Sector specific barriers |
| <ul style="list-style-type: none"> • Geothermal: The primary barriers to the development of Indonesia’s geothermal resources have been the pricing of electricity and a shifting regulatory environment. In general, geothermal projects require more capital to develop than other energy projects. The project developer must invest in drilling to map and evaluate the quality of the resource prior to the capital investment to build the plant. It will be hard for private developers to move forward with these projects without greater confidence in the long-term pricing of electricity • Landfill gas to energy: Current “buy-back rates” for selling electricity generated from landfill gas into the national grid are seen by the private sector as too low to make such an approach commercially viable. As a result all current landfill gas projects in Indonesia are planning to flare the methane only. • Hydro: Financing for hydro projects will remain a major challenge because of the difficulty in negotiating long-term power purchase agreements with PLN. • Biomass: Because Indonesian policy requires rice mills to be situated close to where rice is grown, most mills are small and decentralized. The rice husks produced by rice mills have low bulk density and are expensive to transport, so the technical potential from rice residues probably overstates the economically viable potential. • Gas flaring: Other policy and regulatory barriers that have been identified current regulation only governs the sharing of the production of oil and gas, but there is no policy on how to treat CERs, as this issue is still being addressed by the relevant agencies. |

²⁰ Source: <http://www.cd4cdm.org/publications.htm> Date: 09/24/2007

One of the most significant barriers is the high risk involved with developing CDM projects due to the use of new (for Indonesia) technologies. Another barrier is high transaction costs associated with developing CDM projects. Although revenue from emission reductions under the CDM can improve the financial feasibility of projects, there are considerable costs at the development stage and afterward during project implementation to certify emission reductions. When all of these costs are combined (up to USD 300,000), they place small projects at a disadvantage. A third significant barrier is the pricing of electricity and a shifting regulatory environment which has led to the difficulty of selling renewable energy produced by CDM projects into the national grid.

Attracting investment remains a huge challenge as many investors view renewable energy and GHG projects as compounding risk – combining risky sectors with risky markets with a risky commodity. For example, the primary barriers to the development of Indonesia's geothermal resources have been cited as the pricing of electricity and a shifting regulatory environment. Risks could be reduced with additional liberalization of the energy sector in general, removal of subsidies, clearer rules for CDM, and integrating CDM into the National Energy Policy.

Recent changes to electricity regulations guarantee grid access to small renewable energy producers (<10 MW) and has been an important first step to increase confidence and promote CDM eligible renewable energy projects. However, the procedures for taking advantage of these new regulations are often viewed as overly complex, with too much discretion left to PLN and prices are still considered too low for some projects to be viable.

For example a surge in geothermal development in the 1990s was stimulated by electricity prices between USD 0.069 and USD 0.085. PLN is now seeking to pay prices only under USD 0.05/kWh. In general, geothermal projects require more capital to develop than other energy projects and more time to develop with analysis needed on potential reserves. The project developer must invest in drilling to map and evaluate the quality of the resource prior to the capital investment to build the plant. Although the higher capital costs are offset by the zero fuel cost, it is more difficult for private developers to move forward with these projects without greater confidence in the long-term pricing of electricity (USAID, 2007).

The *National Strategy Study for Indonesia 2001* identified a number of barriers for CDM implementation in Indonesia. Many low-GHG emission technologies for the energy sector are available on the world market, but they are often capital-intensive and their design site-specific due to local conditions such as weather. Policy and regulatory barriers such as production sharing contracts have been identified that limit the implementation of gas flaring projects. For such projects, current regulation only governs the sharing of the production of oil and gas, but there is no policy on how to treat CERs. An additional barrier may be in the form of the high level of investment required to resolve technical matters, such as improvements and maintenance of pipeline systems to reduce leakage. An ongoing study on Indonesia's Carbon Finance Development for Gas Flaring Reduction, funded by the World Bank aims to address this problem.

As mentioned previously, another barrier to the CDM is high transaction costs. Although revenue from emission reductions under the CDM can improve the financial feasibility of projects, there are transaction costs that place small projects such as many biomass projects at a disadvantage. Transaction costs in Indonesia are estimated to range from USD 50,000 up to USD 300,000, depending on the complexity of the project (such as the selection of the baseline methodology and additionality compliance) and the availability of local expertise to help develop the project (USAID, 2007). The challenge for small-scale renewable energy projects in pursuing CDM revenue

lies in the capability of the project owner to pay the transaction costs in advance and the capacity of the project to produce sufficient revenues from CDM to justify the transaction costs. For example in the biomass and biogas sectors, a significant proportion of the project opportunities are small-scale, so streamlining procedures of small-scale projects and developing pooling of small projects is essential. Renewable energy resources have been largely unexploited because of the perceived high up-front costs or the lack of infrastructure to match supply with demand. Decentralized renewable energy systems remain the most cost-effective options in many rural areas and should attract private investment as the government continues to address the regulatory framework for selling power to PLN.

There is a significant portfolio of small hydropower projects planned or under construction in Indonesia. Small hydropower sites will likely receive significant private interest following the change in the law requiring PLN to purchase power from plants up to 10 MW. However, financing will remain a major challenge because of the difficulty in negotiating long-term power purchase agreements with PLN.

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Annex B Learning and Capacity Development Efforts

Capacity Development: Course on Environmental Economics for Development Policy - Bangkok, Thailand, January 14-25, 2008²¹

This Annex represents a summary of the views and evaluations of the individual participants on the usefulness of the course. The report also presents some ideas and proposals on further capacity-building and engagement on environmental and climate change issues within the key economics ministries of finance and coordination of the economy.

Capacity Development Context and Objectives

The participation of the selected five members of the Ministry of Finance (MOF) and Coordinating Ministry for Economic Affairs (*Menteri Koordinasi Ekonomi*, or *Menko* in Indonesian) constitutes part of the World Bank's engagement with the GOI on developing a longer – term strategy for mitigating and adapting to climate change impacts. Specifically, it is a continuing element in a program of assistance to the GOI on a Low Carbon Development Options Analysis for Indonesia.

The Ministry of Finance engaged a program of technical assistance from the World Bank in the lead-up to the Bali Climate Change Conference (UNFCCC COP 13) in December 2007. A working group on climate change has been set up under the auspices of the MOF, which was tasked to provide technical assistance on basic environmental economics, carbon finance and international climate change policy to Minister Sri Mulyani. This resulted in a fruitful collaboration, peaking in a successful meeting of Ministers of Finance at the Bali conference.

During the collaboration, a consensus emerged that MoF needed more analytical capacity to engage on environmental and climate change issues. The regular annual WBI – ADB course on "Environmental Economics for Development Policy" (EEDP) was identified as an ideal option increase capacity-building within MoF and Menko and to provide the latest findings in these policy areas to GOI staff. In response to the invitation from sponsors, the Ministry of Finance identified candidates from the on-going working group process and the Coordinating Ministry identified candidates who had already engaged in a series of workshops on climate change.

The rationale for the sponsor's support is to provide increased capacity-building within the GOI on climate change and environment issues. A World Bank staff member accompanied the Indonesian delegation to facilitate activities and to act as a focal point for policy engagement on climate change economic policy issues with the GOI counterparts.

Course Objectives and Relevance for GOI Participants

The main objective is for the GOI participants to receive a basic introduction into the principles and theories behind environmental economic policy making. The curriculum emphasizes these elements in the first week. While some of the participants have already a basic knowledge on some of these issues from previous study in their degrees, this was also a good opportunity to refresh their theoretical knowledge. The second week heavily emphasized case studies on environmental cost benefit analysis from all over the world. The practical real-world examples provided valuable comparative insights on how best-practice environmental valuation estimates of policy choices

²¹ Participants in the course developed the materials for this Annex, including Amnu Fuady, Mochamad Imron, Teguh Suwondo (Ministry of Finance) and Bey Triadi Machmuddin, Heny Puspitasari (Coordinating Ministry of the Economy). The Annex (from BTOR) was compiled by Kurnya Roesad (World Bank).

can be done. The balanced mix of theory and practical examples provided the GOI participants a practical “toolkit” to bring back as a resource material for the respective ministries.

An additional benefit for the participants is the access to a wide network of practitioners in the field – primarily from the WBI and ADB but also leading regional research institutions, such as SANDEE (South Asian Network for Development and Environmental Economics), EEPSEA (Economy and Environment Program for Southeast Asia) and international environmental NGOs, including IUCN. Moreover, a network among government ministries across the Asia-Pacific region can also be accessed in future with participants from China, Vietnam, Laos, Thailand, India, Nigeria, Philippines, Pakistan. The final and wider outcome is to create awareness among a critical mass of staff within the key economic ministries on environmental economics issues.

Summary of Selected Sessions

The course offered a wide variety of topics, presented in 38 sessions. In the following, the participants summarized the sessions most relevant to them.

| Summary of Relevance of Selected Sessions (compiled from participants’ trip reports) | | |
|---|--|--|
| Session / Topic | Key Learning Points | Relevance |
| Environmental economics and fiscal reform (sessions 6,7, 10) | <ul style="list-style-type: none"> Theories of factoring environmental depletion into economic growth and development Concepts of externalities and free rider problems Optimal pollution taxes / Pigouvian tax | <ul style="list-style-type: none"> Relevant to discuss the feasibility of adopting Pigouvian taxes in Indonesia. Especially MOF would be interested to organize stakeholder discussions on this issue. |
| Sustainable fisheries management (sessions 8, 13) | <ul style="list-style-type: none"> Concept of MSY (maximum sustainable yield) Allocation of quotas Zoning policies | <ul style="list-style-type: none"> Very relevant to Indonesia’s problems in the fisheries sectors GOI participants presented a brief group case study on Indonesia’s situation emphasizing the need to focus on revitalizing education centers for sustainable fishery management and economic incentives to help small and poor fishing communities |
| Contingent valuation methods (sessions 21,24,25) | <ul style="list-style-type: none"> Survey methods to determine WTP (willingness to pay) of respondents Valuing non-market natural resource assets | <ul style="list-style-type: none"> Relevant to gain a better understanding of environmental costs and benefits associated with certain policies – especially for MoF in assessing regulations |
| Economics of climate change (sessions 11,36) | <ul style="list-style-type: none"> Economic impacts and estimated global damages from climate change Policy instruments to address mitigation and adaptation Carbon taxes and carbon markets, CDM and carbon trading | <ul style="list-style-type: none"> Need to step up efforts to increase awareness among various government departments Need to adopt proper taxation/subsidies to foster cleaner technologies in Indonesia |
| Transport planning, environment and climate change (sessions 31,32,36) | <ul style="list-style-type: none"> Concepts to estimate congestion costs Case studies from Norway, Singapore on imposing fuel taxes and congestion fees. | <ul style="list-style-type: none"> Very relevant material given context of severe traffic problems in Indonesian cities Gives good idea on how to estimate economic/ environmental costs of transport policies |
| Poverty and environment (sessions 33,24) | <ul style="list-style-type: none"> Understanding the linkages between macroeconomic policies, environment and household welfare Integration of investment, natural resource use and welfare policies to reduce household poverty rates | <ul style="list-style-type: none"> Main policy lessons of relevance are Clarifying property rights over land (especially with regard to forestry sector, irrigation) Promote pro-poor policies like micro-credit schemes and subsidies to adopt environmentally cleaner technologies |
| Integrating macroeconomics and the environment (sessions 5, 6) | <ul style="list-style-type: none"> Macroeconomic-environment linkages Understanding of role of income elasticity of demand Understanding the role of proper policy instruments (user fees, tax, subsidy reforms, pollution taxes, etc.) | <ul style="list-style-type: none"> Need to integrate environmental indicators into existing policy packages issued by (GOI (for example Inpres No.6/2006 on Policy to accelerate real sector and SMEs). |

Evaluation / Outcome of the Course

Relevance: In terms of relevance, all GOI participants viewed the course as relevant for their work. The course represented a welcome opportunity to learn about the basic environmental economics principles and important case studies from all over the world.

Organization of the course: Generally, the course was perceived to be well organized. On the plus side, the chosen location on the campus of the AIT (Asian Institute of Technology) was good in terms of networking with other participants and lecturers, and enabling a good study environment. On the other side, the far distance to Bangkok was perceived as less favorable, especially given the length of the course (2 weeks). One participant also mentioned that the group was perhaps too big (all in all 48 participants). A smaller group of 25 would have fostered more discussion and in-depth learning. GOI participants would prefer a one week training schedule in future opportunities.

Speakers/curriculum: The presentations were mostly very good in terms of clarity, especially the sessions by John Dixon and Kirk Hamilton. The mix of theory (mostly first week) and then applied case studies (mostly second week) was generally well received. Some felt the case studies should have been more real in the sense that they were based on too many theoretical assumptions.

Ranking of topics and sessions: Environmental taxation, climate change economics, carbon markets and contingent valuation methods were the most popular and relevant for the five GOI participants. This could be of particular importance for the World Bank to engage the GOI further on key environmental policy issues.

Next Steps for Future Capacity Development

Based on several discussions between during the course, several ideas came up to further develop the analytical capacity of MOF and Menko on environmental economics issues and keep climate change on the government's agenda. Generally, there is sense among the participants that the concept of sustainable development should be streamlined into the GOI agenda in all areas. There is a recognition that a necessary next step is to build basic understanding among stakeholders on how important the concept of sustainable development is for long run economic growth. Engaging stakeholders on a regular basis could be done in a monthly or bi-monthly fashion, organized by Menko and MOF, or another government entity.

Short-term potential (2008). In the very short – term, the material obtained in Bangkok presents a good guide and handbook for GOI staff to respond to certain environmental issues on demand. The material of the EEDP course is certainly a good resource material to improve the staff's understanding to design future workshops.

The participants argued that in 2007, environmental topics figured prominently in workshops and seminars organized by the GOI. Menko has initiated a series of seminars, inviting mostly prominent Indonesian experts from universities and the private sector to brief the government staff on environmental policy issues. These workshops fall under the responsibility of Deputy 6 in the Bureau of International Economic Cooperation and Finance, which also coordinates various inter-departmental activities on climate change. Focus group discussions (FGDs) were also used by Menko and proved to be a very effective way to exchange & transfer knowledge. Future workshops could build on this existing capacity.

Another follow-up potential is to organize a seminar to brief interested parties within MOF and Menko on the course material in order to ensure immediate and wide dissemination. Another idea is to pick the most relevant (to Indonesia) topics of the course and organize a series of small

workshops using the exact format of the sessions but tailored to the Indonesian context. An outside domestic expert could be invited to each of these workshops and comment on and use the material to present Indonesian – relevant topics. For example, one immediate follow-up would be to organize a seminar by early March on the status of climate change policies after Bali, possibly also briefing stakeholders within and outside GOI staff on objectives and preliminary results of the study on “Low Carbon Development Options For Indonesia.” The course material on climate change economics would be excellent inputs to the discussion and could be disseminated during that seminar. Similar workshops on other ‘hot’ environmental topics on demand could follow on a bi-monthly or quarterly basis. Internally, the GOI participants of the course could use the material to organize a seminar to brief high-ranking GOI official of selected prioritized environmental economic issues relevant to the Indonesian context. The working group on climate change under the MoF will also benefit from the EEPD material for its need for analytical support on environmental economics issues.

Another immediate step would be to feed environmental economics analysis into the investment package issued by GOI. Specifically, the GOI has issued a Presidential Instruction (Inpres) Number 6 of 2007 concerning the Policies to Accelerate Development of the Real Sector and Empower of Micro, Small and Medium Enterprises (MSMEs). The Inpres issued covers 4 components: 1) Investment Climate Improvement, 2) Financial Sector Reform, 3) Acceleration of Infrastructure Development, and 4) Empowerment of MSMEs. These packages contain policy actions with clear implementation timetables over the next one year, but generally lack any environmental considerations. For example, policy incentives and criteria to speed up green investment flows would be desirable.

The material will also be used within the MOF and Menko to identify priority items for environmental expenditures on the upcoming state budget for 2009. Menko plans to organize focus group discussions on climate change, mitigation and adaptation, building on previous seminars. The EEPD material will be used to frame these workshops. In addition, internal meetings within Menko and MoF can be used to disseminate the EEPD material, particularly on meetings related to regulatory and economic policy issues.

Medium and long-term actions (2009). The main problem is how to internalize environmental perspectives in the national economic policies. Donor cooperation with Menko and MoF could help to organize climate change workshops and seminars aimed at middle managers for decision makers of various ministries. One course could be aimed at higher-ranking policy makers from Menko, MOF or Bappenas or from other Ministries. This could help to build awareness among top executives of the government. These series of meetings and seminars could serve to identify priority environmental themes for the RPJM (medium-term development plan of GOI 2009-2014) and also provide inputs to the COP 14 in Poland in December 2008.

Investing in-house modeling capacity to build in environmental indicators into economic planning is one possible option. Bappenas together with BPS (Statistical Agency) could collaborate on this. MOF would certainly benefit from such projections, as it has the budget power to allocate expenditures and apply tax and subsidies to create incentives. Building up an inter-departmental environmental economics unit led by Menko and /or MOF has also been mentioned in discussions. Participants also mentioned the importance of maintaining and updating the networking activities with links to the World Bank Institute and the environmental economics departments of the MDBs. The previous discussion is summarized in the following matrix.

Capacity Development Recommendations Matrix

| Short – term (2008) | Medium-term (2009) | Long-term (2010 beyond) |
|---|---|--|
| Disseminating EEPD material to relevant GOI agencies and staff to organize workshops and briefing sessions on: | FGDs and workshops to finalize RPJM | Installing an environmental economics / modeling unit in key economics Ministry (Fiscal unit at MOF or Bappenas/BPS) |
| Workshops to follow up on BALI COP and support analytical work preparing for Poland COP (WG MOF and Menko Ekon) | Workshops to support analytical work preparing for Denmark COP (WG MOF and Menko Ekon) | |
| Workshops and FGDs by Menko Ekon on selected priority issues (eg. environmental taxation, climate change economics, carbon markets and contingent valuation methods) | Same | Same with focus on ‘micro’ issues like transportation, flood control, river pollution and traffic control |
| Workshops and FGDs for WG MOF on climate change (WB annual meetings, OECD) | Same | Same |
| Briefing seminars for senior GOI staff for upcoming RPJM (WG MOF and Menko Ekon) | Same | |
| Workshop to disseminate preliminary findings of low carbon growth study (WG MOF and Menko Ekon) | Workshops to disseminate final findings of low carbon growth study (WG MOF and Menko Ekon) | |

Annex C Data Sources and Methods

In this report, data from the International Energy Agency (IEA) were used for long term time series of energy output by country, sector and fuel type. These data are internationally accepted, widely used in this type of analysis, and available since 1970, and provide a detailed energy matrix for all years. See www.iea.org for examples of the available data.

Where possible and relevant, the IEA data were supplemented with more specific Indonesia data from the Ministry of Mining and Energy Resources (Departemen Energi dan Sumber Daya Mineral or ESDM). These data are not as comprehensive being available only since 1990, without an energy matrix for some years. However, the ESDM data and sources provide a better picture of more recent trends and plans in Indonesia. Thus, these sources were used for consideration of alternative possible trends in the future, based on GOI planning documents. Some data are available on www.esdm.or.id, but some of these are also in Bahasa Indonesia.

World Resource Institute (WRI) provides an online resources of greenhouse gas emissions summarized from other sources. WRI also provides energy consumption data available since 1970, but are less disaggregated, and do not provide a detailed energy matrix. WRI data provide much of the underpinning of the forestry and land use analysis. See www.wri.org for examples of available data.

Forestry and land use data were based on the studies of the Ministry of Forestry and Indonesian Forest Climate Alliance. The final comprehensive report has not yet been completed but a number of interim technical studies and summary reports have been issued, based on WRI and Winrock analysis, plus MODIS views of deforestation. Available reports can be viewed on www.dephut.go.id/informasi/litbang/ifca/ifca.htm. Because this detailed sectoral work is ongoing, this preliminary low carbon study incorporated available results and used them in comparison with fossil fuel and energy sector results. These forestry and land use data are preliminary and will be improved as the REDD/IFCA analysis on emissions inventory from forest and land use is completed in the first half of 2008.

Calculation of changes in emissions intensity.²² As seen in Section 3 of this report, both carbon and energy use intensity are the reasons that CO₂ emission in Indonesia grew relatively faster than that in many other countries. Part of the analysis in Section 3 relies on observation of emissions intensity from 1971 (the initial year of Indonesia's fast development) until 2004 (the latest data available for this paper). Decomposition of the CO₂ emissions helps to better understand whether energy intensity or carbon intensity has caused CO₂ emission in Indonesia to increase significantly. The decomposition formula is as follows:

²² Baed on "Decomposing CO₂ Emission from Fossil Fuel Combustions in Indonesia to Understand the Options for Mitigation." Draft Report for The Technical Baseline Study of GHG Emissions and Scenarios. Prepared by Rudy P. Resosudarmo and Frank Jotzo of the Research School of Pacific and Asian Studies. The Australian National University. November 2007.

or
$$\partial CO_{2t} = \partial P_t \cdot \frac{\partial Y_t}{\partial P_t} \cdot \frac{\partial E_t}{\partial Y_t} \cdot \frac{\partial CO_{2t}}{\partial E_t} \partial CO_{2t} = \partial P_t \cdot \frac{\partial Y_t}{\partial P_t} \cdot \frac{\partial E_t}{\partial Y_t} \cdot \frac{\partial CO_{2t}}{\partial E_t} \quad (1)$$

$$\partial CO_{2t} = \partial P_t \cdot \partial y_t \cdot \partial e_t \cdot \partial c_t \partial CO_{2t} = \partial P_t \cdot \partial y_t \cdot \partial e_t \cdot \partial c_t \quad (2)$$

where:

- t = index for year
- ∂ = change in one year
- CO_2 = the amount of CO_2 emission
- P = population
- Y = GDP
- E = the amount of energy use
- y = GDP per capita
- e = energy intensity
- c = carbon intensity.

This report was prepared as part of the Low Carbon Development Options for Indonesia



Fiscal Policy Office
Ministry of Finance
Jalan Dr. Wahidin No.1, 1st Floor
Jakarta, Republik Indonesia
Tel/Fax: +62 21 384 0059 (direct)
Internal: 7004
www.depkeu.go.id



THE WORLD BANK | BANK DUNIA

The World Bank
Jakarta Stock Exchange Building Tower II, 12-13th Floor
Jalan Jendral Sudirman Kav. 52-53
Jakarta 12910
Tel: +62-21-52993000
Fax: +62-21-52993111
www.worldbank.org/id