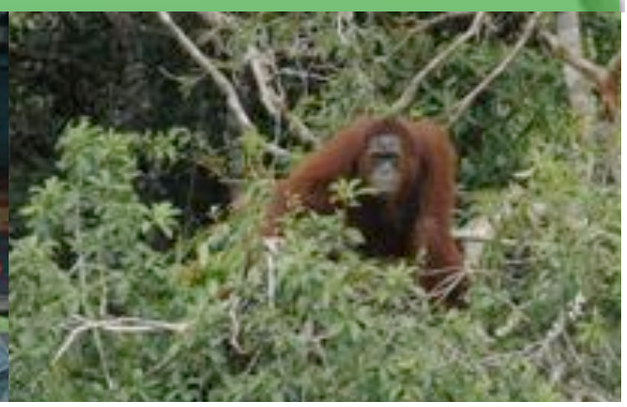
Creating low carbon prosperity in Central Kalimantan



dewan nasional perubahan iklim

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The DNPI and the Government of Central Kalimantan would like to acknowledge McKinsey & Company for its analytical support in connection with this study, particularly in the application of its proprietary greenhouse gas abatement methodologies to the Indonesian national and provincial contexts. The DNPI and the Government of Central Kalimantan would also like to thank the more than 100 government, private-sector, and NGO personnel who made important contributions to this work in various workshops and meetings. While the GHG abatement methodology belongs to McKinsey, and data and input came from many stakeholders and information sources, the conclusions and results set forth in this report are exclusively those of the DNPI and the Government of Central Kalimantan.

Finally, we would like to extend our thanks to the BRR NAD-Nias for the use of the images on the front cover.

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Contents

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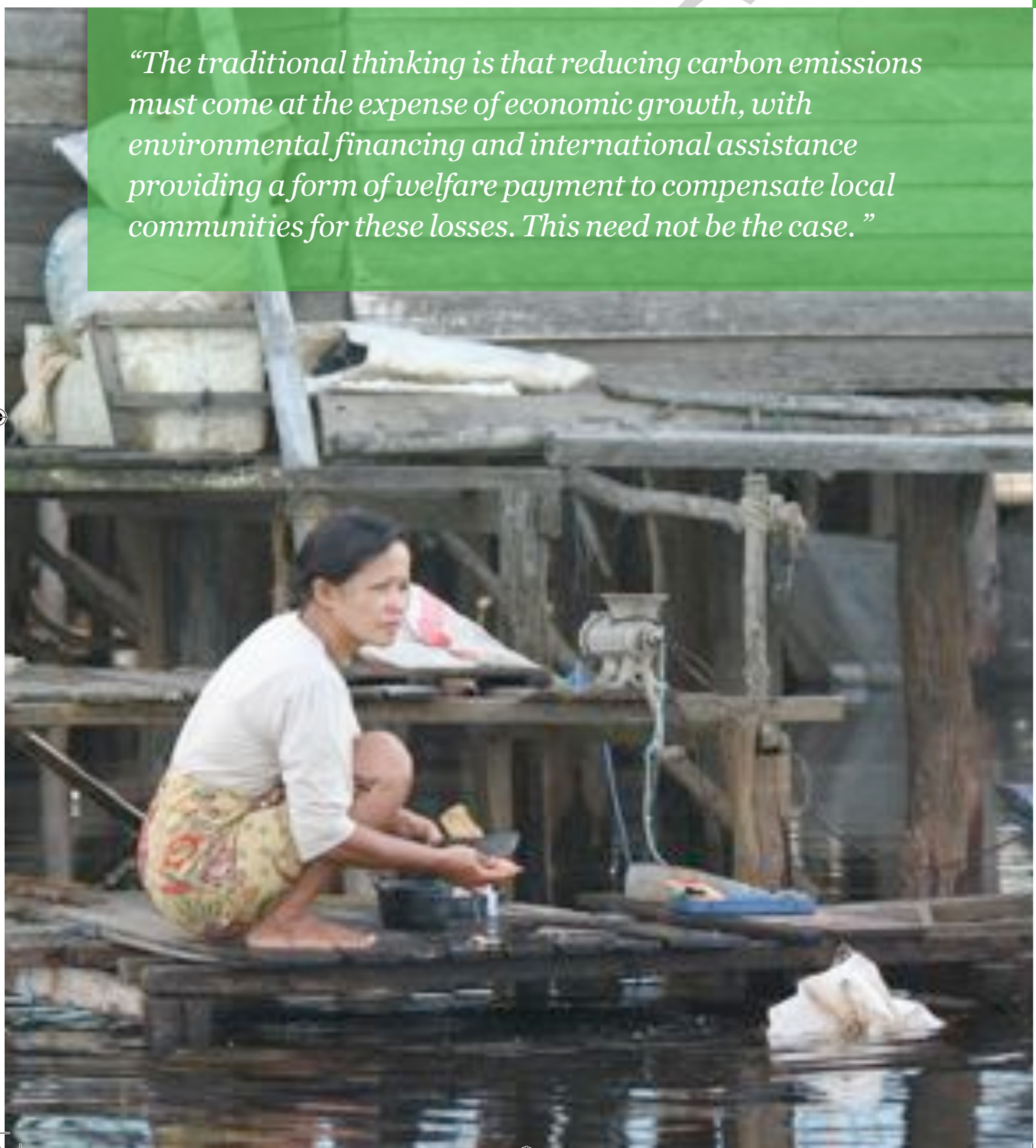


Preface

Under the leadership of President Susilo Bambang Yudhoyono, Indonesia has made several important contributions to the global climate change debate. After hosting the United Nations Framework Climate Change Convention (UNFCCC) Conference of Parties (COP-13) in Bali in 2007, Indonesia has organized or participated in a series of high-level gatherings to address the issue of reducing greenhouse gas (GHG) emissions from the land use, land-use change and forestry (LULUCF) sector. These include the Forestry-11 grouping convened by Indonesia; the Informal Working Group on Interim Financing for REDD; and the April 2009 meeting of Heads of State convened by the Prince's Rainforest Project.

At the September 2009 G-20 summit in Pittsburgh, President Yudhoyono voluntarily committed Indonesia to an ambitious roadmap for reducing its carbon emissions by 26 percent by 2020, the first large developing country to do so. Indonesia reaffirmed its commitment to the reduction target at the COP-15 round of negotiations in Copenhagen in December 2009 and subsequently associated itself with the Copenhagen Accord in January 2010. The government is currently preparing a National Action Plan on Climate Change, which will describe in detail how Indonesia will meet its 26 percent commitment.

The traditional thinking is that reducing carbon emissions must come at the expense of economic growth, with environmental financing and international assistance providing a form of welfare payment to compensate local communities for these losses. This need not be the case. In fact, the scheme to reduce emissions from deforestation and forest degradation (REDD) that was mandated at the Bali Climate Change Conference two years ago can help move Indonesia onto a more sustainable development path to what we can call low-carbon prosperity.

Indonesia's provincial governments are at the heart of this challenge. The government of Central Kalimantan, under the leadership of Governor A. Teras Narang, and the Dewan Nasional Perubahan Iklim (DNPI) have commissioned this low-carbon prosperity analysis to provide a quantitative basis for a discussion of the opportunities for reducing GHG emissions in the province while still being able to reach the province's economic development goals.

This report evaluates the potential for low-carbon prosperity in Central Kalimantan following a three step approach. First, it gives a fact-based assessment of current and likely future GHG emissions for the province. Second, it outlines potential actions to reduce emissions, the relative volume of each of these reduction measures, and an indication of costs (or gains) per measure. Third, and most importantly, it describes new sources of regional growth that would provide more sustainable livelihoods for the local population over the longer term – that is, livelihoods that would result in lower carbon emissions than current livelihoods and reduced pressure on the province's natural endowments.

Our hope is that this work will help build momentum for carbon dioxide (CO_2) reduction in Indonesia by making Central Kalimantan a showcase of how to combine carbon abatement with economic growth and thus inspire others in Indonesia and elsewhere of the potential for low-carbon prosperity. More practically, the design of a workable model for achieving carbon abatement and economic growth will allow Indonesia and Central Kalimantan to better identify and sequence the investments required, and so more effectively raise needed capital from global sources of climate mitigation funds.

"In order to put Central Kalimantan's economy onto a low-carbon growth trajectory, mitigation efforts must be combined with the development of additional sources of economic growth that can provide sustainable livelihoods for the local population."

Executive summary

In a business-as-usual scenario, Central Kalimantan will be a significant contributor to greenhouse gas emissions in Indonesia to 2030.

Central Kalimantan's annual GHG emissions in 2005 were estimated to be 292 $MtCO_2e$[1] – equivalent to roughly 15 percent of Indonesia's total emissions. Peat and Land Use, Land-Use Change, and Forestry (LULUCF) are by far the largest contributors to Central Kalimantan's emissions, representing up to 98 percent of the province's total emissions. If there are no changes in the way the high-emitting sectors are managed, Central Kalimantan's net emissions are expected to grow by some 18 percent between 2005 and 2030 – from 292 to 340 $MtCO_2e$.

Central Kalimantan has a large potential for carbon abatement.

Central Kalimantan has the potential to reduce its GHG emissions by as much as 282 $MtCO_2e$, with the right blend of domestic policies and international support. Of these possible reductions, 50 percent could come from efforts related to conserving peatland and 48 percent from the LULUCF sector. The five largest carbon reduction opportunities represent 80 percent of the total abatement potential of Central Kalimantan: (1) Prevent forest and peatland fires; (2) Reduce deforestation through more effective land use, land allocation policies, and improving agricultural productivity; (3) Rehabilitate idle or degraded peatland; (4) Manage forests sustainably; and (5) Reforest.

Whilst the overall required funding is substantial, the cost per tCO2e abated is relatively low. For example, in 2030, the total cost per tCO2e abated averages between USD 2.75 and 4.67. Of the total abatement opportunities available in 2030, 19 percent are readily achievable abatement opportunities (with reduction potential to be realized by 2015) and partly at even negative societal cost; 54 percent through capturing opportunities that are more challenging to capture (but with reduction potential to be realized by 2020); and the remaining 27 percent through capturing highly challenging opportunities, which could be both, relatively expensive and difficult to capture.

Low-carbon) sources of growth will be needed to ensure continued development, poverty alleviation, and job creation in Central Kalimantan

In order to put Central Kalimantan's economy onto a low-carbon growth trajectory, mitigation efforts must be combined with the development of additional sources of economic growth that can provide sustainable livelihoods for the local population. Seven growth opportunities were prioritized based on their potential impact (current importance to GDP, future growth, quality of employment, and implications for carbon emissions) and feasibility (i.e., fit with current business environment strengths and weaknesses): (1) Estate crops on non-forested land; (2) Sustainable forestry; (3) Environmentally-sustainable mining; (4) Food crops on non-forested land; (5) Aquaculture; (6) Financial services; and (7) Eco-tourism.

1 Greenhouse gas emissions are typically measured in million tons of carbon dioxide equivalent or $MtCO_2e$.

Achieving successful low-carbon economic growth will require a significant transformation, both within government and within the broader society of Central Kalimantan.

The Governor of Central Kalimantan issued a decree on November 16, 2009 establishing a new preparatory team to coordinate REDD and peatland rehabilitation efforts in the province. This preparatory team provides an excellent basis to coordinate the broader low-carbon growth activities in the province. Critically, it reports directly to the Governor, ensuring its visibility and mandate. As this new institution develops it will also be important to include representatives from different levels of government, clearly define relationships and decision-making rights with other government departments, and develop rigorous performance management around a few priority outcomes.

This new institution will also need to support Central Kalimantan in six key functions: (1) Attracting, managing, and distributing international financing for low carbon growth in a transparent, fair, and efficient manner; (2) Providing technical support to establish a province-level baseline and rigorous standards for monitoring, reporting, and verification; (3) Developing regulatory responses to address critical issues such as spatial planning and land tenure; (4) Instituting the processes for engaging with local communities, promoting behavioral change, and building local community enforcement; (5) Developing the critical infrastructure to support emissions reduction and sustainable livelihoods; and (6) Designing strategies with the private sector to support growth and investment in identified growth priorities.

Central Kalimantan will require significant, near-term international support to succeed in its plans to create low-carbon prosperity.

Central Kalimantan will require significant, near-term international support to succeed in its plans to create low-carbon prosperity. In the first year, between USD 143 million and 236 million will be required to establish basic readiness functions to support low-carbon growth. From 2011–2030, ongoing running costs to support implementation of carbon abatement and sustainable livelihood opportunities will gradually increase and reach between USD 0.78 billion and USD 1.32 billion in 2030. Whilst the overall required funding is substantial, the cost per tCO_2e abated is relatively low. For example, in 2030, the full abatement cost per tCO2e abated (including implementation costs) ranges between USD 2.40 and 3.90. In contrast, the McKinsey Global Cost Curve[2] estimated the global average technical cost[3] alone (i.e., excluding implementation costs) to be around USD 3.75 per tCO2e abated.

Initial estimates suggest that absent any financial support or incremental sources of economic growth, implementing carbon abatement measures could decrease real per capita incomes in 2030 by over 10 percent in Central Kalimantan, due to a slowdown of carbon-emitting sectors and the costs of implementation. However, with the required financial support and assuming successful capture of the new sector growth opportunities, average (real per capita) incomes in 2030 in Central Kalimantan could actually increase by around 13 to 17 percent above the base case.

2 McKinsey & Company (2009) Pathways to a Low-Carbon Economy: Version 2 of the Global Greenhouse Gas Abatement Cost Curve

3 This paper considers various costs in evaluating abatement options. Technical costs are defined as the incremental cost of a low emission technology compared to the reference case, measured as USD per tCO2e abated emissions. Technical costs include annualized repayments for capital expenditure and operating expenditure, and thus represent the pure "project cost" to install and operate the low-emission technology. They include neither implementation costs nor social costs (e.g. the loss of biosystem services such as clean, fresh water supply from forests). Full abatement costs include both technical costs as defined above and implementation costs., but not social costs. Finally, opportunity costs refer to the full foregone revenue an agent gives up to switch to a lower emission technology, behaviour or alternative.

Implementation of low carbon growth will need to happen in phases.

Phase 1 involves finalizing the low-carbon growth strategy (summarized in this report) that identifies the major opportunities for abatement and new sector growth, the critical actions required for success, and an estimate of the associated costs. Phase 2 (Mar –Dec 2010) involves developing the basic readiness structures to attract international financing and support low-carbon growth, whilst launching some priority abatement initiatives. These activities include finalizing the organizational structure, staffing the low-carbon delivery unit, and establishing its key performance indicators (KPIs). Phase 3 (Jan–Dec 2011) involves launching a pilot program to support low-carbon growth. Following the pilot and a review of the lessons learned, it is envisaged that there would be a progressive rollout of other pilots in 2012, with the eventual transition to a province-wide approach by 2013.

1. The context for low-carbon growth

In spite of its natural wealth, Central Kalimantan faces enormous challenges to achieving sustainable social and human development. Average incomes are lower than the Indonesian average, and the province has a large dependence on extractive industries (e.g., over one-third of recent GDP growth has come from the mining sector). Central Kalimantan's government is therefore understandably focused on economic development and improving the livelihoods of its people. At the same time though, Central Kalimantan is taking a leading role in combating anthropogenic (e.g., man-made) sources of climate change, particularly those related to forest and land fires.

Central Kalimantan is committed to moving towards a climate-compatible development pathway, reconciling economic development with climate change mitigation. Climate-compatible development has the potential to broaden the base of Central Kalimantan's economy, reducing its reliance on primary resource exports and promoting the sustainable livelihoods of smallholder farmers and forest communities. Achieving this climate-compatible development will require substantial changes to Central Kalimantan's economic structure, land use planning, and government policy. It will also require a new mindset focused on long-term, environmentally-sustainable development taking hold within government, the business community, and the non-profit sector.

The low-carbon growth strategy described in this report is the first step in a much longer process to create sustainable prosperity for the people of Central Kalimantan. It has three core elements (Exhibit 1):

1. CO_2 mitigation: Estimating the size of current and future emissions; assessing the technical abatement potential and the feasibility of abatement levers; developing an action plan to capture prioritized abatement opportunities

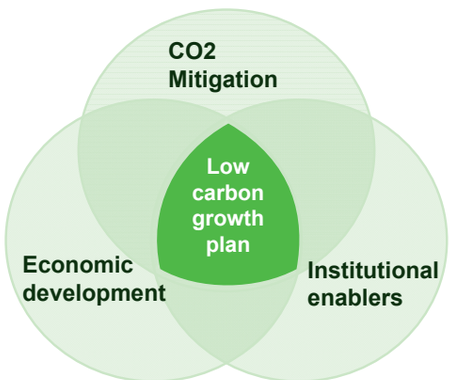
2. Economic development: Analyzing existing competitive strengths and weaknesses; prioritizing growth opportunities based on impact (including economic and environmental impact) and feasibility; developing an action plan to capture prioritized growth opportunities

3. Institutional enablers: Developing a strategy for critical enablers that will underpin the success of the low-carbon growth strategy (e.g., new institutions, monitoring and evaluation, financial distribution mechanisms, spatial planning)

The remainder of this report outlines the current challenges Central Kalimantan faces in each of these three areas and identifies some priority areas of action.

Exhibit 1 Key elements of a Low-Carbon Growth Plan

Framework for Low-Carbon Growth Plan



Key elements

CO2 Mitigation

- Estimate the size of current and future emissions
- Assess the technical abatement potential and feasibility, and implementation cost of individual mitigation initiatives

Economic development

- Analyse existing competitive strengths and weaknesses
- Explore potential new sources of growth (requiring less carbon emissions)

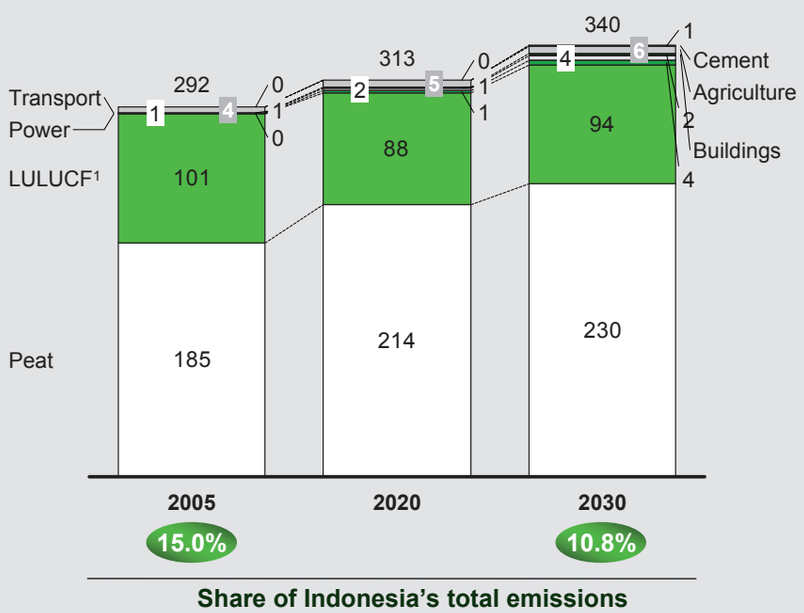
Institutional enablers

- Develop strategy for critical enablers (e.g., monitoring and evaluation, spatial planning, community engagement)
- Estimate the total costs of realizing these opportunities

Exhibit 2 Central Kalimantan's emissions are expected to grow from 292 to 340 $MtCO_2e$ between 2005 and 2030

Projected net emissions, Million tons CO_2e

PRELIMINARY



1 Net emissions allowing for absorption capacity of forests
SOURCE: DNPI Indonesia Cost Curve; team analysis

2. Baseline estimates of current and future emissions

In a business-as-usual scenario, Central Kalimantan will be a significant contributor to greenhouse gas emissions in Indonesia to 2030.

Central Kalimantan's annual GHG emissions in 2005 were estimated to be 292 $MtCO_2e$[4] – equivalent to roughly 15 percent of Indonesia's total emissions. Peat and LULUCF are by far the largest contributors to Central Kalimantan's emissions, representing up to 98 percent of the province's total emissions.[5] If there are no changes in the way the land-use-related sectors are managed, Central Kalimantan's net emissions are expected to grow by some 18 percent between 2005 and 2030 – from 292 to 340 $MtCO_2e$, mainly through increasing emissions from its degraded peatland (Exhibit 2).

3. Abatement opportunities

Central Kalimantan has a large potential for carbon abatement.

Central Kalimantan has the potential to reduce its GHG emissions by as much as 282 $MtCO_2e$,[6] with the right blend of domestic policies and international support. Of these possible reductions, 50 percent could come from efforts related to conserving peatland and 48 percent from the LULUCF sector (Exhibit 3).

Five carbon reduction opportunities represent over 95 percent of the total abatement potential of Central Kalimantan (Exhibit 4). These opportunities are described in more detail below.

1. ***Prevent forest and peatland fires (86 $MtCO_2e$):*** The prevention of forest fires has the largest potential to reduce Central Kalimantan's emissions at a relatively low societal cost of below USD 1 per avoided tCO_2e (excluding implementation costs).

   Major emission reductions could be achieved by prohibiting fire as a tool for land preparation, providing appropriate and practical equipment (and, if appropriate, financial incentives) for manual land clearing, developing appropriate early-warning systems based on fire risk status and field-based fire detection, strengthening fire brigades, ensuring strong enforcement and large penalties for rule violations, and building public awareness of the economic and social costs of forest fires in the province.

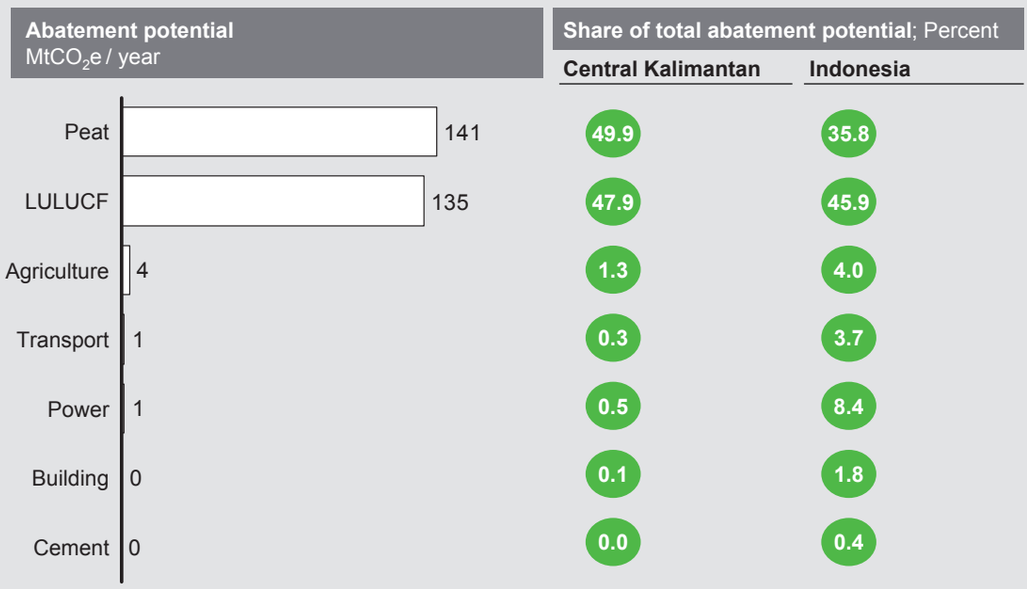
   Past plans for combating fires, such as the 2006 Palangka Raya Declaration on Forest and Land Fires (which produced an action plan focusing on building awareness, developing local knowledge in land preparation, developing early warning systems, and introducing a reward system for villages that are fire free) highlight the need for inclusion of local communities from a very early stage with ongoing interactions, appropriate financial resourcing and funding mechanisms, clear responsibilities, and strong leadership to ensure impact.[7]

4 Greenhouse gas emissions are typically measured in million tons of carbon dioxide equivalent or $MtCO_2e$.
5 Annex 1 contains a description of the methodology used to estimate Central Kalimantan's current and future emissions.
6 Technically the overall abatement potential could be even higher and reach up to 340 $MtCO_2e$, however this would require very large additional investments in infrastructure and building government capacity.
7 See also the "Master Plan for Rehabilitation and Revitalisation of the EMRP Area – Technical Report 1: Forest and Land Fire Management in the Ex-Mega Rice Project Area," which describes the status of fire management in Central Kalimantan and the EMRP area and includes recommended actions.

Exhibit 3

Largest abatement potential is in peat and LULUCF

PRELIMINARY



SOURCE: DNPI Indonesia Cost Curve; team analysis

Exhibit 4

Addressing the 5 largest abatement opportunities could potentially reduce Central Kalimantan's emissions by 80 percent

Projected abatement potential, Million tons CO_2e

PRELIMINARY

Percent of total reduction potential: 30, 28, 19, 15, 5, 3

SOURCE: DNPI Indonesia Cost Curve; team analysis

It should be noted that the technical maximum potential for CO_2e reduction through fire prevention could be as high as 140 Mt CO2e if all anthropogenic fires in Central Kalimantan were suppressed. However, this would require very large investments in infrastructure and fire prevention programs across a very large and geographically remote province.

2. ***Reduce deforestation through more effective land-use and land allocation policies as well as by improving agricultural productivity (78 MtCO_2):*** Reducing emissions from deforestation could principally be achieved by two different approaches. The first approach is basically the REDD approach. This approach targets land owners and pays them for not starting economic activities, such as converting forests into plantations for palm oil and other agricultural crops. This approach comes at relatively high cost, e.g., approximately USD 30 per avoided tCO_2e in the case of palm oil.

   An alternative approach is to reduce emissions from deforestation through a more efficient and sustainable allocation of land – for example by using already degraded land rather than forested land for new agricultural cultivation – and by limiting or stopping agricultural expansion into deep peatlands. This approach would also emphasize increasing agricultural productivity on existing lands through training farmers on agricultural intensification technigues and by diversifying crop selection. While these activities also come at a cost, these costs are assumed to be much lower than paying a land owner for his foregone revenues. Another benefit is that these activities will help to maintain or increase economic development in the province.

   Ensuring effective land allocation is extremely challenging given the cross-jurisdictional nature of land tenure and spatial planning issues.[8] Increased collaboration among national, provincial, and district level governments will be critical to improving spatial planning and must be supported by detailed technical analyses, which can provide an accurate assessment of current land allocation and assess the potential economic benefits of using different land types for different activities. This information then needs to be consolidated into a single land titling system to register deeds and map areas, supported by strong community engagement.[9]

   To create short-term impact, Central Kalimantan could shift inactive agricultural permits on peatlands to non-peat areas. Productivity of existing lands can be improved by increasing knowledge sharing on sustainable and high productivity agricultural practices. The Master Plan for the Rehabilitation and Revitalization of the Ex-Mega Rice Area (Box 1)[10] noted that there is currently limited sharing of knowledge amongst farmers and relatively little absorption of recent agricultural research on extension services. Access to extension services also appears limited in more remote areas (e.g., the Master Plan for the Ex-Mega Rice Area estimates that there is currently one extension worker per 17,000 hectares, an area home to 1,000 farmer households).[11]

   Similar to the case of fire prevention, the maximum technical abatement potential for reducing emissions from deforestation through more effective land-use and land allocation is higher than the estimated potential used in this report, and could reach up to 97 MtCO_2e by 2030. However, as a large part of this abatement opportunity is linked with smallholder activities, there are substantial challenges to be overcome to reach the full technical potential. Given the large number, fragmentation and remoteness of smallholders in Central Kalimantan, it is considered unlikely that the full technical potential could be reached by 2030.

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8 The Central Kalimantan government has recently submitted a spatial planning proposal to the Ministry of Forestry, which is currently under review.

9 Further analysis of land tenure and spatial planning issues is provided in Section 4 – Institutional Enablers.

10 Master Plan for the Rehabilitation and Revitalization of the Ex-Mega Rice Project Area of Central Kalimantan, October 2008.

11 Indonesia as a whole is estimated to have 1 extension services expert for every 1,667 farmers, versus, for example, 1:625 in China and 1:476 in Ethiopia.

3. ***Rehabilitate idle or degraded peatland (53 $MtCO_2$):*** Reduce peatland emissions through reforestation and rehabilitation of the hydrological functions of degraded peatland that has no food or feed production value and for those lands that are protected by law.[12] Here, the key enablers will be stipulating guidelines for re-wetting processes, sponsoring local research into the cost and benefits of alternative peat rehabilitation processes (with the potential to create a local center of excellence), and coordinating with the national government to ensure peat emissions are included in international climate change negotiations. In practice, to make this effort sustainable in the long term, reductions in emissions through rewetting degraded peatland must also be accompanied by effective fire prevention and management as well as efforts to promote reforestation.

Box 1: Master plan for the Ex-Mega Rice Project (EMRP)

Beginning in 1995, the Mega Rice Project aimed to boost rice production in Central Kalimantan's peatlands and lowlands. The area covers 1.4 million hectares (roughly 10 percent of Central Kalimantan's total area) and is home to 25 percent of the population. Extensive drainage of the peatlands and associated deforestation have degraded the peatland and led to a high risk of fire. Extensive fires occurred in the area during the prolonged dry seasons of 1997–1998, 2002, and 2006.

Following a Presidential Instruction (Inpres), the Master Plan for the Rehabilitation and Revitalization of the Ex-Mega Rice Project area was developed with the support of the Dutch government to provide a strategic framework for revitalizing the region and reducing environmental damage. The Master Plan has six main programs: (1) Fire prevention and management; (2) Spatial management and infrastructure; (3) Sustainable peatland management and conservation; (4) Agricultural revitalization; (5) Community empowerment and socio-economic development (6) Institutional development and capacity building.

4. ***Manage forests sustainably (42 $MtCO_2$):*** Non-sustainable extraction of timber from Central Kalimantan's production forests results in significant annual emissions. National policies on sustainable forest management exist, however they are solely focusing on the volume of merchantable timber and cutting cycles but they do not attempt to minimize the total biomass removed during the harvesting activities, which is typically many multiples of the timber extracted for commercially purposes. This includes trees felled to open roads and skidding trails for harvesting operations and to provide materials for bridges as well as trees damaged during the cutting and removal of commercial timber. The loss of this carbon stock is extended where conditions are not conducive to forest regeneration.

   These emissions can be reduced by enforcing more sustainable forest management practices in dry land areas (e.g., by hiring more people to enforce reduced impact logging and to overlook and verify enrichment planting), providing technical support to farmers and loggers, improving forest governance, and educating consumers in key international markets. Ensuring that local communities are fully integrated into the management, monitoring, and enforcement of local forests will be critical and needs to be accompanied by appropriate incentives that reward individuals and communities for promoting the sustainable use of forests, such as in the Juma Sustainable Development Reserve in Brazil (Box 2).[13] There are already a number of ambitious sustainable forest management projects underway in Central Kalimantan. The Heart of Borneo project, for example, is a partnership between Brunei Darussalam, Indonesia, and Malaysia to conserve 220,000 square kilometers of rainforest – almost one-third of the island – through a network of protected areas and sustainably-managed forests.

12 Annex 3 provides an overview of peat and peat-related emissions.
13 "The costs of REDD: lessons from Amazonas", IIED briefing paper, November 2009.

Box 2: Juma Sustainable Development Reserve (Brazil)

At the current rate of deforestation, about one-third of the forest in Brazil's Amazonas will have been lost by 2050, releasing 3.5 billion tonnes of carbon dioxide. Bolsa Floresta in Amazonas (the country's largest state, nearly 98 percent covered by rainforest), has developed the Juma Sustainable Development Reserve, an area of 600,000 hectares (1.2 million acres) bordered by two highways. The project aims to avoid the degradation of 366,000 hectares of rainforest and the emission of 210 $MtCO_2e$ into the atmosphere by 2050. Under the project, local forest communities are rewarded for committing to avoid clearing primary forest and avoid burning vegetation.

Funding is distributed at four levels:

- *Individual families:* payment of around USD 25 per month transferred through a debit card issued to the wife (based on regular inspections to ensure that trees are being maintained)
- *Family associations:* cash grant averaging USD 500 per month per association plus in-kind equipment (such as Internet connections)
- *Social programs:* grants of approximately USD 70,000 per year for each reserve, directed towards social activities, such as education or health, and designed to complement existing state and local government programs
- *Sustainable income generation:* equivalent to USD 70,000 per year for each reserve to support income-generating activities based on sustainable land and resource use

5. ***Reforest (14 $MtCO_2e$):*** Increase the natural carbon sink by enlarging the forest cover outside the peatland with suitable, economically viable tree species, such as native species that can yield timber and non-timber products as well as fast-growing species such as acacias. There are already some reforestation projects underway in Central Kalimantan. In Sebangau National Park, for example, WWF Indonesia and Garuda Airlines are cooperating in a reforestation program, covering an area of 250 hectares with 100,000 trees. Broadening the impact of reforestation efforts will require establishing a province-wide approach to reducing emissions from deforestation and forest degradation (REDD), which can create appropriate incentives and institute a structure for monitoring and enforcement.

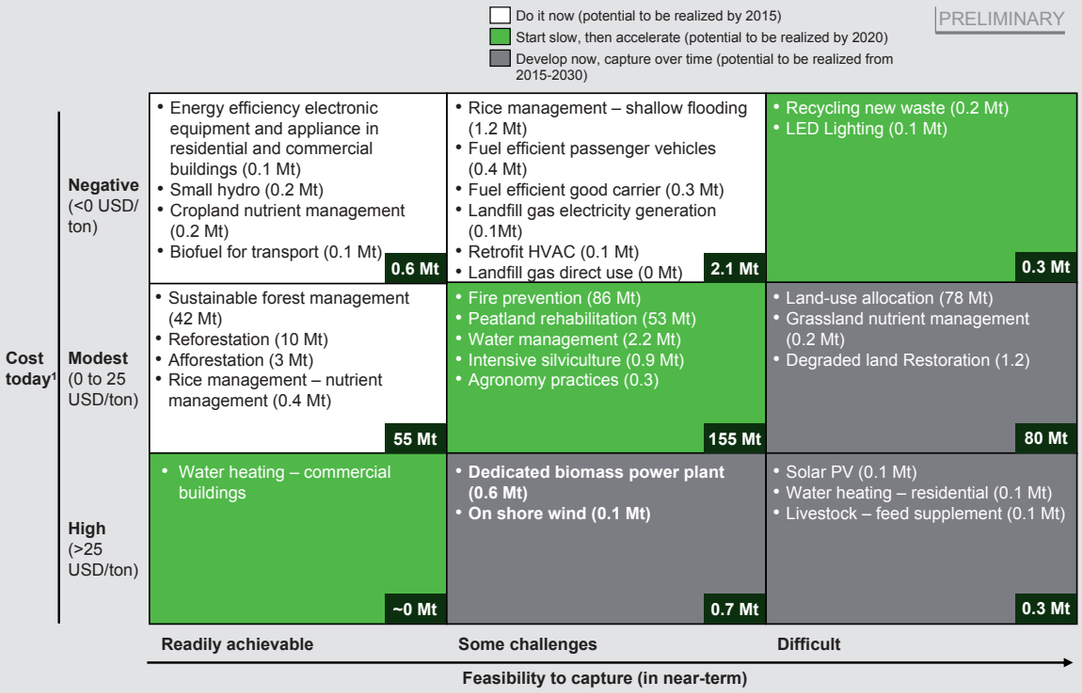
   It should be noted that increasing the carbon sink by afforestation or reforestation can only be realized if these areas are set aside for conservation. However, one way to bring degraded areas back under forest cover could be to plant a temporary timber plantation, which could then be gradually transformed into conservation or protection forest.

Mapping these opportunities against their full abatement cost[14] and feasibility,[15] can help prioritize the implementation of emission reduction opportunities for Central Kalimantan (Exhibit 5). This mapping results in three distinct horizons, with opportunities grouped on the basis of ease of implementation and cost to implement.

14 Full abatement costs include technical costs plus abatement-lever-specific implementation costs. This excludes implementation costs that are not specific to an abatement opportunity (e.g., spatial planning reforms, building MRV systems, scaling up community engagement mechanisms). Annex 5 contains a description of these costs and the methodology used to estimate them.

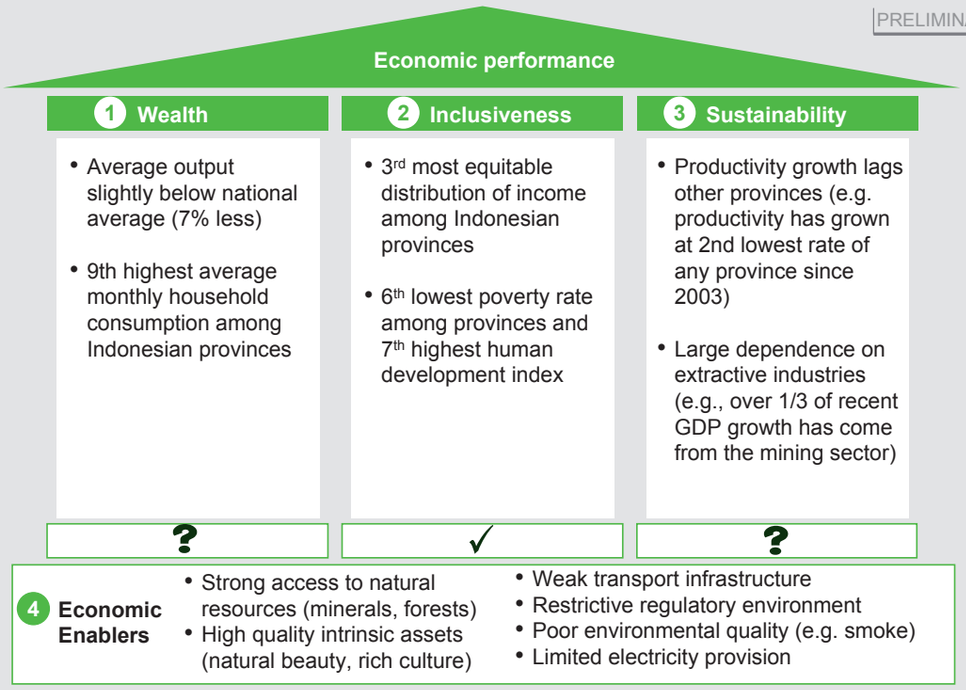
15 The feasibility of capturing each abatement opportunity was assessed using an equally weighted index of seven factors: (1) Financing issues (e.g., capital intensity, pay-off times), (2) Regulatory and institutional capability, (3) Principal-agent issues, (4) Entrenched behaviour, (5) Supply-chain bottlenecks, (6) Political feasibility, and (7) Technological readiness.

Exhibit 5 Prioritizing carbon abatement opportunities



1 Based on abatement-specific implementation costs (excludes cost of critical enablers to support low carbon growth)
SOURCE: DNPI Indonesia Greenhouse Gas Emissions Cost Curve; team analysis

Exhibit 6 Central Kalimantan currently has a mixed economic scoreboard



SOURCE: Team analysis

1. **Horizon 1 - Do it now, no regrets** encompasses opportunities based on existing technology, with low-to-modest implementation barriers and relatively low cost (less than USD 25 per ton). Together, these opportunities could provide 56 $MtCO_2e$ annual reductions by 2030 (16 percent of the 2030 projected emissions).

2. **Horizon 2 – Start now, then accelerate** covers the middle cost/ease grouping of opportunities that provide abatement at relatively low cost (less than USD 25 per ton) with low-to-moderate implementation barriers, or that are cheap but harder to implement, or expensive but somewhat easier to implement. Together, these opportunities could provide 200 $MtCO_2e$ annual reductions by 2030 (59 percent of the 2030 projected emissions) at costs ranging from USD -80 to USD 21 and averaging to USD 5.8 per abated tCO_2e.

3. **Horizon 3 – Explore now, capture over time** covers the most challenging opportunities – those that both cost a lot and face high hurdles, either because they are not yet technologically feasible or because they pose great planning risks and demands on infrastructure. Together, these opportunities could provide 100 $MtCO_2e$ annual reductions by 2030 (29 percent of the 2030 projected emissions).

4. Developing sustainable livelihoods

Low-carbon sources of growth will be needed to ensure continued development, poverty alleviation, and job creation in Central Kalimantan

In order to transform Central Kalimantan's economy to a low-carbon growth trajectory, it is important that additional sources of economic growth be created to provide sustainable livelihoods for the local population. These sources of growth can both help compensate for the potential economic loss associated with some abatement opportunities as well as create prosperity that requires less dependency on carbon-intensive growth sources (e.g., logging).

Central Kalimantan currently has a mixed economic performance (Exhibit 6):

- ***Reasonable wealth:*** Central Kalimantan's output per person is below the national average (7 percent less) and has not kept pace with national growth over last five years, yet average consumption is still seventh highest among Indonesian provinces

- ***Highly inclusive:*** It has the third most equitable distribution of income among Indonesian provinces, sixth-lowest poverty rate among provinces, and seventh-highest human development index.

- ***Questionable sustainability:*** Its productivity growth lags other provinces (e.g., productivity has grown at second-lowest rate of any province since 2003), and it has a large dependence on extractive industries (e.g., over one-third of recent GDP growth has come from the mining sector).

Central Kalimantan has a number of strengths, which it can build upon:

- ***Natural resource wealth:*** Central Kalimantan is abundant in coal, gold, and other minerals as well as forests (currently has roughly 7.5 percent of Indonesia's forests). There is a large potential opportunity to develop downstream industries.

- ***Intrinsic and cultural assets:*** Central Kalimantan has a strategic location (e.g., large ASEAN capitals like Jakarta, Singapore, Kuala Lumpur within 2,000 km), attractive climate, unique wildlife (e.g., orangutans), and a rich cultural heritage, which could support the growth of sectors such as eco-tourism.

- ***Young population:*** Nearly a third of the population is less than 15 years old, providing a steady supply of future labor.

At the same time, there are a number of concerns in the business environment, which need to be addressed.

- ***Weaknesses in human capital:*** There is a relatively low level of education in both quantity and quality in Central Kalimantan. Whilst primary school enrolment rates are fairly high (around 95 percent of primary-school-aged children are attending primary school), post-primary school enrolment is low, falling to 44 percent in upper-secondary school (lower than national average of 52 percent). Ministry of Education surveys suggest that financial concerns of families are the dominant reason for low post-primary enrolment. In terms of quality, Central Kalimantan also has the fifth-lowest high school examination results of any province and the fifth-lowest share of secondary school teachers with appropriate qualifications.

- ***Gaps in transportation infrastructure:*** There are concerns with the quantity and quality of roads – Central Kalimantan has the fifth-lowest road density of any province in Central Kalimantan, and almost 40 percent of existing roads are judged to be in poor condition. In addition, river transportation is limited during the dry seasons.

- ***Electricity shortages:*** Almost a quarter of households rely on lamps for lighting, and both local business leaders and prospective investors highlight lack of access to electricity as a major concern.

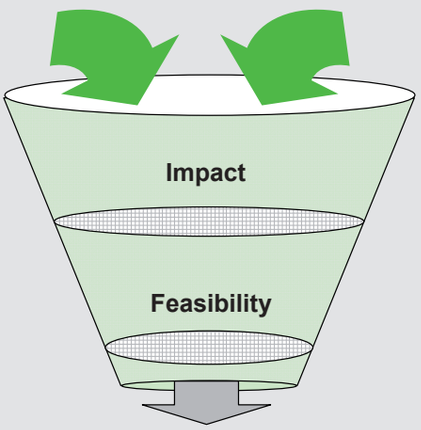
- ***Environmental concerns:*** Forest and peat fires have large negative social and economic costs on the province. The true extent of the costs is difficult to measure accurately, but preliminary survey data from Bank Indonesia suggests fires could levy costs on education, health, transportation, and consumption amounting to up to 8 percent of provincial GDP. For example, Central Kalimantan has the highest rate of asthma of any province in Indonesia (which interviews with local health officials suggest are linked to the fires) and interviews with local business managers suggests heavy smoke days add an additional 10 to 15 percent to road transport costs.

A three-step approach was used to identify and prioritize growth opportunities (Exhibit 7). First, a list of potential growth opportunities was compiled based on interviews and workshops with local business people, government officials, and academics, a review of the province's current economic development plans, and an analysis of growth opportunities pursued by regions with a similar level of economic development and dependency on forest-based sectors (e.g., Guyana, Malaysia, Thailand).

These ideas were then prioritized according to their potential impact (on current importance to GDP, future growth, quality of employment, and implications for carbon emissions) and feasibility (i.e., fit with current business environment strengths and weaknesses noted earlier).

Exhibit 7

Growth opportunities were prioritized according to their impact and feasibility



Methodology

- Interview local business people, government officials and academics
- Review Central Kalimantan economic development plan
- Perform "outside in" analysis of relevant international benchmarks

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- Assess potential impact on:
  – GDP growth
  – Average incomes
  – Carbon emissions

- Determine the feasibility of Central Kalimantan capturing the growth opportunities, based on interviews with sector experts, businesses, academics, and government officials

Based on this process, seven priority growth sectors were identified:

1. ***Estate crops on non-forested land*** *(17 percent of GDP in 2006):* Develop non-forested arable land for crops such as palm oil, rubber, coffee, and spices. Despite the large current contribution of estate crops to Central Kalimantan's output, growth in the sector (particularly palm oil) is associated with significant adverse impacts on the environment (from forested land clearing and peatland drainage). Extension services that can provide farmers with the know-how to improve productivity (and introduce environmentally-sustainable practices) on existing land must be complemented with creating mandatory legal requirements on agricultural processes (e.g., similar to the Roundtable on Sustainable Palm Oil guidelines). Developing downstream industry will require improving access to suitably skilled labor (e.g., by introducing vocational programs), ensuring electricity provision, providing market-based aggregation methods for small-holders, and addressing transportation infrastructure concerns (particularly roads and ports). In addition, to minimize environmental damage from expansion of palm oil plantations, future palm oil plantations should be allocated to already degraded lands (rather than opening new forests). The current annual increase of 70,000 hectares in palm oil acreage implies that palm oil plantations would grow to around 2.3 million hectares by 2030, whereas there is around 6.4 million hectares of potentially available degraded land that could more than accommodate this growth. Addressing land tenure issues will be critical to making this step viable.[16] By instituting these measures, real GDP from estate crops could potentially grow to more than six times the levels of 2006 by 2030, with a much lower carbon footprint.

16 Land tenure issues are discussed in more depth in Section 4 – Institutional Enablers.

2. ***Sustainable forestry*** *(9 percent of GDP in 2006):* Integrate primary and secondary processing of timber, which has been sustainably extracted under stringent controls that enable natural regeneration and sufficient re-growth during the rotation cycle. Expanding this sector in a sustainable manner will require spreading awareness of reduced-impact logging techniques,

   educating key foreign markets to create a premium for sustainably harvested products, and supporting downstream processing by providing access to suitably skilled labor (e.g., by introducing vocational programs), ensuring electricity provision, and improving roads (40 percent of roads are currently assessed as in poor condition).[17] Current efforts to address illegal logging will need to be intensified and bolstered with a comprehensive approach to forest management, including community-based forest management that can supply legally extracted timber to meet local market demand. The opportunity for incremental growth is substantial given international evidence that applying intensive forest management can increase annual yield per acre by about 500 percent.[18]

3. ***Environmentally-sustainable mining*** *(8 percent of GDP in 2006)*: Capitalize on extremely energy-efficient forms of coal found in the province to develop the mining sector whilst minimizing impact on the environment. BHP Billiton, for example, has estimated the useful heat value (UHV) of Central Kalimantan's coal deposits to be about 6,000–7,500 Kcal/Kg.[19] Ensuring that mining companies comply with best practices on environmental sustainability (e.g., as outlined by the International Council on Mining and Metals)[20] and that new infrastructure (e.g., the planned coal railway) is developed in such a way as to minimize the potential impact on the environment will be critical. In addition, it is important that a substantial share of the mining wealth generated is captured locally. Beyond ensuring an efficient auctioning of mining rights, Central Kalimantan should explore possibilities to develop local mining interests (Chile's state-owned mining company ENAMI, for example, develops local junior miners by providing technical, metallurgical, financial, and trading services to correct for market failures; other countries, such as South Africa, promote local participation by introducing regulatory guidelines on local procurement). If Central Kalimantan could match the recent annual growth rates of countries such as Brazil and Chile to 2030 then the size of the sector would be 30 percent higher than if it tracked Indonesia's average.

4. ***Food crops on non-forested land*** *(6 percent of GDP in 2006):* Develop non-forested arable land for commercial agriculture of high-value tropical fruits and vegetables for export. At present, the sector suffers from a lack of high-quality agricultural input services (e.g., R&D, market information), particularly in more remote areas that can equip farmers with the know-how to adopt highly productive and environmentally friendly practices (e.g., low tillage agriculture). This shortfall is compounded by the difficulties that small landholders face in accessing financing and markets and the limited availability of fertile land (only 6 percent of land is covered by flat and fertile alluvial soil).[21] Future growth in this sector can be supported by exploring market-based mechanisms to aggregate small holders in key areas of the value chain (as done relatively successfully in countries such as Morocco) and improving the provision of agricultural extension services by incorporating the lessons of historically successful programs (e.g., Indonesia's pest eradication program). The opportunity for incremental growth is potentially substantial – rice production, which represents about 96 percent of the value of all Central Kalimantan's food crops, yields less than half of those crops in East Java. Assuming this gap could be halved by 2030, this sector's GDP would be 90 percent higher than if historical growth rates were maintained.

17 Indonesia Bureau of Statistics
18 See for example Wann and Rakestraw (1998) study of pine plantations in southern United States.
19 Coal with a Grade A rating, the most efficient based on heat value for a given mass, has a useful heat value (UHV) of greater than 6,200 Kcal/Kg.
20 The World Wildlife Fund (WWF) has compiled a scorecard assessing adherence to standards of environmental best-practice of mining companies operating in Kalimantan.
21 Japan International Cooperation Agency

5. ***Aquaculture*** *(5 percent of GDP in 2006):* Rear freshwater fish and shrimp on non-forested, non-arable land for export in the form of fresh, frozen, or processed product. Fishing is of traditional importance to the Dayak community in Central Kalimantan, which provides a good base of skilled labor. Promoting growth in the sector requires extension services to provide training on new aquaculture techniques, supported by improved infrastructure and cold storage facilities. Assuming that the sector's current GDP growth rate of 2 percent could be improved to match the future growth rate expected in the sector for Asia as a whole (4.4 percent), GDP from the sector would be 65 percent higher in 2030 than that based on its current trajectory.[22]

6. ***Financial services*** *(2 percent of GDP in 2006):* Drive increases in the efficiency and penetration of financial services, extend access to microfinance, and tap international sources of capital (e.g., REDD). At present, financial inclusion is particularly low in the province (e.g., only 3.3 percent of households currently have a loan, versus 5.3 percent nationally).[23] The level of lending to small businesses also appears relatively undeveloped – SME credit represents only 9 percent of GDP (the fourth-lowest contribution amongst the 20 provinces for which data is available),[24] and interviews with local businesses and credit unions suggest that a lack of collateral and land certificates make it difficult for many businesses to access credit. Building on the existing efforts of local entities such as Bank Indonesia and Bappenas' PNPM, there is the opportunity to establish low-cost scalable distribution systems and use potential REDD financing to provide financial access and develop financial literacy in the province's forest communities. Mexico's Diconsa program provides an interesting model that could be adapted to Central Kalimantan (Box 3). Going forward, assuming GDP growth in the sector could match the average of Bangladesh, India, and Mexico (countries where financial inclusion has been successfully promoted), GDP levels in 2030 could be over 1.5 times higher than if the sector matched national growth rates of 4.7 percent.

7. ***Eco-tourism*** *(2 percent of GDP in 2006):* Develop tourism, based on Central Kalimantan's unique wildlife (e.g., orangutans) and biodiversity that minimizes untoward ecological impact. Crucial to stimulating future growth in this sector is developing transportation infrastructure, particularly air links to major hubs. For example, although Palangka Raya (Central Kalimantan's capital) is close to ASEAN capitals (e.g., 1,187 km from Singapore, 1,484 km from Kuala Lumpur), there are currently no international air links, and flights from within Indonesia are often delayed or cancelled due to smoke from peat and forest fires. There are already a number of successful small projects (Box 4), but achieving large impact requires a tourism master plan to help address the cross-cutting challenges that the sector faces, which include tourism promotion, access to skills, and facilities. The opportunity for incremental growth is clear – for example, if Central Kalimantan could transition to a growth rate in tourists similar to that achieved by Bali in the last 20 years, then by 2030 its contribution to GDP could be more than double that based on historical growth.

Combined, these seven sectors currently represent about half of the current output of Central Kalimantan and well over two-thirds of employment. These sectors have the potential to drive Central Kalimantan's low-carbon development.

22 Forecasted Asia growth rate in fishing sector provided by Food and Agriculture Organization (FAO).
23 Indonesia Bureau of Statistics
24 Indonesia Bureau of Statistics

Box 3: Creating financial inclusion in Mexico

Diconsa is a government distribution network supplying over 22,000 community-owned stores with food and other basic goods in rural Mexico. Its reach, history, and community-ownership afford it unique trust and support in Mexico's poorest communities. Diconsa is the backbone of a public–private partnership including telecommunications, financial services, NGOs, and government entities collaborating to roll out a range of social services to remote communities, particularly financial services. The partnership envisages a gradual evolution of financial services offered, beginning with government payments, then establishing savings accounts, remittances, credit, and insurance.

The project will improve access to affordable financial services in Mexico's poorest, most isolated communities. Roughly 5 million families, comprising 20 percent of Mexico's population, live in small, rural communities of fewer than 2,500 inhabitants, which are the target of the Diconsa program.

Box 4: Sebangau National Park

Sebangau National Park in Central Kalimantan covers an area of 568,700 hectares and has tremendous biodiversity. In 2006, the Indonesian Institute of Sciences (LIPI) found 808 herbal plant species, 116 bird species, and 35 species of mammals, including 6,000 to 9,000 orangutans, sun bears, and clouded leopards.

The World Wildlife Fund for Nature Indonesia has begun developing the concept of community-based eco-tourism in Sebangau National Park, based on ensuring the conservation of the area, whilst ensuring the economic participation of the local people.

5. Institutional enablers

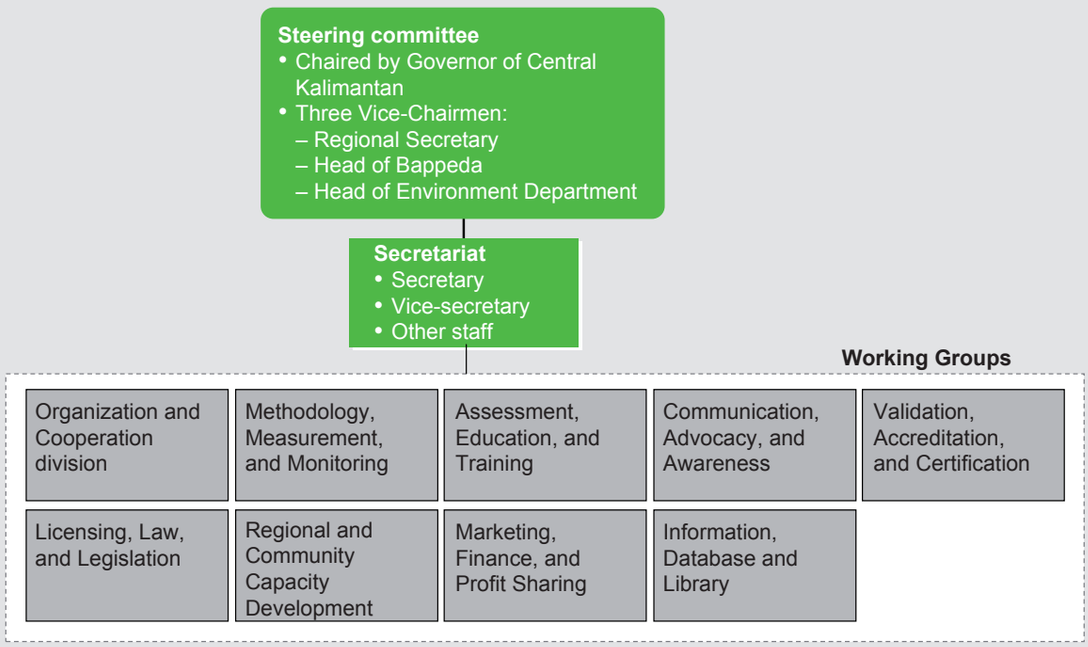
Achieving successful low-carbon economic growth will require a significant transformation, both within government and within the broader society of Central Kalimantan. From an institutional standpoint, supporting low-carbon growth requires a cross-cutting approach that coordinates the various government departments that will be critical to its success (e.g., forestry, environment, agriculture, tourism, education), whilst also ensuring access to the necessary capabilities to carry out this ambitious and urgent program. Like many other developing regions, Central Kalimantan is doubly challenged by critical priorities and constrained resources, most particularly, the limited pool of management talent required to implement transformative change.

Many governments facing similar challenges (including climate change) have established new units to coordinate the government's response and ensure delivery of critical priorities. In Aceh, for example, following the devastating tsunami in late 2004, the Indonesian Government established the Agency for the Rehabilitation and Reconstruction of Aceh and Nias (BRR) to coordinate and oversee the multi-year reconstruction process. Central Kalimantan has also decided to create a new institution to coordinate its response to low-carbon development. The Governor of Central Kalimantan issued a decree on November 16, 2009 establishing a new preparatory team to coordinate REDD and peatland rehabilitation efforts in the province.[25] This institution also provides an excellent basis to coordinate the broader low-carbon growth activities in the province. Critically, the institution reports directly to the Governor and has a mandate to coordinate efforts at the provincial and district levels. The Secretariat has nine sub-units (Exhibit 8).

25 Decree number 18.44/417/2009. See Annex 4 for a summary of the decree.

Exhibit 8

Organizational structure: Central Kalimantan Deforestation, Forest Degradation, and Peatland Degradation Prevention Preparatory Unit



A review of domestic and international delivery units reveals some lessons for Central Kalimantan in developing its own institutional mechanisms for ensuring the successful implementation of a low-carbon growth strategy (Box 5).

Box 5: International and domestic lessons on organizing a delivery unit

1. Must have a direct relationship with and a clear mandate from the highest levels of government (e.g., Aceh's BRR, Morocco Economic Development Board, Guyana Presidential Delivery Unit)
2. Needs to include representatives from different levels of government and non governmental organizations (e.g., Brazil's Amazon Fund, Indonesia's Waclimad)
3. Relationships and decision-making rights must be clearly defined between the new unit, existing ministries, and other stakeholders (e.g., Bahrain's Economic Development Board)
4. Employee compensation and value proposition must be competitive with the commercial sector to attract top talent (e.g., Aceh's BRR, Guyana Presidential Delivery Unit)
5. Develop rigorous performance management around a few priority outcomes (e.g., Bahrain Economic Development Board.)

Relationships and decision-making rights must be clearly defined between the new unit and existing ministries in order to avoid duplication of activities and a lack of coordination. Whilst implementation may remain largely within existing government departments, strategies and policies must be jointly developed between this new unit and existing government departments to ensure the appropriate expertise is brought to bear. KPIs will need to be established for each unit and their outcomes rigorously and regularly assessed and reported back to the steering committee (ideally on a monthly basis).

The new unit must also have linkages to the national and district level governments, as well as local forest communities (to ensure free and informed consent), given that many of the current legal powers to support carbon abatement reside at these levels. The Ministry of Forestry for example controls the usage of lands in the province defined as the "forest estate" (covering about 60 percent of Central Kalimantan), whilst district governments control usage of lands outside forests. Indonesia's Water Council (Waclimad) provides a useful example of "whole of government" collaboration, with its linkages at the national, province, and district levels.

Finding the appropriate talent to staff this new organization will be challenging. Whilst the key positions have already been filled, it may be difficult to get access to the appropriate talent to fill the remaining posts. In the short term, it is envisaged that some of the positions will need to be filled by foreign experts, provided through various technical assistance programs. A similar approach was used successfully in the reconstruction effort in Aceh following the tsunami. A gradual evolution to more local ownership is envisaged by leveraging various innovative recruitment techniques, such as secondment arrangements with the private sector or NGOs, recruiting from the diasporas, and potentially the use of executive search firms. This will need to be accompanied by a formal capacity building program. Critical to attracting the required talent for this organization will be being able to offer competitive salaries – Aceh's BRR was given a waiver to pay staff differently than other civil servants, allowing the organization to attract individuals with needed skills (in return employees had to abide by a strictly-enforced code of professional integrity). Similar flexibility could be valuable as Central Kalimantan seeks to recruit talent to manage its own institution.

This new institution will need to serve six broad functions to support low-carbon growth:

i. ***Attract, manage, and distribute finances:*** Attract international financing for REDD, VER and CDM deals and manage and distribute finances in a transparent, fair, and efficient manner (similar to Brazil's Amazon Fund).

ii. ***Provide monitoring and evaluation support:*** Establish a province-level baseline and rigorous standards for monitoring, reporting, and verification (MRV).

iii. ***Develop policy and planning:*** Develop regulatory responses to support carbon abatement and to create opportunities for sustainable livelihoods. These include optimizing land allocation through spatial planning and resolving land tenure disputes.

iv. ***Enhance community engagement:*** Develop processes for engaging with local communities, including the formation of local community boards to provide input into strategies and ensure free and informed consent, promote behavioral change toward sustainable practices, develop new skills, and build local community enforcement.

v. ***Build critical infrastructure:*** Develop the technology and systems infrastructure (e.g., market information, fire brigades, education, health) and hard infrastructure (e.g., electricity, roads) to support emissions reduction and sustainable livelihoods.

i. Attract, manage and distribute finances

Three finance-related functions will be critical to the success of the low-carbon growth strategy. First, it is crucial to attract international financing to support Central Kalimantan's abatement initiatives. Second, revenue-sharing models will need to be established to allocate funds to various stakeholders (including national, provincial, and district level governments, as well as project developers, individuals, and communities). Third, finances must be managed and distributed in a fair and transparent manner.

Funding from international carbon markets will take too long to enable Central Kalimantan to realize its ambitious emission reduction objectives for 2030. In the short term, interim funding from sources such as the Forest Carbon Partnership Facility, (FCPF), the UN-REDD program, and bilateral programs will be critical to supporting Central Kalimantan's efforts to establish its REDD readiness. The Informal Working Group on Interim Financing for REDD+ (IWG-IFR) envisages a phased transition of funding, with REDD programs initially relying on grants to build institutional readiness, followed by payments for reduced emissions based on simple proxies (e.g., deforestation rates), and finally transitioning to an advanced monitoring system that would be fully funded by the international carbon market.

The specific revenue-sharing model will need to be refined in coordination with various parties, including the Ministry of Finance and the Ministry of Forestry, which has already outlined some initial guidelines for REDD projects.[26] In determining the revenue-sharing model, some key design principles should be considered:

- *Ensure local individuals and communities are incentivized:* In order to support the necessary behavioral change that is required for low-carbon growth to be successful it is critical that those individuals and communities primarily affected by emission reduction initiatives (e.g., forest communities) also reap some of the benefits. In the Juma Sustainable Reserve in Brazil, for example, individuals receive direct payments based on regular inspections of local forests (Box 2).[27] The payments should include incentives linked to input-based metrics (e.g., for building dams, planting trees), performance-based metrics (e.g., reducing fire outbreaks), and eventually outcome-based metrics (linked directly to GHG emissions or proxies for emissions). This is particularly critical, given that much of the decision-making power for land allocation currently resides at the district level and within local communities. Local communities, villages, and districts will need to be appropriately compensated to be willing to participate in a province-wide approach (which is crucial to avoid leakage concerns and provide a more programmatic approach to low-carbon growth). The Amazon Fund for example includes representatives from different levels of government in its decision-making process.

- *Lay the foundation for sustainable livelihoods:* It is important that financing for emissions reductions does not become a form of welfare, but rather creates the foundation to support low-carbon development. For example, the Juma Sustainable Reserve allocates a portion of funds to support income-generating activities based on sustainable land and resource use (Box 2).

- *Create the right incentive structure and framework to engage the private sector:* Private project developers will be critical to supporting these efforts given their access to capital and the essential skills needed for detailed monitoring and project management. The World Bank convened a workshop in November 2008 where REDD project developers provided input on how to support REDD activities in Indonesia. Some of the recommendations included clarification from the national government on where authority lies for decisions on REDD

26 In July 2009, the Indonesian Ministry of Forestry suggested a revenue-sharing model with allocations depending on the type of forest ownership or permit, ranging from 10–50 percent for the government, 20– 70 percent for local communities, and 20–60 percent for developers.

27 "The costs of REDD: lessons from Amazonas", iIIED briefing paper, November 2009.

implementation, helping to fast track the approval process for REDD projects, and providing clarity on whether avoided deforestation carbon credits (verified emission reductions, or VERs) require national government approval before being sold.[28] At present, land usage decisions are split between the Ministry of Forestry, local governments, and community groups. The provincial government could help facilitate a more integrated process and ensure that the concerns of the private sector operators are addressed.

Once the revenue-sharing model is defined, there needs to be a method of allocating funds to the various recipients that complies with basic standards for efficiency, fiduciary oversight, and transparency. Recognizing the critical importance of maintaining the integrity in its operations, Aceh's BRR used a combination of internal audits (carried out by BRR's internal audit team as well as the Financial and Development Supervisory Agency), anti-corruption initiatives (carried out by BRR's Anti-Corruption Unit), external audits (carried out by the Supreme Audit Agency), and public disclosure of financial flows (BRR regularly opened the agency's balance sheet to the public, for example) as well as making all employees sign an "Integrity Pact", which included forbidding employees from receiving any compensation beyond their agreed-upon market salary.[29]

For those funds earmarked for local communities and individuals, there are some existing successful financial distribution platforms, such as Indonesia's Planning Department's (Bappenas) PNPM program, which could be potentially augmented and refined to distribute these funds (Box 7). Funds could initially be allocated at the community level, but potentially gradually evolve to be allocated to individuals, similar to Brazil's Juma Sustainable Development Reserve.

Guiding principles for *finance*:

1. Ensure local individuals and communities are incentivized through a pay for performance scheme.

2. Lay the foundation for sustainable livelihoods (rather than simply providing short-term welfare benefits).

3. Ensure transparency and integrity to reassure donors, private sector, and communities (e.g., independent audits, employee integrity pacts, market-based compensation, public disclosure of financial flows).

4. Develop a collaborative approach to decision-making including national, provincial, district, and community stakeholders (e.g., representatives from each group in steering committee).

5. Establish clear ground rules and incentives for private sector engagement.

28 "Report on Implementation of a Learning Workshop: Developing a Market for REDD in Indonesia," World Bank, January 2009.
29 "Finance – Seven Keys to Effective Aid Management", BRR NAD-NIAS, April 2009.

Box 6: Brazil's Amazon Fund

The Amazon Fund, created in August 2008 by the Brazilian Government, aims to mobilize international funding to combat deforestation and support the conservation and sustainable management of forests. The Amazon Fund operates on a donation basis, raising money on the basis of avoided deforestation achieved in the previous year. This performance is assessed against a moving average reference level of deforestation, adjusted every five years. A Technical Committee with six renowned scientists certifies the emission reductions claimed.

Managed by BNDES, the Economic and Social National Development Bank, the fund grants funding to projects that contribute to the prevention of deforestation as well as to the conservation and sustainable use of the Amazon biome. Funding allocations are determined by a multi-stakeholder committee, organized in a three-chamber system with representatives of local government, national ministries, and civil society (including indigenous peoples, traditional communities, NGOs, industry, and scientists). Decisions are taken with the positive vote of all three chambers.

Box 7: Indonesia's PNPM

Following the move to decentralize governance to the district level, the PNPM program was developed with the objective of reducing poverty while improving local-level governance by using a participatory planning process. Originally developed by the World Bank and currently run by Indonesia's planning agency (Bappenas), the PNPM program supports an open planning community decision-making process by providing grants to local communities, which then choose programs to fund to alleviate poverty.

PNPM was recently extended to include providing funds for environmentally sensitive activities (e.g., reforestation). The program currently operates in almost 3,000 of the 4,700 sub districts in Indonesia, has allocated or disbursed over USD 200 million in grants, and is widely considered to be a model of best practice in strengthening community-level governance.

ii. Provide technical support

A technical support unit is needed to develop the basic MRV systems, which includes refining the initial estimates of a province reference scenario of emissions in the absence of abatement actions, creating basic proxies (such as reduced deforestation) to assess reduction efforts, and developing systems to monitor impact. Brazil's Amazon Fund for example, raises money on the basis of avoided deforestation achieved in the previous year. This performance is assessed against a moving average reference level of deforestation and certified by a Technical Committee of renowned scientists (Box 6).[30]

At present, there are a number of different methodologies being developed for individual carbon projects in Central Kalimantan. In order to reduce transaction costs and increase the likelihood of carbon projects attracting international carbon market payments for verified emission reductions and removal, it is critical that the government incorporates methodologies that have already been independently verified and establishes a province-wide approach (building on the recent work of the Clinton Foundation in Central Kalimantan).

30 "Radical simplicity in designing national climate institutions: Lessons from the Amazon Fund" (Zadek, Maya, Fernanda, Boffino 2009).

Guiding principles for *technical support:*

1. Lower transaction costs of carbon projects by establishing a set of province-wide emission reduction project methodologies.

2. Gradually evolve measurement approaches in line with capabilities (e.g., start with basic proxies to assess reduction efforts).

iii. Develop policy and planning

The most critical regulatory issues are resolving land tenure and title disputes and optimizing land-use allocation through spatial planning. A study by Forest Watch Indonesia (FWI) reported that Central Kalimantan's forests are being converted into oil palm plantations at the fastest rate in Indonesia. The current annual increase of 70,000 hectares implies that palm oil plantations would grow to about 2.3 million hectares by 2030, whereas there are about 6.4 million hectares of potentially available degraded land that could more than accommodate this growth and minimize pressures on Central Kalimantan's disappearing forests. The main reason that these lands are not used for cultivation at present is due to uncertain land tenure and social issues in these areas. To quote one oil palm executive, trying to cultivate these lands becomes a "legal nightmare" due to the uncertainty around land ownership.

Given the cross-jurisdictional nature of land tenure and spatial planning issues, collaboration among national and district level governments will be critical. In addition, any collaboration needs to be supported by detailed technical analyses, which can provide an accurate assessment of current land allocation and assess the potential economic benefits of using land types for different activities to inform spatial planning (Box 8).

This information then needs to be consolidated into a single land titling system to register deeds and map areas. Despite the importance of technology to this process, experience in many countries emphasizes that land titling and spatial planning mix complex, historical, social, economic, and political issues, and it is therefore important to build close community support for these initiatives. These initiatives need to be closely tied to a community engagement approach that undertakes community-based land mapping and land adjudication, builds institutional capacity at the local level, ensures the process is done in a fair and transparent manner, and clearly communicates the benefits to the local people.

Environmental Impact Assessments (AMDAL) also need to be strengthened and broadened, so they do not become a "rubber stamp" but provide a rigorous consideration of environmental concerns before licenses are issued, and are broadened to include a specific focus on carbon emissions and peatlands.

Guiding principles for *policy and planning*:

- Ensure multi-stakeholder coordination (particularly local communities) in developing approaches to spatial planning and land titling.

- Incorporate technology to properly assess economic costs and benefits of land allocation decisions.

- Ensure ease of access to land titling information (e.g., single, publicly available land registry).

- Refine and broaden Environmental Impact Assessments to provide a more rigorous assessment of environmental concerns and incorporate a specific focus on carbon emissions and peatlands.

Box 8: Berau Forest Carbon Program (East Kalimantan)

The Berau Forest Carbon Program (BCFP) in Berau Regency (East Kalimantan) has been established as a demonstration project to reduce emissions from logging and forest destruction (REDD). By 2015, the program is expected to achieve effective management of 800,000 hectares of forests, prevent carbon emissions of 10 MtCO2e in five years, protect land with important hydrological conditions and high biodiversity value (including 1,500 orangutans), and increase economic opportunities for residents living near forests.

Supported by The Nature Conservancy (TNC), the current phase is investing heavily in spatial planning and readiness. TNC is working with ICRAF, Daemeter Consulting, Universitas Mulawarman, and others to develop detailed datasets on carbon stocks, profitability of different land uses, high conservation value areas, and other important inputs for REDD planning. TNC is also working with the University of Queensland to customize a conservation software program that allows a user to input spatial data and characteristics and generate an optimal (lowest cost) emission reduction solution given a set of sustainable development targets.

iv. Enhance community engagement

The keystone to developing and implementing a sustainable economic development strategy is the process through which the government and its agencies involve communities in the decision making process. Organizations of all types, whether they be government agencies, non-profits or private companies, have deployed community engagement programs in Central Kalimantan including BAPPEDA, the Ex-Mega Rice Project, Clinton Foundation, RARE, JP Morgan, and Katingan Peat Conservation Project.

While most of these programs have developed project specific engagement models, other organizations such as Kalimantan Gold, a private mining company, have utilized and enhanced the government's existing *musrenbang* process. The *musrenbang* process is a bottom up community engagement and development process where by each village outlines its development priorities and submits it to the district. These are then rolled into a district plan, which is submitted to the provincial government for funding. Yayasan Tambuhak Sinta, an NGO established by Kalimantan Gold to ensure local communities would be prime beneficiaries of its mining activities, has focused its efforts on improving governance in these local communities. The *Yayasan* assists with the village development plan, which serves as the centrepiece of the overall process. It also assists in the appointment and training of a village management group to oversee the participation and planning process and assist in the identification of specific needs and technical capabilities required for each village. These needs are met through specific training programs and experts brought in by the *Yayasan*. Management compensation, training fees and other programmatic fees are paid for through a Village Development Fund established in support of each community. This is to further supplement any funds provided to each community through the *musrenbang* process. This program currently covers over 30 villages in and around Kalimantan Gold's mining concessions.

Another example of a program leveraging an existing community engagement and development program to support sustainable development is the BAPPENAS managed PNPM (see Box 7). Recently, through technical assistance from the World Bank, PNPM has created a separate set of funds earmarked to support natural resource management and renewable energy schemes. The program, entitled *Green PNPM*, has recently been piloted in Sulawesi with plans to expand to all the Kecamatans in which PNPM is currently operating. A large component of Green PNPM's funding is currently being deployed to support rural electrification through the development of micro-hydro power plants.

The processes for engaging with local communities that need to be developed include the formation of local community boards to provide input into strategies and ensure free and informed consent. The Village Safeguarding and Development Program (PM2L), which aims to strengthen village institutions and promote community-based development, provides a useful platform that could be expanded upon (Box 9).

Box 9: The Village Safeguarding and Development Program (PM2L)

The Governor of Central Kalimantan has initiated a five-year poverty eradication program called Program Mamangun dan Mahaga Lewu – Program for Development and Maintenance of Villages (2006–2010). The program aims to create model villages with the capacity to undertake their own sustainable development. The program focuses on building the capacity of local institutions and people and involving local communities in the creation, implementation, and monitoring of new development strategies.

Community engagement needs to be supported by a clear plan to promote behavioral change toward sustainable practices. Introducing new methods of environmentally-sustainable agriculture and other behavioral changes will be highly challenging. However there are several promising projects, such as the Kalimantan Forest and Climate Partnership (Box 10) already underway in Central Kalimantan, which could provide input into a province-wide program.

Guiding principles for *community engagement*:

1. Ensure free and prior informed consent (FPIC) from local communities participating in carbon emission reduction projects.
2. Strengthen village institutions to improve their ability to engage in and benefit from carbon emission reduction projects (e.g., community facilitators to support local capacity building).

Box 10: Kalimantan Forest and Climate Partnership (KFCP)

KFCP is an AUD 30 million partnership between the Australian and Indonesian governments, aiming to demonstrate a credible and equitable approach to REDD, preserve 60,000 hectares of peat swamp and reduce GHG emissions on up to 40,000 hectares of degraded peatland in Central Kalimantan.

As part of its community involvement efforts, 10 village facilitators will support capacity-building for farmer cooperatives, water-user groups, and other village-level institutions. To date, the facilitators have carried out preliminary consultations with community leaders and conducted a socio-economic baseline survey and livelihood assessment.

The KFCP will also support the development of community-based forest management arrangements that can take responsibility for REDD at the local level. Incentives for REDD activities will include input-based payments (e.g., for building dams, planting trees), performance-based payments (e.g., for protecting forest from encroachment, reducing the incidence and extent of fires), and eventually outcome-based payments (i.e., linked to verifiable GHG emission reductions). Incentive payments will be funded by the KFCP through an independent trust fund.

v. Build critical infrastructure

Two types of infrastructure development will be essential in order to support both the abatement of carbon and the development of sustainable livelihoods. First, technology and systems infrastructure (e.g., improved access to market information systems in the agricultural sector, education and fire surveillance) will need to be developed. Second, hard infrastructure such as electricity and roads will need to be enhanced.

There are several specific challenges to be addressed:

1. *Education:* Despite relatively low illiteracy levels (3.0 percent of Central Kalimantan's population is illiterate versus 7.3 percent nationally), education outcomes are still low. For example, Central Kalimantan has the fifth-lowest scores on national evaluations of secondary school students among Indonesian provinces. Gaps in teacher quality and lack of access to secondary schooling appear to be key underlying issues. Less than two-thirds of secondary school teachers have teaching qualifications (the fifth-lowest rate among Indonesian provinces). Whilst primary school facilities are reasonably widespread across the province and primary school completion rates are relatively good, whether children continue on to secondary education depends largely on family income level and the distance to schools. Improving education levels is critical to enabling the transformation to a low-carbon growth path. There are some interesting lessons from other countries and provinces that could be applied in Central Kalimantan. Chile, for example, has created a high prestige program (Teach for Chile), modeled on those used successfully in the UK and the US to encourage high caliber individuals to become teachers. Recognizing the critical role of leadership to transforming education outcomes, Aceh's BRR launched an internship program to have the principals of junior high and senior high schools in Aceh train for one month in the best schools in Jakarta, Bandung, Yogyakarta, and Malang.[31] The Brazilian Conditional Cash Transfer Program (Bolsa Familia) has also proven successful in alleviating poverty by introducing conditions linked to grant payments (e.g., requiring 85 percent school attendance for children aged up to 15). Linking local community payments to development goals such as education and health could also help support behavioral change.

2. *Healthcare:* Access to healthcare is difficult in many parts of the province. In the Ex-Mega Rice Project area for example, roughly half of the villagers report difficulty accessing a health facility.[32] Mobile health clinics, which have proven effective in providing access to health care in remote regions in other countries, could be used in Central Kalimantan. Brazil increased healthcare coverage to approximately 66 million people (about 40 percent of its population in 2004) by initially deploying mobile units as part of its family health program.

3. *Electricity:* Lack of access to a reliable supply of electricity is one of the key concerns raised by the private sector and households in Central Kalimantan. Less than two-thirds of households have access to electricity from the state provider PLN, and blackouts are relatively frequent. Going forward, in addition to adopting more sophisticated approaches to load-shedding, it will be critical to engage PLN and private sector power providers in a dialog to ensure that the development of electricity supply is closely linked to the province's development trajectory.

4. *Transportation infrastructure:* Transportation infrastructure is also a concern, most notably roads, with almost 40 percent of roads judged to be in poor condition and Central Kalimantan having the fifth-lowest road density (by area) among Indonesian provinces. Given the large investment required to upgrade the province's infrastructure, it will be critical to prioritize investments going forward. Countries such as Australia and Singapore have established joint public–private bodies to develop integrated long-term infrastructure plans that prioritize

31 "Education Health Women Empowerment – Preparing Quality Generation", BRR NAD-NIAS, April 2009.
32 Master Plan for the Rehabilitation and Revitalization of the Ex-Mega Rice Project Area of Central Kalimantan, October 2008.

investments and provide effective oversight of implementation. Such a body could be useful in Central Kalimantan to prioritize infrastructure investments according to private sector and local requirements. As part of Aceh's reconstruction efforts for example, villagers jointly prioritized how they wanted to spend a block grant and, with the help of village facilitators, were responsible for managing the funds and monitoring the implementation.[33] Infrastructure should also be developed in accordance with revised spatial plans to ensure environmental impacts are mitigated. It will also be crucial to limit the corruption that is normally associated with large-scale infrastructure projects. During the large-scale post-tsunami reconstruction effort in Aceh for example, the BRR introduced a range of measures to ensure the integrity of the process, including isolating the procurement committees from any contact from tender participants as well as welcoming rigorous oversight from institutions such as the Supreme Audit Agency.[34]

Guiding principles for *critical infrastructure:*

1. Engage private sector and local communities to prioritize infrastructure investments.
2. Limit the environmental footprint (including carbon emissions) of new infrastructure development.
3. Maintain transparency and integrity in infrastructure procurement through internal and external audits and introducing mechanisms to ensure the integrity of procurement officials.
4. Include plans to improve critical social services (e.g., healthcare) that support economic development.

vi. Support sustainable livelihoods

In order to transform Central Kalimantan to a low-carbon development path, it is critical that the priority growth opportunities identified earlier (in Section 3) are realized. In coordination with the BKPM, public-private sector-level working groups will need to be formed to develop detailed action plans for enhancing growth and attracting investment in each sector. The resources of the BKPM will also need to be enhanced and more closely aligned with the identified growth priorities.

Guiding principles for *sustainable livelihoods:*

1. Engage the private sector in the process to develop and implement strategies to capture identified growth priorities.

2. Strengthen critical investment promotion functions, particularly proactive lead generation, investor servicing, and aftercare, and ensure they are aligned to identified growth priorities.

33 "10 Management Lessons for Host Governments Coordinating Post-disaster Reconstruction", BRR NAD-Nias, 2009.
34 "Infrastructure – Stimulating the Triggering Sector", BRR NAD-NIAS, April 2009.

6. Required funding and potential sources

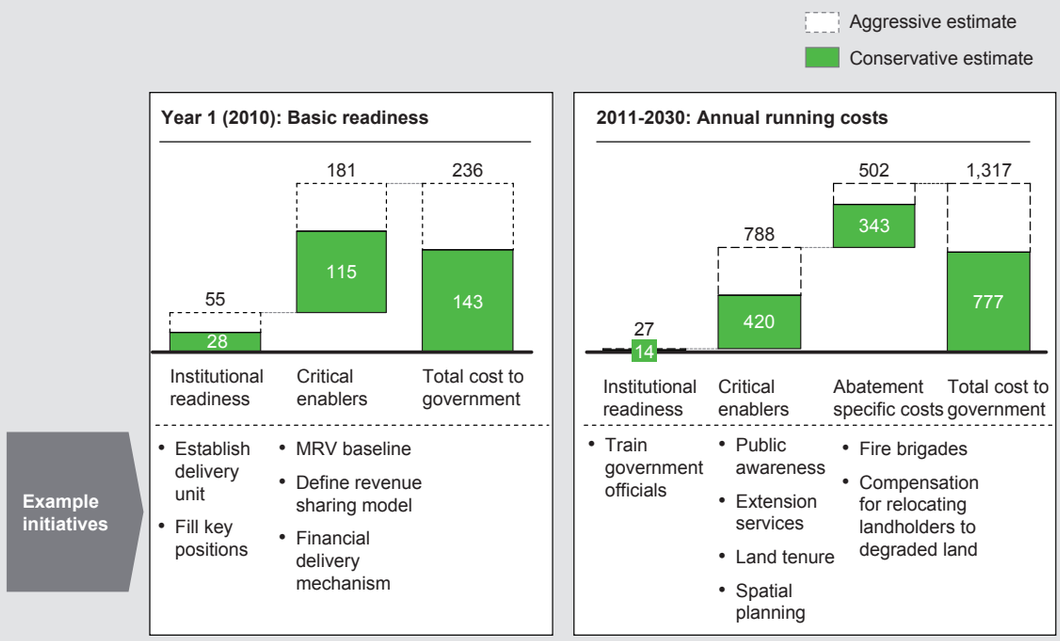
Central Kalimantan will require significant, near-term international support to succeed in its plans to create low-carbon prosperity (Exhibit 9).[35] In the first year, between USD 143 million and up to USD 236 million will be required to establish basic readiness functions to support low-carbon growth. From 2011–2030, ongoing running costs to support implementation of carbon abatement and sustainable livelihood opportunities will gradually increase and reach between USD 0.77 billion and USD 1.32 billion in 2030, assuming capture of the full 282 Mt CO_2e in potential abatement.

Exhibit 9

Total estimates of basic readiness and annual running costs

USD millions per year (2010-2030)

APPROXIMATION



SOURCE: Team analysis

Although the overall required funding is substantial, the cost per tCO_2e abated is relatively low. For example, in 2030, the full abatement cost per tCO_2e abated (including implementation costs) ranges between USD 2.40 and 3.90. In contrast, the McKinsey Global Cost Curve estimated the global average technical cost alone (i.e., excluding implementation costs) to be around USD 3.75 per tCO_2e abated.[36]

Initial estimates suggest that without financial support or incremental sources of economic growth, these carbon abatement measures could decrease real per capita incomes in 2030 by over 10 percent in Central Kalimantan due to a slowdown of carbon-emitting sectors and the costs of implementation.[37]

35 Annex 5 provides an overview of the methodology used to estimate abatement costs.
36 The McKinsey Global Cost Curve estimated a global opportunity cost of EUR 3 per tCO2e, which was converted to USD at an exchange rate of USD 1.25 to EUR (the 2005 exchange rate).
37 Costs of implementation only include costs specific to abatement opportunities (e.g. fire brigades) and exclude costs of non-abatement-specific institutional enablers (e.g., community engagement mechanisms).

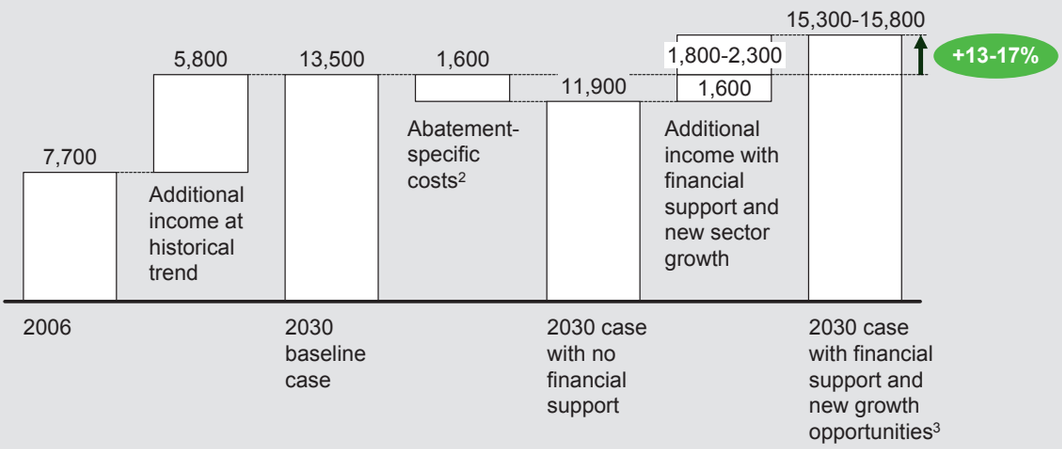
However, with adequate financial support and assuming successful capture of the new sector growth opportunities, average (real per capita) incomes in 2030 in Central Kalimantan could actually be increased by around 13 to 17 percent above the base case (Exhibit 10).[38]

Exhibit 10

With the required financial support, average incomes could actually be 13–17 percent higher than in the base case

Real GDP per capita
Rupiahs 000s[1], constant 2000

VERY PRELIMINARY – TO BE REFINED



1 Rounded to the nearest 100,000 rupiah
2 Excluding costs of critical enablers and including high range of abatement specific costs
3 Range for 2030 real GDP per capita includes a conservative and aggressive scenario
SOURCE: Indonesia Bureau of Statistics; Team analysis

7. Implementation approach

Given the significant transformation required to achieve low-carbon growth, a phased approach is proposed (Exhibit 11).

Phase 1 - Define the low-carbon growth strategy (Sep 2009 –Feb 2010): Develop a low-carbon growth strategy (as summarized in this report) that identifies the major opportunities for abatement and new sector growth, the critical actions required for success, and an estimate of the associated costs.

Phase 2 - Develop basic readiness structures (Mar–Dec 2010): Develop the basic architecture needed to attract international financing and support low-carbon growth. This includes finalizing the organizational design of the low-carbon delivery unit (including establishing reporting and decision-making processes), staffing remaining leadership positions, identifying and obtaining readiness funding, defining a detailed implementation plan and KPIs for the roll-out of the low-carbon growth strategy (including the choice of a Phase 3 pilot project), and beginning to build critical enablers such as the financial delivery mechanisms and MRV methodology.

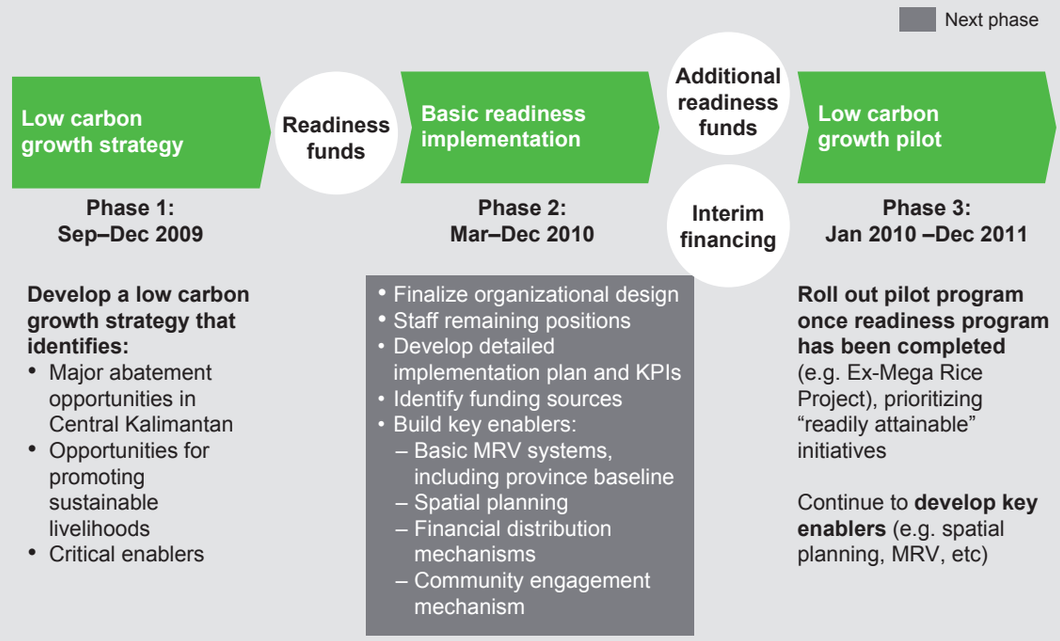
38 Annex 6 provides an overview of the methodology used to estimate the economic impact of the low-carbon growth strategy.

Phase 3 - Pilot low-carbon growth initiatives (Jan – Dec 2011): Launch an initial pilot program to support an approach to low-carbon growth that focuses on the prioritized opportunities for abatement and new growth sectors. Given the extensive overlap in objectives and the detailed analysis already completed, the Ex-Mega Rice Project (EMRP) could potentially be a logical choice for the pilot (Box 10). This project has the added advantage that the President has given the Governor legislative powers over this area (normally the purview of both district and national governments).

Following the pilot and a review of the lessons learned, it is envisaged that there would be a progressive rollout of other pilots in 2012, with the eventual transition to a province-wide approach by 2013.

Exhibit 11

A phased implementation approach is proposed for creating low carbon prosperity



Annexes

A1. Estimating greenhouse gas emissions

Estimates of Indonesia's annual GHG emissions differ between sources, depending on the different sectors included or excluded (e.g., emissions from peatland), applied methodology (e.g., net versus gross emissions from deforestation) and the year chosen as a reference. Given the weight of peat fires in Central Kalimantan's emissions, for example, total emissions may vary considerably each year according to the occurrence of fire.

A methodology broadly consistent to that used by the *Dewan Nasional Perubahan Iklim* (DNPI) in its 2009 interim report on Indonesia's emissions has been used to estimate province-level emissions. As with the 2009 interim report by the DNPI, the methodology used to estimate province-level emissions in Central Kalimantan is consistent with the Intergovernmental Panel on Climate Change (IPCC).

IPCC Methodology

The Intergovernmental Panel on Climate Change (IPCC), established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO), is the primary UN scientific advisory body publishing reports on the science and economics of climate change in order to provide a detailed fact base to policy makers and negotiators. One of its activities is to support the United Nations Framework Convention on Climate Change (UNFCCC) through its work on developing methodologies for National Greenhouse Gas Inventories, which it publishes in the form of detailed guidelines.

The DNPI has relied on the IPCC's national emission reporting guidelines and good practice guides for calculating Indonesia's emission profile. IPCC Guidelines provide three methodological tiers, varying in complexity, to be chosen on the basis of national circumstance (Annex 1 vs non-Annex 1) and availability of data.

Tier 1 is a simple first order approach, whereby emissions are calculated based on IPCC default parameters. DNPI analysis is consistent with a Tier 1 assessment at a minimum for all sectors studied. Tier 2 is a more accurate approach that provides more detailed sector-level and nationally specific parameters for calculating emissions. The DNPI has developed Tier 2 level assessments wherever national sector level emissions data were made available through either multi-stakeholder workshops or expert interviews. At this time, a lack of detailed data precludes the DNPI from using Tier 3 methodology, the highest order method that includes detailed modeling and/or inventory measurement systems with data available at a higher resolution.

The DNPI has shared its methodology for all sectors with UNFCCC reviewers. The UNFCCC does not endorse or certify national emission inventories unless formally submitted as a part of the national communication framework.

Key components of this approach include:

1. **Inclusion of emissions across seven sectors.** Emission estimates from seven different sectors are included: LULUCF, Agriculture, Power, Transportation, Buildings, Cement and Peatland.

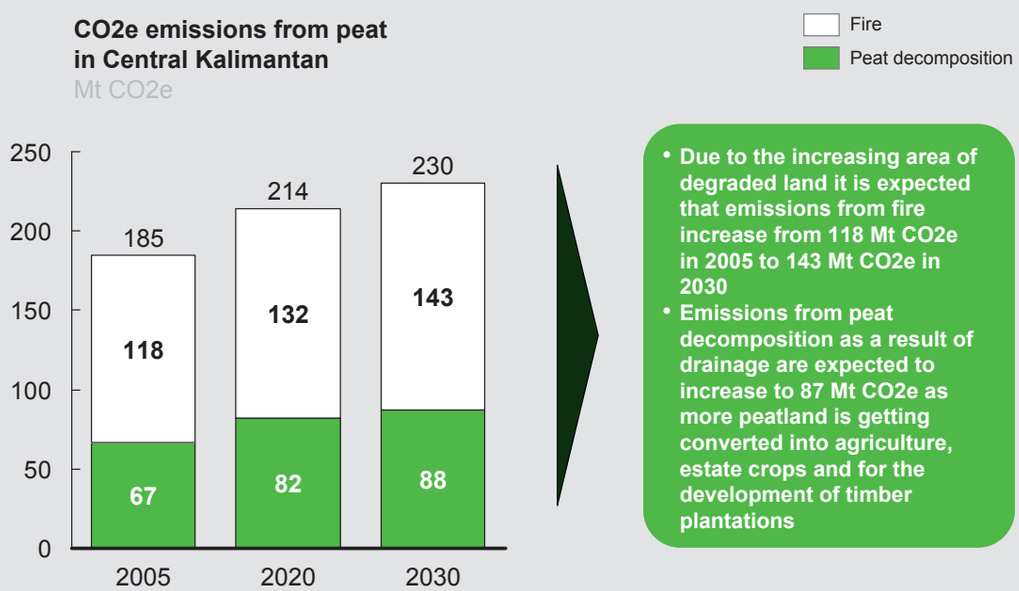
2. **Broad inclusion of land use and land-use change related emissions.** Emission estimates from LULUCF and peatland include deforestation, degradation, peat fires, and peat decomposition. Although there are scientific uncertainties around peat decomposition, there is now consensus in the wider scientific literature that decomposition is an important emission factor and a large source of emissions.

3. **Use of net emissions for LULUCF.** Estimates of emissions from LULUCF are reported as net emissions, i.e., they measure the carbon loss directly resulting from deforestation, forest degradation, and forest fires, adjusted for the re-growth of secondary natural forests, managed forests after harvesting, and afforestation and reforestation efforts.

4. **Annual average approach to peat fire emissions.** Peat fires are a major source of emissions, but their severity varies widely depending on annual rainfall in different parts of the archipelago. A similar approach to that used by the Ministry of Environment in the Second National Communication (2009) is used, drawing on estimates for peat fire emissions published by Van Der Werf et al.(2008). However as we use the average of 2000 to 2006, our estimates vary slightly if compared with specific years during this period (the Ministry of Environment uses the Year 2000 only in its estimates).

Exhibit A1

Peat: Business-As-Usual (BAU) emissions from peat are expected to grow from 185 to 230 Mt CO2e by 2030



1 Including emissions from fire occurring on mineral soil; share of peatland fire app. 85%

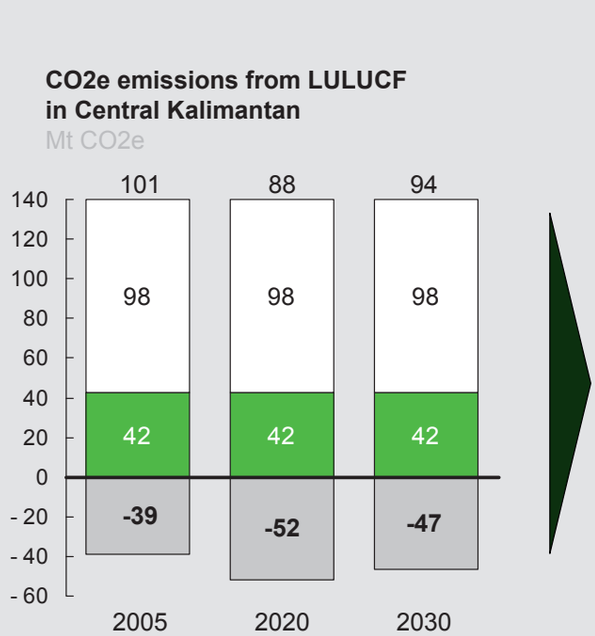
Exhibit A2

Peat Business-As-Usual (BAU): Methodology assumptions

	Methodology	Assumptions	Source
Fires	• Emissions from peat fire are based on research from Van der Werf et al (2008) • Average 2000 to 2006 values instead of annualized emissions due to large climate induced annual variation • Central Kalimantan's share of emissions are calculated based on it's percentage share of Indonesia's degraded peat area • Emissions from fire on mineral soils are estimated from hotspot count	• Degraded and high risk area is increasing as annual area of peatland conversion remains constant • Constant burned area per hotspot on mineral soil • Constant emissions per ha per hotspot on mineral soil	• Van der Werft et al. 2008 • Min of Forestry 2008 • Hooijer et al. 2006 • CIFOR 2002 • WRI 2008
Decomposition	• Split of total peat area into 5 different land types; multiplied with emission from decomposition in relation average to water table below surface	• Linear relationship between water table and emission	• Hooijer et al .2006 • Wösten, Alterra 2005 • Couwenberg et al 2009

Exhibit A3

LULUCF: Business-Aus-Usual (BAU) emissions are expected to decrease to 94 $MtCO_2e$



- **Gross emissions through deforestation and degradation of production forests is expected to remain constant**
- **Deforestation of mature forests into timber and estate crops plantation account for 98 Mt CO2e annually**
- **Timber degradation, resulting in degradation of production forests, account for emissions of 42 Mt CO2e annually**
- **Absorption potential fluctuates over time as large parts of the sequestered carbon get's released at the end of each rotation cycle**
- **As deforestation will continue, absorption of natural forests will decrease over time**

SOURCE: IFCA; Min. of Forestry Indonesia; Team analysis

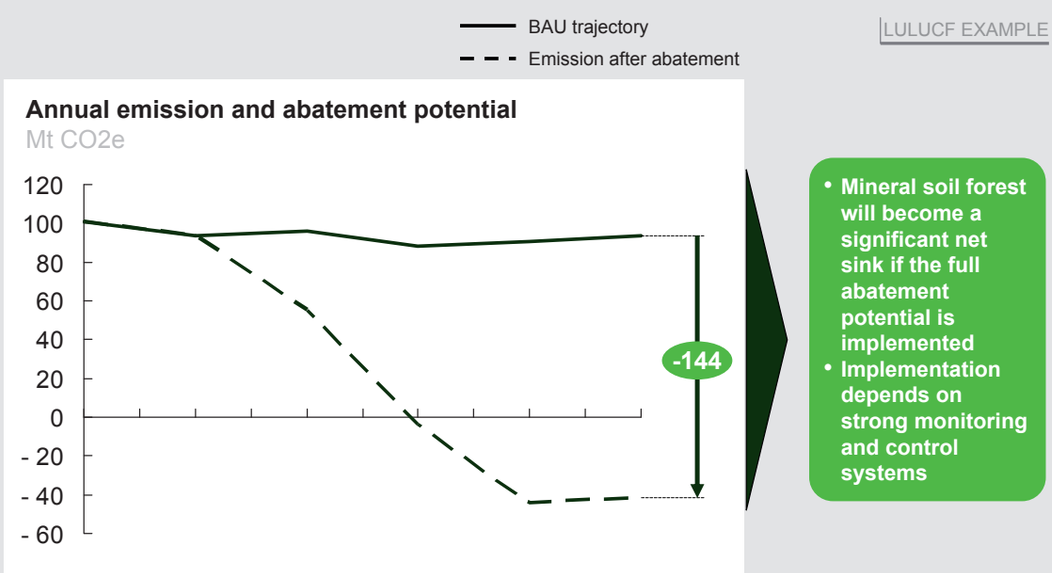
Exhibit A4

LULUCF Business-As-Usual (BAU): Methodology assumptions

	Methodology	Assumptions	Source
Deforestation	• Area of annual deforestation (2000-2005 average) multiplied with carbon density of Central Kalimantan's forests.	• Deforestation rate remains, at a minimum, constant at 120,000 ha per year • Average carbon density of 217 t C/ha	• Min of Forestry 2008 • IFCA 2008
Degradation	• Jambi's total production forest are divided by length of rotation period • Annual logged over area multiplied with assumed carbon losses	• Total concession area of 6.2 million ha • Rotation period is 35 years • Average carbon density is 217 t C/ha • 30% carbon density reduction	• Ministry of Forestry – Forestry statistics 2007 • Statistics of Forest Concessions Estate 2006 • IFCA 2008 • Stanley; 2008 • Lasco et al 2006
Absorption	• Carbon sequestration rates of secondary and man-made forests multiplied with current and expected future area development • Removals at the end of the rotation period taken into account	• Sequestration rates range from 1.2 tC/ha in secondary forests up to 8 tC/ha in timber plantations • Constant decrease of secondary forests and increase of man.made forests	• Min. of Forestry 2008 • ALGAS 1998 • FAO – Global Fiber Supply Assessment 2005 • SNC 2009 • Sheil et al. 2009

Exhibit A5

Large parts of the abatement could be achieved in relatively short time



SOURCE: Team analysis

The majority of emissions in Central Kalimantan stem from LULUCF and peat. The breakdowns of the emission projections in each of these categories, as well as the underlying assumptions are provided in Exhibits A1–A4

A2. Estimating abatement potential

This study focuses on abatement opportunities costing less than USD 80 per ton of CO_2 equivalent (tCO_2e). Our approach and results are both consistent with the national and provincial imperatives of continued development and growth.

Abatement potential is defined as the difference between the emissions volume of a particular source under a business-as-usual scenario and the emissions volume after the abatement lever has been applied.

The emissions baseline is calculated from several driver values, such as the carbon intensity of a specific fossil fuel, the production volume of a basic material, or the fuel consumption of a vehicle. Each abatement lever changes (usually reduces) specific driver values, for which the quantification is determined by literature and through expert discussions.

LULUCF and peatland-related emissions are based on the scenario that, with the exception of smallholder related emissions, these emissions can be stopped completely by 2030. This scenario was adopted from the McKinsey Global Cost Curve methodology and also applied to the DNPI's national-level Indonesian GHG Abatement Cost Curve.

A3. Peat-related emissions

Peat is an accumulation of partially decayed vegetation matter. It forms usually in marshy areas, when plant material is inhibited from decaying fully by acidic and anaerobic conditions. It is composed mainly of marshland vegetation, for example, trees, grasses, and fungi, as well as other types of organic remains, such as insects and animal corpses. Peat forms over thousands of years, growing at a rate of about a millimeter per year and is, under the right conditions, the earliest stage in the formation of coal (Exhibit A6).

Peatlands cover approximately 3 percent of the global land mass, but represent one-third of total global soil carbon (as they contain around 10 times the amount of carbon as the equivalent size of non-peat soil). If the total carbon stored in peat (528 Gt) were released in one year, it would be equivalent to roughly 12 times the world's current total global emissions.

This carbon is under threat, as it is released as CO_2 to the atmosphere through two mechanisms (Exhibit A7):

1. **Drainage** of peatlands (as the peatlands are opened for cultivation) leads to oxidation of the peat material and CO_2 being released into the atmosphere (as 50 to 60 percent of the peat dry matter is carbon)

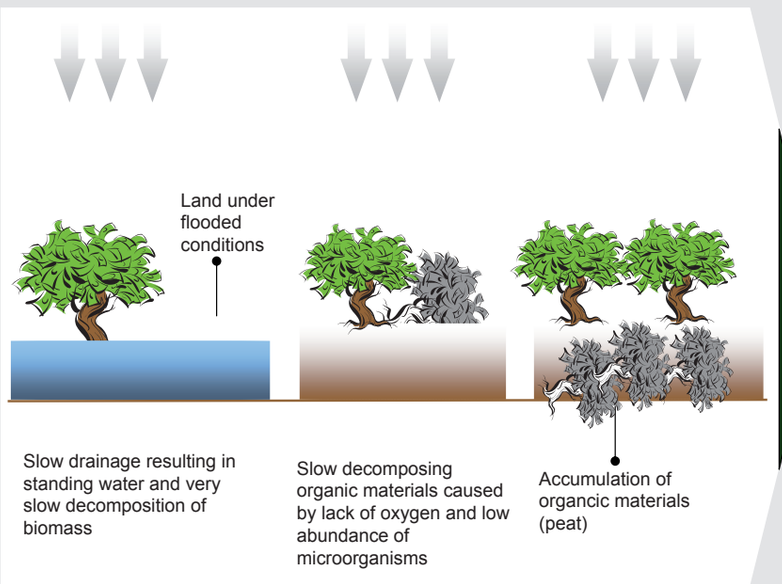
2. **Fire** in degraded peatland results in further CO_2 emissions; fire on non-degraded and non-drained peatlands is extremely rare because of the peatland's naturally high moisture content

In addition, as peatlands are often covered with forest, their exploitation usually goes together with deforestation of the area, exacerbating the CO_2 impact.

Exhibit A6

Thousands of years of very slow decomposition of organic matter creates an enormous carbon storage in peat soil

ILLUSTRATIVE



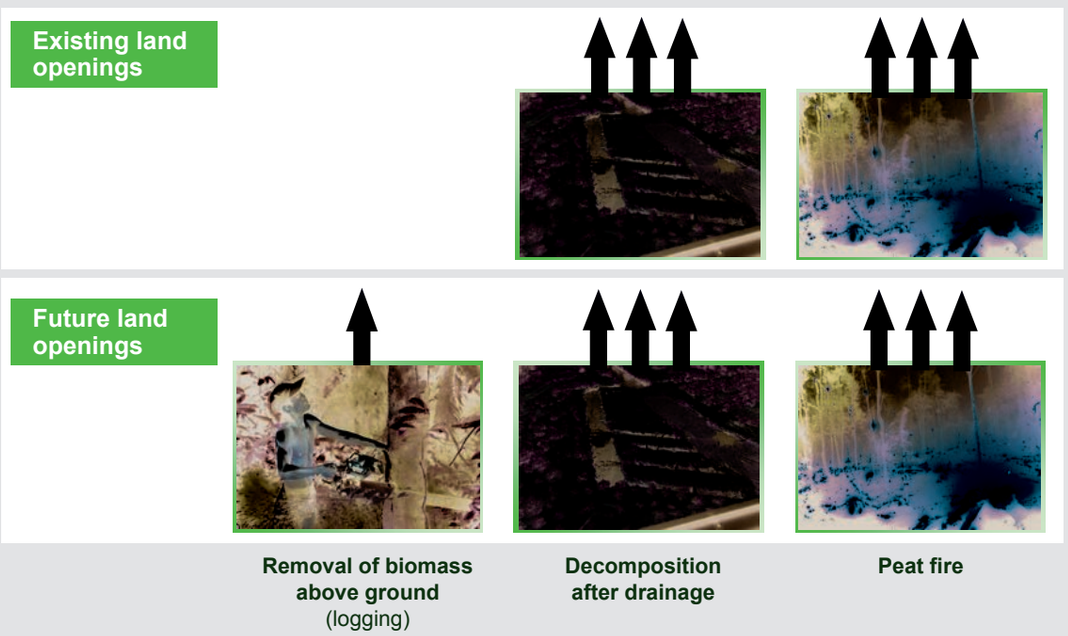
- **Indonesian peat stores 36 Gt of carbon (132 Gt of CO_2e) at present below ground**
- **Peat forest store 4,2 Gt of carbon (15 Gt CO_2e) above ground**
- **As a comparison, the world's largest rainforest, the Amazon, stores 46 Gt of carbon (168 Gt of CO_2e)**

SOURCE: DNPI Indonesia GHG Abatement Cost Curve

Exhibit A7

Peat emissions are driven by decomposition and fires of already degraded land as well as new land openings

ILLUSTRATIVE



SOURCE: DNPI Indonesia GHG Abatement Cost Curve

Indonesia has the largest area of tropical peatland of any tropical country in the world, representing 5 percent of the total global peatland. Indonesia's peatlands are being deforested, drained, and burned at an extremely rapid rate in order to develop oil palm and pulpwood plantations, for agriculture, and to supply the forest products industry with timber. As a result, despite having just 5 percent of total global peatlands, Indonesia accounts for almost 60 percent of total estimated global emissions from peat decomposition (Exhibit A8).

While peat science has a long history in the Nordic region, scientific knowledge related to tropical peat is still at an early stage. Since the dramatic peat fires of the 1997 and 1998 El Nino events, scientists have shifted their focus to tropical peatlands and especially to emissions related to land-use change. Whilst the knowledge of tropical peat-related emissions has improved considerably in recent years as a result of this increased scientific focus, there are still uncertainties in several areas:

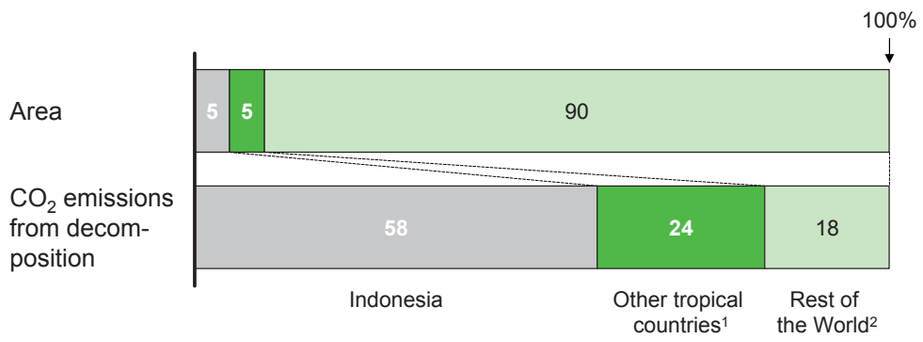
1. Soil and roots respiration

Most of the published research results have not been able to fully exclude natural emissions of soil and roots respiration from their carbon flux[39] measurements. Research that has attempted to separate the two components (e.g., Couwenberg et al. 2009) suggests that 40 to 60 percent of the below ground carbon emissions from peat soils comes from respiration (and not from peat decomposition). Since soil respiration is a natural emission, these emissions should not be included in official UNFCCC emissions estimates. The implication is that emissions from peat decomposition may be overestimated by a factor of two in older publications.

Exhibit A8

Indonesia is responsible for almost 60 percent of global emissions from peat decomposition

Breakdown of global peatland area by surface and corresponding CO_2 emissions
Percent



- 5% of global and 50% of tropical peatlands are located in Indonesia
- Tropical peat has a share of more than 80% of emissions from peat decomposition
- Indonesia's share of total emissions from peat decomposition is 58% or 12 times more than share of area

1 Malaysia, Papua New Guinea; Democratic Republic of Congo, Brazil
2 Canada, Russia, Scandinavia, USA

SOURCE: Hooijer et al 2006; Wetlands International

39 Carbon flux is describing the difference of carbon stock measured at a specific location at multiple times.

2. Subsidence as a consequence of drainage

There is uncertainty about the share of peat subsidence that is driven by peat decomposition. Peat subsidence is influenced by three main factors:

i. Mechanical compression of the biomass as the pore water is drained

ii. Shrinkage of biomass after drying

iii. Decomposition as carbon from biomass components cellulose, hemicellulose, and lignin are oxidized

At present it is commonly accepted that extensive subsidence in the first and second year after drainage is mainly a result of the dewatering of the peat body. However, it is not clear how large the influence of the above mentioned factors is in the following years. Some scientists (e.g., Hooijer et al. 2006) state that decomposition is responsible for up to 60 percent of subsidence, while at the low end, Kool et al. (2006) report values of around 1 percent. The low range is more likely to be correct in areas where the peat is not compressed by heavy machinery (e.g., secondary forests and shrub land).

3. Relationship between drainage depth and decomposition

At present, three different potential models are discussed in the field of peat science. The most established model is a linear relationship developed by Wösten et al. (1997). Other potential models under discussion are following an S-curve or even an inverted U-curve shape approach. However none of the potential models has been published in peer reviewed publications to date. The linear model has been applied in this report. It should be noted that by applying an S-curve or even an inverted U-curve approach the abatement potential of water management will change and likely will become smaller than estimated for this report.

4. Height of peat layer

While the extent of the Indonesian peatland area, the carbon content of peat, and the average bulk density are commonly acknowledged, the data on the thickness of the peat layers is sparse. Measurements of peat thickness can not be done remotely with sufficient accuracy and therefore must be done in the peatland itself. Given the remoteness of the peatlands, this is challenging and time consuming.

All of the above mentioned factors and uncertainties have significant impact on estimates of current and future emissions from peat decomposition as well as on the volume and cost of peat-related abatement initiatives.

A4. Establishment of the deforestation, forest degradation, and peatland degradation prevention preparatory unit

Governor decree 18.44/417/2009 (issued on November 16, 2009) established a new unit tasked with facilitating the demonstration and implementation of REDD (Reducing Emissions from Deforestation and Degradation) and peatland protection and rehabilitation initiatives in Central Kalimantan. The unit's key functions include:

- Coordinating the development and implementation of strategies to promote REDD and peatland protection and rehabilitation in the province with regional and national stakeholders (e.g., Dewan Nasional Perubahan Iklim, DNPI)
- Facilitating the development of a province-wide baseline of current and future CO_2 emissions
- Developing a mechanism to effectively monitor CO_2 emissions
- Developing a payment distribution system for REDD activities
- Conducting education, training, and awareness activities related to REDD and peatland protection activities

The unit reports directly to the Governor, who acts as Chair. There are three Vice Chairmen, assisted by a Secretary and Vice-Secretary, and nine divisional heads.

A5. Calculating abatement costs

Full abatement costs include both technical costs (e.g. the cost to install the appropriate low-emission technology) as well as the implementation costs specific to individual abatement initiatives. In addition, there are costs for the general enablers, which are required but not specific to any one initiative (e.g. spatial planning).

Abatement-specific costs

Abatement-specific costs: These are the incremental costs against a business-as-usual scenario that are directly associated with capturing a specific abatement opportunity. The costs represent cumulative annualized repayments for capital expenditure and operating expenditure until 2030. These costs include replacement costs likely to be incurred in implementation. For example, avoiding deforestation by shifting new estate crops or pulpwood plantations to degraded land requires some form of payment to compensate the concession holder for the lost revenue of not cutting down their forests. The broader social costs (e.g., the costs of forest and peat fires on health and the economy) which might be beneficial for the broader society are excluded due to the uncertainty of their estimates and the desire to focus the analysis on the incremental direct costs likely to be faced by government or the private sector. The cost of financing has also been excluded due to the uncertainty into the method of financing (e.g., international grants, government financing, private-sector investment).

1. **Prevent forest and peatland fires:** Estimated costs comprise only direct investments needed to tackle vegetation fires (e.g., equipment and training for fire fighting crews, establishing fire information systems and fire fighting infrastructure such as wells). Costs exclude the broader cross-sectoral enablers such as setting up an information campaign and launching extension service programs to support non-fire methods of land clearing; these are captured separately. Estimated costs also do not include social costs associated with the fires (e.g., the costs of forest and peat fires on health, education, and the economy). Costs are provided as a range in which the low-end estimates focus on only attacking fires while the high-end estimates aim for the total prevention of fires. Key sources of information include the Master Plan for the Rehabilitation and Revitalisation of the Ex-Mega Rice Project Area, the JP Morgan CDM project methodology, and interviews with fire-prevention experts from APRIL.

2. **Reduce deforestation through more effective land allocation policies and improved agricultural productivity:** Costs for land-use allocation include compensation payments for already-issued concessions to convert land for estate crops or timber plantations. Compensation payments could differ significantly based on crops. In this report it is assumed that the majority of new plantations can be allocated to degraded land, and that the concession holder will only be compensated for lost revenues of one-time timber sales and not the entire lost revenues from the crop production. This results in significantly lower costs than that of the full opportunity cost approach in which the concession holder would be paid for the full forgone future revenues.

3. **Rehabilitate idle or degraded peatland:** Cost estimates are based on information provided by the Master Plan for the Rehabilitation and Revitalisation for the Ex-Mega Rice Project Area and extrapolated for the total degraded peatland area of Central Kalimantan.

4. **Manage forests sustainably:** Includes costs for purchasing harvesting equipment and planning software and making compensation payments for lost revenues from timber extraction.

5. **Reforest:** Costs for reforestation are based on direct costs required for replanting areas and on budgets per hectare published by the Ministry of Forestry in Indonesia. Indirect costs (e.g., spatial planning, land titling) are excluded and covered under the general enabler costs.

Cost of general enablers

Costs of general enablers: These are the incremental costs that are critical to the overall success of the low-carbon growth strategy, but are not solely related to any one specific abatement opportunity. These enabler costs are separated into seven sub-categories:

1. **Basic institutional readiness:** The incremental costs associated with establishing the basic institutional structures needed to support low-carbon growth. These include the costs of establishing and staffing the recently established delivery unit as well as training government officials. Cost estimates outlined for institutional readiness are based on information provided by the Master Plan for the Rehabilitation and Revitalisation for the Ex-Mega Rice Project Area and extrapolated for the total area of Central Kalimantan. In addition, additional costs have been included for the recruitment and employment of key leadership positions within the delivery institution.

2. **Attracting, managing, and distributing finance:** The incremental costs associated with attracting international financing for REDD, VER, and CDM deals and managing and distributing finances in a transparent, fair, and efficient manner. Cost estimates are based on information provided by the Master Plan for the Rehabilitation and Revitalisation for the Ex-Mega Rice Project Area and extrapolated for the total area of Central Kalimantan and

include specific costs in the first year to develop and establish pilot programs to test a variety of management and distribution models to identify the most appropriate models for Central Kalimantan.

3. **Monitoring and evaluation:** The costs associated with establishing a province-level baseline and implementing standards for monitoring, reporting, and verification (MRV) are related to the tier approach suggested by IPCC and based on data provided by the United Kingdom based consultancy LTS International. The cost estimate is based on the assumption that Central Kalimantan has to meet Tier 3 standards: the low-end cost estimate is based on the assumption the Central Kalimantan is able to build on existing national inventory infrastructure, while the high-end cost estimate is based on the assumption that the complete MRV system has to be built from scratch. Targeting a Tier 3 reporting scheme will enable Central Kalimantan to engage in carbon trading. The costs also assume a participatory approach in which some of the inventory tasks (e.g., sampling on the ground) will be undertaken by communities living close to forest. A participatory approach would have the advantage that 1) communities would be engaged in the overall MRV process; 2) parts of the funding will flow to communities and 3) jobs would be provided in rural areas. As Central Kalimantan has significant areas of degraded peatland, the inclusion of optical remote sensing technology Light Detection And Ranging (LiDAR) data is likely to be beneficial by providing detailed information about emissions related to fire and even peat decomposition. The inclusion of LiDAR represents the majority of MRV costs (65% of total costs).

4. **Policy and planning:** The incremental costs associated with developing regulatory responses to support carbon abatement and create opportunities for sustainable livelihoods. These include the costs of developing a spatial plan and land certification. Cost estimates for spatial planning are based on information provided by the Master Plan for the Rehabilitation and Revitalisation for the Ex-Mega Rice Project Area and extrapolated for the total area of Central Kalimantan, while the cost estimates for land titling and certification are from World Bank benchmarks. The World Bank suggests that land titling costs on average reach USD 80 per hectare covered (including infrastructure costs) and in the case of Central Kalimantan it is assumed that 80 percent of the province does not have a clear title in place.

5. **Community engagement:** The incremental costs associated with developing and implementing the processes for engaging with local communities, including the formation of local community boards to provide input into strategies and ensure free and informed consent, supporting behavioral change toward sustainable practices, and promoting local community enforcement. Community engagement costs were extrapolated from the Master Plan for the Rehabilitation and Revitalization for the Ex-Mega Rice Project Area. Specific programs include the development of a multi-stakeholder engagement framework supported by the appointment of community facilitators. Additionally, the community engagement program includes specific allocations towards developing and maintaining public information campaigns.

6. **Infrastructure:** The incremental costs responsible for developing the technology and systems infrastructure or soft infrastructure (e.g., market information, fire brigades, education, health) and hard infrastructure (e.g., electricity, roads) to support emissions reduction and sustainable livelihoods. The costs for building critical hard and soft infrastructure have been extrapolated from the Master Plan for the Rehabilitation and Revitalization for the Ex-Mega Rice Project Area and further extrapolated for the entire province. These costs can be grouped broadly into four program areas: public health and sanitation, transportation, community infrastructure projects (including infrastructure for extension services) and electricity. Costs for two additional infrastructure items, education and law enforcement, were calculated by estimating how much it would cost to bring Central Kalimantan's budgetary allocations for education and law enforcement up to the national average (to give a low end of the range) and up to the average of the top one-third of provinces (to give a high end of the range).

7. **Sustainable livelihood development:** The incremental costs associated with developing sector strategies for sustainable livelihoods and attracting investment for identified growth priorities. The costs for sustainable livelihood development have been extrapolated from the Master Plan for the Rehabilitation and Revitalization for the Ex-Mega Rice Project Area and further? extrapolated for the entire province. These costs include programs for agricultural extension services, formation of cooperatives and small enterprises, and increasing local processing of goods. Additional costs include strengthening the provincial Investment Coordination Board (BKPMD) office through additional staffing and budgets to support its role in attracting new investments into the province.

It is important to stress that we have focused on estimating the *incremental* costs associated with creating low-carbon growth (i.e., above and beyond the costs that government or the private sector would incur in usual activities). For enablers such as infrastructure, estimating the incremental costs can be extremely challenging, and therefore for these cost items we have relied on a combination of outside-in analysis, combined with local expert interviews.

A6. Assessing economic impact of low-carbon growth strategy

The economic model is developed by forecasting individual economic sectors. For each sector, three future growth scenarios to 2030 are estimated:

i. **Base case scenario:** The forecast for each sector is based primarily on the historical growth rate of the sector in the province. Where growth is judged to be unsustainably high (e.g., greater than 10 percent real per annum growth), a transition to the historical growth rate of the sector at the national level is assumed.

ii. **Conservative climate compatible growth (CCG) scenario:** This a higher growth scenario compared to base case. The sector is assumed to continue to grow at the historic growth rate until 2011, and then it will trend toward regional benchmark growth rates (identified for each sector below).

iii. **Aggressive climate compatible growth (CCG) scenario:** This the highest growth scenario. The sector is assumed to continue to grow at the historic growth rate until 2011, then trends towards best-in-class benchmark growth rates identified for each sector.

Exhibit A9 provides an overview for the alternative growth scenarios for the seven sectors identified as growth priorities.

Below are the detailed assumptions used for each of the seven sectors identified as growth priorities. For the sectors that were not identified as growth priorities, it is assumed that they grow at the same rate as the base case scenario.

Exhibit A9

Overview of Central Kalimantan economic model outputs

Millions of Billion Rupiahs, constant 2000

	Current GDP (% share of total)	2030 BAU GDP (% share of total)	2030 Climate compatible growth (low)	2030 Climate compatible growth (high)	CCG scenarios gap to BAU (%)
Estate crops	2.6 (17.4%)	11.3 (21.1%)	11.8	12.1	5 to 8
Sustainable forestry	1.4 (9.3%)	1.2 (2.2%)	2.1	2.3	80 to 97
Mining	1.2 (8.3%)	7.3 (13.8%)	9.6	9.9	30 to 35
Food crops	1.0 (6.4%)	0.7 (1.4%)	1.0	1.4	36 to 88
Aquaculture	0.8 (5.3%)	1.2 (2.2%)	2.0	2.0	65
Financial services	0.3 (2.0%)	1.3 (2.5%)	2.1	3.3	64 to 154
Eco-tourism	0.2 (1.5%)	1.2 (2.3%)	1.4	2.8	14 to 127

SOURCE: Country case studies; Indonesia Bureau of Statistics; Global Insight; Ministry of Forestry; Food and Agriculture Organization of the United Nation; Team analysis

1. Estate crops on non-forested land

- Current GDP contribution split by crop value – 63% palm oil, 36% rubber, 1% other.[40]

Yield assumptions (Palm oil)

- Historical yield growth 14% p.a. (2003–2006) and current (2006) yield of 4.1 t/ha (tons per hectare), 10% above Malaysia yield of 3.7 t/ha.
- ***Base case scenario:*** Assume sustainable continued growth to 5.9 t/ha in 2030 (implied growth rate of 1.5% p.a.), matching absolute yield projection of Malaysia (Malaysia projected to grow at 2% p.a. to reach 5.9 t/ha in 2030).
- ***Conservative CCG scenario:*** Current yield rate grows to 6.2 t/ha (implied growth rate of 1.7% p.a.), 5% above absolute yield projection of Malaysia (which is projected to grow at 2% p.a. from 3.7 t/ha in 2006 to 5.9 t/ha in 2030).
- ***Aggressive CCG scenario:*** Current yield rate grows to 6.4 t/ha (implied growth rate of 1.9% p.a.), to maintain 10% gap above absolute yield projection of Malaysia.

40 Crop information obtained for Indonesia from the Ministry of Agriculture and the Ministry of Forestry; for international benchmarks, the Food and Agricultural Organization (FAO) is the principal source.

Area assumptions (Palm oil)

- Historical growth 33% p.a. (2003–2006); current area in 2006 of approximately 572,000 hectares.
- For all three scenarios, assume growth to 2.3 million hectares, based on 2003–2006 growth of approximately 70,000 hectares per year. An area of 5.2 million hectares of degraded land (defined by the Ministry of Forestry as "not critical", "potentially critical" and "somehow critical") is available, so 2.3 million hectares in 2030 appears viable. Historic growth rate is unreasonable, since if growth continues at this rate (i.e., 33% p.a.), all of Central Kalimantan's land would be occupied by palm oil by 2018.
- Main difference between the scenarios is that the area will come from different sources – area in base case scenario is assumed to come from expanding into forested areas; while in the CCG scenarios, the new planted area comes from the usage of degraded land, resulting in different emission levels.

Yield assumptions (Rubber)

- Historical yield growth of 0.9% p.a. (2003–2006); current (2006) yield of 1.0 t/ha, 10% above Malaysia (0.9 t/ha).
- **Base scenario:** Grow at 0.22% (Malaysia projected growth rate), resulting in 2030 yield of 1.04 t/ha.
- **Conservative CCG scenario:** Reach 8% above Malaysia's 2030 projected yield rate, i.e., end up with yield of 1.05 t/ha (implied growth rate of 0.26%).
- **Aggressive CCG scenario:** Reach 10% above Malaysia's 2030 projected yield rate (2030 implied yield of 1.07 t/ha at growth rate of 0.36% p.a.).

Area assumptions (Rubber)

- Historical (2003–2006) growth of -1% p.a.; current (2006) area of approximately 257,000 hectares.
- ***For all three scenarios***, assume continued growth at -1% p.a. to ~211,000 hectares in 2030.

Other estate crops

- Assume same overall historical GDP growth in agriculture (2003–2006) of 1% p.a.

2. Sustainable forestry

- Historically, GDP grew negative by -15% p.a. (2003–2006).
- **Base case scenario** assumes continued historical growth trend

Yield assumptions for climate-compatible growth scenarios

- Current (2006) yield of 8.9 t/ha.

- ***Conservative CCG scenario:*** Yield grows by 50% (to 13 t/ha) by 2030 (constant yield rate for five years then growth rate of 2% p.a., implied growth rate of 1.6%), based on increased yield from sustainable forestry practices.[41]

- ***Aggressive CCG scenario:*** Yield doubles (to ~16 t/ha) by 2030 (constant yield rate for five years then growth rate of 3% p.a., implied growth rate of 2.4%), based on sustainable forestry practices.

Area assumptions for climate-compatible growth scenarios

- Assume no change from number of hectares in 2006.

3. Environmentally-sustainable mining

- Historically, GDP grew by 45% p.a. (2003–2006) and current (2006) share of overall province GDP of 8.3%.

- ***Base case scenario:*** Assume growth at sustainable rate of half historical rate (22% p.a.) for five years, then match national average of 4.2% p.a. until 2030.

- ***Conservative CCG scenario:*** Assume growth of 22% p.a. until 2011, then match Chile's historical (2003–2006) average of 5.7% p.a. until 2030.

- ***Aggressive CCG scenario:*** Assume growth of 22% p.a. until 2011, then match Brazil/Chile historical (2003–2006) average of 5.9% p.a. until 2030.

4. Food crops on non-forested land

Rice production represents 96 percent of the total value of food crops in Central Kalimantan. Scenarios are therefore based on forecasts for this food crop (scaled appropriately to equal sector GDP).

Yield assumptions

- Historical growth in yields of -1.1% p.a. (2003–2006).

- Current yield of 2.4 t/ha (45 percent of East Java's yield of 5.3 t/ha).

- ***Base case scenario:*** Assume maintaining yield growth rate going forward (-1.1%) to 1.8 t/ha in 2030.

- ***Conservative CCG scenario:*** Current yield rate grows at historic growth rate (-1.1%) for five years, then at 0.5% (East Java historical growth rate) to 2.5 t/ha (implied overall growth rate of 0.2% p.a.) in 2030.

- ***Aggressive CCG scenario:*** Current yield rate of 2.4 t/ha grows at historic growth rate (-1.1%) for five years, then at 2.2% (to match half of East Java's projected 2030 yield rate) to 3.5 t/ha (implied growth rate of 1.5% p.a.) in 2030.

41 Wann and Rakestraw (1998) for example found that yields per hectare grew by 500 percent for pine plantations in southern United States after the introduction of sustainable forestry practices

Area assumptions

- For all three scenarios, assume constant area for paddy plantations at 140,000 ha (which is consistent with growth rate from 2003–2006).

5. Aquaculture

- Historic (2003–2006) GDP growth of 2% p.a.
- ***Base case scenario:*** Assume continued growth of 2% p.a.
- ***Conservative and aggressive CCG scenarios:*** Assume continued growth of 2% p.a. until 2011, then match FAO Asia average (ex. China) of 4.4% p.a. until 2030.

6. Financial services

- Historic GDP growth (2003–2006) of 13% p.a.
- ***Base case scenario:*** Assume continued growth of 13% p.a. until 2011, then match national average of 4.7% p.a. until 2030.
- ***Conservative CCG scenario:*** Assume continued GDP growth of 7% p.a. until 2011, then 8% p.a. based on average growth rates of Costa Rica.
- ***Aggressive CCG scenario:*** Assume continued growth of 16% p.a. until 2011, then match benchmark rates (Mexico, India, Bangladesh average) of 10% p.a. until 2030.

7. Eco-tourism

- Historic GDP growth (2003–2006) of 7% p.a.
- ***Base case scenario:*** Assume continued growth of 7% p.a.
- ***Conservative CCG scenario:*** Assume continued GDP growth of 7% p.a. until 2011, then 8% p.a. based on average growth rates of Bali and Costa Rica.
- ***Aggressive CCG scenario:*** Assume continued GDP growth of 7% p.a. until 2011, then 12% p.a. growth based on historical growth in tourist numbers in Bali and Phuket.

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