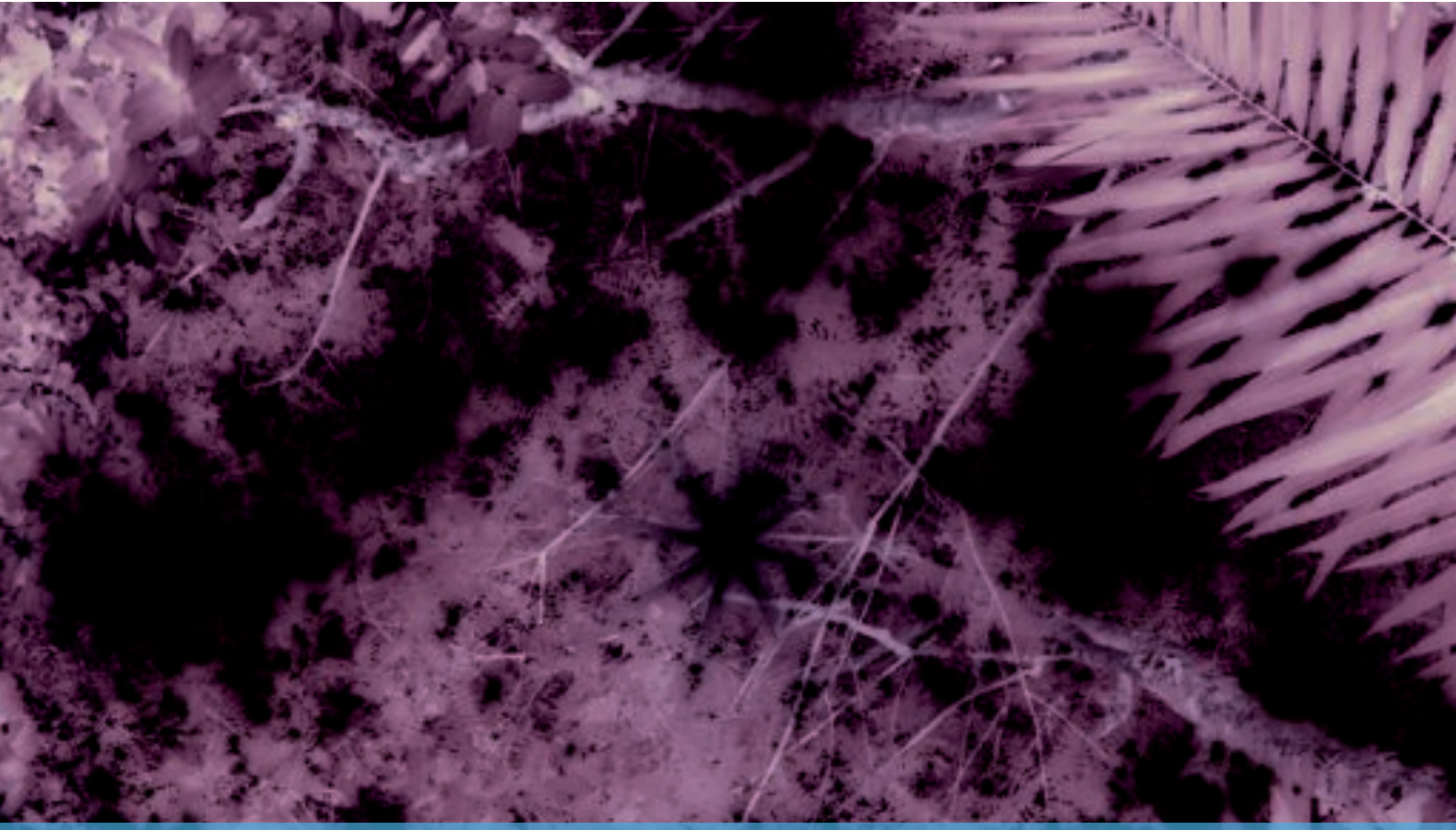
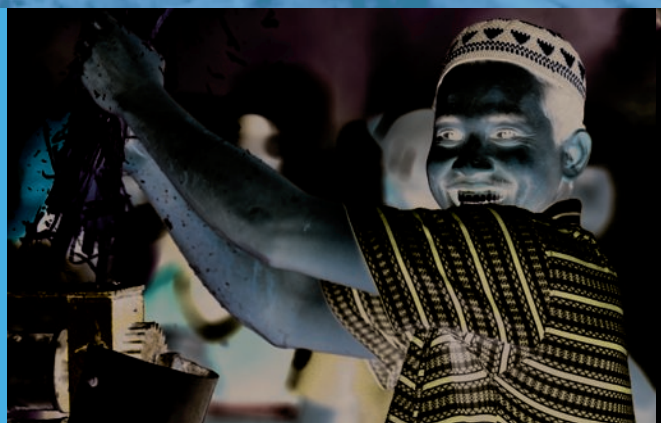


Creating low carbon prosperity in Jambi



dewan nasional perubahan iklim

SEPUCUK JAMBI SEMBILAN LURAH

Creating low carbon prosperity in Jambi

Contents

Foreword

Under the leadership of President Susilo Bambang Yudhoyono, Indonesia has made important contributions to the global climate change debate. This is only fitting, as the Indonesian archipelago is particularly vulnerable to the impact of climate change. With its vast forests and peat swamps, Indonesia also holds the potential to be an important part of the global formula for cutting carbon emissions and sequestering carbon. And finally, as a developing nation, Indonesia is deeply concerned that global climate change mitigation efforts are equitable, and carried out through a model of low-carbon growth development that betters the lives of Indonesians, and builds a sustainable economy.

The Province of Jambi exemplifies these three dimensions of climate change for Indonesia – impacted by environmental hazards, its particular environmental and emissions profile makes the province an important element in any effort to reach Indonesian (and global) emissions reductions targets. And while a relatively prosperous province in many ways, Jambi also faces a strong imperative to deliver sustainable economic development to its diverse population.

In the run up to and following the COP-15 Copenhagen meetings, President Yudhoyono convened a set of meeting with several Indonesian governors and solicited their help in implementing the national emission reduction targets. As a result of that meeting, the Dewan Nasional Perubahan Iklim (DNPI), Indonesia's National Climate Change Council, and the Office of the Governor of the Province of Jambi, have developed this report. *Creating Low Carbon Prosperity in Jambi* outlines a high-level strategy for delivering economic growth while making deep cuts in carbon emissions.

Our hope is that this work will help build momentum for carbon dioxide (CO2) reduction in Indonesia by making Jambi an inspiration for the potential of low-carbon prosperity.

Executive Chairman
DNPI

Governor
Province of Jambi

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 Jambi, under the leadership of Governor Zulkifli Nurdin, 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 Jambi 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 (CO2) reduction in Indonesia by making Jambi 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 Jambi to better identify and sequence the investments required, and so more effectively raise needed capital from global sources of climate mitigation funds.

Acknowledgements

The DNPI and the Government of Jambi would like to express our appreciation to the Agence Française de Développement (AFD), the ClimateWorks Foundation, the Norwegian Government, and the Packard Foundation for partially funding this effort to develop a low-carbon growth strategy for the Province of Jambi.

The DNPI and the Government of Jambi 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 Jambi 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 Jambi.

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

Executive summary

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

Jambi's annual GHG net emissions in 2005 were estimated to be approximately 57 MtCO2e1 – equivalent to roughly 3 percent of Indonesia's total emissions. Peat and LULUCF are by far the largest contributors to Jambi's emissions, representing up to 85 percent of the province's total emissions. If there are no changes in the way the high-emitting sectors are managed, Jambi's net emissions are expected to grow by some 30 percent between 2005 and 2030 – from 57 to 74 MtCO2e.

Jambi has a large potential for carbon abatement.

Jambi has the potential to reduce its GHG emissions by as much as 55 MtCO2e, with the right blend of domestic policies and international support. Of these possible reductions, 48 percent could come from efforts related to conserving peatland and 38 percent from the LULUCF sector. The five largest carbon reduction opportunities represent 80 percent of the total abatement potential of Jambi: (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 6.8 and 12.3. 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; 50 percent through capturing opportunities that are more challenging to capture (but with reduction potential to be realized by 2020); and the remaining 31 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 Jambi

In order to put Jambi'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. Six 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) Food crops on non-forested land; (3) Sustainable forestry; (4) Eco-tourism; (5) Aquaculture; and (6) Financial services.

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

Like many other developing regions, Jambi is doubly challenged by critical priorities and constrained resources, most particularly, the limited pool of management talent required to

1 Greenhouse gas emissions are typically measured in million tons of carbon dioxide equivalent or MtCO2e

implement transformative change. Many governments facing similar challenges have established specialized units to coordinate the government's response and ensure delivery of critical priorities. A new institution could help coordinate Jambi's low-carbon growth agenda, covering six core functional areas: (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.

In order to ensure a strong mandate and visibility, it is critical that this institution reports directly to the Governor. As the institution develops it will also be important to include representatives from different levels of government, clearly define relationships and decision-making rights with existing government departments, and develop rigorous performance management around a few priority outcomes.

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

Jambi will require significant, near-term international support to succeed in its plans to create low-carbon prosperity. In the first year, between USD 19 million and 39 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 373 million and USD 676 million in 2030. Whilst the overall required funding is substantial, the cost per tCO2e abated is relatively low. For example, in 2030, the full abatement cost per tCO2e abated (including implementation costs) ranges between USD 6.8 and 12.3. The McKinsey Global Cost Curve[2] estimated the technical costs[3] alone (i.e., excluding implementation costs) of the average abatement lever 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 around 3 percent in Jambi due to a slowdown of carbon-emitting sectors and the costs of implementation. However, with the right policies, the required financial support and assuming successful capture of the new sector growth opportunities, average (real per capita) incomes in 2030 in Jambi could actually increase by around 5 to 13 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 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

A phased implementation approach is proposed.

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

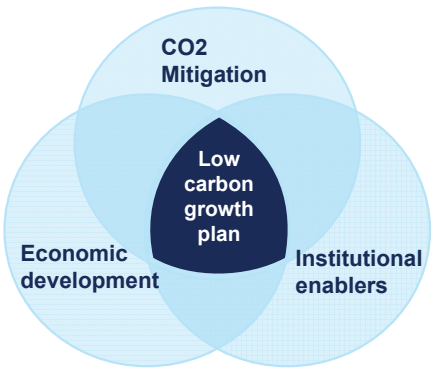
Jambi faces significant challenges to sustainable human development. Its average incomes are more than a third less than the Indonesian average, and it is largely dependent on two main industries (agriculture and LULUCF account for about 30 percent of output and 58 percent of jobs), which have been rapidly losing employment (76,000 net job loss from 2003–2006). Jambi's government is therefore understandably focused on economic development and improving the livelihoods of its people. At the same time though, Jambi is taking a leading role in combating anthropogenic sources of climate change, particularly those related to forest and land fires.

Jambi 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 Jambi'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 Jambi'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.

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

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 Jambi. It has three core elements (Exhibit 1):

1. **CO2 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 Jambi faces in each of these three areas and identifies some priority areas of action.

2. Baseline estimates of current and future emissions

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

Jambi's annual GHG net emissions in 2005 were estimated to be 57 MtCO2e – equivalent to roughly 3 percent of Indonesia's total emissions.[4] Peat and LULUCF are by far the largest contributors to Jambi's emissions, representing up to 85 percent of the province's total emissions.[5] These emissions from LULUCF and peatland are driven by deforestation, forest degradation, peat fires, and peat decomposition. If there are no changes in the way the land-use-related sectors are managed, Jambi's emissions are expected to grow by almost 30 percent between 2005 and 2030 – from 57 to 74 MtCO2e (Exhibit 2), mainly by increasing emissions from its degraded peatlands but also from the ongoing conversion of natural forests in pulpwood plantations.

3. Abatement opportunities

Jambi has a large potential for carbon abatement.

Jambi has the potential to reduce its GHG emissions by as much as 55 MtCO2e [6] by 2030, with the right blend of domestic policies and international support.[7] Of these possible reductions, 48 percent could come from efforts related to conserving peatland and 38 percent from the LULUCF sector (Exhibit 3).

Five carbon reduction opportunities represent around 85 percent of the total abatement potential of Jambi (Exhibit 4). These opportunities are described in more detail below the exhibit.

---

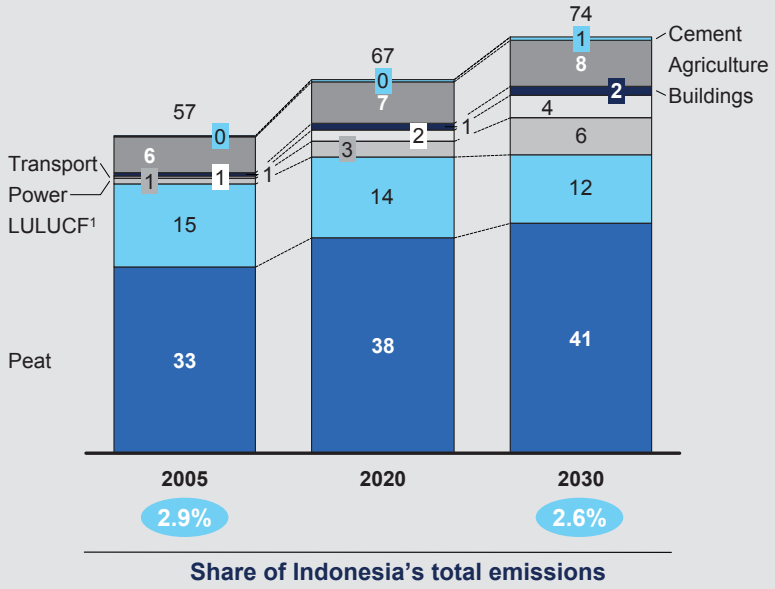
4 Greenhouse gas emissions are typically measured in million tons of carbon dioxide equivalent or MtCO2e
5 Annex 1 contains a description of the methodology used to estimate Jambi's current and future emissions.
6 Technically the overall abatement potential could be even higher and reach up to 69 MtCO2e, however this would require very large additional investments in infrastructure and building government capacity
7 Annex 2 contains a description of the methodology used to determine the abatement potential in Jambi.

Exhibit 2

Jambi's emissions are expected to grow from 57 to 74 $MtCO_2e$ between 2005 and 2030

PRELIMINARY

Projected net emissions, Million tons CO_2e

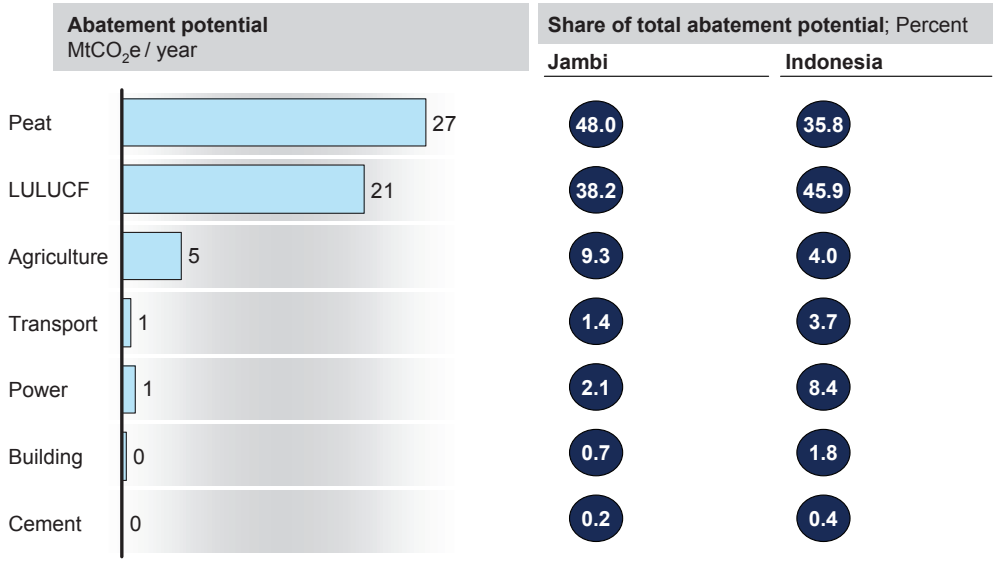


1 Net emissions, including absorption of secondary natural forests, timber, and estate crops plantations and afforestation/reforestation as part of GERHAN
SOURCE: DNPI Indonesia Cost Curve; team analysis

Exhibit 3

Largest abatement potential is in peat and forestry

PRELIMINARY



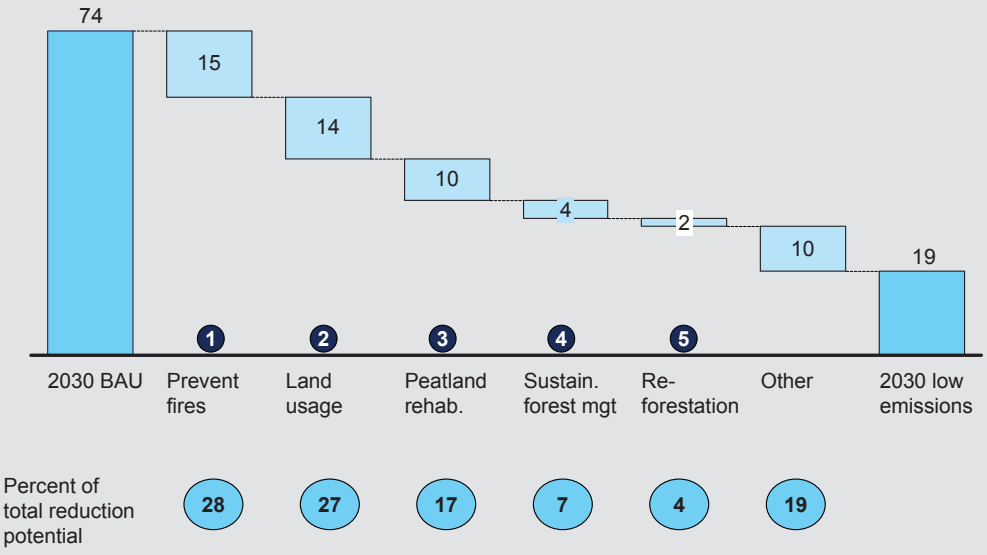
SOURCE: DNPI Indonesia Cost Curve; team analysis

Exhibit 4

Almost 81 percent of Jambi's abatement potential is concentrated in 5 levers

PRELIMINARY

Projected annual abatement potential, Million tons CO_2e



Percent of total reduction potential	28	27	17	7	4	19

SOURCE: DNPI Indonesia Cost Curve; team analysis

1. *Prevent forest and peatland fires* (15.3 MtCO2e annual emissions reduction potential in 2030):

   The prevention of forest fires has the largest potential to reduce Jambi's emissions, at a relatively low societal cost of below USD 1 per avoided tCO2e (excluding implementation costs).

   Major emission reductions could be achieved by prohibiting fire as a tool for land preparation, providing appropriate and practical technologies (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. There is currently a partnership between Jambi Province, Singapore's National Environment Agency, and the Asia Pacific Resource International (APRIL) to tackle forest and land fires in one regency in Jambi, which can provide useful insights for designing a province-wide approach (Box 1).[8]

   It should be noted that the technical maximum potential for CO2e reduction through fire prevention could be as high as 26 Mt CO2e if all anthropogenic fires in Jambi were suppressed. However, this would require very large investments in infrastructure and fire prevention programs across a very large and geographically remote province, and thus this report uses the more conservative figure of 15.3 Mt CO2e.

2. *Reduce deforestation through more effective land allocation policies and improving agricultural productivity* (14.5 MtCO2e):

   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

8 "Final Report and Recommendations for Master Plan to Deal with Land and Forest Fires for Muaro Jami Regency", April 2009.

Tackling land and forest fires in Muaro Jambi Regency

Box 1

Jambi Province, the Singapore National Environment Agency, and Asia Pacific Resource International Ltd (APRIL) have cooperated to reduce forest and land fires in Muaro Jambi Regency. A rapid field assessment and workshop was conducted to identify underlying drivers of the fires and develop action plans to address these issues. The rapid field assessment found that uncontrolled drainage, illegal logging, and land encroachment have caused and continue to degrade peatland, which when burning is the largest source of smoke and haze in the regency. Fire was found to be widely used and acceptable practice for land-clearing by individual farmers in small communities, and low-cost alternatives to burning (e.g., mechanical land-clearing techniques) were generally not available. Local villages were also found to have limited capacity to extinguish forest and land fires, mainly due to limited training and a lack of early warning systems and fire-fighting equipment. The final recommendations emphasize that improving fire suppression capabilities of local villagers and the limited government fire-fighting teams alone will be insufficient to address the fires, especially during severe or extended dry seasons (El Nino). These measures must be supported by a comprehensive land-use management, rehabilitation and sustainable development plan for the degraded peatlands in the regency.

plantations for palm oil and other agricultural crops. This approach comes at relatively high cost, e.g., approximately USD 30 per avoided tCO2e 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 (e.g., 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. 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]

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 18 MtCO2e 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 Jambi, it is considered unlikely that the full technical potential could be reached by 2030.

3. *Rehabilitate idle or degraded peatland* (10 MtCO2):

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.10 The key enablers will include stipulating guidelines for re-wetting processes, sponsoring local research into the cost and benefits of alternative peat rehabilitation

9 Further analysis of land tenure and spatial planning issues is provided in Section 4 – Institutional Enablers.
10 Annex 3 provides an overview of peat and peat-related emissions.

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. Effective fire prevention and management as well as efforts to promote reforestation must accompany these actions to make these efforts sustainable in the long term.

4. *Manage forests sustainably* (4 MtCO2):

   Non-sustainable extraction of timber from Jambi'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).[11]

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 MtCO2e 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

11 The costs of REDD: lessons from Amazonas", IIED briefing paper, November 2009.

5. *Reforest* (2 MtCO2):

   Increase the natural carbon sink by enlarging the dry land forest cover on mineral soil with suitable and economically viable tree species, such as native species that can yield timber and non-timber products as well as species such as acacias. There are already some ambitious reforestation projects underway in Jambi. In the Harapan rainforest, located in Jambi and South Sumatra, the Harapan rainforest agency is leading a large-scale effort to reforest some of its 101,355 hectares, including issuing a moratorium on logging in the area. 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, plus instituting a structure for monitoring and enforcement.

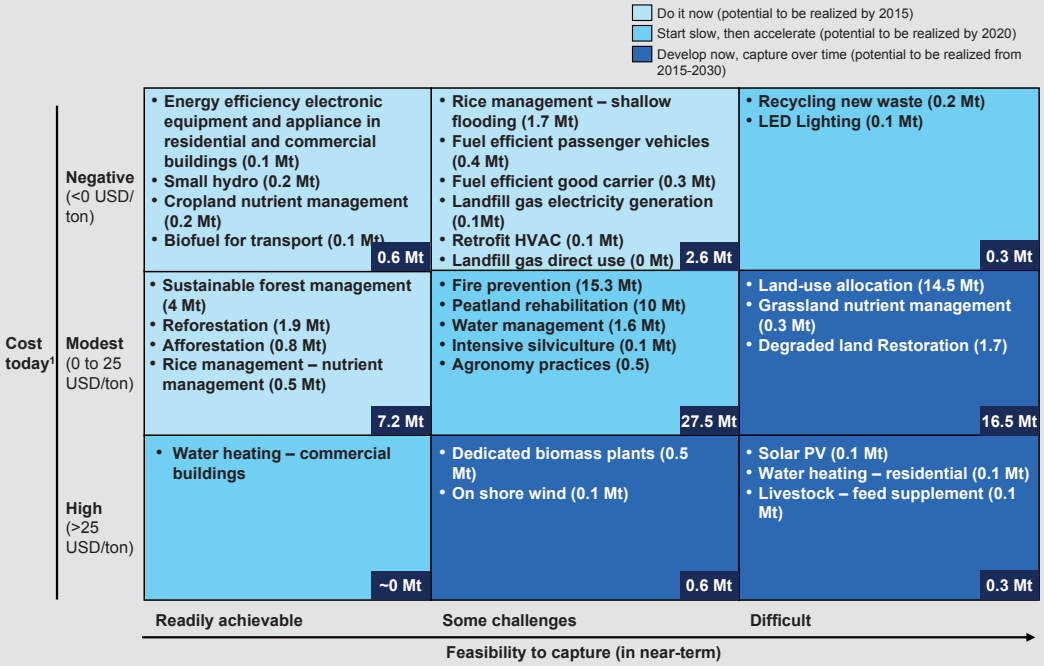
   It should be noted that increasing the carbon sink by afforestation or reforestation can only be realized if these areas are set aside for conservation. However, one way to bring degraded areas back under forest cover could be to plant a temporary timber plantation, which could then be gradually transformed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

Mapping these opportunities against their full abatement cost[12] and feasibility[13] can help prioritize the implementation of emission reduction opportunities for Jambi (Exhibit 5).

Exhibit 5

Prioritizing carbon abatement opportunities

PRELIMINARY



1 Based on costs specific to abatement opportunities. Excludes costs of critical enablers which are common to multiple abatement opportunities
SOURCE: DNPI Indonesia Greenhouse Gas Emissions Cost Curve; team analysis

12 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.

13 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.

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 10.4 MtCO2e annual reductions by 2030 (19 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 28 MtCO2e annual reductions by 2030 (50 percent of the 2030 projected emissions) at costs ranging from USD -80 to USD 21 and averaging to USD 5.8 per abated tCO2e.

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 17.4 MtCO2e annual reductions by 2030 (31 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 Jambi.

In order to transform Jambi's economic growth 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).

Jambi currently has a mixed economic performance (Exhibit 6):

- *Relatively low wealth:* output per person is significantly below the national average (37 percent less)
- *Highly inclusive:* Jambi has the 7th most equitable distribution of income among Indonesian provinces; 8th lowest poverty rate among provinces; and 12th highest human development index
- *Questionable sustainability:* productivity growth is relatively fast compared to other provinces, but productivity levels are still more than a third lower than national levels; large dependence on two main industries (agriculture and forestry account for about 30 percent of output and 58 percent of jobs), which have been rapidly losing employment (76,000 net job loss from 2003 to 2006).

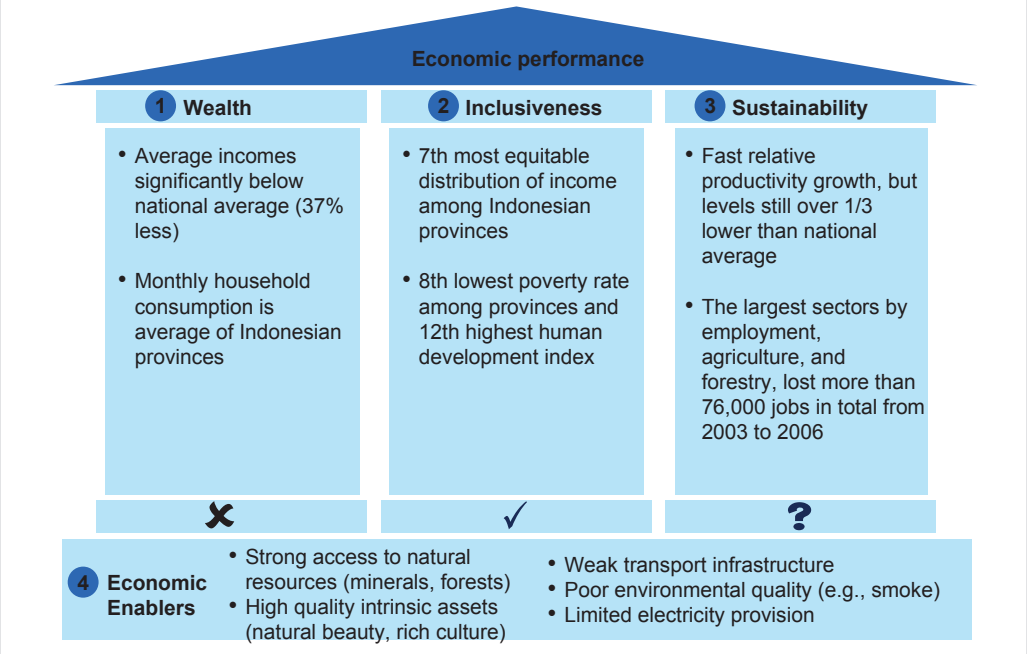
Jambi has a number of strengths, which can be built upon:

- *Intrinsic and cultural assets:* Jambi has a strategic location (e.g., major ASEAN capitals within 700 km), attractive climate, unique wildlife (e.g., Sumatran tiger), 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 strong supply of future labor
- *Relatively good human capital:* Education outcomes are relatively good compared to rest of Indonesia (e.g., illiteracy rate is more than a third less than national average; 14th highest province on National Evaluation Grades for secondary school students). However, there are still gaps. Whilst primary school enrolment rates are fairly high (around 93 percent of primary school aged children are attending primary school), post-primary school level enrolment is low, falling to around 52 percent in upper-secondary school. Ministry of Education surveys suggest

Exhibit 6

Jambi currently has a mixed economic scoreboard

PRELIMINARY



SOURCE: Team analysis

that financial concerns are the dominant reason for low enrolment post-primary (50 percent of those without post-primary education mention financial concerns as a dominant reason for their choice).

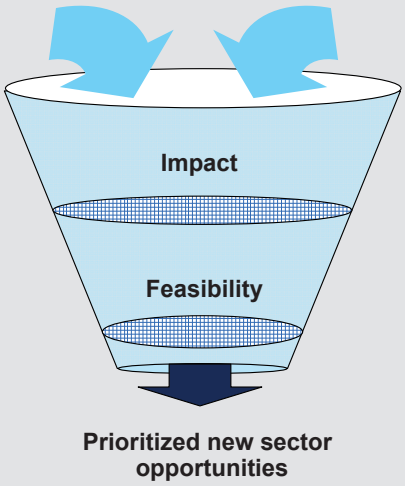
At the same time, there are a number of concerns in the business environment that need to be addressed. For example:

- *Gaps in transport infrastructure:* There are concerns with the quantity of roads and quality of ports – Jambi has the ninth lowest road density (relative to its geographical area) of any province in Indonesia. The Jambi 2006–2010 development plan has also highlighted the need to improve the efficiency of port and customs procedures.
- *Electricity shortages:* Almost a fifth of households rely on oil lamps for lighting, and frequent electricity outages affect many companies, forcing them to have their own electricity supply, which increases their fixed costs. Access to electricity is a principal concern raised by potential investors in the province.
- *Environmental concerns:* Forest and peat fires have large negative social and economic costs on the province. The true extent of the costs are difficult to measure accurately, but interviews and anecdotal evidence suggests the fires impose large costs on education, health, transport, and consumption. For example, ISPA (upper respiratory infection) rates are relatively high in Jambi, with an 18 percent increase following large fire outbreaks in 2006. The forest fires in July–September 2006 also resulted in a significant decrease of air traffic (roughly 8 percent fewer passengers versus normal activity).

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

Exhibit 7

Growth opportunities were prioritized according to their impact and feasibility



Methodology

- Interviews with local business people, government officials and academics
- Jambi economic development plan
- "Outside in" analysis of relevant international benchmarks

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

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

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).

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

1. *Estate crops on non-forested land (13 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 Jambi'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 improved 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 road and port transportation). In addition, to minimize environmental damage from palm oil plantation growth, future palm oil plantations should be allocated to already degraded lands (rather than opening new forests). Based on historical annual increases in palm oil plantation acreage, by 2030, there will be 1.2 million hectares dedicated to palm oil production in Jambi. However there are roughly 1.8 million hectares of potentially available and suitable non-forested land (after allowing for growth in other crops) that could accommodate this growth. Addressing land tenure and spatial planning issues will be critical to making this viable. By instituting these measures, real GDP from estate crops could potentially grow to more than four times the levels of 2006 levels by 2030, with a much lower carbon footprint.

2. *Food crops on non-forested land (12 percent of GDP in 2006):* Develop non-forested arable land for commercial agriculture of high-value tropical fruits and rice for export. At present, the sector suffers from weak road and port infrastructure (e.g., interviews with local tropical fruit producers suggest that spoilage rates for produce during transportation are up to 20 percent of the total crop), 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. Future growth in this sector can be supported by addressing infrastructure concerns, 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 significant – rice production, which represents about 95 percent of the value of all Jambi's food crops has yield rates currently less than three quarters of those in East Java. Assuming this gap could be closed by 2030, this sector's GDP would be 6 percent higher than if historical growth rates were maintained.

   Sustainable forestry (10 percent of GDP in 2006): Integrate primary and secondary processing of timber that has been more sustainably extracted under stringent controls enabling 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 (Jambi has a low road density of 1.6 km road per 10,000 sq km). 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 "legal" 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.[14]

3. *Eco-tourism (2 percent of GDP in 2006):* Develop tourism based on Jambi's unique wildlife (e.g., Sumatran tiger) and biodiversity that minimizes the ecological impact of growth in the sector. Crucial to stimulating future growth in this sector is developing transportation infrastructure, particularly air links to major hubs. For example, although Jambi is close to major ASEAN capitals (e.g., 323 km from Singapore, 569 km from Kuala Lumpur), there are currently no international air links, and flights from within Indonesia are often delayed or cancelled by smoke from forest fires. Even within the province, access to eco-tourism attractions is difficult (Box 3). 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 Jambi could transition to a growth rate in tourists similar to that achieved by Bali in the last 20 years, its contribution to GDP in 2030 could be more than double that of historical growth rates.

4. *Aquaculture (1 percent of GDP in 2006):* Rear fresh water 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 rural communities in Jambi, 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 negative GDP growth rate of 1 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 more than 2.5 times in 2030 than that based on its current trajectory.[15]

---

14 See for example Wann and Rakestraw (1998) study of pine plantations in southern United States.
15 Forecasted Asia growth rate in fishing sector provided by Food and Agriculture Organization (FAO).

Box 3

Kerinci Sebelat National Park

Kerinci Sebelat National Park is one of the largest national parks in Asia with 360 species of birds, 4,000 flora species, and endangered animals like the Sumatra tiger, Sumatra rhino, and Sumatra elephant. However, transport concerns and a lack of tourism facilities are currently constraining growth. For example, there are currently no regular flight connections from Jambi city to Kerinci, a journey of around 10 hours by car.

5. *Financial services (1 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 2.5 percent of households currently have a loan, versus 5.3 percent nationally).[16] The Jambi 2006–2010 Development Plan also noted that investment credit for small businesses is currently very limited. Building on the existing efforts of local entities such as Bank Indonesia and Bappenas's PNPM, there is the opportunity to establish low-cost scalable distribution systems and use potential REDD financing to provide financial access and build financial literacy among the province's forest communities. Mexico's Diconsa program provides an interesting model that could be adapted to Jambi (Box 4). 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 (4.7 percent p.a.).

Box 4

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.

Combined, these seven sectors currently represent about 40 percent of the current output of Jambi and over two-thirds of employment. These sectors have the potential to drive Jambi's low-carbon development.

16 Indonesia Bureau of Statistics

5. Institutional enablers

Achieving successful low-carbon economic growth will require a significant transformation, both within government and within the broader society of Jambi. 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, Jambi 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.[17] A review of domestic and international delivery units reveals some lessons for Jambi 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., BRR, Morocco Economic Development Board, Guyana Presidential Delivery Unit)
2. Needs to include representatives from different levels of government (e.g., Brazil's Amazon Fund, Indonesia's Waclimad, and the Mega Rice Project)
3. Relationships and decision-making rights must be clearly defined between the new unit, 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, Bahrain's Economic Development Board)
5. Develop rigorous performance management around a few priority outcomes (e.g., Bahrain Economic Development Board)

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 40 percent of Jambi), 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. 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

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

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 Jambi seeks to recruit talent to manage its own institution.

This new institution will need to serve six broad functions to support low-carbon growth (Exhibit 8):

i. *Finance collection and distribution:* 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).

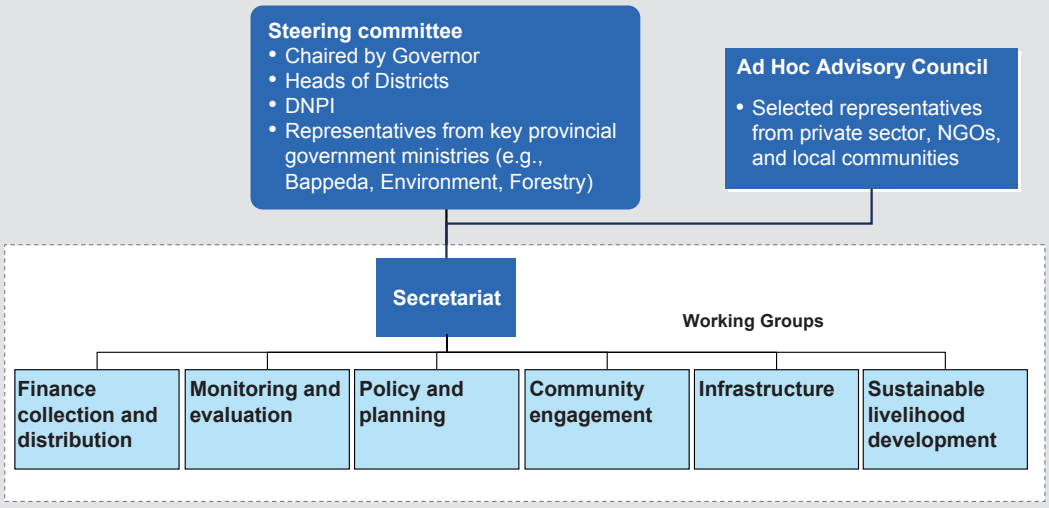
ii. *Monitoring and evaluation:* establish a province-level baseline and rigorous standards for monitoring, reporting, and verification (MRV).

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

iv. *Community engagement:* develop 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, promote behavioral change toward sustainable practices, develop new skills and build local community enforcement.

Exhibit 8 **Proposed organizational structure**

PRELIMINARY



v. *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.

vi. *Support sustainable livelihoods:* Develop strategies to support growth and attract investment for identified growth priorities.

The 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 (Exhibit 9). Whilst the 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, with reporting back to the steering committee (ideally on a monthly basis).

Exhibit 9

Suggested scope of responsibilities

PRELIMINARY

Sole responsibility
Joint responsibility (with existing gov't department)
No responsibility

	Develop strategy	Implement	Monitor results	Comments
Finance collection and distribution				• New sub-unit to ensure transparency and accountability; implementation shared with existing entities (e.g., PNPM)
Monitoring and evaluation				• New sub-unit as no existing government department has capacity to do detailed baselining and monitoring
Policy and planning				• Joint strategy development with relevant department • Set KPIs and monitor impact vs. target
Community engagement				• Joint strategy development with relevant department • Set KPIs and monitor impact vs target
Infrastructure				• Joint strategy development with relevant department • Set KPIs and monitor impact vs target
Sustainable livelihood development				• Joint strategy development with relevant department (e.g. BKPM) • Set KPIs and monitor impact vs target

SOURCE: Team analysis

i. Finance collection and distribution

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 Jambi's abatement initiatives. Second, revenue-sharing models that allocate funds to various stakeholders (including national, provincial, and district level governments, as well as project developers, individuals, and communities) will need to be established. Third, finances must be managed and distributed in a fair and transparent manner.

Funding from international carbon markets will take too long to enable Jambi to realize its ambitious emission reduction objectives for 2030. In the short term, interim funding from sources such as the Indonesian Climate Change Trust Fund, the Indonesian Green Investment Fund, the Forest Carbon Partnership Facility, (FCPF), the UN-REDD program, and bilateral programs will be critical to supporting Jambi'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.[18] 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).[19] 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 Government on where authority lies for decisions on REDD 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 Government approval before being sold.[20] 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 their 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), public disclosure of financial flows (BRR regularly opened the agency's balance sheet to the public

18 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.

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

20 "Report on Implementation of a Learning Workshop: Developing a Market for REDD in Indonesia," World Bank, January 2009.

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.[21]

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.

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.

Guiding principles for *attracting, managing and distributing 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); and
5. Establish clear ground rules and incentives for private sector engagement.

21 "Finance – Seven Keys to Effective Aid Management", BRR NAD-NIAS, April 2009.

ii. Monitoring and evaluation

A monitoring and evaluation 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).[22]

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.

Guiding principles for *monitoring and evaluation*:

1. Lower transaction costs of carbon projects by establishing a set of province-wide emission reduction project methodologies; and
2. Gradually evolve measurement approaches in-line with capabilities (e.g., start with basic proxies to assess reduction efforts).

iii. Policy and spatial planning

The most critical regulatory issues are resolving land tenure and title disputes and optimizing land use allocation through spatial planning. Based on historical annual increases in palm oil plantation acreage, by 2030, there will be 1.2 million hectares dedicated to palm oil production in Jambi. However there are roughly 1.8 million hectares of potentially available and suitable non-forested land (after allowing for growth in other crops) that could accommodate this growth. 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 landownership.

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.

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 tied closely 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.

---

22 "Radical simplicity in designing national climate institutions: Lessons from the Amazon Fund", December 2009 (Simon Zadek, Maya Forstater, Fernanda Polacow and João Boffino).

Guiding principles for *policy and spatial planning*:

- Ensure multi-stakeholder coordination (particularly local communities) in developing spatial planning and land titling approaches;
- Incorporate technology to properly assess economic costs / benefits of land allocation decisions;
- Ensure ease of access to land titling information (e.g., single, publicly available land registry); and
- 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.

iv. Community engagement

This working group will be responsible for developing 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. Community engagement needs to be supported by a clear plan to promote behavioral change toward sustainable practices.

An example of a program leveraging an existing community engagement and development program to support sustainable development is the BAPPENAS managed PNPM. 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.

Guiding principles for *community engagement*:

1. Ensure free and prior informed consent (FPIC) from local communities participating in carbon emission reduction projects; and
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).

v. 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, and education, health, 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 that need to be addressed:

- *Education:* Improving education levels is critical to enabling the transformation to a low-carbon growth path. As discussed in Section 3, post-primary school enrolment rates are currently low in Jambi. There are some interesting lessons from other countries that could be applied in Jambi to address this. The Brazilian Conditional Cash Transfer Program (Bolsa Familia) has 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 help support behavioral change.

- *Healthcare:* Access to healthcare is difficult in many parts of the province. Approximately half of people in Jambi do not currently access health care services.[23] Mobile health clinics, which have proven effective in providing access to health care in more remote regions in other countries, could be used in Jambi. 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.

- *Electricity:* Lack of access to a reliable supply of electricity is one of the key concerns raised by the private sector and households in Jambi. 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.

- *Transportation infrastructure:* Transportation infrastructure is also a concern, most notably roads, with Jambi having relatively low road density relative to its geography (9th lowest of any province in Indonesia). 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 investments and provide effective oversight of implementation. Such a body could be useful in Jambi 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.[24] 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 rigorous oversight from institutions such as the Supreme Audit Agency.[25]

Guiding principles for *infrastructure*:

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

vi. Support sustainable livelihoods

In order to transform Jambi 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

23 Indonesia Bureau of Statistics
24 "10 Management Lessons for Host Governments Coordinating Post-disaster Reconstruction", BRR NAD-Nias, 2009.
25 "Infrastructure – Stimulating the Triggering Sector", BRR NAD-NIAS, April 2009.

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

6. Required funding and potential sources

Jambi will require significant, near-term financial support to succeed in its plans to create low-carbon prosperity. In the first year, between USD 19 million and 39 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 373 million and USD 676 million in 2030, assuming capture of the full 55 Mt CO2e in potential abatement.

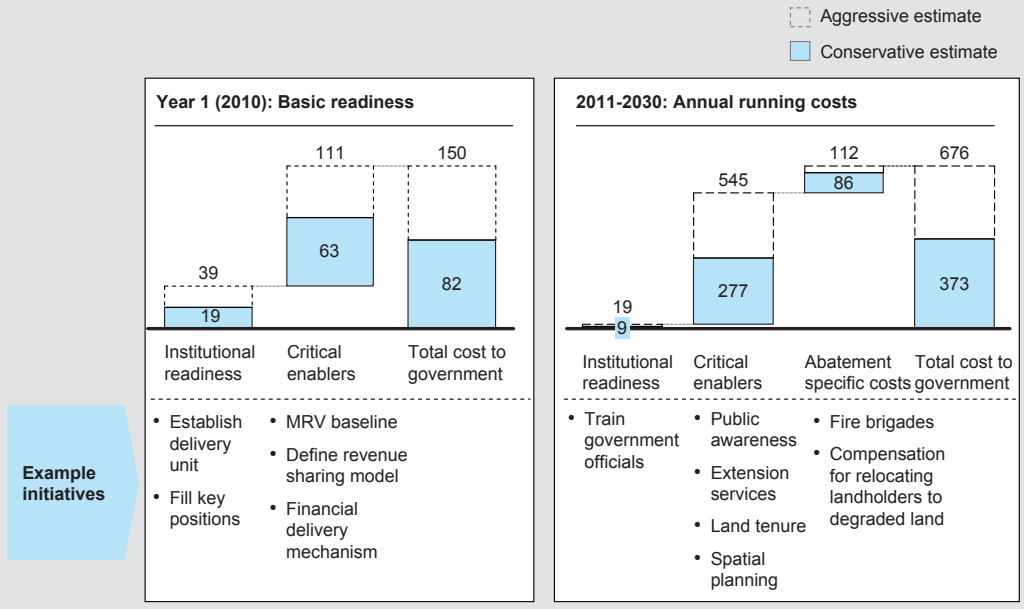
Although the overall required funding is substantial, the cost per tCO2e abated is relatively low. For example, in 2030, the full abatement cost per tCO2e abated (including implementation costs) ranges between USD 6.8 and 12.3. The McKinsey Global Cost Curve estimated the global average technical cost alone (i.e., excluding implementation costs) to be around USD 3.75 per tCO2e abated.

Exhibit 10

Total estimates of basic readiness and annual running costs

USD millions per year (2010-2030)

APPROXIMATION



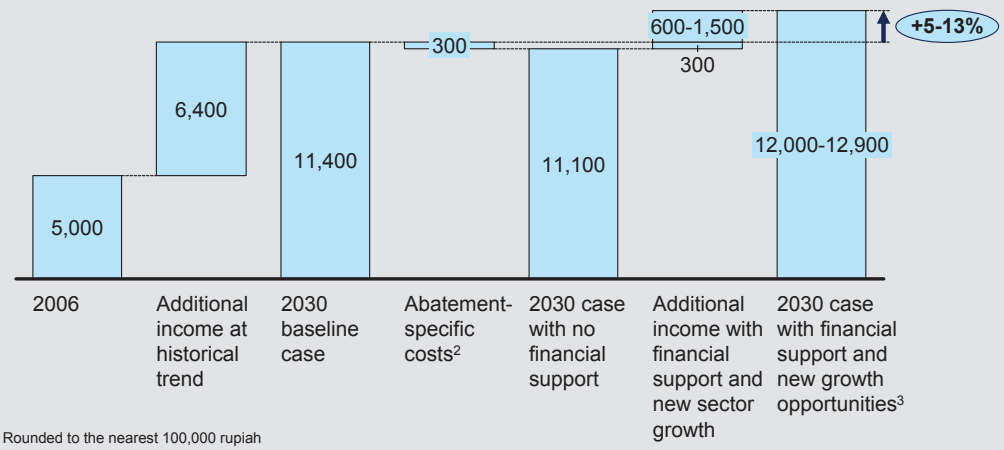
SOURCE: Team analysis

Exhibit 11

With the required financial support, average incomes could actually be 5-13 percent higher than in the base case

APPROXIMATION

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



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

Exhibit 12

The implementation will follow a phased approach

Current phase

Low carbon growth strategy → **Readiness funds** → **Basic readiness implementation** → **Additional readiness funds** / **Interim financing** → **Low carbon growth pilot**

Phase 1: Sep–Dec 2009

Develop a low carbon growth strategy that identifies:
- Major abatement opportunities in Jambi
- Opportunities for promoting sustainable livelihoods
- Critical enablers

Phase 2: Mar–Dec 2010

Phase 2a (Jan–Jun 2010)
- Establish legal powers for new delivery unit
- Finalize organizational design
- Staff key leadership positions
- Identify funding sources
- Develop detailed implementation plan and KPIs

Phase 2b (Jul–Dec 2010)
- Develop basic MRV systems, including province baseline
- Develop financial distribution mechanisms
- Finalize community engagement mechanism
- Roll-out of "readily available" abatement initiatives

Phase 3: Jan–Dec 2011

Roll out pilot program once readiness program has been completed

Continue **roll-out of "readily attainable" abatement initiatives**

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 around 3 percent in Jambi due to a slowdown of carbon-emitting sectors and the costs of implementation. [26]

However, with the required financial support and assuming successful capture of the new sector growth opportunities, average (real per capita) incomes in 2030 in Jambi could actually be increased by around 5 to 13 percent above the base case (Exhibit 11).[27]

7. Implementation approach

Given the significant transformation required to achieve low-carbon growth, a phased approach is proposed (Exhibit 12).

Phase 1 – Define the low-carbon growth strategy (Sep–Dec 2009): 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 has two sub-phases:

- *Phase 2a (Mar–Jun 2010):* Legally establish the new climate change delivery unit, finalize its organizational design (including establishing reporting and decision-making processes), staff key leadership positions, identify and obtain readiness funding, and define 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.
- *Phase 2b (Jul–Dec 2010):* Build the basic supporting mechanisms to support low-carbon growth. These include refining the financial delivery mechanisms and MRV methodology. In parallel, in order to ensure quick impact, support government departments in rolling out Horizon 1 abatement initiatives (i.e., those abatement opportunities that are readily achievable given their low cost and ease of capture).

Phase 3 – Pilot low-carbon growth initiatives (Jan 2011–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.

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.

26 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).
27 Annex 5 provides an overview of the methodology used to estimate the economic impact of the low-carbon growth strategy.

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 Jambi'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 Jambi 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.

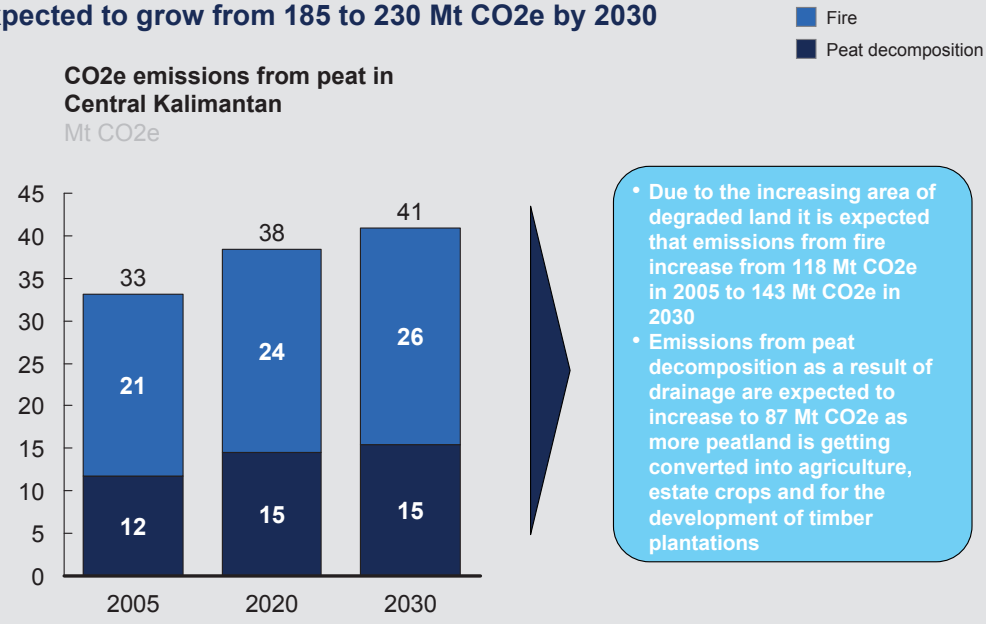
3. **Use of net emissions for LULUCF.** Estimates of emissions from LULUCF are reported as net emissions, i.e., they measure the carbon loss directly resulting from deforestation, forest degradation, and forest fires, adjusted for the re-growth of secondary natural forests, managed forests after harvesting,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

   The majority of emissions in Jambi 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 A1–4.

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%

SOURCE: IFCA; Min. of Forestry Indonesia; Hooijer et al 2006- PEAT CO2e; Alterra; Wetlands International; Expert interviews; Couwenberg et al 2009; Van der Werf et al 2008; Team analysis

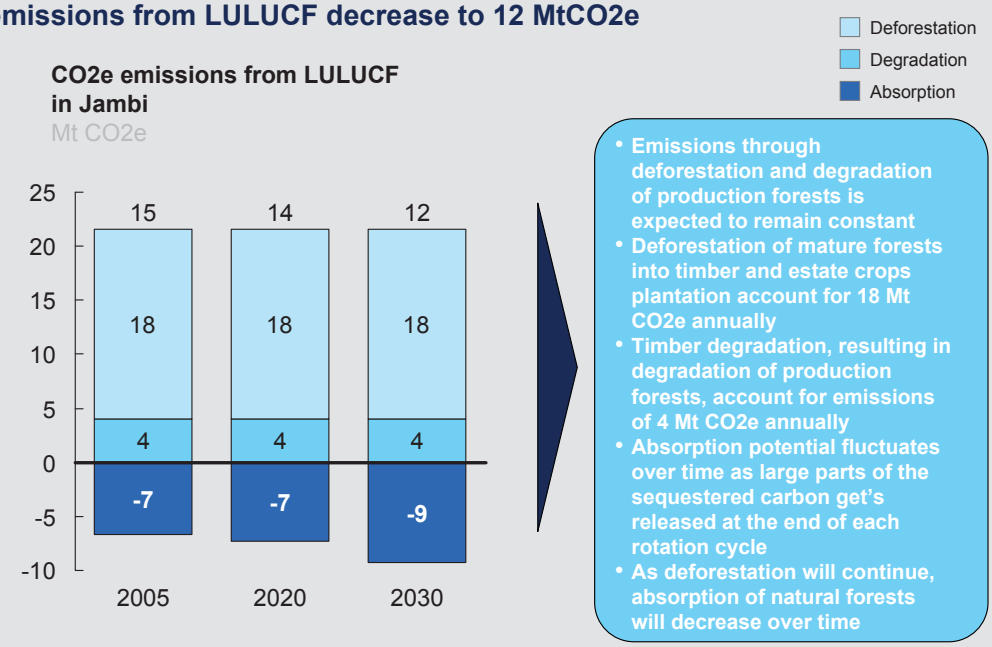
Exhibit A2

Peat BAU: 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 • Jambi'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: As absorption of "man-made" forest will increase over time, emissions from LULUCF decrease to 12 MtCO2e



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

Exhibit A4

LULUCF BAU: assumptions

	Methodology	Assumptions	Source
Deforestation	• Area of annual deforestation (2000-2005 average) multiplied with carbon density of Jambi's forests.	• Deforestation rate remains, at a minimum, constant at 25,000 ha per year • Average carbon density of 190 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 630,000 ha • Rotation period is 35 years • Average carbon density is 190 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

A2. Estimating abatement potential

This study focuses on abatement opportunities costing less than USD 80 per ton of CO2 equivalent (tCO2e). 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. For example, fuel consumption can be reduced by 70 percent by improvements to passenger vehicles. This leads to an abatement 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. (Exhibit A5).

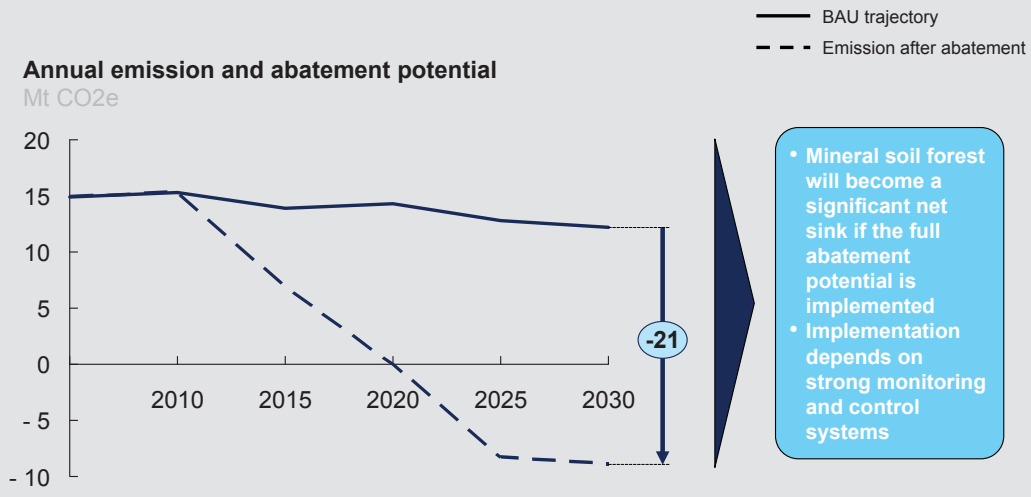
A3. Peat-related emissions

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

Exhibit A5

Large parts of Jambi's emissions reduction from the forestry sector could be achieved in relatively short time

LULUCF EXAMPLE



SOURCE: Team analysis

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 sized non-peat soil). If the total carbon stored in peat (528 Gt) was 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 CO2 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 CO2 being released into the atmosphere (as 50 percent to 60 percent of the peat dry matter is carbon)

2. **Fire** in degraded peatland results in further CO2 emissions; fire in non-degraded and non-drained peatlands is extremely rare because of their naturally high moisture content

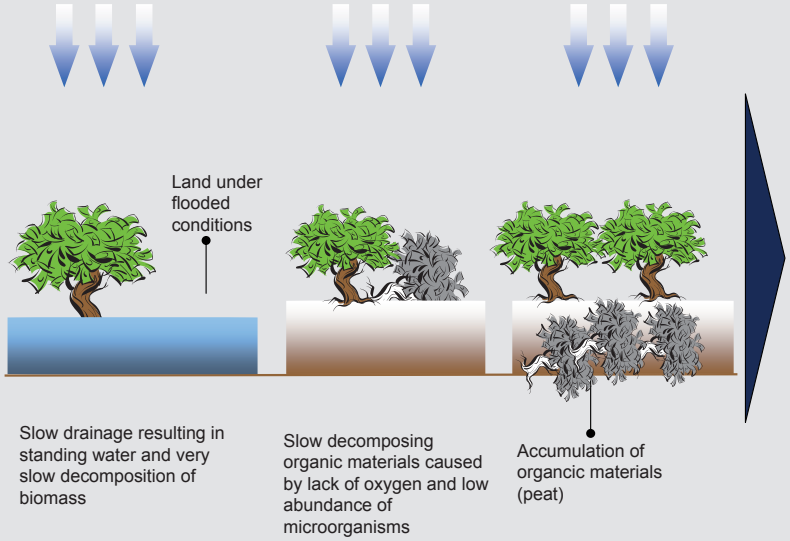
In addition, as peatlands are often covered with forest, their exploitation usually goes together with deforestation of the area, exacerbating the CO2 impact.

Indonesia has the largest area of tropical peatland of any 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, agriculture, and to supply the forest products industry with raw materials. As a result, despite having 5 percent of the total global peatlands, Indonesia accounts for almost 60 percent of total estimated global emissions from peat decomposition (Exhibit A8).

Exhibit A6

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

ILLUSTRATIVE



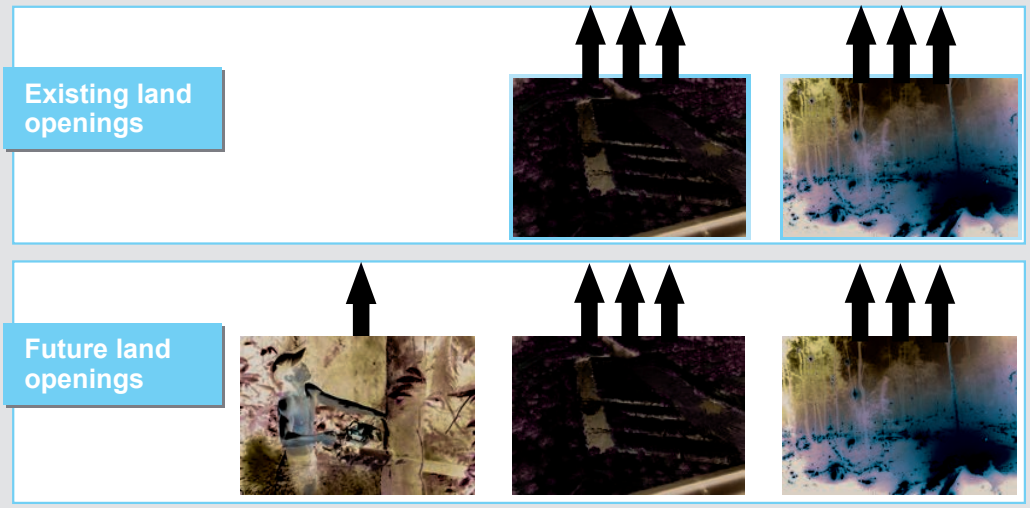
- Indonesian peat stores 36 Gt of carbon (132 Gt of CO_2e) at present below ground
- Peat forest store 4,2 Gt of carbon (15 Gt CO_2e) above ground
- As a comparison, the world's largest rainforest, the Amazon, stores 46 Gt of carbon (168 Gt of CO_2e)

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

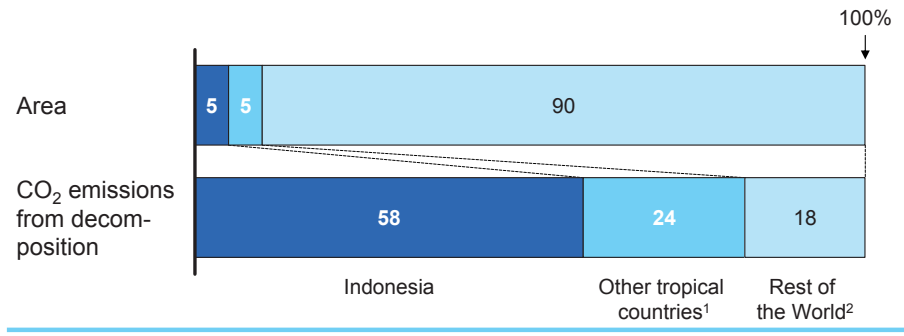


SOURCE: DNPI Indonesia GHG Abatement Cost Curve

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
- Topical 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

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[28] 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.

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

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

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 an inverted U-curve approach the abatement potential of water management will change and likely will become smaller than estimated for this report

4. Thickness of peat layer

While the extent of the Indonesian peatland area, the carbon content of peat, and the average bulk density of peat in Indonesia 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. 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 opportunity or 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) 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 don't 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 in Central Kalimantan, 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 Jambi.

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

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 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 Revitalization for the Ex-Mega Rice Project Area and extrapolated for the total area of Jambi..

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

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 Jambi has to meet Tier 3 standards: the low-end cost estimate is based on the assumption the Jambi 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 Jambi 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 Jambi 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 (45% of total costs).

4. **Policy and spatial 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 Jambi 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 $80 per hectare covered (including infrastructure costs) and in the case of Jambi 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 Jambi'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 sustainable livelihood sector strategies 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 extrapolated for the entire province. These costs include programs focused on agricultural extension, formation of cooperatives and small enterprises and increasing local processing of goods. Additional costs added to this include strengthening the provincial Investment Coordination Board (BKPM) 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 this low-carbon growth (i.e., above and beyond the costs that government or the private sector would incur in their usual activities). For enablers such as infrastructure, estimating

the incremental costs can be extremely challenging, and for these cost items, we have relied on a combination of "outside in" analysis, combined with local expert interviews.

A5. 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 trend toward best-in-class benchmark growth rates identified for each sector

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

Exhibit A9

Overview of Jambi economic model outputs

Trillion Rupiahs[1], constant 2000

	Current GDP (% share of total)	2030 BAU GDP (% share of total)	2030 Climate compatible growth scenarios (low)	(high)	CCG scenarios gap to BAU (%)
Estate crops	1,800 (13.2%)	7,200 (15.5%)	7,400	7,800	3 - 9
Agriculture	1,500 (11.6%)	5,400 (11.8%)	5,500	5,800	1 - 6
Forestry, paper, and wood products	300 (9.5%)	100 (3.5%)	400	500	231 - 298
Tourism	200 (1.6%)	900 (1.9%)	1,200	2,500	44 - 186
Financial services	100 (1.4%)	1,000 (2.1%)	1,600	3,300	64 - 154
Aquaculture	200 (1.3%)	100 (0.3%)	400	400	162

1 Rounded to the nearest 100 trillion rupiah
SOURCE: Team analysis

Below are the detailed assumptions used for each of the 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.

1. Estate crops on non-forested land

- Current GDP contribution split by crop value – 62 percent palm oil, 35 percent rubber, 3 percent other.[29]

Yield assumptions (Palm oil)

- Historical yield growth 7 percent p.a. (2003–2006) and current (2006) yield of 3.4 t/ha (tons per hectare) – 8 percent below Malaysia yield of 3.7 t/ha.
- *Base case scenario:* Assume sustainable continued growth to 5.5 t/ha in 2030 (implied growth rate of 2 percent p.a.), matching Malaysia's historical growth rate (Malaysia projected to grow at 2 percent p.a. to reach 5.9 t/ha in 2030).
- *Conservative CCG scenario:* Current yield rate grows to 5.7 t/ha (growth rate of 2 percent p.a. until 2011, then 2.1 percent p.a. until 2030), which is 5 percent below absolute yield projection of Malaysia (which is projected to grow at 2 percent p.a. from 3.7 t/ha in 2006 to 5.9 t/ha in 2030).
- *Aggressive CCG scenario:* Current yield rate grows to 5.9 t/ha (growth rate of 2 percent p.a. until 2011, then 2.3 percent p.a. until 2030), to match the absolute yield projection of Malaysia.

Area assumptions (Palm oil)

- Historical growth 8 percent p.a. (2003–2006); current area in 2006 of approximately 570,000 hectares.
- For all three scenarios, assume growth to 1.2 million hectares, based on 2003–2006 growth of approximately 28,000 hectares per year. There is 1.8 million hectares of suitable non-forested land (defined by the Ministry of Forestry as "not critical", "potentially critical", and "somehow critical") available, so 1.2 million hectares in 2030 appears viable. Historic growth unreasonable since if growth continues at this rate (i.e., 8 percent p.a.), over 60 percent of Jambi's land will be occupied by palm oil plantations by 2030.
- Main difference between the scenarios is that the area will come from different sources – area in base case scenario assumed to come from expanding into forested areas; while in the CCG scenarios, the area comes from the usage of degraded land, resulting in different emission levels.

Yield assumptions (Rubber)

- Historical yield growth of 10 percent p.a. (2003–2006); current (2006) yield of 0.8 t/ha – 10 percent below Malaysia (0.9 t/ha).
- *Base scenario:* Grow at 0.22 percent (Malaysia projected growth rate), resulting in 2030 yield of 0.86 t/ha.
- *Conservative CCG scenario:* Reach 5 percent below Malaysia's 2030 projected yield rate, i.e., end up with yield of 0.92 t/ha (growth at 0.23 percent p.a. until 2011, then growth rate of 0.59 percent p.a.).
- *Aggressive CCG scenario:* Match Malaysia's 2030 projected yield rate (2030 implied yield of 0.97 t/ha at growth rate of 0.23 percent p.a. until 2011, then growth rate of 0.73 percent p.a.).

29 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 (Rubber)

- Historical (2003–2006) growth of 1 percent p.a.; current (2006) area of approximately 430,000 hectares.
- For all three scenarios, assume continued growth at 1 percent p.a. to ~512,000 hectares in 2030.

Other Estate crops

- Assume match of overall historical GDP growth in agriculture (2003–2006) of 5 percent p.a.

2. Food crops on non-forested land

- Rice production represents 95 percent of the total value of food crops in Jambi. Scenarios are therefore based on forecasts for this food crop (scaled appropriately to equal sector GDP).
- Historically, GDP has grown by 5 percent p.a. (2003–2006).
- *Base case scenario:* Assumes continue historical growth trend

Yield assumptions

- Historical growth in yields of 2.2 percent p.a. (2003–2006).
- Current yield of 3.9 t/ha (73 percent of East Java yield of 5.3 t/ha).
- *Base case scenario:* Assume maintaining yield growth rate going forward (2.2 percent) to 6.5 t/ha in 2030.
- *Conservative CCG scenario:* Current yield rate grows at historic growth rate (2.2 percent) for five years, then at 2.3 percent (to match 95 percent of East Java's projected 2030 yield rate) to 6.6 t/ha (implied overall growth rate of 2.3 percent p.a.) in 2030.
- *Aggressive CCG scenario:* Current yield rate of 2.4 t/ha grows at historic growth rate (2.2 percent) for 5 years, then by 2.5 percent (to match East Java's projected 2030 yield rate) to reach 6.9 t/ha (implied growth rate of 2.5 percent p.a.) in 2030.

Area

- For all three scenarios, assume constant area for paddy plantations of 140,000 ha.

3. Sustainable forestry

- Historically, GDP has grown by -3 percent p.a. (2003–2006).
- *Base case scenario:* Assumes continue 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 percent (to 13 t/ha) by 2030 (constant yield rate for five years then growth rate of 2 percent p.a., implied growth rate of 1.6 percent), based on increased yield from sustainable forestry practices.
- *Aggressive CCG scenario:* Yield doubles (to ~16 t/ha) by 2030 (constant yield rate for five years then growth rate of 3 percent p.a., implied growth rate of 2.4 percent), based on sustainable forestry practices.[30]

30 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 climate-compatible growth scenarios

- Assume no change from number of hectares in 2006.

4. Eco-tourism

- Historic GDP growth (2003–2006) of 6 percent p.a.
- *Base case scenario:* Assume continued growth of 6 percent p.a.
- *Conservative CCG scenario:* Assume continued GDP growth of 6 percent p.a. until 2011, then 8 percent p.a. based on average of Costa Rica growth rates.
- *Aggressive CCG scenario:* Assume continued GDP growth of 6 percent p.a. until 2011, then 12 percent p.a. growth based on historical growth in tourists in Bali and Phuket.

5. Financial services

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

6. Aquaculture

- Historic (2003–2006) GDP growth of -1 percent p.a.
- *Base case scenario:* Assume continued growth of -1 percent p.a.
- *Conservative and aggressive CCG scenarios:* Assume continued growth of -1 percent p.a. until 2011, then match FAO Asia average (ex. China) of 4.4 percent p.a. until 2030.

Bibliography

Cross sector

- **Indonesia's Technology Needs Assessment on Climate Change Mitigation,** Ministry of Environment, March 2009
- **The Economics of Climate Change in Southeast Asia: A Regional Review**, Asian Development Bank, April 2009
- **Pathways to a Low-Carbon Economy : Version 2 of Global Greenhouse Gas Abatement Cost Curve**, McKinsey and Company, 2009
- **Payment Mechanism, Distribution and Institutional Arrangement: Second Draft**, IFCA, October 2007
- **Indonesia Low Carbon Option study: Phase 1 Status: Report and Findings, Ministry of Finance and World Bank**, November 2008
- **Pathways to a Low-Carbon Economy for Brazil**, McKinsey and Company
- **Climate Change & Fiscal Policy Issues: 2008 Initiatives**, Fiscal Policy Office Ministry of Finance Republic of Indonesia, December 2008
- **Identifying optimal area for REDD intervention: East Kalimantan, Indonesia as a case study**, Nancy L Harris, Silvia Petrova, Fred Stolle and Sandra Brown, IOP Publishing LTD, September 2008
- **Master Plan for Rehabilitation and Revitalisation of the EMRP Area**, Main Synthesis Report, October 2008
- **10 Management Lessons for Host Governments Coordinating Post-disaster Reconstruction**, The Executing Agency of Rehabilitation and Reconstruction for Aceh and Nias (BRR NAD-NIAS), 2009
- **Infrastructure: Stimulating the Triggering Sector,** The Executing Agency of Rehabilitation and Reconstruction for Aceh and Nias (BRR NAD-NIAS), April 2009
- **Education, Health, Women Empowerment: Preparing Quality Generation,** The Executing Agency of Rehabilitation and Reconstruction for Aceh and Nias (BRR NAD-NIAS), April 2009
- **Finance: The Seven Keys to Effective Aid Management,** The Executing Agency of Rehabilitation and Reconstruction for Aceh and Nias (BRR NAD-NIAS), April 2009
- **The costs of REDD: lessons from Amazonas**, IIED briefing paper, November 2009.
- **The Development Study on Comprehensive Regional Development for the Western Part of Kalimantan**, Executive Summary, Japan International Cooperation Agency, March 1999
- **Report on Implementation of a Learning Workshop: Developing a Market for REDD in Indonesia**, World Bank, January 2009
- **Radical simplicity in designing national climate institutions: Lessons from the Amazon Fund,** Simon Zadek, Maya Forstater, Fernanda Polacow and João Boffino, December 2009

Agriculture

- **Adapting to Climate Change: The Case of Rice in Indonesia**, World Bank, 2008
- **Yearly report: Research and Development for Agricultural Land Resources, Ministry of Agriculture**, 2008
- **FAOSTAT Agricultural Data,** http:// faostat.fao.org/, FAOSTAT, 2007, May 2009
- **Indonesia Forestry Statistics**, Ministry of Forestry, 2007
- **Guidelines for National inventory - AR4 -WG3 Chapter 8: Agriculture,** Cambridge University Press, IPCC, 2007
- **Global Anthropogenic Non-CO2 Greenhouse Gas Emissions,** USEPA, 1990-2002 2006
- **Greenhouse Gas Mitigation Potential in U.S. Forestry and Agriculture,** USEPA,, EPA 430-R-05-006, 2005
- **Inventory of U.S. Greenhouse Gas Emissions and Sinks**, USEPA, 1990-2005, 2006
- **Peat CO2: Assessment of CO2 Emissions from Drained Peatlands in SE Asia, WL Delft Hydraulics**, Alterra, Wetlands International, 2006
- **Peatlands: Potential for Agriculture and Environmental Aspect, Ministry of Agriculture,** European Union, ReGrin, ICRAFT, 2008
- **Master Plan for the Rehabilitation and Revitalization of the Ex-Mega Rice Project Area in Jambi : Summary of Main Synthesis Report**, Euroconsult Mott MacDonald and Deltares, October 2008

LULUCF and peatland management

- **Methodology for Monitoring and Setting Baseline for Deforestation and Forest Degradation**, IPCC
- **Towards the Inclusion of Forest-Based Mitigation in A Global Climate Agreement: Project Catalyst**, The Climate Works Foundation, May 2009
- **Climate Regulation of Fire Emission and Deforestation in Equatorial Asia**, G.R. Van der Werf, J. Dempewolf, ect PNAS Vol.51, December 2008
- **Consolidation Report Reducing Emission From Deforestation And Forest Degradation in Indonesia**, IFCA, Forestry Research and Development Agency (FORDA), Ministry of Forestry, 2007
- **Manual for the Control of Fire in Peatlands and Peatlands Forest. Climate Change, Forests and Peatlands in Indonesia Project**, Adinugroho W.C., I Nyoman N. Suryadiputra, Bambang H. Saharjo, and Labueni Siboro, Wetlands International – Indonesia Programme and Wildlife Habitat Canada, 2005
- **Reducing Emission from Deforestation and Forest Degradation (REDD): An Option Assessment Report**, Meridian Institute, March 2009
- **A Guide to the Blocking of Canals and Ditches in Conjunction with the Community. Climate Change, Forests and Peatlands in Indonesia** Suryadiputra, I N.N., Alue Dohong, Roh, S.B. Waspodo, Lili Muslihat, Irwansyah R. Lubis, Ferry Hasudungan, and Iwan T.C. Wibisono, Project. Wetlands International – Indonesia Programme and Wildlife Habitat Canada, 2005
- **Determination of Eligible Lands for A/R CDM Project Activities and for Priority Districts for Project Development Support in Indonesia**, Murdiyarso, D., Atie Puntodewo, Atiek Widayati, Meine Van Noordwijk,Center For International Forestry Research (CIFOR), 2006

- **Strategies for Implementing Sustainable Management of Peatlands In Borneo**, Wosten, H, European Commission INCO-DEV, 2005
- **Do Trees Grow On our Money? The Implications of Deforestation Research Policies To Promote REDD**, Kanninen, M. Daniel Murdiyarso, Frances Seymour, Arild Angelsen, Sven Wunder, Laura German, Center For International Forestry Research (CIFOR), 2007
- **PEAT-CO2**, Hooijer et al., Delft Hydraulics, 2006
- **Cost of Avoiding Deforestation**, Grieg-Gran. M, International Institute for Environment and Development, 2006
- **The Economic Value of Peatland Resources**, Van Beukering et al, Wetlands International, 2008
- **State of World Forests – Indonesia,** Matthews. E, World Resource International, 2002
- **Deforestation, Forest Degradation, Biodiversity Loss and CO2 Emissions in Riau, Sumatra, Indonesia**, Uryu et al., WWF, 2007
- **Climate Change**, Financing Global Forest; Eliasch Review, 2008
- **Review of Carbon Flux Estimates and Other GHG Emissions From Oil Palm Cultivation on Tropical Peatlands**, Verwer et al., Alterra, 2008
- **Climate Regulation of Fire Emission and Deforestation in Equatorial Asia**, Van der Werft et al., PNAS, 2008
- **Forestry Executive Data Strategic ,** Forest Planning and Statistic, Forest Planology Agency, Ministry of Forestry, 2008.
- **Forestry Statistics of Indonesia, 2007**, Forestry Planning and Statistic Agency, Forestry Planology Agency, Ministry of Forestry
- **Maps of Peatland Distribution, Area and Carbon Content in Papua**, Wahyunto, Bambang Heryanto, Hasyim Bekti dan Fitri Widiastuti (2006). Wetlands International – Indonesia Programme and Wildlife Habitat Canada, 2000–2001
- **Maps of Peatland Distribution, Area and Carbon Content in Kalimantan**, Wahyunto, S. Ritung dan H. Subagjo (2004). Wetlands International – Indonesia Programme and Wildlife Habitat Canada, 2000–2002.
- **Maps of Peatland Distribution, Area and Carbon Content in Sumatera**, Wahyunto, S. Ritung dan H. Subagjo (2003). Wetlands International – Indonesia Programme and Wildlife Habitat, 1990–2002
- **Climate Change, Forests and Peatlands in Indonesia**, Wahyunto, S. Ritung, Suparto, H. Subagjo, Wetlands International – Indonesia Programme and Wildlife Habitat Canada, 2005
- **Statistics of Timber Culture Estate**, Bureau of Statistic, 2006
- **Statistics of Timber Concession Estate**, Bureau of Statistic, 2006
- **Statistics of Timber Concession Estate**, Bureau of Statistic, 2004
- **Forest Inventory and Maps,** Forest Planology Agency, Forest Resources Monitoring, Ministry of Forestry, 2008
- **Environment Statistics Of Indonesia***,* Bureau of Statistic*,* 2008
- **Final report and Recommendations for Master Plan to Deal with Land and Forest Fires for Muaro Jambi Regency,** Singapore National Environment Agency, Jambi Province and Asia Pacific Resource International Ltd, August 2009

Power

- **Electricity for All: Options for Increasing Access in Indonesia**, World Bank, 2005
- **Energy Information Administration, Country Analysis Brief: Indonesia,** www.eja.doe.gov, 2007
- **Key Indicators of Indonesia Energy and Mineral Resources,** Center for Data and Information on Energy and Mineral Resources (PUSDATIN ESDM). 2007
- **Indonesia Power Report Q1 2008 Including 5-year Industry Forecasts,** Business Monitor International, 2007
- **Indonesia Energy Statistics and Balances in the IEA Databases, Training Session Coal Statistics,** Mr. Jérôme Garcia, NMC Section, Energy Statistics Division, 2008
- **Carbon Capture and Storage – Financing Challenges and Opportunities, Investment Drivers, Incentives and Financing Options - The Role of Developing Countries,** Hardiv Situmeang, 2008
- **Geothermal Today,** US Department Of Energy, 2005
- **EU-Indonesia Infrastructure Forum: Indonesian Power Sector,** European Business Chamber of Commerce in Indonesia, 2006
- **Presentation on the Policy for Indonesia Sustainable Development,** Zuhal.
- **Presentation on Indonesia Country Report,** National Nuclear Agency of Indonesia**,** Tri Murni Soedyartomo Soentono, 2008
- **Indonesia Country Report Annex 3, From Ideas To Action: Clean Energy Solutions For Asia To Address Climate Change**, International Resources Group (IRG), 2007
- **Projection CO2 Sources For Power Sector (For Discussion Only,** CSS-Working Group PLN, 2009
- **Presentation for the Community Based Educational and Partnership Actions - Carbon Neutral Initiative for Community Empowerment and Climate change Mitigation in Indonesia,** Teddy Lesmana, 2008
- **Electricity Governance Initiative: Case of Indonesia, Final Report,** World Resource Institute, 2007.
- **Power Generation Cost Assumption,** International Energy Agency, 2007

Cement

- **Mitigation Approach of Climate Change in Industry,** Agency of Industrial Research and Development, Ministry of Industry, 2008
- **Status of Efforts on CO2 Emission Reductions for Industry Sector,** Ministry of Industry, 2009
- **Statistical Yearbook of Indonesia 2008**, Bureau of Statistics, 2008
- **Annual Report Highlights 2008**, PT.Holcim Indonesia
- **Annual Report Highlights 2008,** PT.Semen Gresik
- **Annual Report Highlights 2008,** PT. Indocement
- **WBCSD CO2 Inventory Form**, PT.Holcim Indonesia
- **WBCSD CO2 Inventory Form,** PT.Indocement

- **McKinsey GHG Abatement Cost Curve V2.0,** McKinsey & Company, 2009

Transport

- **Emission Factors**, swisscontact, 2005
- **Promoting Green Diesel Technology and Introducing Green Diesel Passenger Cars in Indonesia – Executive Summary and Summary of Recommendation,** PUSTRAL UGM, 2007
- **Clean Air Jakarta – Project Implementation Report For Clean Bus Program,** Swisscontact
- **Final Report Clean Bus Program Phase II 1999–2000,** Swisscontact
- **Implementation Report CAP Jakarta Phase III 2001–2003,** Swisscontact
- **Fuel economy and & Vehicle Kilometers Traveled,** Swisscontact
- **Lampiran & Asumsi Update November 2008, PUSTRAL UGM, 2008.**
- **Urgensi Paket Kebijakan Dan Program Komprehensif Dalam Penghematan BBM Transportasi,** Tim Pemantauan dan Evaluasi Kinerja Transportasi Nasional (TPEKTN), 2008
- **Vehicle Emission Per Sub-Category,** Swisscontact.
- **Averting an Infrastructure Crisis: A Framework For Policy And Action,** The World Bank**,** 2004
- **Potential for Biofuels for Transport in Developing Countries**, ESMAP, 2005
- **Energy Efficiency and Climate Change Considerations for On-road Transport in Asia,** ADB-DFID, 2006
- **APEC Biofuels Task Force: Initial Findings and Next Steps Forward,** NIST, Brazilian National Institute of Metrology, and INMETRO, 2007
- **Palm Oil in Biodiesel- A Green energy Perspective,** Greenenergy

Building

- **Technical Potential to Reduce Fossil Fuel Usage Through Solar Water Heating,** National Renewable Energy Lab (NREL)**,** 2007
- **“LED Sector: The Future’s Bright, The Future’s Green”**, Daiwa Analyst Report, 2007
- **“The Potential To Lower Global Lighting Energy Consumption”,** IEA: Presentation by Paul Waide.
- **“Daylight, Dimming, and The California Electricity Crisis” LBNL,** Rubenstein, Neils, and Colak, 2001