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Renewable
Energy



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**Biofuel Policy and Strategy
Recommendations for Lao PDR**

Vientiane

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Lao Institute for Renewable Energy

LIRE

For

Department of Electricity (DOE)

Ministry of Energy and Mines (MEM), Lao PDR

Biofuel Assessment Study in Lao PDR:

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1. Introduction

As a result of increasing concerns for energy security since 2006 due to the rising price of imported fossil fuels, the GoL established an Ad hoc Committee for the Formulation of National Strategy on Bio-fuel Energy, chaired by the Vice Minister of the Ministry of Energy and Mines (MEM) with participation from the Prime’s Minister Office (PMO), Ministry of Public Works and Transport (MPWT), Ministry of Agriculture and Forestry (MAF), Ministry of Industry and Commerce (MIC), Ministry of Finance (MoF), Ministry of Education (MoE), National Authority for Science and Technology (NAST), and Water Resource and Environment Administration (WREA). In parallel, the GoL has issued the following legislation:

Resolution of the VIII General Congress of the Lao Revolutionary Party, 2006 - Section 5.1. : Development Plan for Industrial Sectors (pp 114-116 Lao language)

Decree of the Prime Minister’s Office on Fuel Saving No. 09/PMO, 25 May 2006

MEM Policy on Fuel Saving and Promotion of Biofuel Production in Lao PDR, Non-official draft, 20 October 2006

The present document offers a concise set of recommendations for biofuel policy and strategy in the Lao PDR, based upon the findings of a rapid six-month baseline assessment and impact analysis completed in December 2009. The study was undertaken by the Lao Institute for Renewable Energy, LIRE, under the direction of the Department of Electricity (DoE), MEM. The key desired features of the draft biofuel policy are that it will be prepared in close collaboration with the Ministry of Agriculture and Forestry in order to reflect its potential role and effects on rural development, and that it should also take into consideration the targets and pillars of the NGPES, namely economic growth, socio-cultural development and environmental preservation. These recommendations aim to ensure the development of a balanced and comprehensive biofuel policy.

2. Current Situation

Energy consumption

Energy consumption in the Lao PDR is dominated by traditional utilization of biomass (fuel wood) for cooking and heating; in rural areas it accounts for 69% of consumption per capita. National energy consumption is presented by sector and by energy source in *Figure 1* and *Figure 2* respectively.

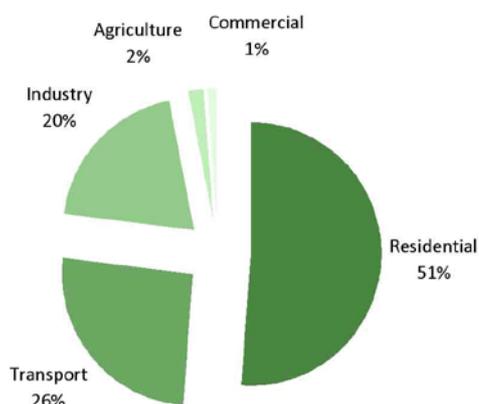


Figure 1: Energy Consumption by Sector

(Source: ADB, in LIRE 2008)

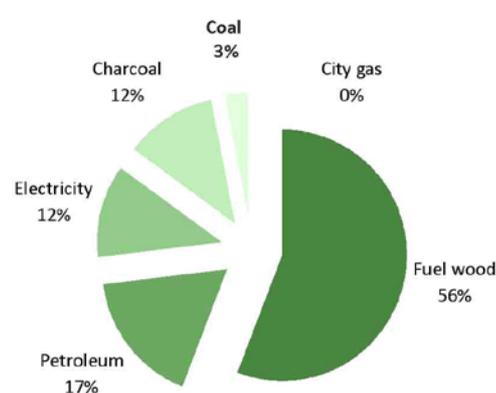


Figure 2: Energy Consumption by Resource

(Source: ADB, in LIRE, 2008)

As a landlocked nation with no indigenous production of petroleum fuels, the Lao economy is vulnerable to fluctuations in the price of the fossil fuels it imports. Nationwide, fossil fuel is mostly

used for transport; in rural areas, diesel is also widely used for lighting, electricity generation (50% of the population in 2008 did not have access to national electricity grids), and productive uses (such as water pumping and rice mills). Compounded with higher diesel prices in rural areas, poor access to energy represents a major constraint for the development of isolated communities. Moreover, the **rural poor are most affected by fluctuations in the price of fossil fuels.**

Fossil fuel consumption in the Lao PDR is rising rapidly. In 2006 Lao PDR imported 450 million litres of fossil fuel, this rose to 558 million litres in 2008. According to the MEM from 2000-2004, the number of vehicles increased tenfold from 51,000 in 2000 to 557,000. The transport sector consumed 165 million litres of gasoline and 365 million litres of diesel in 2008. In the same year there was 631 million litres of fossil fuels used for transport, 16 million litres for agriculture and 10 million litres for industry.

The MEM estimated that fuel consumption in 2010 will be 561 million litres, and to increase to 716 million litres by 2015. Imports are estimated to rise to 914 million litres by 2020. An alternative projection, based on fossil fuel imports of the Lao State fuel Company, suggests future consumption could be much higher: 831 million litres in 2015 rising to 1,166 million litres in 2020.

The Lao biofuel sector in 2009

Thanks to investment from various parties, by 2009 the Lao PDR had an emerging biofuel sector. At that time there were few assurances to suggest that biofuel development would achieve government targets, nor proceed in accordance with the objectives of national development. The private sector was playing a major role in terms of biofuel feedstock production, especially *Jatropha Curcas*. However, **without a favourable market for local biofuel processing and utilisation, the majority of feedstock would be exported overseas.** Although this may have macro-economic benefits for the Lao PDR, there would be no impact upon fossil fuel consumption. Cultivation of *Jatropha* in 2009 is summarized in *Table 1*.

Table 1: *Jatropha* cultivation in 2009. Source: LIRE Biofuel Assessment and Policy recommendations 2009

Investment	49,991,800 USD
Area recorded in 2009	26,057 ha
Area planned in 2020	334,750 ha
Plantation age	1-3 years old
Total yield up to 2009	1.478 tons
Farm gate price	735 LAK
Contract farming 2+3 model	86.1 %
Contract farming 1+4 model	13.5 %
Plantation model	< 1%

Several isolated biofuel development initiatives have been instigated by GoL, with focus given to *Jatropha*. In Vientiane Municipality, the NAST Bio-Energy Research & Development Project (BERDP), funded by Mekong Agro-Industry Co. Ltd, comprised a 20ha plot of trial plantations. The Lao State Fuel Company operated two R&D sites in the same province. In Luang Prabang, the Provincial Department of Industry (PDI) is promoting cultivation of *Jatropha* and Stone *Jatropha* cultivation. In addition public institutes and associations involved in research and promotion activities on feasible feedstock crop production.

Despite **negligible production of biofuel in 2009**, a few laboratory-scale demonstration and research facilities have been installed. One such system was constructed by TRI, using waste-cooking oil as feedstock. One fully automatic batch system has been installed at the NSC research site, KM14. The

Faculty of Engineering (FoE) in Vientiane, National University of Laos (NUOL), has laboratory items and chemicals available to conduct biodiesel production for training and teaching purposes. There are **no fuel-grade bioethanol processing facilities**, however FoE is equipped with basic distillation laboratory equipment which could be used to train and teach basic bioethanol production.

Commercial viability and financial benefit of biofuel production

Bio-fuels are not currently commercially viable in any county in the world without state support. In Brazil and United States (US), bio-diesel feedstock is produced very efficiently, but still requires state support. National markets also tend to require trade protection policies; research suggests that no bio-diesel pathway and product combination can provide a low-risk and profitable investment without some kind of government fiscal support (Kojima et al. 2007).

Although further market analysis is required, the **opportunities for export appear limited to the Asian market**; the US and European markets are considered to be closed by most exporters due to heavy protective regulation. **Within Asia the biofuel market is highly competitive** with many countries, including Thailand, producing fuels at low prices. However, **there are opportunities represented by diversification of feedstock.**

Diverting more than 10% of a given crop to a biofuel market could link its price to the world petroleum market (Kojima & Johnson 2006). Thus, the promise of **energy security is not assured by large-scale biofuel development, particularly when strongly linked to external markets.**

The net effect of increased production of bio-fuels on a large scale will be higher food prices, which will benefit food producers but harm consumers. **Net buyers of food will thus experience higher expenditure**, which will need to be justified by savings in the cost of biofuel relative to fossil fuel. The government may need to preferentially subsidise biofuel to ensure this economic condition.

3. Resources and Potential

Agriculture lands covered 8% of the total country area in 2009, a figure which has increased annually by 8% from 1997 to 2007 (FAOSTAT). This expansion is expected to decrease in the following decade, constrained by topography (70% of land having a slope greater than 20 degrees), and by land allocation programmes due to end in 2010. Considering expected economic and population growth, rice demand is predicted to rise in response, and as such, **land pressure is likely to increase in the next decade.**

Biofuel feedstock cultivation may lead to direct (e.g. deforestation for Jatropha) or indirect land use changes (a knock-on effect due to increased pressure on other land). These can result in changes to the carbon stock of land, and hence ill-planned practices of **biofuel cultivation can lead to a net increase in green house gas emissions and loss of biodiversity** from land use change alone. Moreover, reduction of the non-forest areas (47% of land cover, including bamboo forest, bush, rocky area, fallow and upland rai system) will impact upland farmers' income and food security since non-timber forest products (NTFPs) have long used to be crucial to meeting subsistence needs of these communities.

A demand to increase production of biofuel feedstock can be achieved through biomass use substitution, crop area expansion, shortening crop rotation cycles, or direct yield improvement. Except for the latter, all strategies result in indirect land-use effects. Therefore, **feedstock cultivation land may impact directly food supply and price.**

In addition to land resources, **biofuel feedstock production will require sufficient labour force.** Depending on the scale of production, migrant labour may be required to meet requirements for labour-intensive crops such as Jatropha.

Resource requirements to substitute 10% of diesel by Jatropha biodiesel in 2020

A model calculation¹ of biofuel production is presented in *Table 2*. **A 10% offset of diesel consumption in 2020 is equivalent to 64 million litres of bio-diesel.** However, when taking expected exports into account, local production of Jatropha oil would need to reach 266 million litres, which would require 517,669 ha of agricultural land. Therefore, **to meet a 10% offset of diesel consumption and current export estimates, 15% of agricultural land would be required for Jatropha cultivation.** It is important to consider the opportunity cost of this shift in land use; which agricultural products will not be grown, which markets, which trade opportunities and which tax revenues will be forgone due to Jatropha expansion. **The resources of the Lao PDR are thus considered insufficient to meet both expectations of exports and targets for domestic production based on Jatropha.**

Table 2: Jatropha production required to meet 10% target.

Year	2015	2020	2025
Target (% total diesel consumption)	5%	10%	15%
Predicted total diesel fuel consumption (litres)	457,048,831	641,034,629	899,084,229
Domestic biodiesel consumption required (litres)	24,929,936	64,103,463	130,775,888
Biodiesel required, accounting for export (litres)	83,099,787	213,678,210	435,919,626
Jatropha oil for biodiesel required (litres)	88,404,029	227,317,244	463,744,283
Total domestic biodiesel and Jatropha oil consumption (litres)	93,056,873	239,281,310	488,151,877
Jatropha oil exported (litres)	10,339,653	26,586,812	54,239,097
Total oil to be produced (litres)	103,396,525	265,868,122	542,390,974
Tones of seed required (tonnes)	301,984	776,504	1,584,126
% of national plantation that is mature	50%	75%	100%
Required Jatropha Area (ha)	301,984	517,669	792,063

In the current legislative environment, at best half of the currently planned 334,750 ha contract farming of Jatropha by 2020 is likely to be achieved, representing a 3.2% offset diesel import, assuming most production is for export. **This means that 167,375 hectares would be sufficient for a 10% offset, but this would require a strong reduction of biofuel exports.**

Resource potential for small-scale biofuel

In order to estimate the resource potential for small scale production and utilisation of biodiesel, it is further necessary to evaluate local energy demand. Nationwide diesel consumption per capita in 2007 was 56.7 litres². For rural households relying on diesel/kerosene for lighting, typical annual consumption is up to 40 litres³. The biofuel produced from 1 ha of Jatropha⁴ is thus approximately equivalent to the diesel demand of 10 households. Therefore **Jatropha biodiesel could be interesting for small scale production, in areas that meet the necessary criteria for land and labour availability.** The economic viability of small-scale biofuel has not yet been tested under real conditions in the Lao PDR.

¹ Calculation from Biofuel Assessment and Policy Recommendations, LIRE 2009

² Based on diesel consumption records of MEM, and updated national census 2007

³ Assuming 3.5 hours burn time per day, LIRE research, unpublished

⁴ 2 tones per hectare, producing 500 litres of finished B100 biodiesel

Environmental costs

Bio-diesel subsidies in a number of countries in the past have exceeded the value of the environmental gains from fuel substitution (Kojima & Johnson 2006). There is concern about the environmental cost of widespread bio-diesel plantation development in Lao PDR as other countries in Southeast Asia have experienced a rapid increase in the burning and clearing of rain forests to plant palm and soybeans.

Feedstock production and bio-diesel processing may also carry environmental costs such as water and air pollution, soil depletion, habitat loss, and potentially net increases to green house gas (GHG) emissions associated with the conversion of forests and grasslands to cropland.

4. Government Policy

A domestic biofuel market is unlikely to appear without government leadership, due to the interdependencies inherent to the development of each component in the supply chain. Therefore, **the role of the GoL is to enable and incentivise foreign and domestic actors to engage with local production and utilisation of biofuel, subject to local viability, whilst monitoring and mitigating negative impacts as they emerge.** The government policy is to utilise the following policy tools to varying degrees to guide the development of the biofuel sector. Selection of an appropriate policy for Lao PDR will depend on the availability of budget, resources and information, but also transaction costs and political economy considerations (Rajagopal & Zilberman 2008).

Tax and subsidy is a limited option for the Lao PDR, as petroleum fuels are subsidised. The GoL may consider removing the subsidy or raising the price of unblended fuel, in order to incentivise the purchase of blended biofuel. Bio-fuels are not typically naturally competitive (Kojima et al. 2007). For the Lao people, taxes and tariffs are superior to tax credits, price support and trade subsidies. The former generate public money whilst the latter spend it.

Direct Control via bio-fuel targets and blending mandates⁵ can achieve market regulation. In contrast to tax credits, market regulation through direct control drives up the price of fuel (Gardner 2003).

Agricultural Policies can have a strong influence on production economics, as the production cost of biofuel largely depends on the cost of feedstock. Numerous policy mechanisms are available to the government to regulate price and availability of feedstock, notably price supports, land use and trade regulation.

Trade Policies serve to restrict the movement of feedstock and bio-fuel. Import tariffs and quotas can protect domestic producers and restrict benefit to trade partners. Taxing exports can have a similar impact, reducing the volume of goods leaving the country.

Research and Development funding has been argued as the most appropriate government support given to bio-fuels. As biofuel research is of public interest and benefit, it is more likely to be undertaken if centrally financed (Rajagopal & Zilberman 2008).

Table 3 sets out the impact of various bio-fuel policies on economic and environmental indicators. Each have the ability to increase bio-fuel supply whilst reducing demand for liquid fossil fuels, but the scale of impact may be marginal. Additionally, policies that only encourage bio-fuel production will increase farm income, which will benefit larger landowners over smallholder.

These statements should not be taken in isolation; they do not account for the potential interacting effects of different policies. However, predicting the outcomes of interaction is beyond the scope of any existing research.

⁵ In India, China and Thailand mandatory blending ranges from 5-10%; In Brazil, ethanol blending varies from 20-25% depending on availability of supply.

Table 3: Impact of bio-fuel policies on economic and environmental indicators

Policy Instrument	Reduction of oil use	GHG Reduction	Farm Income	Bio-fuel Producers	Consumer Benefit (Food)	Consumer Benefit (Energy)	Government Budget
Energy and Fuel							
Bio-fuel tax credit	+	?	+	+	-	?	-
bio-fuel mandate	+	?	+	+	-	-	?
Carbon/Gasoline Tax	+	+	?	?	?	-	+
Efficiency standard	+	+	?	?	?	+	?
Vehicle Subsidy	?	?	?	?	?	?	-
Agricultural and Trade Policies							
Price Support	+	?	+	?	+	+	-
Area control	?	?	+	-	-	-	-
Import tariff	+	?	+	+	-	-	+
Export Subsidy	?	?	+	+	-	-	-
Export quota	+	?	-	+	+	+	?
	+ Positive Impact		- Negative Impact		? Uncertain Impact		

Source: LIRE, adapted from (Rajagopal & Zilberman 2008)

Mitigation of external factors

Interventions may be necessary to decrease the external pressures associated with the bio fuel sector like fuel and food demand.

In the context of national development, it is important to observe that the variables for bio-fuel production employed in the model used in this study are dominated by two external parameters: the projected food and energy demands of the country. Indeed, since the development of bio-fuel is being supported with the primary intention of improving the wealth of the Lao PDR, it should be noted that growth implies increasing food and energy demand (Rajagopal 2008). Thus, given limited resources, especially land and labour, the development of bio-fuel must be undertaken within the wider context of efforts to improve the productivity and efficiency of the Lao economy. From an agricultural perspective, this entails increasing crop yields and improved management of food inventories. In terms of national energy demand, additional initiatives are required to improve energy efficiency, and reduce the demand for fossil fuels. Such initiatives should include the wider adoption of alternative (and locally available) energy sources.

Producing bio-fuels or bio-fuel feedstock in the Lao PDR for sale in the external market for will not directly contribute to the goals set by the GoL. However, there are opportunities to utilise the capacity of neighbouring economies during a transitional period, and as a means to stimulate infrastructure development in the country.

It will be important to establish trade arrangements for importation of finished bio-fuels, and introduction of blended biodiesel in urban areas at a cost to harmonise with liquid fuel costs in rural areas. Bio-fuels should be introduced to the public transport sector before the private sector, especially intercity buses which have no alternative energy source to liquid fuel. In addition it would be helpful to promote the use of electric transport in urban areas to reduce fuel consumption.

5. Government Target

The following recommendations have been made using the basic data that was available to the study “Biofuel Assessment and Policy Recommendations” carried out by LIRE for DoE. **Additional in-depth analysis and follow up studies will be required to provide accurate advice regarding future**

scenarios. These are elaborated in the action plan. In review of the motivation for developing biofuels in the Lao PDR, the following points of understanding must be central to any target for government strategy:

- **In terms of energy security, the rural poor are most vulnerable to fluctuations in the price of fossil fuel.**
- **A national volumetric target would be dominated by the growth of the transport sector in urban areas.**
- **Small-scale biofuel crop production may contribute to rural development through improved access to energy and diversification of income.**
- **Large scale monocultures are likely to have negative impacts on rural livelihoods and the environment.**

The urban and rural situations are distinctly different, and in order to achieve energy security, rural development and environmental objectives, it may be necessary to develop different biofuel market chains in parallel. The GoL may then consider one or both of the following revised targets:

TARGET 1: To substitute 10% of diesel imports with biodiesel by 2020

TARGET 2: Biofuel technology is utilised by 10% of rural small-holders by 2020

The *first target* could be achieved **providing exportation is greatly reduced, yield per hectare is increased to at least 2 tonnes per hectare, infrastructure is developed for processing and distributing blended fuel, the growth of fossil fuel demand is reduced** through energy efficiency initiatives.

The *second target* responds to the observation that **rural development targets favour small-scale production.** This will contribute to the NGPES more concretely than the 10% biodiesel substitution target.

Additionally, the GoL could consider importing biofuel from countries with established bio-fuel industry such as Thailand or Korea for the interim. Although this policy would not immediately achieve the stated goals of the bio-fuel targets, namely ensuring energy security, rural development and protection of biodiversity in Lao PDR, it would serve to kick start the bio-fuel industry in Lao PDR, begin to create demand for bio-fuel, increase public awareness and build investor confidence. As such a bio-fuel industry would develop and the stated goals achieved in the future.

6. Strategic Objectives

The following strategic objectives are elaborated in the Road Map.

Long term objective: Develop a biofuel industry that contributes to the NGPES goals.

Medium term objective: Build a domestic market for biofuel.

How: Increase the number of smallholders growing biofuels; increase the local level production capacity; begin using biofuels in government and public transport vehicles; increase public awareness of biofuels.

Short term objective: Gain a full understanding of the potential outcomes of different biofuel strategies.

How: Undertake the studies recommended in the road map elaborated in the following section.

7. Road Map and Action Plan

Programmatic Recommendation	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1 Provide leadership for biofuel development															
1.1 Clearly defined policy targeted sector	█														
1.2 Set up a Biofuel National Agency (BNA) with mandate to direct biofuel sector	█														
1.3 Link BNA to local level activities						█									
1.4 Improve access to information and cross ministry communication															
1.5 Develop expertise, implement and facilitate interventions															
1.6 Develop understanding of the viability of producing for export markets															
1.7 Analyze and monitor the domestic market															
1.8 Make accurate estimate of financial costs of developing bio fuel															
1.9 Find the revenue to finance interventions necessary to fund biofuel															
2 Create enabling environment for biofuel development															
2.1 Design legal framework for biofuel development															
2.2 Improve investment laws															
2.3 Increase international integration															
2.4 Strengthen investment procedure															
2.5 Develop finance mechanism															
3 Ensure domestic market development															
3.1 Initiate biofuel production															
3.2 Initiate biofuel distribution															
3.3 Initiate biofuel consumption															
3.4 Provide incentives for domestic biofuel production															
3.5 Initiate small scale production															
3.6 Provide access to financing, soft credit and loans for small-scale production															
4 Promote biofuel development															
4.1 Identify suitable site for Jatropha, cassava and sugar cane plantation															
4.2 Provide incentives to farmers															
4.3 Improve access to financing, soft credit and loans															
4.4 Provide incentive to producer															
4.5 Encourage final consumer to use biofuel															
5 Ensure the sustainability of biofuel development															
5.1 Fund research and development															
5.2 Engage in technology transfer from neighboring countries															
5.3 Build extension service															
5.4 Build local capacity															
5.5 Enhance farmer rights, rural Development and poverty alleviation															

8. Budget Requirement to Implement this Strategy

Making an estimate of the cost of implementing this strategy is challenging given the limited availability of cost data. *Figure 3* sets out the information that needs to be gathered in order to make an accurate prediction of the costs associated with establishing a bio-diesel industry in Lao PDR, and is intended to direct further study. In particular it illustrates the need to understand the opportunity cost of creating a bio-diesel industry.

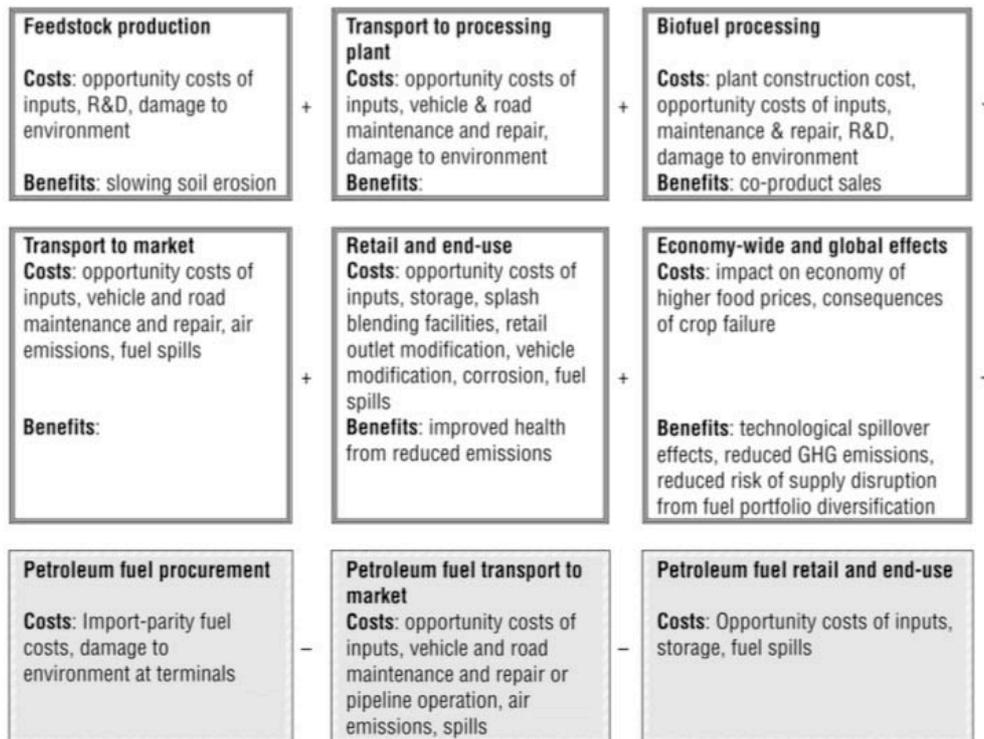


Figure 3: Required Economic analysis of bio-diesel production and marketing for a country importing transportation fuel, (Kojima & Johnson 2006).

The costs of the institutional components of the ‘Lao Biofuel Programme’ can be minimized by fully utilizing existing capacities of government organizations and including Biofuel components into the annual budget and activity plans of all relevant offices. In parallel to assigning new responsibilities in this manner, the government should evaluate the ability of offices to fulfil these roles, and where necessary, employ technical assistance to build capacity. The government may also consider the opportunity of enabling civil society, including communities-based organisations, non-profit associations and mass organizations, to channel information to the public.

Capacity-building activities and further studies represent a major part of the costs over the short term, followed by infrastructure development that increases through the mid-term. The costs associated with recommended biofuel and feedstock imports over the short term may to some extent be covered by reduced imports of fossil fuels, but cannot be determined without a full external market analysis.

Providing certain external conditions are met, foreign investment and funds are likely to contribute significantly to the development of biofuel in the Lao PDR. The experience of FDI to date for contract farming however demonstrates the need for the government to ensure national and international interests are met. Providing attractive returns of investment can be offered by a domestic biofuel market rather than export, several of the existing biofuel companies have expressed an interest to adapt their business strategies⁶. In terms of development funds, until at least 2012 there are good

⁶ According to stakeholder analysis in Biofuel Assessment and Policy Recommendations, Part 1, LIRE 2009.

prospects for financing projects related that focus on energy access, climate change, biodiversity, green employment, rural development, bio-energy, and energy efficiency.

There are several activities that are however, unlikely to achieve adequate foreign finance, and thus would require government support (including development loans). The infrastructure for national level blending, quality analysis⁷ and standards certification, and distribution shall require substantial government investment, unless these activities are assigned to a foreign enterprise. Essential in-country R&D shall also require government funding, although this need may be relaxed by fostering stronger technology transfer and research partnerships.

9. Long Term Perspective

The global market price for fossil fuels is on an upward trend. Despite efforts to limit the growth in demand through the development of alternative energy sources, the issue of increasing scarcity of petroleum oil is likely to remain, and thus in real terms, the price of diesel and gasoline for the Lao PDR in 2020 and beyond will likely increase. It is therefore in the interest of energy security to both reduce dependency upon fossil fuels, promote efficient utilisation, and where possible source locally available resources such as energy crops.

Long-term bio fuel development will require support for research and development of feedstock diversification and bio fuel applications. In Lao PDR, a number of biofuel research programs have been developed, concerning issues from optimisation of cultivation practices to utilisation of waste oil as biofuel feedstock. The timescale for generating new opportunities for biofuels in the Lao PDR is generally quite long, and the output of research in the Lao PDR is delayed by insufficient funding, and a lack of coordination and sharing between public and private research centres.

Finally, as the worldwide demand for energy resources and commodities increases, the Lao PDR will continue to experience pressure from external markets to make its resources available. This may be in the economic interest of the Lao PDR, but overall the continuing role of the government is to determine whether short term opportunities bring long term value to the nation.

10. References

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⁷ Laboratory equipment required would cost ~\$100,000 each for biodiesel and bioethanol, based on a preliminary cost analysis of the Thai market in 2009, LIRE.

Annex 1: Programmatic and Organisational Recommendations

1 Provide leadership for biofuel development	
Programmatic Recommendation	Organizational Recommendation
1.1 Clearly defined policy targeted sector	Prioritizes energy security, rural development, environmental protection, or developing export market. Steering committee meeting to review recommendations. All member to provide a summary of past and ongoing promotion activities, including costs and staff, offices, and resources used.
1.2 Set up a Biofuel National Agency (BNA) with mandate to direct biofuel sector	Institutionalize Ad hoc committee on bio-fuel Establish a schedule of regular steering meetings, twice per year. (<i>Agenda: 1) each member reports on action carried out in period, review of data and status of activities 2) review and discuss progress 3) formulated action plan for next period including recommendations for changes to targets if necessary</i>) Ad hoc committee on bio-fuel, MEM and concerned ministry should agree which ministry leads BNA, responsibilities and duties
1.3 Link BNA to local level activities	Define province and district implementator Provisionally assign responsibilities to PAFO+PDEM, DAFO+DDEM offices. Provide strategy document to all offices District level capacity building should begin to support market regulation and law enforcement. (<i>Prior to this action: Spatial study of biofuel viability; Develop extension materials</i>) Enable communication between the appropriate authorities
1.4 Improve access to information and cross ministry communication	Identify information needed by BNA and its source. (<i>elaborate as a simple list of information and related ministries in 10-page document</i>) Mobilise province and district authorities to collect village-level data Design a network linking BNA with concerned ministry and define clear responsibilities for specific information for each office. The process should be done in collaboration with the relevant ministry BNA to adopt a single measure and single value for each relevant piece of information required by BNA. (<i>example: agreement on single estimate of forecasted diesel demand, land availability, etc</i>) Enable BNA to evaluate factors that may not fall within its usual scope of expertise BNA to review internal capacity to provide public information resources Publish all relevant information resources and make available to all stakeholders Publicise small-scale pilot projects operated by private and public sector organisations Build awareness of domestic utilization of biofuel. (<i>after technical capacity and viable model is available in the country</i>)
1.5 Develop technical expertise required to pilot biofuel development, implement and facilitate the required market intervention	Provide technical training and support to government bodies from third parties Contract technical experts on short term basis to present technical reviews of sector progress Policy review in collaboration with ongoing RE strategy team Integrate the various policies that are relevant to the development of the bio fuel sector. This policies include: Agriculture, Economic and Energy
1.6 Develop understanding of the viability of producing for export markets	Undertake market analysis of EU and Asian markets (<i>especially Japan and India who could be the potential buyers</i>) conduct bilateral discussions with neighbouring nations to establish trade agreements in return for technology dissemination (<i>strong requirement to limit export commitments</i>)
1.7 Analyze and monitor the domestic market	Undertake detailed resource and market mapping study Inform ALL province and district authorities, and publicise the areas designated as high potential for small and large scale biofuel development Biofuel Market monitoring with market indicator Analysis of potential for compulsory use of specific blends Develop forecast demand for transport fuel Conduct a study of detailed rural energy needs, identify energy needs most dependent upon petroleum fuels
1.8 Make accurate estimate of financial costs of establishing bio fuel industry	Undertake full economic analysis of biofuel industry development detailed cost analysis of centralised blending, quality testing and standard certification Undertake further cost analysis of bio fuel production development, including consultation of private sector to determine economic conditions for supply to domestic market
1.9 Find the revenue with which to finance the essential and expensive interventions necessary to fund bio fuel development	Increase price of petroleum fuels in urban areas (note: also promotes energy efficiency) raise public awareness to use revenue from fossil fuel price rises to develop domestic biofuel (<i>bill board, TV, ...</i>) Tax revenue from bio fuel exports Analysis of tax revenue from 'polluters' - major fossil fuel consumers and related imports (e.g. vehicle imports) Redirect tax revenue from sectors contributing to fossil fuel demand (<i>after Analysis of tax revenue from 'polluters'</i>)

2 Create enabling environment for biofuel development	
Programmatic Recommendation	Organizational Recommendation
2.1 Design legal framework for biofuel development	<p>Develop licensing and regulations for bio fuel purchase and distribution. Define the role of LSF</p> <p>Set mandatory sale of blended fuel in urban areas</p> <p>Develop regulations for bio fuel production and distribution for local markets</p> <p>Develop Legislation for contract farming</p> <p>Clearly define and publish roles, responsibilities, rules and regulation of farmer and buyers for contract farming</p> <p>Develop legislation for farming associations</p> <p>Clearly define and publish roles, responsibilities, rules and regulation of farmer and buyers for farmer organization</p> <p>Make strict classification of land</p> <p>Legislation to facilitate contract farming</p>
2.2 Improve investment laws	<p>Legislation to facilitate foreign investment</p> <p>Facilitate investment and overcome services barriers by strengthening local capacity</p> <p>Introduce and strengthen electronic commerce</p> <p>Develop legal framework for foreign investment</p>
2.3 Increase international integration	<p>Promotion of WTO membership</p> <p>Ensure transparency and consistency in the legal and regulatory of foreign direct investment law</p> <p>Facilitate bi-lateral trade agreements</p>
2.4 Strengthen investment procedure	<p>Implementation and enforcement of the anti-corruption decree</p> <p>Ensure transparency and consistency in the legal and regulatory of foreign direct investment law</p> <p>Evaluate and develop regulations for infrastructure development with investor</p>
2.5 Develop finance mechanism	<p>Develop local capacity in finance and economics</p> <p>Improve and involve national banks (e.g. commercial or agriculture banks) in financing process</p> <p>Improve and standardize the process of customs when exporting to other countries: Transit should be simplified</p>
3 Ensure domestic market development	
Programmatic Recommendation	Organizational Recommendation
3.1 Initiate biofuel production	<p>Import of Jatropha seed from neighboring countries to initiate production</p> <p>cost analysis of centralised bioethanol blending QA, and certification</p> <p>review of possible infrastructures for (centralised blending), quality assurance, standard certification, and distribution</p> <p>invite expressions of interest for bioethanol development for domestic market</p> <p>Incentivise feedstock diversification by limiting Jatropha biodiesel production to 10% of diesel demand</p>
3.2 Initiate biofuel distribution	<p>Import bio-diesel for interim (Note: This measure requires further market analysis before implementation)</p> <p>develop infrastructure for blending, quality assurance, standard certification, and distribution</p>
3.3 Initiate biofuel consumption	<p>Mandate use of blended biodiesel for public sector vehicles</p> <p>Bio fuel for rural electrification should be encouraged</p> <p>Mandate blended fuel for public transport, or urban users by 2015</p>
3.4 Incentives domestic biofuel production	<p>Levy export taxes on bio fuel: lower tax for bio-diesel than raw feedstock or raw oil</p> <p>Develop price guarantees for domestic bio fuel producers based on diesel import price</p>
3.5 Initiate small scale production	<p>Establish pilot projects by identifying suitable location, undertaking spatial analyses and making funds available</p> <p>Make soft loans available for small holder farmers</p> <p>Provide support for pilot projects for small scale biofuel use</p> <p>Provide financial incentives for biofuel producers</p> <p>Make soft loans for processing equipment available</p> <p>Shift from a volumetric target of 10% biodiesel substitution, to a target of 10% rural small holders making use of bio fuel technology by 2020.</p>
3.6 Provide access to financing, soft credit and loans for small-scale production	<p>Soft loans with long payback terms should be encouraged by government bank and credit organization such as Garmin Bank and APB</p> <p>Special promotion must be undertaken for rural electrification and agriculture mechanization projects.</p> <p>Supply trans-esterification units and methanol manufacturing plants</p>

4 Promote biofuel development	
Programmatic Recommendation	Organizational Recommendation
4.1 Identify suitable site for Jatropha, cassava and sugar cane plantation	Create database on suitable areas for Jatropha and sugar and starch crop production including climate data (NLMA, MAF), grade of slope, available size and other relevant data spatial analysis of land clusters available for bioethanol feedstock crops
4.2 Provide incentives to farmers	Provide quality seed materials for free Make additional land concessions Arrange tax incentives Allocate marginal land to farmers for Jatropha cultivation Provide financial compensation during first year of cultivation
4.3 Improve access to financing, soft credit and loans	Encourage soft loans for farmers with long payback terms from by government bank and credit organizations Assess and strengthen a business model for Jatropha production Provide special promotion for innovative projects
4.4 Provide incentive to producer	Devise taxation mechanisms and price regulation to support investment in production and promote the domestic market
4.5 Encourage final consumer to use biofuel	A public awareness campaign needs to be facilitated regarding appropriate bio fuel production and utilisation Set retail price of biodiesel slightly lower than fossil fuel diesel
5 Ensure the sustainability of biofuel development	
Programmatic Recommendation	Organizational Recommendation
5.1 Fund research and development	Coordinate existing research in a more productive way by appointing an appropriate biofuel stakeholder to channel efforts jointly Fund R&D into yield optimization Fund R&D into bio fuel applications such as cooking, heating, transport and electricity Make research publicly available Fund research through taxation of vehicles and bio fuel company profit Fund R&D into biofuel feedstock diversification
5.2 Engage in technology transfer from neighboring countries	Build technical capacity within suited local institutions Technology dissemination initiatives Undertake partnership with international universities Support university curriculum development and training centers
5.3 Build extension service	Develop extension services specialized on cultivation techniques, weed management, pest management, pruning and harvesting Knowledge exchange with neighboring countries on cultivation issues Provide training in cultivation techniques and research exchange with other countries
5.4 Build local capacity	Capacity building within DAFO in order to provide suitable extension service at cultivation sites Provide extension services for small holder farmers Promote the use of Jatropha on marginal land Developed decision making and basic economic tools for assisting farmers decision process Provide training in cultivation techniques Provide information concerning yield, labor input, crop calendar, farm gate price Highlight conservative practices such as inter-cropping, fencing and cultivation on marginal land Provide training at community level regarding processing techniques
5.5 Assist Rural Development, improve farmer rights and contribute to poverty alleviation	Provide support for farmers in case of appeal against private company. Provide regulation to fix farm gate price for bio fuel crops

Annex 2: Institutional targets to be met over the next 15 years

	Target 2010	Target 2015	Target 2020	Target 2025
1 Provide leadership for biofuel development 1.1 Clearly defined policy targeted sector 1.2 Set up a Biofuel National Agency (BNA) with mandate to direct biofuel sector 1.3 Link BNA to local level activities 1.4 Improve access to information and cross ministry communication 1.5 Develop expertise, implement and facilitate interventions 1.6 Develop understanding of the viability of producing for export markets 1.7 Analyze and monitor the domestic market 1.8 Make accurate estimate of financial costs of developing bio fuel 1.9 Find the revenue to finance interventions necessary to fund bio fuel	Policy and agenda NBA Registration Identify data needed Technical training Market analysis Market mapping study Gather economic data Setup tax tariff to export	Operational province and district implementors Operational Cross ministry network Concerned government bodies trained Operational monitoring system Operational monitoring system Accurate financial cost Operational funding system		
2 Create enabling environment for biofuel development 2.1 Design legal framework for biofuel development 2.2 Improve investment laws 2.3 Increase international integration 2.4 Strengthen investment procedure 2.5 Develop finance mechanism	Contract farming law	Legal framework completed Investment law improved Operational bilateral trade agreement Decrease corruption Local capacity developed; Loan procedure setup	Transparency in investment procedure	WTO membership
3 Ensure domestic market development 3.1 Initiate biofuel production 3.2 Initiate biofuel distribution 3.3 Initiate biofuel consumption 3.4 Provide incentives for domestic biofuel production 3.5 Initiate small scale production 3.6 Provide access to financing, soft credit and loans for small-scale production		3% biodiesel offset Operational blending and distribution infrastructure for BD Blended BD mandated 50 % of the production use for domestic market 5 % of rural smallholder making use of Biofuel tech Improve loans access and conditions for farmers	10% BD, 5% BE offset Operational blending and distribution infrastructure for BE Blended BE mandated 10 % of rural smallholder making use of Biofuel tech Improve loans access and conditions for farmers	15% BD, 10% BE offset Improve loans access and conditions for farmers
4 Promote biofuel development 4.1 Identify suitable site for Jatropha, cassava and sugar cane plantation 4.2 Provide incentives to farmers 4.3 Improve access to financing, soft credit and loans 4.4 Provide incentive to producer 4.5 Encourage final consumer to use biofuel	Suitable area for Jatropha mapped	Suitable area for cassava / sugarcane mapped Viability of Jatropha cultivation improved Loans access and conditions improved Number of producers increased Set retail price	Number of smallholders cultivating Jatropha increased Number of producers increased 50% of diesel vehicles use BD	50% of vehicles use BF
Ensure the sustainability of biofuel development 5.1 Fund research and development 5.2 Engage in technology transfer from neighboring countries 5.3 Build extension service 5.4 Build local capacity 5.5 Enhance farmer rights, rural Development and poverty alleviation	Operational funding mechanisms Technology transfer initiated	Research coordinated Operational University curriculum in BF and partnership Operational extension service 50% smallholder trained Operational farm gate price mechanisms of regulation	Jatropha yield and BF applications improved 100% smallholder trained Operational farmer law organization	Biodiesel feedstock diversified

Annex 3: Volumetric targets to be met over the next 15 years

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Biodiesel offset target	0%	0%	0%	1%	1.5%	2%	3%	5%	7%	9%	10%	11%	12%	13%	14%	15%
Target of biodiesel offset produced from Jatropha	0%	0%	0%	1%	1.5%	2%	3%	5%	7%	9%	10%	10%	10%	10%	10%	10%
Volume Biodiesel requested (Million liters)	0	0	0	4	6	8	13	23	34	45	53	56	59	61	65	68
Seed needed (Thousand tones)	0	0	0	14	22	31	48	84	124	167	195	205	215	226	237	249
Area requested (Thousand hectares)	0	0	0	7	11	15	24	42	62	84	97	102	107	113	118	124
Target of biodiesel offset produced from alternative feedstock	0	0	0	0%	0%	0%	0%	0%	0%	0%	0%	1%	2%	3%	4%	5%
Volume Biodiesel requested (Million liters)	0	0	0	0	0	0	0	0	0	0	0	56	117	184	258	339
Bioethanol offset target	0%	0%	0%	0%	0%	0%	0-5%	0-5%	0-5%	0-5%	5%	6%	7%	8%	9%	10%
Volume Biodiesel requested (Million liters)	0	0	0	0	0	0	NA	NA	NA	NA	22	27	34	40	48	55
Indicator from BE production based only on cassava																
Cassava needed for 100% production(Thousand tones)	0	0	0	0	0	0	NA	NA	NA	NA	121	152	186	223	264	308
Area requested (Thousand hectares)	0	0	0	0	0	0	NA	NA	NA	NA	6	7	9	11	13	15
Indicator from BE production based only on sugarcane																
Seed needed (Thousand tones)	0	0	0	0	0	0	NA	NA	NA	NA	310	391	479	575	679	792
Area requested (Thousand hectares)	0	0	0	0	0	0	NA	NA	NA	NA	8	10	13	15	18	21
Combined biofuel offset target	0%	0%	0%	1%	1%	1%	2%	3%	4%	5%	8%	9%	10%	11%	12%	13%

It is very important to note that these figures assume no biofuel is exported from Lao PDR. If export of fuel or feedstock occurs the amount of fuel required will be significantly higher.