



This issues brief series is developed by the Poverty-Environment Initiative of Lao PDR to address poverty and environment issues in the current development and national planning processes. The purpose of the briefs is to provide evidence-based information and practical policy options to support transformation of the Lao economy towards a sustainable pro-poor development path.

Past publications:

01/2010: Poverty reduction and environmental management: Joint development goals for sustainable growth

02/2010: Poverty-Environment Indicators for monitoring and evaluating sustainable growth goals

03/2010: Investments and women's economic empowerment

04/2010: Economic, social and environmental impacts of investments in plantations

Future publications:

- Economic, social and environmental impacts of other key investment sectors

BRIEF Increasing concerns about energy security, climate change and energy for rural development are driving growing interest in bioenergy, including biofuels, around the world. Private and public investment, policy support, subsidies and mandates for biofuels are growing in developed and developing countries. The International Energy Agency (IEA) estimated in 2006 that world biofuels output would increase by 7% per year to meet about 4% of all road transport fuel demand by 2030.

Biofuels can lead to both positive and negative outcomes. As well as opportunities for reducing greenhouse gas emissions, improving energy security and rural electrification, boosting rural development and economic revenues, there are also inherent risks and challenges for sustainable development. Cultivation of biofuel crops can jeopardize biodiversity, food and water resources, contribute to conflicts and competition over land, and reinforce social inequalities. Currently, like other energy infrastructure, the biofuels sector also requires subsidies and other forms of government support and protection.

This biofuels brief focuses on investments in the production and use of biofuels in the Lao context and provides key information for decision-makers in Lao PDR.

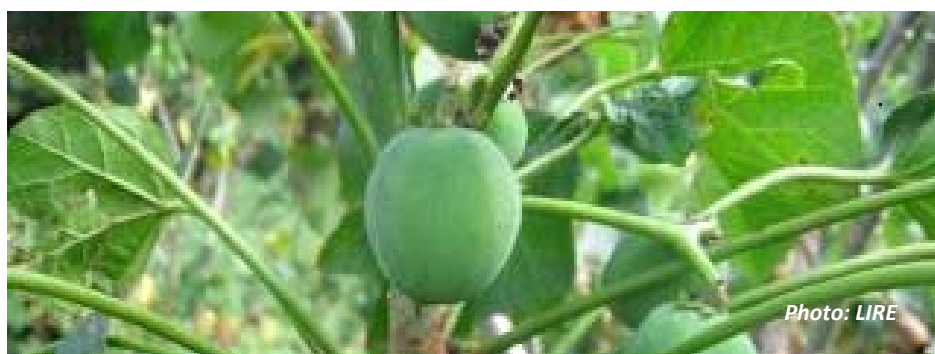


Photo: LIRE

Box 1. Definitions

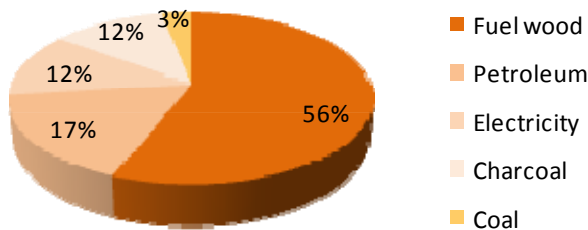
Biomass	Material from recently living plant or animal sources
Bioenergy	Energy produced from biomass whether for heat, electricity, lighting, mechanical power or transport
Biofuels	Liquid or gaseous fuels produced from biomass that can be used to replace petrol, diesel and other petroleum fuels
Bioethanol	Petrol replacement produced from sugar or starch crops such as sugarcane, cassava, sugarbeet, corn and wheat
Biodiesel	Diesel replacement composed of methyl (or ethyl) esters of long chain fatty acids derived from oil plants such as jatropha, coconut, rapeseed, palm and soy, or animal fat
First Generation	Biofuels produced from existing food and feed crops using simple and well established processing technologies (nearly all currently used biofuels are first-generation)
Second Generation	Biofuels produced from a wider range of inedible biomass including agricultural wastes and plant species such as switchgrass and willow, and often requiring more advanced thermo-chemical or bio-chemical processes.
Biogas	Gas produced from anaerobic digestion or fermentation of biomass and composed mainly of methane and carbon dioxide and for electricity, heat, or use in vehicles that run on Compressed Natural Gas (CNG) or Liquid Petroleum Gas (LPG).

(Source: Lao Institute of Renewable Energy (LIRE); and IUCN. 2008. *Implementing Sustainable Bioenergy Production: A compilation of Tools & Approaches*. Gland, Switzerland.)

1. Energy consumption and biofuels in Lao PDR

Energy consumption in the Lao PDR is dominated by traditional utilization of biomass (fuelwood) for cooking and heating; in rural areas it accounts for 69% of consumption per capita (national energy consumption by source is shown in Figure 1).

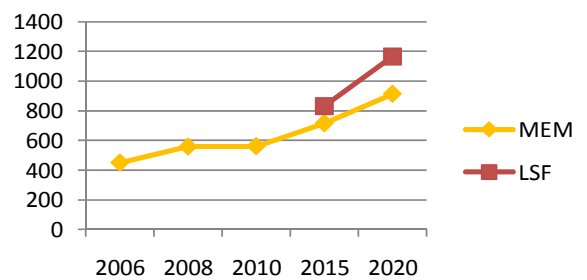
Fig. 1: Fuel consumption by resource, Lao PDR¹



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. Nationwide, fossil fuel is mostly used for transport; in rural areas, diesel is also widely used for lighting, electricity generation and production. Fossil fuel consumption in Lao PDR is rising rapidly. In 2008, Lao PDR imported 558 million litres of fossil fuel, an increase from 450 million litres in 2006. The Lao Ministry of Energy and Mines (MEM) estimates that fuel consumption in 2010 will be 561 million liters

¹ LIRE. 2010. *Biofuel Development in the Lao PDR: Baseline Assessment and Policy Evaluation*

Fig. 2: Fuel consumption and forward projections, Lao PDR (million litres)¹



and 716 million liters by 2015². Estimates by the Lao State Fuel Company are even higher (see Figure 2).

The Government of Lao PDR (GoL) has played a key role in promoting biofuels in the country. As well as recognizing the role of biofuels in development plans, MEM’s 2006 draft energy saving and biofuels policy included targets for domestic consumption and the Prime Minister’s Office and National Authority for Science and Technology (NAST) has since become actively involved in supporting biofuels initiatives, mostly focusing on the oil plant jatropha. The largest research initiative is a 20 hectare (ha) trial jatropha plantation jointly managed by NAST and a private company. The GoL has set the target of offsetting 10% of petroleum consumption with biofuels by 2025.

Lao PDR thus has an emerging biofuels sector, with a focus on the production of feedstock crops for export

² LIRE, 2009(a). *Biofuels Assessment Study in Lao PDR: Biofuel Policy and Strategy Recommendations for Lao PDR* [Final Draft]. Vientiane, Lao PDR.

(such as cassava and sugarcane) and with several jatropha initiatives funded through private investment, government and development partners. However, production of biofuels in Lao PDR is still negligible. According to a stakeholder consultation conducted by the Lao Institute for Renewable Energy (LIRE) in 2009, there were approximately 30,000 ha at the time under jatropha cultivation, dominated by private sector investment, with only 1.478 tons of jatropha harvested up until 2009³, the majority destined for export markets. Greater amounts of land are currently being used for crops such as maize, cassava and sugarcane, but these are either for food/fodder or for export, with none so far designated for domestic biofuels production.

2. Investments in biofuels: key issues

Economic viability. As of 2009, biofuels currently supply less than 1% of transport fuel worldwide and approximately 3% across developing countries in Asia⁴. Biofuels are not currently commercially viable in any country in the world without state support. Even in Brazil and the United States, where biodiesel feedstock is produced efficiently and a market exists, state support is still required. Research suggests that no biodiesel pathway can provide a low-risk and profitable investment without some kind of government support⁵. National biofuels industries and markets may require protection and export markets are still limited. The US and European markets are heavily protected while the Asian market, more relevant to Lao PDR, is highly competitive.

In Indonesia, the government reportedly committed US\$1.1 billion for biofuels infrastructure subsidies, in addition to research and development and general fossil fuel subsidies. The state-owned fuel company, Pertamina lost a total of US\$40 million during 2006-2008 (see Box 2 for more detail). In Lao PDR, biofuels do offer potential financial benefits, such as a reduction in fossil fuel imports and a concurrent reduction in subsidies for diesel (currently about 48 billion kip/year), which could be reinvested in the biofuels sector⁶. Because Lao PDR currently spends so much on imported fuel, even a small reduction in these imports will make money available for use in other sectors of the economy. However, the successful development of a biofuels sector (that also con-

tributes to rural development) will require significant interventions by government.

Domestic use versus export. These two directions for biofuels development entail different sets of opportunities and risks. As mentioned, economic viability is an issue and the economics of biofuels production in Lao PDR has not been calculated in detail. According to LIRE estimates¹, the long term per-litre cost of domestic bioethanol from cassava or sugarcane, or biodiesel from Jatropha, would be competitive with petroleum fuels. However, large initial investments for infrastructure and facilities may prove an insurmountable barrier. Financial subsidies may therefore be needed to ensure blended fuels are competitive, and incentives could be required to support processing facilities, provide protection from biofuels imports from other countries and introduce new technologies or the upgrade of old technologies.

Exporting biofuels feedstock is simpler and industrial crops production is already familiar in Lao PDR. However, the Lao economy would then miss out on the added value, as well as the potential energy security and environmental benefits, of biofuels. Although the viability of small-scale biofuels production and energy generation has not yet been tested in Lao PDR, LIRE estimates that the biofuels produced from 1 hectare of Jatropha is approximately equivalent to the diesel demand of 10 households, thus holding promise for rural energy schemes⁷.

Large-scale versus smallholder plantations. As with other industrial and agricultural crops, biofuel feedstock crops (such as cassava, jatropha, maize and sugarcane) pose a number of choices and challenges. The growing conditions and plantation models have significant implications for its overall sustainability. The issues surrounding large-scale plantations in Lao PDR are consistent for biofuels crops production. These include: competition over land resources; contribution to deforestation and biodiversity loss; displacement of farmers; availability of sufficient labour; reduced food security; and the poor implementation of laws and regulations designed to mitigate these situations. Smallholder contract farming has the potential to contribute more to rural economic growth and development with fewer negative environmental and social impacts. However, contract farming systems pose their own challenges, such as the need for farmer support and extension, protection of poor and marginal farmers, food security and attracting investment.

³ LIRE, 2009(a).

⁴ USAID. 2009. *Biofuels in Asia: An Analysis of Sustainability Options*.

⁵ Kojima et al. 2007, in LIRE 2009(a).

⁶ LIRE, 2009(b). *Biofuels Assessment Study in Lao PDR: Indicative requirements and recommendations to substitute 10% of fossil fuel with biofuels by 2020* [Final Draft]. Vientiane, Lao PDR.

⁷ LIRE, 2009a.

Jatropha may end up being a key biofuel crop for Lao PDR because it can be grown on depleted soils, meaning less competition with other plantations and rice. According to LIRE estimates, a 10% offset of diesel consumption by 2020 is equivalent to 64 million litres of biodiesel, equating to around 135,000 ha of Jatropha plantations, or 4% of agricultural land. The land requirement is so large because of the extrapolated fossil fuel demand and because of the relatively poor yield of Jatropha. Moreover, this is likely to be an underestimate of the amount of jatropha needed, as without strong government intervention a majority of the jatropha seed grown would be exported. Putting this into perspective, the *National Forest Strategy to 2020* envisages 500,000 ha for all industrial tree plantations by 2020⁸; a figure that could be comparable to all the land needed to meet a 10% biofuels target. To meet an even more modest target, serious thought must be given to land and

Box 2. Indonesia's experiences with biofuels promotion

In 2006, the Indonesian Government (GoI) established its first national policy on biofuels. Plans envisaged that biofuels would meet 10% of transport fuel consumption by 2010, create new jobs and lead to energy self-sufficiency for rural villages. In 2007, the GoI signed 67 agreements for biofuels development, worth almost US\$10 billion and reportedly committed approximately US\$1.1 billion to infrastructure subsidies. The state-owned fuel company Pertamina was also required to sell fuel blended with 5% biofuel.

In late 2007-2008, prices for biofuel feedstocks soared, plans for new developments were halted, several refineries suspended operations and producers preferred to export to OECD countries. Pertamina's losses due to biofuel blending totaled about US\$40 million from 2006 to June 2008, a cost born by the government, in addition to existing subsidies for petroleum fuels.

In 2008, prices eased again and biofuels production in Indonesia began to trend upward again. The GoI revised its biofuels target to 2.5% of transport fuel consumption by 2010. This flexibility has not been welcomed by producers but eases the burden on the economy. According to the International Institute for Sustainable Development (IISD), allowing fuel prices to rise benefits the Indonesian economy in the long-term, lessening the burden of subsidies, encouraging fuel efficiency and improving energy security.

(Source: IISD Global Subsidies Initiative. 2008. Biofuels – At What Cost? Government Support for Ethanol and Biodiesel in Indonesia. Geneva, Switzerland).

⁸ Office of the Prime Minister. 2005. *Forestry Strategy to the Year 2020*.

labour availability, reducing exports and determining if such acreage of jatropha can be grown by small-holder farmers⁹.

Environmental impacts. Cultivation of biofuels crops and production of biofuels can have both negative and positive environmental impacts. Positive effects on the environment can include a reduction of greenhouse gas (GHG) emissions from fossil fuels, the restoration of wastelands to productive use and improved erosion control. Currently, production of biofuels in Lao PDR is minimal and is having minimal impacts on the environment. However, production of biofuels around the world to date has demonstrated that, despite its potential to reduce GHG emissions, it can cause other environmental problems. Large-scale biofuels plantations, like other industrial plantations, can result in further deforestation and biodiversity loss, as has occurred in the oil palm plantations of Indonesia and Malaysia. There have also been cases where planned plantation projects have never been implemented – forests have been cut down but the plantation never goes ahead. In Lao PDR, more than 3000 ha in Bolikhamxay were logged in 2004-2006 for a coconut plantation that was never delivered¹⁰. Biofuels produced from crops grown on previously forested land, wetlands or peatlands, can have a very long carbon pay-back period (i.e. it may take thousands of years for the reduction in transport GHG to make up for the emissions from deforestation).

Further, as with many crops, expanding biofuel crop production raises concerns about water use. In India, producing 1 litre (L) of ethanol from sugarcane needs almost 3500L of scarce irrigation water; in contrast, in Brazil, rain-fed sugarcane can produce 1L of ethanol from only 90L of irrigation water¹¹. Certain biofuel crops, like jatropha and sweet sorghum, need less water and compete less with food crops. In Lao PDR, rain-fed sugarcane and cassava cultivation may also be possible.

The development of biofuels feedstock plantations and processing facilities requires careful planning, environmental assessment and monitoring. There are greater environmental and economic benefits from producing and using biofuels as geographically close to each other as possible and by producing a diverse range of feedstocks and fuels.

⁹ LIRE, 2009(a).

¹⁰ LLTP/GTZ. 2007. *Study on Land Conflicts and Conflict Resolution in Lao PDR*.

¹¹ IWMI. 2008. "Water Implications of Biofuel Crops: Understanding Trade-offs and Identifying Options". *Water Policy Brief*, Issue 30.

Impacts on farmers. Farmers will be at the forefront of the impacts, positive and negative, of biofuels development. If done well, biofuels production can offer an important extra income stream for farmers and an alternative source of energy, helping to alleviate poverty. However, many challenges remain. Under a plantation model, there is a risk that rural people will lose agricultural land, common forest and wetlands to plantations, especially if the requirements of investment, land and forest laws are not fully implemented. Large-scale plantation development may also lead to uneven employment and immigration to meet labor needs. For example, many hectares of land have been given over to commercial rubber, cassava and corn plantations in Lao Ngam



District of Saravan Province, with some villages providing almost all their agricultural land, yet not all villagers benefit from regular employment on plantations¹². Smallholder contract farming also requires certain conditions to be successful: support and extension for farmers; monitoring to ensure that contracts are honored and that food security is not at risk; and access to markets and market information. Research by WWF and SNV has shown that smallholders have so far benefited little from sugarcane and jatropha projects in Lao PDR. Both contract farmers and day laborers receive less return on their labour compared to commercial rice-farming¹³. However, if these challenges are addressed, smallholder biofuels production could contribute to rural development.

¹² NERI and IUCN. 2010. *Report on Economic, Social and Environmental Impacts of Investments in Saravan Provinces* [Draft, July 2010].

¹³ The study shows that Farmers participating in a contract farming model received net margins ranging from US\$1.36/day (for sugarcane) and \$1.50/day for jatropha, compared with \$2.5/day for commercial rice. Hired laborers get a return for labor at \$1.54/day for sugarcane and \$2.12/day for jatropha, still less than rice-farming. (Source: WWF & SNV. 2009. *Developing Sustainable Pro-poor Biofuels in the Mekong Region and Nepal*).

3. Policy options

The development of biofuels in Lao PDR is aimed at meeting a number of economic, environmental and social goals, including to: improve energy security; promote rural development; and to generate economic growth and attract investment in a new sector¹⁴. These goals should guide efforts to develop biofuels to ensure they are supporting sustainable development, not harming it. Policy options to guide the biofuel sector include:

- **Developing a national land use planning system.** The GoL has already taken the positive step of conducting a Strategic Environmental Assessment (SEA) on this sector, informing the development of a draft Decree on Biofuels. In addition, the introduction of a land use planning system at central and local levels is a target of the *National Forestry Strategy to 2020* of the GoL. Given the amount of land and labor required for large scale biofuels production, like other industrial plantations, biofuels development plans should not proceed without the full implementation of economic, environmental and social checks. A comprehensive national land use planning system and a full assessment of Lao PDR's labor resources may help to determine how land should be allocated to rubber, rice paddies or biofuels, for example.
- **Taking an integrated approach.** If the reduction of emissions and the improvement of energy security is a goal of biofuels development, then a strategy for the transport sector as a whole is required. Biofuels will be more effective if there are also initiatives to: reduce energy consumption, particularly fuel for transport and electricity; increase energy efficiency; and introduce alternatives, such as vehicles which run on alternative fuels or electricity. Energy efficiency initiatives may deliver a greater reduction in energy use and emissions at a cheaper cost, compared to subsidizing expensive alternatives, while having less impact on the environment and rural poor¹⁵.
- **Facilitating and growing the domestic market.** If the long-term objective of developing a biofuels industry to contribute to economic growth and sustainable development is to be achieved, then there must be a domestic market for biofuels for transport and energy. Further, the environmental and energy security benefits of biofuels will only

¹⁴ Draft Decree on Promotion of Biofuels, Prime Minister's Office of Lao PDR, 2008.

¹⁵ IISD Global Subsidies Initiative. 2008. *Biofuels – At What Cost? Government Support for Ethanol and Biodiesel in Indonesia*. Geneva, Switzerland.

be achieved if biofuels are used domestically. This will require significant policy interventions over the long-term, including support to develop viable plantations, increase the number of smallholders, and introduce local-level processing, distribution and technologies that utilize biofuels or blended fuels¹⁶. Reducing subsidies for petroleum fuels can help to reduce both a burden on the government and the consumption of fossil fuels. Launching the use of biofuels in government and public transport vehicles may also be considered. In addition, importation of biofuels from other countries may be required to help boost the domestic market.

- **Favor small-scale production over large scale production.** Commitments to both rural development and biofuels expansion are more likely to be met through the development of small-scale biofuels plantations in which farmers (and not large companies) reap the benefits. These plantations should be designed to be integrated—the biofuels feedstock should be processed and sold locally to keep revenue within the local economy.
- **Minimize the negative, maximize the positive.** Although biofuels are envisaged as a support to sustainable development, the environmental and social risks of biofuels development are significant. As with other industrial crops, biofuel feedstock plantations have the potential to result in negative impacts such as deforestation and biodiversity loss, over use of water resources, land alienation, social disruption and food security problems. However, there are ways to minimize these problems: promote smallholder, diversified plantations over large-scale monocultures; use a diverse range of feedstocks for biofuels production; plant rain-fed crops like jatropha and sorghum over those requiring irrigation; plant on marginal land only; implement controls over chemical fertilizer and pesticide use; and pay attention to the environmental and social impacts of processing facilities; ensure environmental and social impact assessments (ESIAs) and environmental management plans are prepared for all plantation and biofuel projects. While GoI may want to consider policies that ensure these practices are strictly followed, investors can also improve their capacity to understand how laws and regulations apply to their project and their ability to comply with them. For example, investors can focus in truly fulfilling the ESIA

mandate by conducting only quality ESIAs. Guidelines and tools to ensure the sustainability of biofuels have been, and are, under development by a range of organizations (see Box 3).

- **Not all biofuels projects are created equal:** Biofuels development will require government support and increased investment. However, not all biofuels projects have the same potential to contribute to sustainable development. Rather than provide tax breaks/concessions for the sector as a whole, governments can consider using incentives to reward those that follow more sustainable models, such as diversified smallholder plantations, environmental and social programs and international best practice.
- **Consider other biofuels options.** Current, first generation biofuels will only contribute to sustainable development with careful controls and monitoring. Other bioenergy options are also available, such as processing the waste streams of industries into biofuels and second generation biofuels. This approach not only creates new, cleaner fuel sources, but can also improve waste

Box 3. Tools for more sustainable biofuels

In 2008, IUCN published the guide “Implementing Sustainable Bioenergy Production: A Compilation of Tools and Approaches”, detailing existing options for increasing the sustainability of biofuels. These include:

- **Bioenergy Impact Analysis (BIAS)**, a methodology currently under development by FAO which uses a set of existing GHG, land and water tools to assess impacts of different bioenergy production systems.
- **Organic and sustainable agriculture** guidelines and certification schemes can potentially be applied to biofuels crops.
- **The High Conservation Value Forests (HCVF)**, developed by the Forest Stewardship Council (FSC), aims to ensure that areas of especially high ecological, cultural, landscape and socio-economic value are maintained and enhanced within production landscapes. It is also referenced in the respective sustainability roundtables for palm, soy and biofuels.
- **The Roundtable on Sustainable Biofuels (RSB)** is currently developing principles and criteria for sustainable biofuels with the input from a broad range of stakeholders. As well as guiding industry, governments may use the RSB principles and criteria upstream to differentiate between sustainable and unsustainable sources for biofuels.

(Download the full report at:

http://cmsdata.iucn.org/downloads/biofuels_compilation_of_tools_final.pdf)

¹⁶ Local-level processing of biodiesel (e.g. from jatropha) is more practicable than local-level production of bioethanol, which requires significant energy, technical and financial inputs.

management. In the future more second generation or even third generation biofuels may become economically promising, while offering reduced risks to food security, land use change and biodiversity loss. Small-scale production of both first and second generation biofuels are promising options for consideration in Lao PDR. Encouraging research, development and investments into more advanced and innovative approaches is a key role for government agencies.

What is PEI?

The United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP) support the Poverty-Environment Initiative (PEI), a program that aims to mainstream poverty and environmental issues into national level planning and development processes. The objective of PEI in Lao PDR is to ensure that the country's rapid economic growth generates inclusive and sustainable development. PEI supports the strengthening of institutional capacity in national development planning and private investment management, the development of guidelines for social and environmental impact assessments, and the generation of evidence-based research on the social and environmental costs of land use decisions. The project is coordinated by the Ministry of Planning and Investment with project components managed by Department of Planning, Investment Promotion Department, National Economic Research Institute and the Department of Environmental and Social Impact Assessment of the Water Resources and Environment Administration.

www.unpei.org/programmes/country_profiles/lao-pdr.asp

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Photo: Banethom Thepsombath

- **Study and analyze the options.** Additional studies, analyses and pilot projects will be required to provide the accurate and Lao-specific information needed by decision-makers in Lao PDR. In particular, more contextual and detailed information is required regarding future scenarios and projections, the market potential overseas and at home, the costs and benefits of different land uses and biofuels crops, and the design of approaches for more sustainable biofuels, such as integrated farming systems.

This issues brief has been prepared by IUCN Lao PDR and LIRE under the auspices of the Poverty-Environment Initiative.

IUCN, the International Union for Conservation of Nature, helps the world find pragmatic solutions to our most pressing environment and development challenges by supporting scientific research; managing field projects all over the world; and bringing governments, NGOs, the UN, international conventions and companies together to develop policy, laws and best practice.

The world's oldest and largest global environmental network, IUCN is a democratic membership union with more than 1,000 government and NGO member organizations, and almost 11,000 volunteer scientists and experts in some 160 countries. IUCN's work is supported by over 1,000 professional staff in 60 offices and hundreds of partners in public, NGO and private sectors around the world. IUCN's headquarters are located in Gland, near Geneva, in Switzerland.

www.iucn.org

LIRE, the Lao Institute for Renewable Energy, is an independent research and development organization established in 2006 and registered as a Lao Non-for-Profit Association. LIRE's core activity is the development of commercially-viable renewable energy solutions as long-term alternatives to conventional practices. LIRE is offering technological, agronomical and socio-environmental and economic research services, capacity building and training programs and provides consultancy on renewable energy policy development.

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