

Energy for Life

COUNTRY PROFILE



Lao PDR 2010



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Figure 1 (Front cover): Administrative structure of Laos, Source:

http://www.mapcruzin.com/free-maps-laos/laos_pol_2003.jpg

List of content

List of content	4
List of figures	6
List of tables	6
1 Background information	7
1.1 Country data	7
1.2 RES targets	9
1.3 Status of the renewable energy market	10
1.4 Legal framework	10
Supporting laws and policies	10
1.5 Key supporting factors	11
Financing and funding possibilities for RE projects	11
1.6 CDM projects in Laos	12
2 Current status of RES	13
2.1 Energy related data	13
2.2 Current situation	16
Electricity	16
Electricity transmission	17
2.3 Biomass installed and identified systems	17
Biogas	17
2.4 Hydroelectric installed and identified systems	18
2.5 Solar installed and identified systems in Laos	21
2.6 Wind energy installed and identified systems	22
2.7 Other renewable energy sources installed and identified systems	22
Geothermal	22
Wand and tidal	22
3 Potentials of RES in Laos	23
3.1 Biomass Energy Resource potential	24
Biogas	25
Biofuel	26
3.2 Hydro Energy Resource potential	27
3.3 Solar Energy Resource potential	33
3.4 Wind Energy Resource potential	35

3.5	Other renewable energy sources potentials	36
	Geothermal	36
	Wave or Tidal	36
4	References	37
	Books	37
	Internetsources	37
4.1	Related links	39
	Government organizations	39
	Asian organizations	40
	International organizations	40
	Other information sites	40

List of figures

Figure 1 (Front cover): Administrative structure of Laos, Source: http://www.mapcruzin.com/free-maps-laos/laos_pol_2003.jpg	3
Figure 2: Population growth 2003 to 2010	8
Figure 3: Climate and weather in Laos	8
Figure 4 Number of households using on- and off-grid electricity by provinces (NSC, 2005; MIH, 2003)	9
Figure 5: Energy sent out of Laos 1990 - 2008	14
Figure 6: Electricity installed capacity	15
Figure 7: Electricity net consumption	15
Figure 8: Electricity net generation	15
Figure 9: Energy source by type	16
Figure 10: Electricity demand forecast	16
Figure 11: Electricity transmission in Laos	17
Figure 12: Sunshine hours	34
Figure 13: Solar radiation in Laos	34
Figure 14: Wind energy potential in Laos	35

List of tables

Table 1: Summary of Electricity Demand forecast according to PDP2004-13 (EDL, 2004)	14
Table 2: Lao PDR major dams	18
Table 3: Hydroelectric Power Projects in Lao PDR - Development before 2000	19
Table 4: Hydroelectric Power Projects in Lao PDR - Operational	20
Table 5: PV applications in Laos	21
Table 6: Primary Energy Resources in Lao PDR	23
Table 7: Biogas based energy potential of rice straw	25
Table 8: Manure generation of relevant livestock (NSC, 2004)	26
Table 9: Hydroelectric Power Projects in Lao PDR - Under Construction	28
Table 10: Hydroelectric Power Projects in Lao PDR - Planning Stage (PDA Stage)	29
Table 11: Hydroelectric Power Projects in Lao PDR - Planning Stage (PDA Stage) (cont.)	30
Table 12: Hydroelectric Power Projects in Lao PDR - Feasibility Stage (MOU Stage)	31
Table 13: Hydroelectric Power Projects in Lao PDR - Feasibility Stage (MOU Stage)(cont)	32
Table 14: Hydroelectric Power Projects in Lao PDR - Feasibility Stage (MOU Stage)(cont)	33

1 Background information

1.1 Country data¹

Location of country:	Southeast Asia, northeast of Thailand, west of Vietnam
GPS:	18 00 N, 105 00 E
Total area:	236,800 sq km
Capital:	Vientiane
Currency ² :	Kip
Language:	Lao (official), French, English, and various ethnic languages
Religion:	Buddhist 67%, Christian 1.5%, other/unspecified 31.5% (2005)
Population:	6.4 million (2010) 85% rural (2007) 3.
Population density ⁴ :	23 persons per sq. km
Climate:	tropical monsoon; rainy season (May to November); dry season (December to April)
Temperature ⁵ :	average 34 °C, highest 35 °C, lowest 17°C
Precipitation ⁶ :	1714 mm (67.5 in) rainfall per year, or 143 mm (5.6 in) per month
Terrain:	Mostly rugged mountains; some plains and plateaus
Elevation:	Lowest: Mekong River 70 m. Highest: Phu Bia 2,817 m
GDP ⁷ :	USD 2,300 per capita per year (2009)

¹ Laos, The world fact book, January 2011

² Asia Pro Eco, 2006

³ Theuambounmy, Houmpheng, 5-7. June 2007 , Bangkok Thailand. United Nations ESCAP.

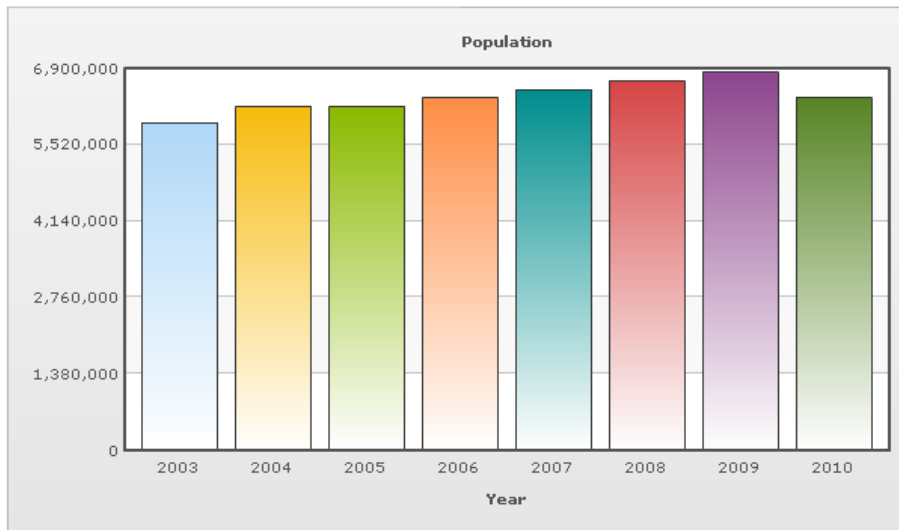
⁴ Idem

⁵ World weather and climat graphs..., February 2011

⁶ Idem

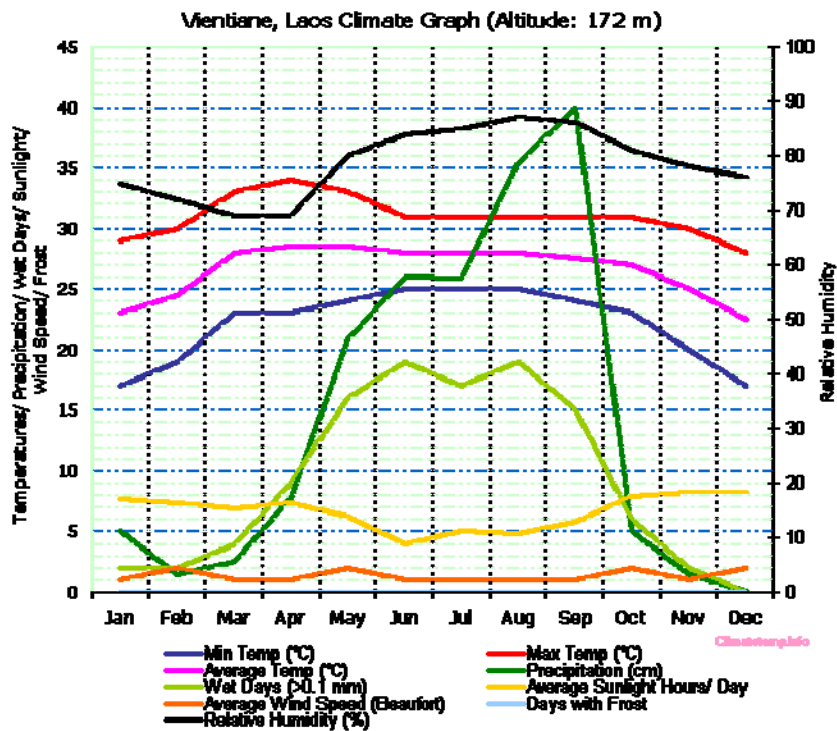
⁷ IMF Country Report, February 2009

Figure 2: Population growth 2003 to 2010



Source: Index Mundi, July 2010

Figure 3: Climate and weather in Laos



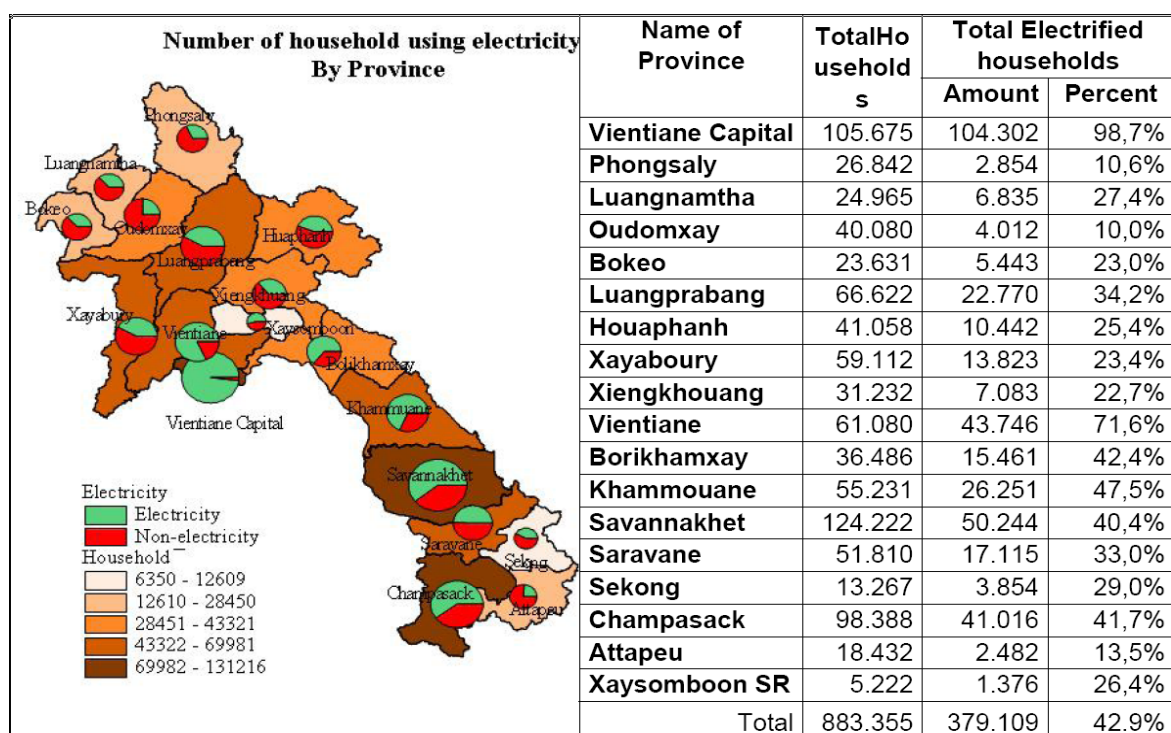
Source: World weather and climat graphs..., February 2011

1.2 RES targets⁸

There is currently no specific policy on renewable energy in Laos. Nevertheless, renewable energy is included in the electrification policy towards global electrification including rural areas. The aim is to provide rural electrification through an off-grid system to achieve the Government's target of raising the national electrification rate to 90% by the year 2020.

Specific renewable energy policies need to be well formulated and implemented as to encourage exploration, development and use of renewable energy sources through the country. The following figure shows the levels of rural electrification according to the various provinces of Laos.

Figure 4 Number of households using on- and off-grid electricity by provinces (NSC, 2005; MIH, 2003)



Source: Asia Pro Eco, 2006

⁸ Theuambounmy, Houmpheng, 5-7. June 2007

1.3 Status of the renewable energy market⁹

There are great renewable energy resources in Laos. Currently, the main source of energy comes from biomass 68% and from hydroelectric dams 12%. Although most of the biomass is wood, other sources such as saw dust, rice husks, etc. need to be further developed. Moreover, there is continuous development in solar and wind energy, which also offer great potential.

1.4 Legal framework

The Department of Energy Promotion and Development (EPD) was organized in parallel with the establishment of the Ministry of Energy and Mines (MEM) in 2007. It was reinstated from the Bureau of Secretariat of the Lao National Committee for Energy that was succeeded by the MEM. The Department is a technically administrative organization under the hierarchy of the MEM, which has the functions to provide assistance to the Ministry of MEM in relation to the promotion and the development of energy sources in the form of independent power projects (IPP) (TOR) that may be carried out by private or jointly by public-private sector or Non-Lao Governmental entities throughout the country¹⁰.

Supporting laws and policies

Since the early 1980s, the government of Lao PDR has embarked on a programme of legislative structure regulation in order to create an environment favourable to the promotion of socioeconomic development. There is currently no legislation dealing specifically with renewable energy production. Nevertheless, the Electricity Law (1997) provides a solid basis to formulate specific legislation on renewable energy, especially under those laws dealing with Rural Electrification. In addition, the Power Sector Policy Statement emphasizes the use of local resources for small-scale hydropower, solar, wind, thermal, coal, biogas and biomass to produce energy in local and rural areas while supporting the development of rural livelihoods in remote areas. With the “National Environmental Strategy for 2001-2020” the Lao government set among its objectives to strengthen environmental protection, to provide 90% of the country’s households with electricity by 2020 and to promote the application of new renewable energy resources. The government established an off-grid programme intending to supply rural areas without road access, and designed grid extension electrification plans to supply urban and rural areas with road access. In the context of rural electrification, the government focuses on mini or micro-hydroelectric generating stations with a mini-grid connection to serve one or several villages located nearby and solar home systems for individual households or pico-hydro stations serving several households in unconnected clusters¹¹.

⁹ Theuambounmy, Houmpheng, 5-7. June 2007

¹⁰ Powering Progress, EPD, January 2011

¹¹ Klauß-Vorreiter, Antje, Völler, Cindy, February 2011

Electrification is seen as a key component of the government's poverty eradication policy by raising the standard of living of the predominantly rural population, stimulating investment and providing opportunities to enter national and regional markets. Attention has focused mainly on the provision of grid electrification, but recent institutional reorganisation has increased the profile of RE within the Department of Energy. The government has focused on the providing finance through the off-grid promotion fund and the poverty reduction fund, set up through the Prime Minister's office to finance small-scale investment and services that contribute to village development including energy. Policy and legislation for independent power producers (IPP) has been developed for hydropower but this experience has not been transferred over to the extension of off-grid electricity. If IPP legislation is linked to the government's reforms of decentralizing responsibilities in the administration and management of electricity activities, then further investment in market-based incentives within the private sector may assist in the promotion of off-grid extension to rural areas.

A major step in the development of a broad-based forum for research and development of RE is the recent formation Lao Institute for Renewable Energy (LIRE)¹², combining a range of private, state and civil society. LIRE intends to develop research and development capacity within the country for RE ensuring technologies are commercially viable and affordable. An opportunity also exists to link LIRE with the renewable energy stakeholder network developed through this Asia Pro Eco project. How the institute intends to establish itself, and what its exact position is vis-à-vis policy, research and extension, remains to be seen¹³.

1.5 Key supporting factors

Financing and funding possibilities for RE projects¹⁴

The Off-Grid promotion fund and the Poverty Reduction Fund are the two available funds for off-grid promotion. Both funds act as a vehicle to channel finances from both foreign and domestic donors in the form of grants, loans, budget allocations, contributions from international government and organizations

The Off-Grid Promotion Fund and Support Programme (OPS) was set up on the request of the Ministry of Industry and Handicrafts in 2004 (MIH, 2004). The aim of the OPS is to effectively extend off-grid electrification to remote rural areas in order to improve the quality of life for

¹² LIRE, January 2011

¹³ Asia Pro, 2006

¹⁴ Idem

villagers. The Fund is managed by an Advisory Committee and Secretariat within the Ministry of Industry and Handicraft, now Ministry of Energy and Mining.

The poverty reduction fund is to finance small-scale investment and services and strengthen local capacity in respect of village development, giving priority to villages located in isolated rural areas with high rate of poverty.

Loan: The Agricultural promotion bank provides loans to farmers with interest rates of 12 % per year for agricultural purposes and livestock and 15-18 % for commercial purposes. The procedure to get his loans is very bureaucratic and time consuming.

Loan: Additionally there are micro credit facilities on the local level as village promotion funds and the Fund for Agriculture in Champasak Province. Those funds offer loans between 10 and 500 US\$ with very unfavourable conditions: interest rates of 3 to 5 % per month and short duration often only 6 month.

1.6 CDM projects in Laos

To date, only one project was submitted and successfully registered in Laos. This is for an energy improvement project for a beer brewery. Emission reductions are calculated at 3338 metric tonnes per year¹⁵.

¹⁵ UNFCCC, January 2011

2 Current status of RES

Lao PDR offers significant energy sources around the country. Currently, the main source of energy remains fuel wood, which accounts for 90% of the total energy requirements. This is obviously a non-sustainable resource directly responsible for the high illegal logging in Lao, which is associated with severe environmental impacts. Hydropower is currently the most attractive source of energy as it is also cost-effective¹⁶. Unfortunately, large hydropower dams are also responsible for considerable environmental damages with large flooding areas obliging the displacement of people and animals and the destruction of plants and natural habitats¹⁷.

2.1 Energy related data

Electrification rate ¹⁸	44% of the household in Laos have access to electricity (2004).
Actual electricity consumed ¹⁹	264 kWh per capita (2009)
Electricity cost ²⁰	Ranging from USD 0.025/kWh to 0.093 0.025/kWh depending on the number of kWh consumed.
Electricity generation in 2009 ²¹	1,656 GWh
Electricity installed capacity 2005 ²²	682.02 MW
Electricity projection in 2020 ²³	12,250 GWh
Main power generation sources ²⁴	Wood, (90%), hydro, others.

¹⁶ Powering Progress, The Energy Sector in Laos, February 2009

¹⁷ WCD, January 2011

¹⁸ Worldbank, April 2007

¹⁹ Laos, The world fact book, January 2011

²⁰ Electricity Tariffs, January 2011, 2010

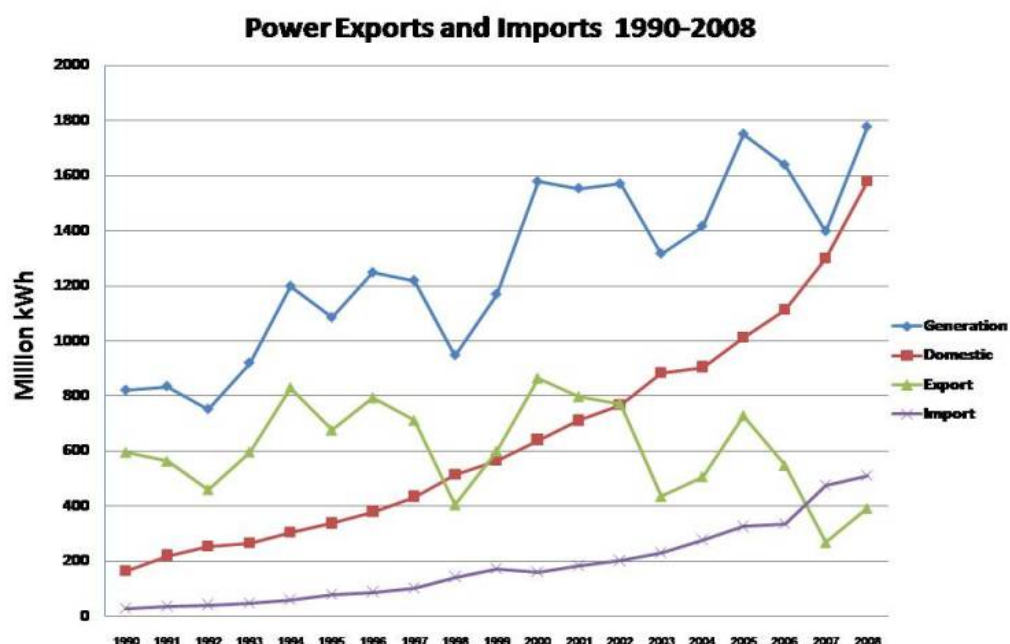
²¹ Laos, The world fact book, January 2011

²² Asia Pro Eco, 2006

²³ Nikkei.com, December 6, 2010

²⁴ Powering Progress, The Energy Sector in Laos, February 2009

Figure 5: Energy sent out of Laos 1990 - 2008



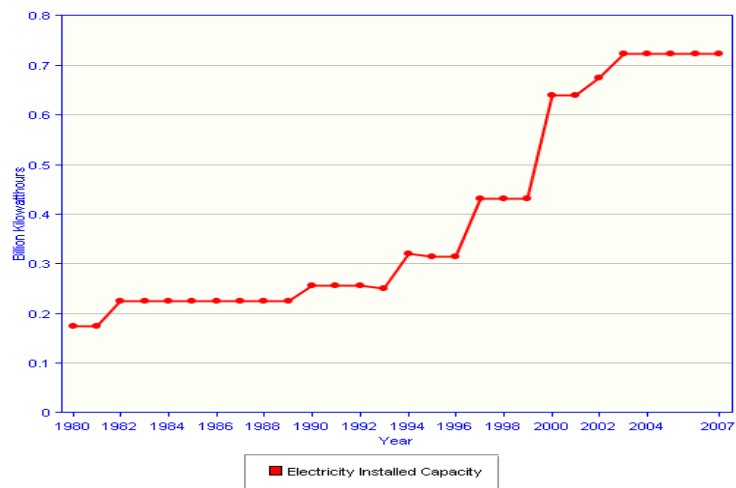
Source: Powering Progress, Lao PDR Power Exports and Imports, January 2011

Table 1: Summary of Electricity Demand forecast according to PDP2004-13 (EDL, 2004)

Items	Unit	2010	2015	2020
Energy Consumption	GWh	2.684,1	3.650,8	4.854,7
Average growth rate	%	11	6	6
Peak Load	MW	510,7	694,6	923,6
Average growth rate	%	9	6	6
Load Factor	%	60.0	60.0	60.0

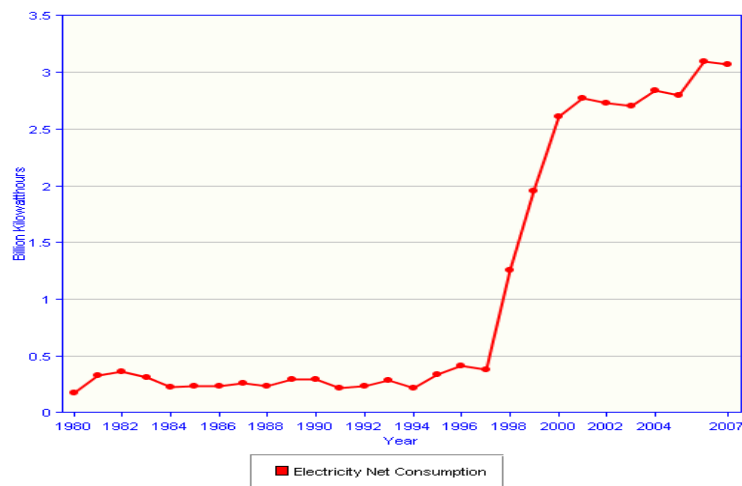
Source: Asia Pro Eco, 2006

Figure 6: Electricity installed capacity



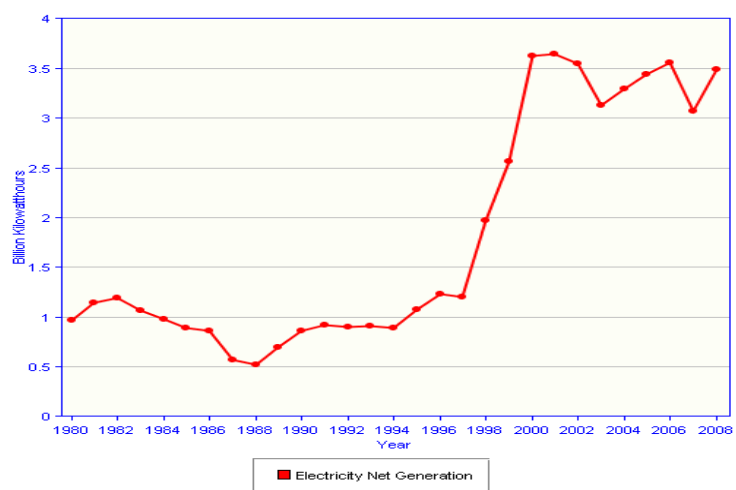
Source: IEA, January 2011

Figure 7: Electricity net consumption



Source: IEA, January 2011

Figure 8: Electricity net generation

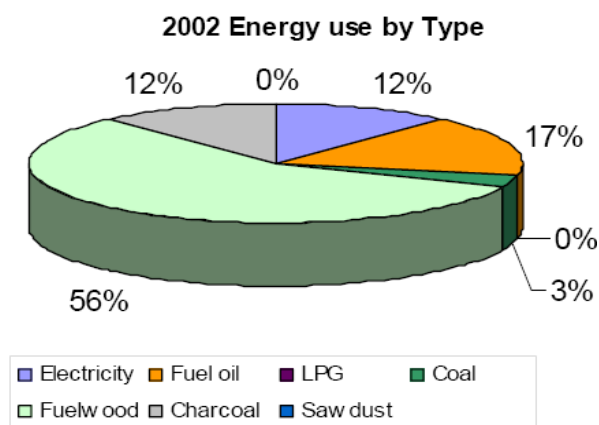


Source: IEA, January 2011

2.2 Current situation

As shown in the following figure, the main sources of energy production are biomass mainly as fuel wood and hydro electricity power in the form of electricity.

Figure 9: Energy source by type

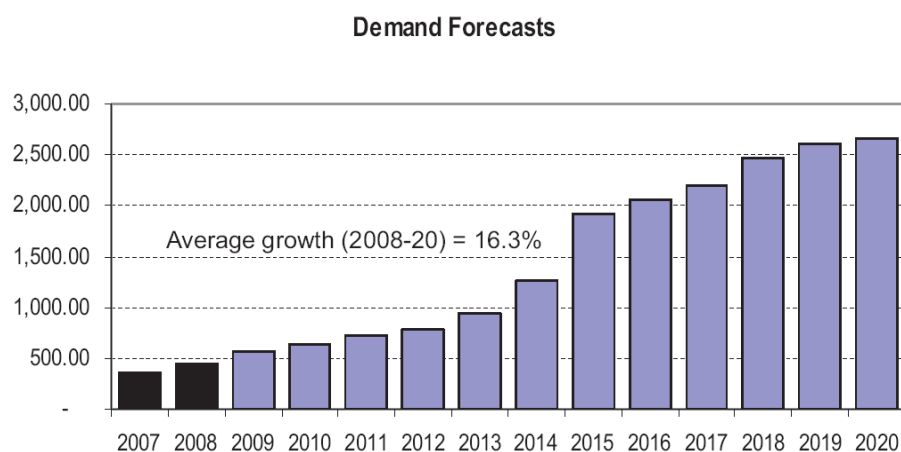


Source: Theuambounmy, Houmpheng, 2007

Electricity

Electricity demand has increased importantly over the past years and is expected to surge in the next 10 years.

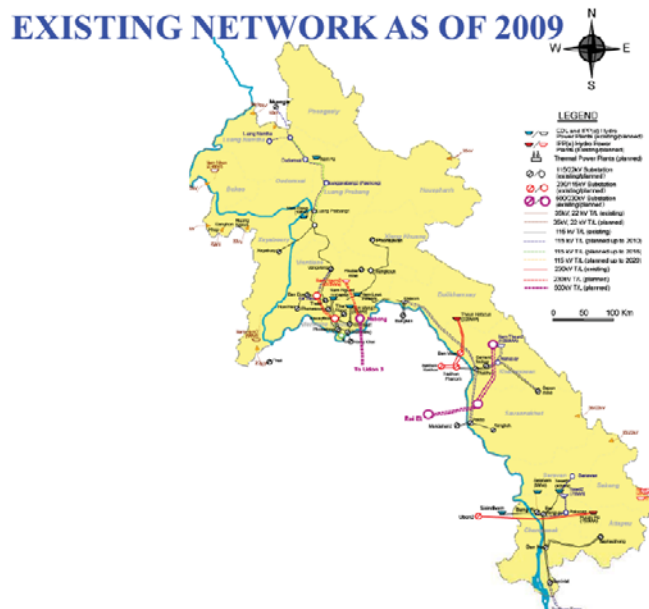
Figure 10: Electricity demand forecast



Source: Country Reports, Lao PDR 25-27 November 2009

Electricity transmission

Figure 11: Electricity transmission in Laos



Source: Country Reports, Lao PDR 25-27 November 2009

2.3 Biomass installed and identified systems

Biogas

As of the year 2010, approximately 1,000 installations were operational, mostly small scale systems. Large systems are currently being planned²⁵. The number of biogas systems is increasing daily.

Biomass sources for electricity generation²⁶

- Agricultural Waste
- Saw dust
- Rice husk

²⁵ LIRE, January 2011

²⁶ Theuambounmy, Houmpheng, 2007

2.4 Hydroelectric installed and identified systems

All of the existing and potential dams are located on the tributaries of the Mekong river. One of the country's earliest major dams is located on the Ngum river close to Vientiane. Much of the energy is sold to Laos' neighbour Thailand.

Table 2: Lao PDR major dams²⁷

Name of dam	Location	Power
Ngum dam	Near Vientiane	150 MW
Houay-Ho	South of the country	150 MW
Theun-Hinboun	Center of the country	210 MW

Source: Wikipedia, Reservoirs and dams in Laos, June 2010

²⁷ Wikipedia, Reservoirs and dams in Laos, June 2010

Table 3: Hydroelectric Power Projects in Lao PDR - Development before 2000²⁸

No	Name of Project	Location	Installed Capacity	STATUS		Investors (Sponsors)	Planned Market	Remarks
		Province		Progress of MOU/PDA/CA	Commercial Operation Date			
1	Houay Ho (IPP)	Champasak/Attapeu	150 MW	BOT agreement signed 23 Sept 1993	1999	<ul style="list-style-type: none"> EdL (Laos) 20% Suez Energy (Belgium) 60% HHTC (Thailand) 20% 	Thailand	In Operation
2	Nam Dong Hydropower (State Utility)	Luangprabang	1 MW	PDA/CA not required	1970	Electricité du Laos (EdL)	Laos	In Operation
3	Nam Ko (State Utility)	Oudomxay	1.5 MW	PDA/CA not required	1996	Electricité du Laos (EdL)	Laos	In Operation
4	Nam Leuk Hydropower (State Utility)	Vientiane	60 MW	PDA/CA not required	2000	Electricité du Laos (EdL)	Laos/Thailand	In Operation
5	Nam Mang 3 Hydropower (State Utility)	Vientiane	40 MW	PDA/CA not required	2004	Electricité du Laos (EdL)	Laos/Thailand	In Operation
6	Nam Ngum 1 Hydropower (State Utility)	Vientiane	155 MW	PDA/CA not required	1971	Electricité du Laos (EdL)	Laos/Thailand	In Operation
7	Selabam Hydropower (State Utility)	Champasak	5 MW	PDA/CA not required	1970	Electricité du Laos (EdL)	Laos	In Operation
8	Se Xet 1 (State Utility)	Saravane	45 MW	PDA/CA not required	1990	Electricité du Laos (EdL)	Laos/Thailand	In Operation
9	Theun-Hinboun (IPP)	Bolikhamxay	210 MW	CA signed 17 Oct 1994	1998	<ul style="list-style-type: none"> EdL (Laos) 60% Nordic 20% GMS 20% 	Laos/Thailand	In Operation
10	Xekaman 1 (IPP)	Attapeu	468MW	CA signed 15 Nov 1997		Anscan Int'l (Malaysia/BVI)		Terminated in 2005
11	Namtheun 3 (IPP)	Borikhamxay	263MW	PDA signed 1 Augt 1994		Heard Energy (USA/BVI)		Terminated in 2004
12	Hongsa (IPP)	Xayabury	720MW	PDA signed 22 July 1994		TLL (Thailand)		Terminated in 2006

Note:

CA: Concession Agreement

FS: Feasibility Study

HOA: Heads of Agreement equivalent to Project Development Agreement (PDA) after enactment of Electricity Law in 1997

IPP: Independent Power Producer

MOU: Memorandum of Understanding

PDA: Project Development Agreement

PPA: Power Purchase Agreement

TBD: To Be Determined

SIOD: Schedule Initial Operation Date

Note: CA or BOT Agreement equivalent to Project Development Agreement (PDA) before enactment of Electricity Law in 1997. There were only two stages in the development process that started from MOU and then PDA whereby concession rights were granted. After 1997 PDA or HOA was inserted as interim stage between MOU and CA. In the PDA or HOA mandate given in the MOU is upgraded to exclusive rights to develop the project but such rights are still contingent upon concession rights that shall be further granted in Concession Agreement

²⁸ www.poweringprogress.org

Table 4: Hydroelectric Power Projects in Lao PDR - Operational²⁹

No	Name of Project	Location	Installed Capacity	STATUS		Investors (Sponsors)	Planned Market	Remarks
		Province		Progress of MOU/PDA/CA	Commercial Operation Date			
1	Houay Ho (IPP)	Champasak/Attapeu	150 MW	In Operation	1999	<ul style="list-style-type: none"> • EdL (Laos) 20% • Suez Energy (Belgium) 60% • HHTC (Thailand) 20% 	Thailand	
2	Nam Dong Hydropower	Luangprabang	1 MW	In Operation	1970	Electricité du Laos (EdL)	Laos	
3	Nam Ko	Oudomxay	1.5 MW	In Operation	1996	Electricité du Laos (EdL)	Laos	
4	Nam Leuk Hydropower	Vientiane	60 MW	In Operation	2000	Electricité du Laos (EdL)	Laos/Thailand	
5	Nam Lik 1-2 Hydropower (IPP)	Vientiane	100 MW	In Operation	2010	<ul style="list-style-type: none"> • EDL 10% • CWE (China) 90% 	Laos	
6	Nam Mang 3 Hydropower	Vientiane	40 MW	In Operation	2004	Electricité du Laos (EdL)	Laos/Thailand	
7	Nam Ngum 1 Hydropower	Vientiane	155 MW	In Operation	1971	Electricité du Laos (EdL)	Laos/Thailand	
8	Nam Theun 2 Hydropower (IPP)	Khammouane and Bolikhamxay	1070 MW	In Operation	2010	<ul style="list-style-type: none"> • LHSE (Laos) 25% • EDF (France) 35% • EGCO (Thailand) 25% • ITD (Thailand) 15% 	Laos/Thailand	
9	Selabam Hydropower	Champasak	5 MW	In Operation	1970	Electricité du Laos (EdL)	Laos	
10	Se Xet 1	Saravane	45 MW	In Operation	1990	Electricité du Laos (EdL)	Laos/Thailand	
11	Se Xet 2 Hydropower State Utility	Saravane	76 MW	In Operation	2009	Electricité du Laos (EdL) 100%	Laos/Thailand	
12	Theun-Hinboun (IPP)	Bolikhamxay	210 MW	In Operation	1998	<ul style="list-style-type: none"> • EdL (Laos) 60% • Nordic 20% • GMS 20% 	Laos/Thailand	

Note:

CA: Concession Agreement

PDA: Project Development Agreement

FS: Feasibility Study

PPA: Power Purchase Agreement

HOA: Head of Agreement

TBD: To Be Determined

IPP: Independent Power Producer

SIOD: Schedule Initial Operation Date

MOU: Memorandum of Understanding

²⁹ www.poweringprogress.org

2.5 Solar installed and identified systems in Laos

In 2006, an estimated 0.178 MW_{el} were installed in 106 locations in the various provinces of Laos³⁰. In 2008, approximately 5,000 systems were installed. However, many systems underwent failures for various reasons³¹.

Table 5: PV applications in Laos

Type of project,	Location of the plant	Planner-Backer	Year of Implementation	energy type to be generated	Type of system	total installed capacity, (Watts)
Telecommunication system						
Solar PV for Communication (microwave repeaters and substations)	All provinces of Lao PDR	LTC/MCTPC	Since 1980s	electricity for communication systems	stand alone or hybrid systems	122.000 Wp (MIH, 2003)
TRI's demonstration systems						
Demonstration Solar BCS	Savannakhet province	TRI-SIDA TRI-CTTE	1997	Electricity	Community Battery charging station	1.875+1.775= 3.650 W (2 BCS)
Demonstration Solar Home – BC System	Vientiane municipality	TRI-NEDO	2001	Electricity	Solar home-Battery charging station	15 SHBC x 240 Wp = 3.600 Wp
MIH-JICA's pilot systems						
Pilot BCS	Bolikhamxay province	MIH-JICA	1999	Electricity	Battery Charging station	254 SHS
Pilot 55 WpSHS & 110 WpSHS	Vientiane province	MIH-JICA	1998	Electricity	55 Wp SHS 110 WpSHS 1-3 kWp BCS	152x55WpSHS 102x110WpSHS 3 BCS(3165Wp)
Pilot BCS	Bolikhamxay province	MIH-JICA	1998	Electricity	BCS	1x3kWp BCS 1x2kWpBCS
MIH-WB's pilot systems						
Rent-to-buy solar home systems	Vientiane province	EDL- MIH-WB	1999-2001	Electricity for lighting and entertainment	stand alone SHS	11 villages (~ 40 SHS)
Rent-to-buy solar home systems	Luang Namtha province	MIH-WB	2000	electricity for lighting and entertainment	stand alone SHS	901 households in 32 villages
Rent-to-buy solar home systems	Oudomxay province	MIH-WB	2001-2004	electricity for lighting and entertainment	stand alone SHS	1.133 SHS in 44 villages
Rent-to-buy solar home systems	Xayaboury province	MIH-WB	2001-2004	electricity for lighting and entertainment	stand alone SHS	346 SHS in 6 villages
Rent-to-buy solar home	Xiengkhouang	MIH-WB	2001-2004	electricity for lighting	stand alone SHS	192 SHS in 2

Type of project,	Location of the plant	Planner-Backer	Year of Implementation	energy type to be generated	Type of system	total installed capacity, (Watts)
systems	province			and entertainment		villages
Rent-to-buy solar home systems	Vientiane province	MIH-WB	2001-2004	electricity for lighting and entertainment	stand alone SHS	867 SHS in 22 villages
Sunlabob's systems						
Community system	Remote areas of Lao PDR	Sunlabob Co.	since 2001	electricity for health post, school, private home, etc	Stand alone solar community systems	948 systems, capacity of 59.941 Wp
Pilot, Rented solar (PV) home system	Vientiane mun., Xiengkhouang, Vientiane, Bolikhamxay, Khammuane, Champasak & Sekong provinces	Sunlabob Co.	2003-present	electricity for lighting and entertainment	Stand alone solar home system	925 systems with total installed capacity of 24,610 Wp

³⁰ Asia Pro Eco, 2006

³¹ LIRE, January 2011

Note:

BCS: Battery Charging Station

SHS: Solar Home System

TRI: Technology research institute

STE: Science, Technology and Environment Agency

RETC: Renewable Energy Technology Centre

CTTE: Canadian-Thai Trilateral Environment project

*NEDO: New Energy & Industrial Development
organization*

JICA: Japan International Cooperation Agency

SIDA: Swedish International Development Agency

*MCTPC: Ministry of Communication, Transport, Post
and Construction*

LTC: Lao Telecom

MIH: Ministry of Industry & Handicraft

EDL: Electricité du Laos

SHBC: Solar home - Battery charging systems

*InWent: Internationale Weiterbildung und
Entwicklung gGmbH*

Source: Asia Pro Eco, 2006

2.6 Wind energy installed and identified systems

Wind speeds of around 1 m/s have been observed at Luan Prabang and Vientiane, and mountain areas would likely have higher wind speeds.

2.7 Other renewable energy sources installed and identified systems

Geothermal

There is currently no identified geothermal installed capacity.

Wave and tidal

Lao PDR is a landlocked country and as such, has no wave or tidal systems.

3 Potentials of RES in Laos

As mentioned previously, although a poor country, Laos is rich in energy resources, as shown in the following table.

Table 6: Primary Energy Resources in Lao PDR³²

Resource	Reserves	Potential
Oil and Gas	Three exploration concessions in central and southern Laos mapping and geophysical investigations carried out, including one deep drill hole (2.560 m). Results not yet evaluated	Possibly in the longer term (10-15 years), if sufficient reserves found
Coal (Lignite)	major resource located at Hongsa in northwest Lao PDR about 810 million tonnes proven reserve, of which over 530 million tonnes is deemed economically recoverable Energy content 8-10 MJ/kg, relatively low sulphur content of 0,7-1,1 %	sufficient reserves for about 2,000 MW installed capacity
(Bituminous and Anthracite)	Reserves, mainly anthracite, dispersed in various fields throughout Lao PDR. exploration ongoing total proven reserve to date about 100 million tonnes Energy content 23-35 MJ/kg	current annual production of 130.000 tones, used for local factories or export possible longer-term option for around 500 MW installed capacity, depending on results of exploration
Solar	annual solar radiation received in Lao PDR about 1800 kWh/m ² , possibly less in mountain areas corresponds to conditions in southern Europe (Italy, Spain)	photovoltaic modules have been already used for small-scale off-grid applications in remote areas
Wind	mean wind speeds at Luang Prabang and Vientiane around 1 m/s, in mountain areas	costs in areas of less than 4 m/s likely to be in upper end of range US\$ 0.05-

³² Asia Pro Eco, 2006

	likely to be somewhat higher	0.25 per kWh, hence limited potential
Biomass (waste)	Biomass resources dispersed throughout the country	current share of biomass (mainly wood fuel) in total energy consumption about 88% wood-fired cogeneration (heat and power) plants could be economic for self-supply in wood processing facilities
Hydropower	Average annual precipitation about 2,000 mm Total runoff around 240,000 million m ³ Theoretical hydropower potential of 26.500 MW	exploitable hydropower potential, including share of mainstream Mekong, around 18.000 MW

Source: Asia Pro Eco, 2006

3.1 Biomass Energy Resource potential

Wood-fired cogeneration (heat & power) plants could be economic for self-supply in wood processing facilities but remain uneconomic for large-scale export plants³³. This being said, biomass energy has enormous potential in Laos based on the availability of agricultural and forestry residues totalling some 18,907 MWh or 1922 million litres of diesel fuel per year. However, to determine the actual potential of biomass in off-grid rural areas it is necessary to consider both the availability and accessibility of these residues to farming communities, especially as both agricultural and forestry resources are already under the increasing strain of food and income security. The acceptance of energy farming needs to be seen in the context of where production occurs relative to markets and support services, and the willingness of farmers to turn food crops over to energy production, which may not be applicable for Laos³⁴.

It is estimated that the biomass (mainly fuel-wood) supply is around 46 million tonnes per year and that the country could generate about 3.9 million tonnes of agricultural residues per year. Of this volume, about 2.9 million tonnes would be in the form of rice straw, 0.44 million tonnes as rice husk, and 0.15 million tonnes as maize stalks. An estimate shows that about 264 million cubic meters of gas per year could be generated from the manure of buffalo, cows and pigs³⁵.

³³ Powering Progress, The Energy Sector in Laos, February 2009

³⁴ Asia Pro Eco, 2006

³⁵ Theuambounmy, Houmpheng., 2002

Biogas

The biogas potential of rice straw in the country accounts to 43,1 Million m³ biogas per year which is equal to 259 GWh total or 65 GWh electrical energy. Thus about 7% of the countries' electricity demand could be covered with rice straw residues based energy³⁶.

Table 7: Biogas based energy potential of rice straw

Category	Amount	Unit	Rice Straw Properties
Dry Matter (DM)	210,750	t/year	25 % FS
Volatile Solids (VS)	195,998	t/year	93 %DM
Biogas	43,119.450	m ³ /year	220 m ³ /kg VS
Total Energy potential	259	GWh/year	5 KWh/m ³
Total Electricity potential	65	GWhel/year	1,5 KWh/m ³

Source: Asia Pro Eco, 2006

The potential for biomass gasification is estimated at less than 40 tonnes dry mass per hectare, which is quite high compared to Europe's less than 15 tonnes per hectare. Feasibility studies still need to be conducted to make conclusive decisions.

The biogas generation potential from manure is also important, as shown in the following table. Manure is no increasingly utilized by farmers in the generation of energy, mainly for domestic usage.

³⁶ Asia Pro Eco, 2006

Table 8: Manure generation of relevant livestock (NSC, 2004)

	Provinces	Cattle	Buffaloes	Pigs	Poultry	Goat & sheep
		tons of dung per year				
1	Vientiane mun.-	512.000	300.000	74.000	151.920	8.000
2	Phongsaly	160.000	408.000	130.000	29.200	2.000
3	Luang Namtha	176.000	276.000	104.000	23.040	6.000
4	Oudomxay	568.000	444.000	182.000	134.640	21.000
5	Bokeo	272.000	252.000	90.000	33.600	5.000
6	Luang Prabang	192.000	660.000	270.000	88.160	25.000
7	Huaphanh	280.000	792.000	268.000	120.080	14.000
8	Xayaboury	384.000	744.000	190.000	136.560	8.000
9	Xiengkhouang	512.000	528.000	140.000	40.320	9.000
10	Vientiane province	704.000	708.000	184.000	118.080	7.000
11	Bolikhamxay	832.000	480.000	84.000	61.680	2.000
12	Khammuane	352.000	804.000	136.000	74.400	7.000
13	Savannakhet	400.000	3.396.000	436.000	159.840	1.000
14	Saravanh	3.128.000	1.020.000	254.000	130.240	11.000
15	Xekong	760.000	288.000	70.000	9.280	6.000
16	Champasak	120.000	1.440.000	148.000	181.040	3.000
17	Attapeu	1.008.000	540.000	40.000	20.000	2.000
18	Xaysomboune	96.000	276.000	32.000	46.320	3.000
-	Lao PDR	10.456.000	13.356.000	2.832.000	1.558.400	140.000

Source: Asia Pro Eco, 2006

Biofuel

Although no biofuel is yet produced in Laos, there is high interest in energy plantations; biofuel could well be produced using the naturally occurring Jathropa³⁷.

³⁷ LIRE, January 2011

3.2 Hydro Energy Resource potential

The potential for hydropower is estimated at 26,500 MW, not counting the mainstream Mekong. Of this, approximately 18,000 MW are technically exploitable. 12,500 MW can be exploited from the major Mekong sub-basins and the remainder in minor Mekong and non-Mekong basins. It is estimated that less than 2% of the country's hydropower potential has been developed over the past 30 years. With the existing new government policies, it is expected that the development of hydropower will accelerate as to supply electricity to the rapidly growing economies in the South East regions. Several agreements for hydropower exports have been signed with Thailand, Vietnam and Cambodia. Moreover, domestic energy consumption is growing at a rate of 8% to 10% annually³⁸.

A minimum of eleven sites have been identified for the construction of large dams that are to be built by the year 2020. This will allow the production of 5,000 MW electricity. Dams to supply Thailand would be on the rivers Ngiep, Ngum and Theun. For Vietnam, the dams will be built on the Kong, Mo, Xe Pian and Xe Kaman in the south of the country. The largest project is the long planned Nam Theun II, 50 KM upstream of the Theyn-Hinboun. It will be 50 meters high and provide 1,000 MW. The environmental impacts associated with this project are due to the large 450 km² area that will be flooded for this project; its cost is estimated at half Laos' annual GDP³⁹.

³⁸ Powering Progress, The Energy Sector in Laos, February 2009

³⁹ Wikipedia, Reservoirs and dams in Laos, June 2010

Table 9: Hydroelectric Power Projects in Lao PDR - Under Construction

No	Name of Project	Location	Installed Capacity	STATUS		Investors (Sponsors)	Planned Market	Remarks
		Province		Progress of MOU/PDA/CA	Commercial Operation Date			
1	Hongsai Lignite (IPP)	Kayaboury	1800 MW	PDA (HOA) Signed 18/12/2006 and period 18 months, renewal 19/12/08 to 20/6/09 Tariff MOU 13/5/09 (PDA signed with Thai-Lao Lignite of Thailand on 22 July 1994 was procedurally terminated in October 2006)	2015	<ul style="list-style-type: none"> LHSE 20% Ratchaburi 40% BANPU 40% 	Laos/ Thailand	
2	Nam Ngum 2 Hydropower (IPP)	Vientiane	615 MW	PDA 16/01/1991 CA Signed 21/03/2006	IOD 2011 COD 2013	<ul style="list-style-type: none"> EdL (Laos) 25% CH. Kanchang (Thailand) 28.5% PT Construction & Irrigation Co., (Laos) 4% Ratchaburi (Thailand) 25% Bangkok Expressway PCL (Thailand) 12.5% TEAM Consulting Engineering 1% Shalapak Group (USA) 4% 	Thailand	Progress Construction 95.84%
3	Nam Nhone	Bokeo and Luangnamtha	2.4 MW	PDA not required CA Signed 3/3/2006	2009	Nam Nhone Power Company 100%	Laos	Progress Construction 91%
4	Nam Ngum 5 Hydropower (IPP)	Luangprabang and Xiengkhouang	120 MW	CA Signed 10/4/2007	2011	<ul style="list-style-type: none"> EDL 15% Sinohydro (China) 85% 	Laos	Progress Construction 50%
5	Tad Salen Hydropower (IPP)	Savannakhet	3.2 MW	<ul style="list-style-type: none"> PDA not required CA Signed 03/02/2009 	TBD	SIC Manufacturer (Thailand) 100%	Laos	Progress Construction 25%
6	Theun-Hinboun Hydropower Expansion (IPP)	Bolikhamxay	220+60 MW	<ul style="list-style-type: none"> CA Amended 27/8/2008 	2012	<ul style="list-style-type: none"> EDL 60% Nordic Group (Norway) 20% MDX (Thailand) 20% 	Laos/ Thailand	Progress Construction 58%
7	Xekaman 3 Hydropower (IPP)	Sekong	250 MW	<ul style="list-style-type: none"> PDA not required CA Signed 4/01/2006 	2010	<ul style="list-style-type: none"> EDL 15% VLP (Vietnam) 85% 	Laos/ Vietnam	Progress Construction 72.06%

Source: Powering Progress, January 2011

Table 10: Hydroelectric Power Projects in Lao PDR - Planning Stage (PDA Stage)

No	Name of Project	Location	Installed Capacity	STATUS		Investors (Sponsors)	Planned Market	
		Province		Progress of MOU/PDA/CA	Commercial Operation Date			
1	Don Sahong (Mekong)	Champasak	360 MW	• PDA Signed 13/02/2008	2015	• GOL 20% • Mega First (Malaysia) 80%	Laos/ Thailand	F/S on-going
2	Nam Beng	Oudomxay	50 MW	PDA Signed 10/3/2010		China National Electrical Equipment Corp.	Laos	
3	Nam Kong 1 (IPP)	Attapeu	75 MW	PDA Signed 23/06/2008	2012	• Region Oil (Russia) 80% • LHSE 20%	(Thailand or Vietnam) or Laos	F/S on-going
4	Nam Lik 1 (IPP)	Vientiane	60 MW	PDA Signed 08/4/2008	2013	• GOL 20% • Hydro Engineering Co. (Thailand) 80%	Laos	F/S on-going
5	Nam Mang 1 (IPP)	Bolikhamxay	60 MW	PDA Signed 20/5/2010	2012	Far-East Industrial Co., Ltd	Laos	
6	Nam Mo (IPP)	Xiengkhouang	105 MW	PDA Signed 30/03/2008	2014	• GOL 15% • Viet-Lao Economical Cooperative General Company 85%	Vietnam	
7	Nam Ngiep 1 Hydropower (IPP)	Bolikhamxay	278 MW	• PDA Signed 27/4/2006 and period 18 months, renewal 27/5/08 to 26/2/09	2015	• LHSE 25% • Kansai Electric & Nippon Keoi (Japan) 45% • EGAT Inter 30%	Laos/ Thailand	
8	Nam Ngiep 2	Xiengkhouang	155 MW	PDA Signed 25.8.2010 and period 18 month	TBD	• CWE (China)		
9	Nam Ngum 3 Hydropower (IPP)	Vientiane and Xieng Khouang	440 MW	• PDA Signed 15/11/97 • CA /PPA Under Negotiation	2014	• LHSE (Laos) 23% • Marubeni (Japan) 25% • Ratchaburi (Thailand) 25% • GMS (Thailand) 27%	Thailand	
10	Nam Ou (IPP)	Phongsaly/ Luangprabang	1100 MW	PDA Signed 15/10/2007	2013-2016	• GOL 10 - 25% • Sinohydro (China) 90% - 75%	Thailand or China and Laos	F/S on-going
11	Nam Phak	Champasak	75 MW	PDA Signed 06.11.2009	TBD	• EDL 20% • Kobe Green Power Co., Ltd (Japan) 40% • Investor yet to be found 20%	Laos	
12	Nam Pha	Luangnamtha/ Bokeo	70 MW	PDA Signed 20.8.2010 and period 18 months	TBD	AP Bizlink Group (Malaysia)	Laos	

Source: Powering Progress, January 2011

Table 11: Hydroelectric Power Projects in Lao PDR - Planning Stage (PDA Stage) (cont.)

No	Name of Project	Location	Installed Capacityz	STATUS		Investors (Sponsors)	Planned Market	
		Province		Progress of MOU/PDA/CA	Commercial Operation Date			
13	Nam Sim (IPP)	Houaphan	8 MW	PDA Signed 2/10/2007	2012	• ECI (Laos) 25% • Energy Development as (Norway) 75%	Laos	
14	Nam Sane 3 (IPP)	Xiengkhouang	60 MW	PDA Signed 19/06/2008	2013	• GOL 25% • Rohas Euco Industries Berhad (Malaysia) 75%	Laos	
15	Nam Seuang 1	Luangprabang	56 MW	PDA Signed 11.8.2010 and period 18 month	TBD	Bru Thai International	Laos/ Thailand	
16	Nam Seuang 2	Luangprabang	220 MW	PDA Signed 11.8.2010 and period 18 month	TBD	Bru Thai International	Laos/ Thailand	
17	Nam Theun 1 Hydropower (IPP)	Bolikhamxay	523 MW	• CA/ PPA Under Negotiation (tariff concluded) • PDA Signed 28/11/04	2016	• LHSE 20% • Gamuda (Malaysia) 40% • EGCO (Thailand) 40%	Laos/ Thailand	
18	Sekong 4 Hydropower (IPP)	Sekong	300 MW	PDA signed 23/6/2008	2013	• Region Oil (Russia) 80% • LHSE 20%		
19	Se Kong 5 Hydropower (IPP)	Sekong	400 MW	• PDA signed 19 May 2009	TBD	Region Oil (Russia) Strategic partners to be invited	Thailand or Vietnam) or Laos	
20	Xayaboury (Mekong) (IPP)	Xayaboury/ Luangprabang	1260 MW	PDA Signed 25/11/2008 and period 24 months	TBD	Ch.Kanchang and PT	Laos/ Thailand	
21	Xepian-Xenamnoy (IPP)	Attapeu and Champasak	390 MW	PDA Signed 14/11/2008 and period 18 months	2015	• LHSE 24% • SK Engineering & Construction (Korea) 26% • Korea Western Power Co., Ltd 25% • Ratchaburi Electric Generating Holding Public Co., Ltd 25%	Thailand	
22	Xe Katam (IPP)	Champasak	61 MW	PDA Signed 20/12/2007 and period 18 months	2012	• GOL 25% • Kansai (Japan) 55% • Thai investor 20%	Laos	
23	Xekaman 1 Hydropower (IPP)	Attapeu	322 MW	PDA Signed 30/3/2008	2013	• GOL 15 - 30% • VLP (Vietnam) 70-85%	Vietnam/ Laos	
24	Xelanong 2	Saravane	60MW	PDA Signed 20/9/2007	TBD	• GOL 25% • J.R.C Service Co., Ltd (Japan) 75%	Laos	

Source: Powering Progress, January 2011

Table 12: Hydroelectric Power Projects in Lao PDR - Feasibility Stage (MOU Stage)

No	Name of Project	Location	Installed Capacity	STATUS		Investors (Sponsors)	Planned Market	Remarks
		Province		Progress of MOU/PDA/CA	Commercial Operation Date			
1	Ban Koum (Mekong)	Champasak	2330 MW	MOU Signed 25/3/2008 and period 30 months to 25/9/2010	TBD	- Italian Thai - Asia Corp Holdings Limited.	Laos/ Thailand	
2	Dak e meule Hydropower (IPP)	Sekong	130 MW	• MOU Signed 8/1/2008 and period 18 month to 08/07/2009	TBD	• GOL • Viet-Lao Power	Vietnam/ Laos	
3	Houay Champi	Champasak	5 MW	MOU Signed 26/5/2009 and period 18 month to 16/9/2010	TBD	SV Group Company Ltd.	Laos	
4	Lat Sun (Mekong)	Champasak	800 MW	MOU Signed 2/4/2008 and period 30 months	TBD	Charoen Energy and Water Asia	Laos/ Thailand	
5	Luangprabang (Mekong)	Luangprabang	1410 MW	MOU Signed 13/10/2007 and period 30 month to 10/4/2010	TBD	Petrovietnam Power Corporation	Laos/ Vietnam	
6	Nam Bak 1	Vientiane	132 MW	• MOU Signed 11.4.2007 Renewal 12.10.2008 to 12/5/2009	TBD	Num Ngum 2 Power Company limited.	Thailand	
7	Nam Bak 2	Vientiane	27 MW	• MOU Signed 11.4.2007 Renewal 12.10.2008 to 12/5/2009	TBD	Num Ngum 2 Power Company limited.	Laos/ Thailand	
8	Nam Et 1, 2, 3	Houaphan	140 + 170 + 110MW	MOU Signed 31/12/2008 and period 8 months to 30/6/2010	TBD	EVN International Joint Stock Co., BacHaInvestment joint stock Co.,	Laos/ Vietnam	Return to GOL
9	Nam Feuang	Vientiane	28 MW	MOU Signed 3.4.2007 Renewal 2/10/2008 to 3/6/2009	TBD	• Yunan Provincial Power Investment	Laos	
10	Nam Ham	Xayaboury	3.5 MW	• MOU Signed 6.4.2005 Renewal 14.12.2008	TBD	• Simuang Group (Laos)	Laos	
11	Nam Khan 2	Luangprabang	130 MW	MOU Signed 13.10.2006 and period 18 month to 13/4/2008	TBD	Sinohydro (China)	Laos	
12	Nam Khan 3	Luangprabang	95 MW	MOU Signed 13.10.2006 and period 18 month to 13/4/2008	TBD	Sinohydro (China)	Laos	
13	Nam Kong (down stream)	Attapeu	60-80 MW	MOU Signed 31/8/2010 and period 18 months	TBD	Hong Anh Gai Lai Mineral Joint Stock Company		
14	Nam Kong 2	Attapeu	70 MW	MOU Signed 19/01/2010 and period 18	TBD	Hong Anh Gai Lai Mineral Joint Stock Company		
15	Nam Kong 3	Attapeu	35 MW	MOU Signed 31/8/2009 and period 18 months to 30/02/2011	TBD	Hong Anh Gai Lai Mineral Joint Stock Company		
16	Nam Ma 1, 2, 3	Houaphan	175 MW	MOU Signed 30/12/2008 and period 18 months to 29/6/2010	TBD	Linh Linh JFC Electrical Construction Investment Joint Stock Company	Laos/ Vietnam	

Source: Powering Progress, January 2011

Table 13: Hydroelectric Power Projects in Lao PDR - Feasibility Stage (MOU Stage)(cont)

No	Name of Project	Location	Installed Capacity	STATUS		Investors (Sponsors)	Planned Market	Remarks
		Province		Progress of MOU/PDA/CA	Commercial Operation Date			
17	Nam Mo 1	Xiengkhouang	62 MW	MOU Signed 4.3.2010 and period 18 month	TBD	EVN International Joint Stock (Viet Nam)		
18	Nam Mouan	Khammouan	137 MW	MOU Signed 26.2.2010 and period 18 month		Chubu Electric Power (Japan)		
19	Nam Neun	Houaphan	65 MW	MOU Signed 8/10/2009 and period 18 months to 8/04/2011	TBD	Indochina Consulting Co., Ltd (Korea)		
20	Nam Nga	Luangprabang/ Oudomxay	80 MW	MOU Signed 26/11/2007 and period 24 months to 25/11/2009	TBD	Norpower as	Laos	
21	Nam Ngiep	Bolikhamxay	40 MW	MOU Signed 25.2.2010 and period 18 month	TBD	• Phongsubthavy Bridge Road Construction		
22	Nam Ngum Downstream	Vientiane Municipality	70 MW	MOU Signed 28/1/2008 and period 18 months	TBD	CEIEC China	Laos	
23	Nam Ngum 4	Vientiane/ Xiengkhouang	220 MW	MOU Signed 30/3/2008 and period 18 months	TBD	Saigon Investment Group	Laos/ Vietnam	
24	Nam Phai	Vientiane	60 MW	MOU Signed 24.7.2009 Renewal 31.11.2008 to 31/5/2009	TBD	Norinco International Cooperation (China)		
25	Nam Phoun	Xayaboury	60 MW	MOU Signed 5.12.2008 and period 18 month to 4/6/2010	TBD	SOK Corporation Ltd.	Laos	
26	Nam Pod	Houaphan	25 - 30 MW	MOU Signed 26/11/2009 and period 18 months	TBD	ACE Consultant (Laos)		
27	Nam Tha 1	Oudomxay	168 MW	MOU Signed 16.6.2010 and period 18 month	TBD	• EDL • China Southern Power Grid Co. LTD	Laos	
28	Nam Theun 4	Bolikhamxay	110 MW	MOU Signed 30.9.2008 and period 18 month to 29/3/2010	TBD	REE Power Plant Inc (Vietnam)		
29	Nam Sum 1& 3	Houaphan/ Luangprabang	228 MW	MOU Signed 30/3/2008 and period 18 months to 29/9/2009	TBD	Saigon Investment Group	Laos/ Vietnam	
30	Pakbeng (Mekong)	Oudomxay/ Xayaboury	1300 MW	MOU Signed 29/8/2007 and period 30 month to 29/2/2010	TBD	Datang International Power Generation		
31	Pak Lay (Mekong)	Xayaboury and Vientiane	1320 MW	MOU Signed 11/6/2007 and period 30 month to 11/7/2010	TBD	CEIEC+ SINOHYDRO	Thailand/ Laos	
32	Sanakham (Mekong)	Xayaboury/ Vientiane	500 MW	MOU Signed 11/12/2007 and period 30 month to 11/6/2010	TBD	Datang International Power Generation	Laos/ Thailand/ China	
33	Sekong 3 (Upper and Lower)	Sekong	150 MW	MOU Signed 29/1/2008 and period 18	TBD	Song Da Corporation Company	Laos/ Vietnam	
34	Thakho	Champasak	30 MW	MOU Signed 17/3/2009 and period 18 months	TBD	Compagnie Nationale du Rhone (CNR) EDL	Laos	

Source: Powering Progress, January 2011

Table 14: Hydroelectric Power Projects in Lao PDR - Feasibility Stage (MOU Stage)(cont)

35	Xebanghieng 1	Savannakhet	65 MW	MOU Signed 25/11/2008 and period 18 months to 24/7/2010	TBD	Song Da Corporation Company		
36	Xebanghieng 2	Savannakhet	250 MW	MOU Signed 25/11/2008 and period 18 months to 24/7/2010	TBD	Song Da Corporation Company		
37	Xebungnuan	Saravane	80 MW	• MOU Signed 26.8.2005 and period 18 month renewal to 8/3/2008	TBD	Sitath Road - Bridge Construction Co., LTD		
38	Xekanman 4	Sekong	66 + 96 MW	MOU Signed 19.12.2006 Renewal 18.5.2008 to 17/2/2009	TBD	Viet-Lao Power Company	Vietnam	
39	Xelanong 1	Savannakhet	60 - 80 MW	MOU Signed 26/11/2007 and period 24 months to 26/11/2009	TBD	Norpower as	Laos	
40	Xe Neua	Khammouane	40 MW	MOU Signed 16.5.2006 and period 18 month to 16/11/2007	TBD	Phonesack B.&Road Construction Co., Ltd	Laos	
41	Xepone 3	Savannakhet	70 - 100 MW	MOU Signed 21/4/2008 and period 18 months	TBD	China National Machinery & Equipment Import & Export Corporation (CMEC)	Laos	
42	Xepian-Houaysoy	Attapeu	120 MW	MOU Signed 26/6/2010 and period 18 months	TBD	Houay Ho Power		

Source: Powering Progress, January 2011

3.3 Solar Energy Resource potential

Laos receives 300 days per year of sunlight and therefore makes it a potentially good location for PV and solar thermal systems⁴⁰.

Although photovoltaic systems can offer great applications especially in rural areas of Laos, the costs of large scale solar thermal or photovoltaic power make plants currently unfeasible⁴¹.

Sunlight hours⁴²:

- 4.0 hours average per day in June
- 8.2 hours average per day in November
- 2,420 hours average per year
- 6.6 hours average sunlight per day.
- Sunlight days per year

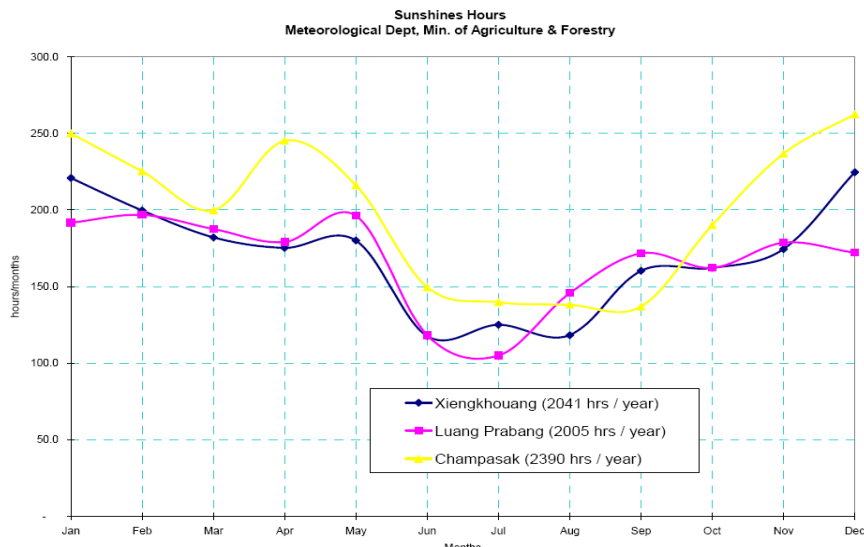
⁴⁰ Theuambounmy, Houmpheng, 05 – 07 June 2007

⁴¹ Powering Progress, The Energy Sector in Laos, February 2009

⁴² World weather and climat graphs..., February 2011

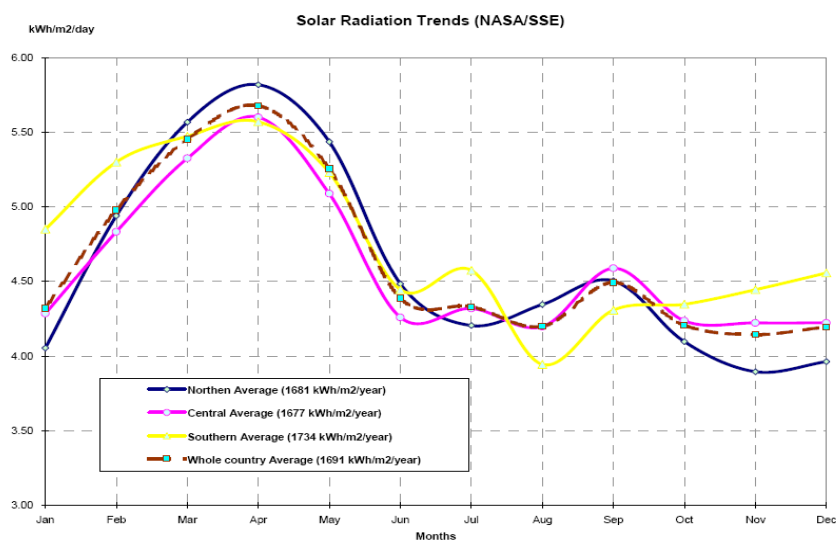
- 300 days per year
- Radiation intensity⁴³:
- 3.9 kWh/m²/day in the lowest month
- 5.8 kWh/m²/day in the highest month and
- 4.6 kWh/m²/day is an average over the country

Figure 12: Sunshine hours



Source: Asia Pro Eco, 2006

Figure 13: Solar radiation in Laos



Source: Asia Pro Eco, 2006

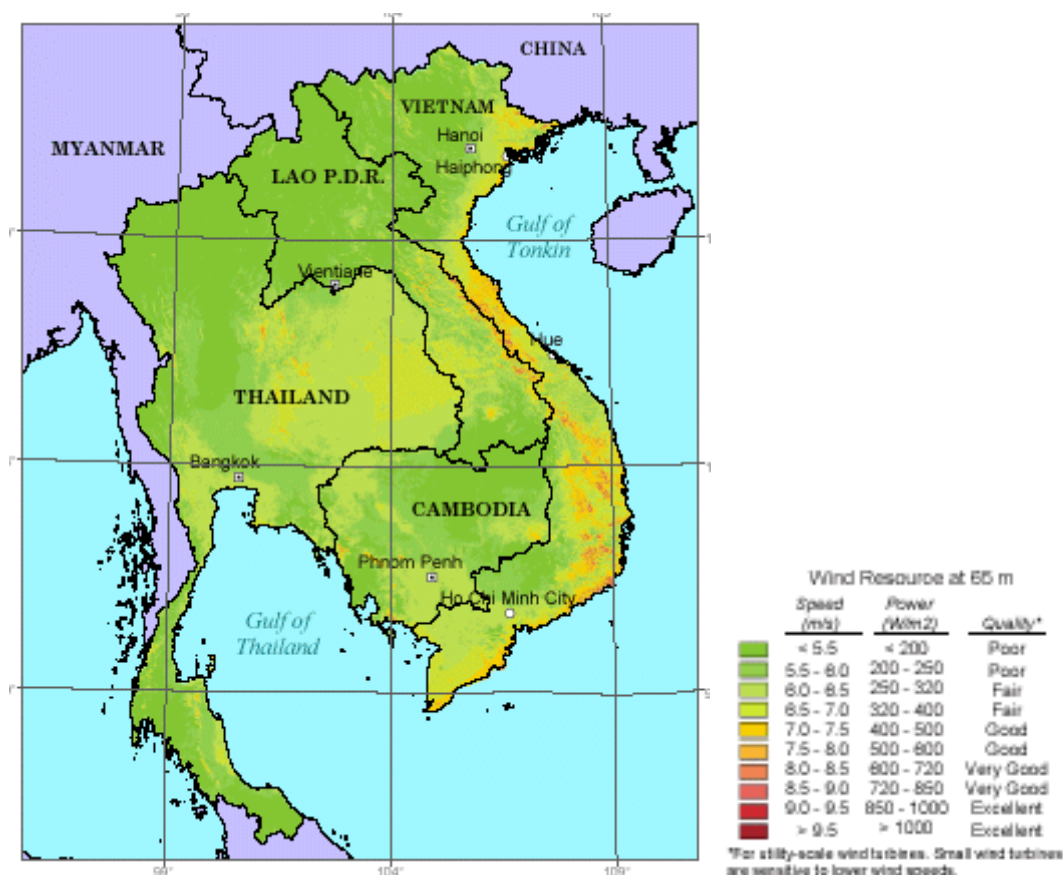
⁴³ Asia Pro Eco, 2006

3.4 Wind Energy Resource potential

Wind energy offers limited potential due to the average low wind speeds and the high costs of units⁴⁴. Nevertheless, there are reasonable good wind resource areas for large-scale wind energy-based electricity systems in the central region of the country⁴⁵.

Wind speed⁴⁶: 1 m/sec in Lang Kraband and Vientiane areas (higher speeds in mountainous areas).

Figure 14: Wind energy potential in Laos



Source: M. I. Cabrera and T. Lefevre, 2002

⁴⁴ Powering Progress, The Energy Sector in Laos, February 2009

⁴⁵ Theuambounmy, Houmpheng, 05 – 07 june 2007

⁴⁶ Asia Pro Eco, 2006

3.5 Other renewable energy sources potentials

Geothermal⁴⁷

Current situation

There are no significant known geothermal energy reserves and therefore there is limited potential for geothermal power generation

Wave or Tidal

Laos is a landlocked country and therefore has no wave or tidal energy potential

⁴⁷ Powering Progress, The Energy Sector in Laos, February 2009

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4.1 Related links

Government organizations

Organization	Web site
Bank of Lao PDR	n/a
Electricité du Laos	http://www.edl-laos.com/
Lao National Sports Committee	n/a
Lao National Tourism Administration	http://www.tourismlaos.org/web/index.php
Ministry of Agricultural and Forestry	http://www.maf.gov.la/
Ministry of Education	http://www.moe.gov.la/
Ministry of Energy and Mine	http://www.mem.gov.la/
Ministry of Finance	http://www.mof.gov.la/
Ministry of Foreign Affairs	http://www.mofa.gov.la/
Ministry of Industry and Commerce	http://www.moic.gov.la/lao/index.asp
Ministry of Information and Culture	http://www.mic.gov.la
Ministry of Justice	n/a
Ministry of Labour and Social Welfare	n/a
Ministry of National Defense	n/a
Ministry of Planning and Investment	n/a
Ministry of Public Health	http://www.moh.gov.la/
Ministry of Public Security	n/a
Ministry of Public Work and Transportation	http://www.mpwt.gov.la/
National Authority for Post and Telecommunication	n/a
National Authority of Science and Technology	http://www.nast.gov.la/
Presidential Office	www.laopdr.gov.la/
Prime Minister Secretariat	www.laopdr.gov.la/
Prime Minister's Office	www.laopdr.gov.la/

Public Administration and Civil Service Authority	
Water Resource and Environment Administration	http://www.wrea.gov.la/wrea/

Asian organizations

Organization	Web site
Institute for Global Environmental Strategies (IGES)	www.iges.or.jp
International Affairs Department, National Institute of Advanced Industrial Science and Technology (AIST)	www.biomass-asia-workshop.jp

International organizations

Organization	Web site
Asian Development Bank	www.adb.org/carm or http://www.adb.org
Food and Agriculture Organization of the United Nations	www.fao.org
International Energy Agency	www.iea.org
International Monetary Fund	www.imf.org
JICA - Japan International Cooperation Agency	www.jica.org.kh
United Nations Development Programme	www.undp.org
World Bank	www.worldbank.org

Other information sites

Organization	Web site
Central Intelligence Agency, USA	www.cia.gov/library/publications/the-world-factbook
Climate & temperature	www.climatetemp.info
Deutsche Gesellschaft für Sonnenenergie e.V.	www.dgs.de
Index Mundi	www.indexmundi.com
Internet World Stats	www.internetworldstats.com
NASA Atmospheric Science Data Center	http://eosweb.larc.nasa.gov

Probe International	www.probeinternational.org
Promotion of the Efficient use of Renewable Energies in Developing Countries	www.reepro.info

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