

WORLD BANK

**LAO PDR HYDROPOWER
SECTOR ENVIRONMENTAL
ASSESSMENT**

DRAFT FINAL REPORT Executive Summary

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NORPLAN 

SUMMARY

1.1 Hydropower Sector

Lao PDR is situated in the Lower Mekong Basin. The country has the largest hydropower potential in the region but only a small percentage of it has been developed to date.

A policy objective of Government of Lao PDR is to develop its hydropower resources for the benefit of the country in order to:

- *Provide power to provide reliable and affordable power to cover the national demand and thereby promote economic and social development.*
- *Develop part the hydropower potential to generate export income for the country by selling power to neighbour countries.*

1.1.1 Demand Forecasts

The domestic demand has been increasing at a high rate since the last decade even through there was a period of economic recession in the region. This high level of growth is expected to continue over the next 15 years with tendency towards a slight decrease at end of this period. The demand forecast used as a basis for the Power Sector Development Plan is shown in Table 1 and is based on the governmental policy of providing electricity to 90 % of the households by 2020. The rather high increase in growth for the period of 2002 to 2005 is mainly due to the assumed start up of the Xepon copper/gold mine (40 MW) and the cement plant at Mahaxai (20 MW), both of which will require considerable power. Irrigation schemes are estimated to reach a load demand of 10 MW in 2020.

Table 1. PSDP Energy and Peak Demand Forecast (Meritec et al 2004)

	Unit	2002	2005	2010	2015	2020
Energy Consumption)	GWh	937.0	1,924.5	3,061.0	4,026.4	5,332.8
Av. annual growth	%		27%	10%	6%	6%
Peak Load (MW)	MW	186.4	378.3	548.6	721.8	956.1
Av. annual growth	%		27%	8%	6%	&5

Export power demand cannot be modelled in the same way as the national demand, since external factors and uncertainties are too great for any precise prediction of the long-term demand or optimization of sequencing and timing. Some determining factors will be:

- The future cost difference between hydropower and other energy sources
- Progress in regional transmission systems and power grids
- Availability of capital
- Progress in competing hydropower plans in neighbouring countries

The PSDP presents two development scenarios for export projects: a base scenario and an optimistic scenario (Table 2).

Table 2. Export Generation Scenarios (Meritec 2004)

	Base Export Scenario	MW	Optimistic Export Scenario	MW
2006				
2007				
2008	Theun Hinboun Ext.	150	Theun Hinboun Extension Nam Mo	150 100
2009	Nam Mo	100		
2010	Nam Theun 2	1000	Nam Theun 2 Xe Kaman 3	1000 250
2011	Xe Kaman 3	250		
2012				
2013			Xe Kaman 1	468
2014	Xe Kaman 1	468		
2015			Xe Kong 5	348
2016				
2017	Xe Kong 5	348	Nam Ngum 3B	580
2018				
2019			Nam Ngum 2B	183
2020	Nam Ngum 3B E	580		
	Total capacity	2796		2979

The sequence of the scenarios shown above is based on the professional judgement of the consultant, taking into consideration the following factors:

- Economics of the project and the quality of the site
- Substance and sincerity of the sponsor
- Market conditions, including demand growth, reserve margin and political support for power trading
- Capacity of Lao institutions to manage the on current implementation of multiple projects.

Export projects dominate the 15-year development plans in Lao PDR. The total projected capacity demand of the export projects is about three times the modelled national demand of the same period. Taking into consideration the uncertainties in the development of export projects, it is very challenging to determine the overall generation scenarios for hydropower development in the country.

1.1.2 Hydropower Project Development Plans

The hydropower sector is one of the most thoroughly planned sectors in Lao PDR from an economic and technical point of view. Over the last decades a number of studies have been carried out to establish a realistic list of projects and the most economic viable sequence for their construction. The definition of what is a feasible project and the principles of project ranking have, however, been constantly changing. A large number of potential hydropower projects have been identified in Lao PDR, but both the projects and their technical specifications included in these

“long lists” have changed over the years due to the collection of additional data and changing socio-economic and technical frame conditions.

In addition to EdL’s own ranking of projects (Electricité de Lao Generation Expansion Plan, 2005–2020) the following 6 hydropower ranking studies have been carried out in Lao PDR in the last 7 years:

- Hydropower Development Plan for Lao PDR (HDP) in 1997
- Power System Planning in the MIH (PSP) in 1997
- Nam Theun 2: Study of Alternative (NT2SOA) in 1998 (Lahmeyer & Worley)
- Se Kong, Se San and Nam Theun River Basins Study in 1998 (Halcrow et al.)
- Hydropower Development Strategy Study (HDSS) in 2000 (Worley & Lahmeyer)
- Power System Strategy Study (PSSS) in 2002 (Electrowatt & PA)
- Power System Development Plan (PSDP) in 2004 (Meritec & Lahmeyer)

The list of projects analysed in these environmental sector studies (Table 3) are partly based on projects for domestic consumption ranked by EdL and the most promising export generation projects from the PSDP ranking. This contains the projects that are most likely to be built in the next 15 year in Lao PDR.

Table 3. EdL Generation Expansion Plan (2004-2020) for domestic projects and the most promising export projects (PSDP).

No.	Project	Year of commissioning	Installed capacity (MW)	Level of study
1	Nam Mang 3	2005 (domestic)	35	FS
2	Xeset 2	2006 (domestic)	76	FS
3	Nam Lik	2007 (domestic.)	100	FS
4	Xepon	2008 (domestic.)	74	I
5	Theun Hinboun Ext.	2009 (export)	105	MoU / FS
6	Nam Mo	2009 (export)	100	CA /FS /EIA
7	Nam Theun 2	2009 (dom./exp.)	75 + 1000	CA /FS /EIA
8	H. Lamphan Gnai	2010 (domestic)	60	I
9	Xe Kaman 3	2010 (export)	250	Constr./MoU/FS
10	Nam Ngum 5	2012 (domestic)	90	PFS
11	Thakho	2013 (domestic)	36	MoU /PFS
12	Xeset 3	2014 (domestic)	20	FS
13	Xe Kaman 1	2014 (export)	468	CA / FS
14	Nam Ngum 4A	2015 (domestic.)	55	I
15	Nam Kong 3	2016 (domestic.)	25	I
16	Nam Pot	2017 (domestic.)	38	I
17	Xe Kong 5	2017 (export)	248	MoU / I
18	Nam Bak 2B	2018 (domestic.)	116	MoU / I
19	Nam Ngum 4B	2019 (domestic.)	56	I
20	Xe Xou	2020 (domestic.)	59	I
21	Nam Ngum 3B	2020 (export)	580	CA /FS /EIA

MoU=Memorandum of understanding, PFS=Pre-Feasibility study, CA=Concession agreement; I=Initial study.

1.1.3 *Financing and Development Sequence*

There is a growing acceptance that the capital required to expand the power systems in order to keep pace with demand are far higher than the financial capacity of both the Lao PDR government and the multilateral or bilateral financial institutions. So far only two privately financed hydropower projects based a Build-Own-Operate-Transfer (BOOT) agreement have been built in Lao PDR, the Theun-Hinboun and the Houay Ho hydropower plants.

A number of MOUs between the Government of Lao PDR and private developers have been signed both before and after the Theun-Hinboun and Houay Ho were initiated. Only a few of these have yet reached the stage where it is possible to foresee a time schedule for implementation. The most advanced project in terms of preparation is the Nam Theun 2 project where financial closure is expected in 2005.

The involvement of private investors, as is the case in Lao PDR, has resulted in a partial breakdown of the system of ranking and selection of projects for development by least cost criteria, as promoted by the World Bank and the Asian Development Bank and modelled in the recent Sector Development Plans. In the system of public and donor financing, least cost planning is able to allocate investments to the “best” projects. With the private investors in the lead such scheduling has manifested itself as being very difficult to apply, as governments have little impact on project preparation and financing processes.

1.2 **Legal and Administrative Setting and the Implementation of Environmental and Social Safeguard Measures**

The Environmental Protection Law (1999) is the most important piece of legislature. This has been further elaborated by an implementation decree of 2002. A general framework entitled “Regulation on Environmental Assessment in Lao PDR” was issued in 2000. Based on this regulation the Department of Electricity of Ministry of Industry and Handicraft (MIH) developed and issued their own environmental and social assessment regulations and standards from 2001 to 2003. These regulations and standards appear to be broadly consistent with international guidelines.

The environmental and social safeguard institutions responsible for the hydropower sector at central level are the Social and Environmental Management Division of the Department of Electricity in MIH and the Department of Environment under the Science, Technology and Environment Agency (STEA). Of these two, STEA, through the provisions in the Environmental Protection Law, has overall responsibility for the environmental safeguard system and thus has the duty to oversee all issues in the sector ministries, such as MIH. The Social and Environmental Management Division in MIH is more directly involved in the supervision of the EIA process and associated processes. They are involved at an early stage in determining the level of assessment needed, the development of ToRs for Initial Environmental Evaluation or Environmental Impact Assessments and review of documents.

A comprehensive and modern system of addressing environmental and social impacts of hydropower development in Lao PDR is now in place. The implementation of this advanced set of environmental and social regulations and guidelines for the hydropower sector is, however, dependent on the capacity and

competence of the staff of the Social and Environmental Division of the Department of Electricity and the administrative and political “strength” of this unit to be an equal partner with the developers and the promoters of hydropower projects in the Government.

Presently the Division consists of only five people who have to follow up and implement the demanding and comprehensive set of regulations and guidelines. Considering also the limited resources available for field travel and monitoring, the staff are faced with an almost overwhelming task. Thus, the apparatus that today is available for implementation of environmental regulation appears to present a real and serious obstacle for proper environmental and social safeguarding in connection with hydropower development.

1.2.1 *EIA Experiences*

A brief assessment has been made of the quality of previous EIAs and their adequacy compared to today’s requirements. Most of the experiences with environmental and social assessment in connection with hydropower development are from a time when the national standards were not yet in place. The NT2 is a special case where the EIA processes started more about 10 years ago and has continued in a situation where the EIA regulations both in Lao PDR and in the International Funding Institutions have been constantly strengthened.

In summary, it can be said that a number of quality reports have been prepared, assisting in the planning for “better” projects, identifying needs for mitigation and compensation, and increasing the general understanding and knowledge of the environmental and social situation in Lao PDR. However, several shortcomings and problems have been demonstrated. Among others these are:

- Findings and recommendations have not been followed up (particularly serious in the case of resettlement)
- Crucial information and analysis were only available after the construction had started or PPAs signed so that project design and operation could not be modified as a mitigation measure
- A narrow definition of the Project Impact Zone has resulted in some impacted communities or natural environments not being covered in the analysis (in particular downstream issues)
- A lack of a mechanism for addressing cumulative impacts in river basins
- Minimum flow releases have been decided without any solid environmental and social assessments
- The knowledge of fisheries and fish biodiversity is weak resulting in a focus on scientific description more than prediction of impacts
- The format of the reports and the analytic methodology differs considerably sometimes making the reports unintelligible for those other than specialists

1.3 **Potential Environmental and Social Impacts**

The study has made an assessment of the combined impacts of the 21 hydropower projects planned for implementation before 2020.

Some of the assumed impacts and impact indicators for the studied projects are summarised in Table 4.

Table 4: Summary of project characteristics and key impacts.

Project	Installed capacity MW	Type of project	Active storage Mill m ³	Inundated land Km ²	Resettlement: No. people	Interference with protected areas
Nam Mang 3	35	S	45	9.5	750	
Xeset 2	76	RoR	0	1.5	0	Close to forest CA
Nam Lik	100	S	826	42.2	0	
Xepon	75	S	361	29.5	1500	Close to NBCA
Theun Hinboun Ext.	105	S, IT	2870	126	1220	Inside prop. NBCA
Nam Mo	100	S	264	10.8	0	
Nam Theun 2	1074	S, IT	3510	450	4800	Border of NBCA
H. Lamphan Gnai	60	S	89	3.5	0	Inside prop. NBCA
Xe Kaman 3	250	S	109	5.2	0	
Nam Ngum 5	90	S	252	14.6	300-500	
Thakho	36	RoR	0	0	0	In important biodiversity area
Xeset 3	20	RoR	0	1.3	0	
Xe Kaman 1	468	S	3340	222	>800	In NBCA
Nam Ngum 4A	55	S	332	14.5	1470	
Nam Kong 3	25	S	299	36.9	1550	
Nam Pot	38	S	71	6.1	0	
Xe Kong 5	248	S	2210	70	980	In NBCA
Nam Bak 2B	116	S, IT	119	4.8	0	
Nam Ngum 4B	56	RoR	0	0.5	0	
Xe Xou	59	S	1710	113	500	In NBCA
Nam Ngum 3E	580	S	983	26.5	500	
Total	3666		17.390	1188.4	>15.000	

Legend: S = Seasonal Storage, RoR = Run-of-River, IT = inter basin transfer

It is likely that the negative impacts on primary forest and unique wildlife found in the mountainous areas of Lao PDR will be significant. Three of the short-listed projects are located inside NBCAs and 2 others are located in areas that have been proposed as NBCAs. In addition, some projects are located close to areas of documented biodiversity value thus contributing to increased pressure on these vulnerable areas, such as NT2 whose reservoir will form the boundary of the Nakai-Nam Theun NBCA.

A characteristic feature of most of the planned projects is the long distance between the intake at the reservoir and the discharge point back into the river; nine projects have a diversion distance of more than 5 km and 14 more than 1 km. River-based biodiversity and fisheries will thus be lost and water use for irrigation, water supply, transport, etc., might be severely restricted.

In general the dams proposed are high. Only Xeset 2 and Thakho have dams or intakes of a height less than 15 m while 14 projects have dams of more than 50 m and 8 with more than 90 m. This implies that dam safety is an issue for most projects and that the dams will effectively stop all upstream migration of fish.

According to available information the total land area that will be inundated in connection with the construction of reservoirs and intake headponds adds up to approximately 1200 km². The majority of the projects have reservoirs of small or moderate size, with Nam Theun 2 (450 km²), Xe Kaman 1 (222 km²), Theun Hinboun Extension (126 km²) and Xe Xou as (113 km²) being exceptions.

The available studies indicate that 12 of 21 projects will include resettlement, adding up to a total figure of more than 15,000 people. It should be noted that this is likely to be a minimum figure. Some of the data are old and the populations will have

grown and in addition there is a general tendency for underestimating resettlement needs in the initial phases of project preparation. In 12 projects the number of resettled people will exceed 200 and thus be above the number the World Bank and Lao PDR requirement of a Resettlement Action Plan will be triggered.

Most of the projects are located in the higher reaches of the river basins where the majority of the local people will belong to ethnic minorities. Given their dependence on the natural resource base and their general low degree of integration into the mainstream economy, ethnic minority groups tend to be more vulnerable to the effects of hydropower development. It is likely that the development will accelerate the ongoing process of integration of ethnic minorities into the main Lao culture. The Xepon project seems to be particularly critical in this respect as the project is planned in the heartland of the 1,500 people belonging to the Pako group.

The loss of waterfalls is mentioned as a feature of 2 of the planned projects, but is likely to be a feature of more projects. To what extent this is considered a loss of a potential tourist attraction is not known. Most of the projects are located far from areas presently visited by tourists. The experience from the Nam Ngum 1 reservoir shows that, in this country which is deficient in natural lakes, reservoirs might be of significant value as tourist and recreational sites. The most likely candidates for attracting tourists will be Nam Theun 2 and the Theun-Hinboun Extension (Nam Theun 3).

Except for Nam Mo all proposed hydropower development projects are located on rivers draining into Mekong, thus having a potential of impacting on the reach shared with Thailand, the downstream areas in Cambodia and the Mekong Delta in Vietnam. The determining parameter for the downstream changes in river flow is active storage, of which a total for all planned Mekong Basin projects in Lao PDR will be about 17,400 mill. m³.

1.4 Recommendations

There are actions that can be taken to avoid, minimize or compensate for potential negative impacts of planned hydropower schemes. In general these include water related mitigation measures, land-based mitigation and compensatory programmes. Compensatory programmes includes, forestation plans, catchment protection programmes, fisheries development plans, nature protection and compensation plans, and social development plans, including Ethnic Minority Development Plans (EMDPs) and Resettlement Action Plans (RAPs).

The experiences from the Nam Theun 2 project should be of great value for the development of future compensation and management arrangements for large hydropower projects in Lao PDR. An audit of the lessons learned in the preparation of the NT2 safeguard plans and of the experiences gained in implementation should thus be carried out. This would enable future studies to be more streamlined and more focussed on key problems and challenges.

Certain issues should be addressed specifically in order to enable better safeguarding of the biodiversity values and social values in connection with hydropower development. These are listed in the table below. Capacity building is implicit in most of these issues in terms of having qualified personnel with the right understanding and appreciation of the issues and with the ability to make scientific assessments and informed make decisions. It also assumes that there will be ample funding available to carry out social and environmental mandates.

Table 5: Recommendations

Issues	Recommendations
Integration of government and private sector issues	Up-front requirements for private sector – document that outlines GOL's social and environmental laws, regulations and requirements for investors
Strengthening the EIA process through capacity building	<ol style="list-style-type: none"> 1) Standardisation of guidelines, criteria and procedures for STEA and line agencies 2) Improve over-all knowledge of regulations and procedures through training and workshops 3) Funding mechanisms for STEA and line agency Social and Environmental Divisions for participation in planning, monitoring and auditing 4) On-the-job training with local and international experts at all levels of EIA preparation and monitoring 5) Improvement of skills through university degrees, distance education and Internet-based learning 6) Courses on management, financing and language skills for improved performance and reporting
Report format and approaches	Establish clear outlines and tables of contents for report writing and checklists and guidelines on what information is to be covered and how – for standardisation of EIA guidelines
Fisheries and Biodiversity	Development of clear criteria and characterisation for data collection, analysis and monitoring together with international organisations, such as IUCN, WWF and WCS – for standardisation of EIA guidelines
Consultations	Develop guidelines on consultation requirements, procedures and documentation in relation to the project cycle – for standardisation of social guidelines
Resettlement, compensation and livelihood development	<ol style="list-style-type: none"> 1) Standardisation of approach, integration of technical, socio-economic and cultural requirements, and procedures for resettlement planning, implementation and monitoring 2) Establish clear criteria for assessing livelihood systems and compensation for losses of assets
Ethnic Minorities	Training of GOL staff on ethnic minority concerns and culturally sensitive approaches to impact assessments, consultations/involvement and project implementation for EMs
Minimum flow requirements	Establishment of general principles on how minimum flow levels can be defined scientifically and include these in EIA regulations
Definitions of Impact Zones	Clear guidelines for defining impact zones, especially for downstream impacts should be included in EIA regulations
River Basin Management	Formation of River Basin Management units, possibly in cooperation with MCR for optimal management of multiple uses of river systems (integrated water resource planning)
Hydropower development in or near NBCAs	Clarification of principles for more appropriate preparations and overall plans for protection and development in the different NBCAs – should be included in EIA regulations
Undeveloped rivers assessment	Assessment of undeveloped rivers in Lao PDR in order to legal protection of valuable ecosystems according to the 'intact river' concept – reduces case-by case disputes about conservation and development of rivers
Environmental and social monitoring systems	Establishment of databases and support systems for data storage and dissemination, both for reporting on the general state of the environment and for special issues, such as hydropower project assessments
Monitoring of environmental performance	Establish a clear system of indicators and criteria for good environmental and social practice against which implementation results can be measured – should be included in EIA regulations and guidelines