

**ASIAN DEVELOPMENT BANK  
Independent Evaluation Department**

**SECTOR ASSISTANCE PROGRAM EVALUATION**

**FOR THE ENERGY SECTOR**

**IN LAO PEOPLE'S DEMOCRATIC REPUBLIC**

In this electronic file, the report is followed by Management's response and the Board of Directors' Development Effectiveness Committee (DEC) Chair's summary of a discussion of the report by DEC.



## Evaluation Study

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Sector Assistance Program Evaluation  
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# Energy Sector in the Lao People's Democratic Republic

Independent Evaluation Department

Asian Development Bank

## CURRENCY EQUIVALENTS

(as of 30 June 2010)

Currency Unit	–	kip (KN)
KN1.00	=	\$0.000121
\$1.00	=	KN8,262

## ABBREVIATIONS

ADB	–	Asian Development Bank
CAPE	–	country assistance program evaluation
DEPD	–	Department of Energy Promotion and Development
DOE	–	Department of Electricity
DWR	–	Department of Water Resources
EdL	–	Electricité du Laos
EGAT	–	Electricity Generating Authority of Thailand
EIA	–	environmental impact assessment
EIRR	–	economic internal rate of return
EMD	–	Environmental Management Division
EMP	–	environmental management plan
EPF	–	Environmental Protection Fund
ESP	–	Environment and Social Program
FIRR	–	financial internal rate of return
GDP	–	gross domestic product
GMS	–	Greater Mekong Subregion
GWh	–	gigawatt-hour
IEE	–	initial environmental examination
IWRM	–	integrated water resources management
kV	–	kilovolt
kW	–	kilowatt
Lao PDR	–	Lao People's Democratic Republic
LHSE	–	Lao Holding State Enterprise
MEM	–	Ministry of Energy and Mines
MOF	–	Ministry of Finance
MW	–	megawatt
NARPDP	–	Northern Area Rural Power Distribution Project
NLHP	–	Nam Leuk Hydropower Project
NORAD	–	Norwegian Agency for Development Cooperation
NPA	–	national protected area
NPESSHS	–	National Policy on Environment and Social Sustainability of the Hydropower Sector
NTPC	–	Nam Theun 2 Power Company
PIZ	–	peripheral impact zone
PKK Park	–	Phou Khao Khouay Park
POE	–	Panel of Experts
PPA	–	power purchase agreement
PRC	–	People's Republic of China
PTDP	–	Power Transmission and Distribution Project
RPTCC	–	Regional Power Trade Coordination Committee

SAPE	–	sector assistance program evaluation
SDR	–	special drawing right
SEMFOP	–	Social and Environmental Management Framework and Operational Plan
STEA	–	Science, Technology and Environment Agency
TA	–	technical assistance
THHP	–	Theun-Hinboun Hydropower Project
THPC	–	Theun-Hinboun Power Company
THXP	–	Theun-Hinboun Expansion Project
WACC	–	weighted average cost of capital
WMPA	–	Watershed Management and Protection Authority
WREA	–	Water Resources and Environment Administration

### NOTE

In this report, "\$" refers to US dollars.

### Key Words

asian development bank, adb, energy, lao pdr, evaluation, ied, independent evaluation department, program, sape, sector assistance program evaluation, sector reform

Director General	H.S. Rao, Independent Evaluation Department (IED)
Director	H. Hettige, Independent Evaluation Division 2 (IED2), IED
Team Leader	K. Thukral, Senior Evaluation Specialist, IED2, IED
Team Members	R. Lumain, Senior Evaluation Officer, IED2, IED R. Perez, Senior Operations Evaluation Assistant, IED2, IED

### Independent Evaluation Department, SE-24

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The guidelines formally adopted by the Independent Evaluation Department (IED) on avoiding conflict of interest in its independent evaluations were observed in the preparation of this report. Ruel Janolino, James Chamberlain, and Feroisa Concordia assisted as consultants. To the knowledge of the management of IED, there were no conflicts of interest of the persons preparing, reviewing, or approving this report.

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## EXECUTIVE SUMMARY

The Asian Development Bank (ADB) has made substantial contributions towards creating energy infrastructure in the Lao People's Democratic Republic (Lao PDR). In line with government policies and programs and in conjunction with assistance from other development partners, ADB energy sector assistance since the late-1980s has focused on hydropower projects, high-voltage grid extension, rural electrification, and capacity building to manage power sector infrastructure and utility operations. Total ADB energy sector assistance from 1988 to 2009 was about \$290 million for loan projects and \$13.9 million for technical assistance (TA) projects. During the sector assistance program evaluation (SAPE) period (2000–2009), ADB approved support for two energy sector projects: the Nam Theun 2 Hydropower Project and the Northern Area Rural Power Distribution Project (NARPDP). ADB's total energy sector assistance approvals during the SAPE period comprised \$100.0 million in loans and \$5.6 million in TA support. Seventy percent of loans and more than 50% of TA approvals were linked directly to the Nam Theun 2 project.

As an input to the country assistance program evaluation, this SAPE assesses the performance of ADB assistance to the Lao PDR energy sector. More specifically, the SAPE examines the development effectiveness of ADB-funded projects. It identifies lessons for further development of the energy sector and makes recommendations for future interventions.

### Energy Sector Context and Key Findings

The Lao PDR is a landlocked, mostly rural and agrarian country rich in natural resources, and a country that is becoming more urbanized and better integrated within the Greater Mekong Subregion. Traditional energy sources (mostly fuelwood and charcoal) are giving way to electricity and petroleum. While the Lao PDR imports all of its petroleum products, it has large hydropower potential, and a major portion of existing hydropower capacity is for power exports. The key energy sector objectives of the government include bringing electricity to all by expanding and improving the main grid or, where cost effective, by off-grid electrification; and earning foreign exchange by setting up export-oriented hydropower projects and exporting electricity. The government's energy objectives have remained remarkably consistent since the 1990s and through the SAPE period; only priorities for achieving the policy objectives have undergone some change from time to time.

**It is essential to mainstream screening of hydropower project developers and to build capacity to do so.** Experience from the ADB-supported Theun-Hinboun and Nam Leuk hydropower projects show that adverse environmental and social impacts can linger for a decade or more after project commissioning. Taking the necessary steps up front to manage environmental and social impacts and preempt serious erosion of financial gains from all large hydropower projects (upwards of 50 megawatts [MW]) is recognized by the government and the development community, and was done for the Nam Theun 2 project (for which the Nam Theun 2 project company played a key role). The massive interest from international developers and investors over the past few years to sign memoranda of understanding for developing more of such large hydropower projects has reinforced the government's convictions on the importance of mitigating environmental and social impacts. However, to do this, there is a need to improve capacity to screen the developers better and instill competition among them, and enhance technical, financial, commercial, and environmental and social mitigation skills and expertise to improve capabilities with regard to project agreement negotiations.

**A requisite institutional base needs to be built over the medium term to ensure that all new hydropower projects comply with a certain minimum level of environmental and social safeguards.** Along with other development partner assistance, ADB has contributed to building capacity to manage the environmental and social impacts of large hydropower projects. However, since the Nam Theun 2 project began to be perceived as a success, heightened interest from the project developer and investor community has reinforced the government need to acquire and institute a wide array of expertise in environmental and social disciplines. Although the Nam Theun 2 project was implemented with a good measure of compliance with World Bank and ADB safeguard standards, it will probably be difficult to follow the processes used and repeat them for future projects without external support. Against this background, and given the increased government awareness on the need for environmental and social mitigations, there is a need to build capacity and adopt measures that ensure an appropriate level of compliance with environmental and social safeguards across the board for all large hydropower projects.

**Financial and operational performance of Electricité du Laos needs to improve.** Electricité du Laos (EdL) is today facing an enormous challenge of meeting the government's 90% electricity access target by 2020. This entails huge investments that call for a judicious mix of grid extension and off-grid renewable energy options. To achieve this target, EdL needs to continue making efforts in several directions to improve its operational and financial performance. On the technical side, this may mean the introduction of a high-voltage transmission system (500 kilovolt [kV] and 230 kV) to enable integration of its four isolated grids, improving power supply reliability, and possibly enabling EdL to offtake its entire entitled energy from export-oriented hydropower projects. Besides, EdL also needs to continue to focus on (i) managing accounts receivable; (ii) further reducing transmission and distribution system losses; and (iii) adjusting tariffs and reducing cross-subsidies, while taking into account the consumers' ability and willingness to pay, so that nontechnical transmission and distribution losses do not increase.

Private sector participation that is sought for small and medium-sized hydropower and other renewable energy projects also needs to be carefully managed, as it raises issues such as streamlining regulations and procedures to minimize ambiguity (for instance, regarding payment of taxes and royalties), putting in place suitable incentives, and developing new business models.

**Greater Mekong Subregion-wide power system integration remains a medium-term goal.** Progress thus far has been limited and remains confined essentially to dedicated high-voltage transmission lines from a few export-oriented hydropower projects, and other specific high-voltage lines and substations that enable power interchange between, e.g., the Lao PDR and Thailand. Given their varying perspectives—that reflect, for instance, a strong transmission network in Thailand coupled with power import requirements versus a weak transmission network in the Lao PDR but large hydropower export potential—this entails a concerted effort that is likely to take several years. Along with such convergence of perspectives, it is necessary that harmonization of standards for transmission regulations, metering arrangements, grid codes, etc., are also addressed and agreed upon by the Greater Mekong Subregion countries concerned.

**A holistic energy sector perspective is needed.** The government has formulated a hydropower policy that calls for sustainable hydropower development. A renewable energy law is under preparation. However, there is no integrated energy policy, and the emerging issues



related to environmentally and socially sound lignite mining practices need to be suitably addressed.

### **Evaluation of ADB's Energy Sector Assistance**

Both projects approved for ADB support during the SAPE period were completed 3–4 months after the end of the SAPE period. Available information on these projects makes it possible to comment on all evaluation criteria. The assessment also considers advisory and project preparatory TA as necessary, and outcomes of other interventions prior to the SAPE period.

**Strategic positioning.** The ADB energy sector support strategy is rated *satisfactory* from the strategic relevance perspective. It has been substantially aligned to address challenges related to hydropower development and increasing electricity access. Although the overall size of ADB's energy lending and nonlending portfolio has remained small, the trend over a longer period is one of increasing sophistication in the terms and scope of the projects and TA. For hydropower projects, the sophistication reflects the manner in which the environmental and social issues are proposed to be addressed during the construction and operating periods. For transmission and distribution projects, the sophistication is due to the need to strike a balance between grid extensions to increasingly remote rural settlements and off-grid alternatives. Through assurances, ADB has also sought to improve EdL's financial performance. ADB has preferred to let the World Bank provide thought leadership on tariff rationalization, accounts receivable management, and energy efficiency improvement. Along with other development partners, ADB has also contributed to the environmental and social mitigation capacity building effort.

**Relevance.** ADB support to the energy sector for expanding the energy supply-side system (generation, transmission, and distribution) was *highly relevant* to the requirements of the Lao PDR. The Nam Theun 2 Hydropower Project that was approved in April 2005 and went on stream in April 2010 incorporated lessons at the design stage from previous ADB-supported hydropower projects. The advisory TA that attempts to find solutions for livelihood generation following involuntary resettlement is in response to the need felt during implementation of the Nam Theun 2 project. Although the advisory TA is ongoing, the fact that it has adopted a participatory land-use planning approach has brought to the fore some issues such as encroachment into land within village boundaries to which the villagers do not have a clear title. If and when such issues are suitably resolved, it will set a precedent for other large hydropower projects in the future. The NARPDP, which closed in March 2010, extends the transmission backbone in the northern provinces and contributes to the meeting of rural electrification targets. The project preparatory TA projects reflect evolving government priorities, such as better management of environmental and social impacts, and removing barriers for deployment of off-grid electricity technologies.

**Efficiency.** ADB's interventions in the Lao PDR energy sector are assessed *efficient*. The 1,088 MW Nam Theun 2 Hydropower Project is an export oriented project with a strong economic internal rate of return (EIRR) of more than 15% (at appraisal), embodies a bankable power purchase agreement (PPA), and has a strong concession agreement that incorporates environmental and social mitigation measures and related concerns of the development community. During implementation, there have been time and cost overruns but well below the average overruns for ADB-supported projects. For the NARPDP that closed in March 2010, however, a delay of about 18 months is essentially attributable to the contractor. Even though EdL's bid management skills have shown a distinct improvement since the 1990s, there were

some delays that can be attributed to EdL, but these were subsumed within the 18-month contractor delay. Although EIRR of the NARPDP at closure remains to be estimated, it is likely that the increased project cost will depress the attractive estimate of 23.3% at appraisal.

**Effectiveness.** ADB's assistance program to the Lao PDR energy sector is assessed *effective*. Continued commitment from the development community during the construction of the Nam Theun 2 project suggests a good measure of compliance with environmental and social safeguards. Upon completion of the physical resettlement process, the livelihood generation process has progressed satisfactorily (as majority of the households consider themselves better off, following resettlement). However, it is recognized that (i) there are delays in providing livelihood support to some resettled households; (ii) certain government policies, such as those related to consolidation of ethnic groups for administrative ease, have been implemented without due regard to some vulnerable groups; and (iii) provisions in the concession agreement that have been implemented do not always recognize the indigenous notions of time and space. These drawbacks are expected to be corrected through ongoing advisory TA that has sought to strengthen land tenure and associated livelihood activities through a participatory land-use planning approach. The participatory approach is mandated in the concession agreement and has been accepted by the government. As part of the public expenditure management strengthening program, the government has also instituted a system to channel into poverty reduction programs the \$1.9 billion contribution expected from the Nam Theun 2 project during the concession period. The effectiveness and efficacy of this program will be known only several months after commercial operations have started when the project company makes its royalty payments to the government.

The NARPDP is also *effective*; it dovetailed investments in the 115 kV transmission lines and substations with investments made through a previous loan approved in 1997, and connected more villages that were remote, distant, and sparsely populated than originally envisaged at appraisal. One project preparatory TA project approved during the SAPE period has already resulted in approval of a transmission project in January 2010. Following approval of other project preparatory TA projects, necessary work on policy dialog, advisory TA, capacity building, and loan or grant approvals is also in progress. For example, the study of the cumulative impacts of the Nam Ngum 3 Hydropower Project appears to have contributed to successful tariff negotiations for the Nam Ngum 3 Hydropower Project with the Electricity Generating Authority of Thailand (EGAT), wherein the levelized tariff over the concession period is set at an attractive rate.

**Sustainability.** ADB's energy lending and nonlending portfolio are rated *likely to be sustainable*. The Nam Theun 2 project is likely to be technically and financially sustainable. The contractor is experienced in establishing large hydropower projects, and the dam safety review panel has ascertained the safety aspects. The Nam Theun 2 project's financial analysis at appraisal shows an impressive financial rate of return (FIRR) of 12.4%, which is comfortably above the weighted cost of capital of 10.1%. The long-term financial sustainability of the Nam Theun 2 project also reflects (i) the project company's cash flow stream that provides a natural hedge to its debt repayment obligations (the debt currency mix is designed to match the tariff payments from EGAT and EdL), and (ii) long-term PPAs with EGAT and EdL that include take-or-pay clauses at agreed tariffs (the tenor of the PPAs is beyond the final payment date of the Nam Theun 2 project's debt).

It is likely that the Nam Theun 2 project will also be environmentally and socially sustainable, as the concession agreement includes provisions to address both anticipated and unforeseen environmental and social impacts in the coming years. The Nam Theun 2 project is

also expected to demonstrate that the operations of an organization, such as the Watershed Management and Protection Authority, can be sustained through project revenues.

The financial sustainability of other ADB-supported hydropower projects has been reiterated at various stages since the projects were approved in the 1990s. However, at the time of project performance evaluations of the Theun-Hinboun and the Nam Leuk projects in 2002 and 2004 respectively, certain environmental and social issues remained to be addressed for both. In the case of the Theun-Hinboun project, where the project company is addressing the outstanding issues along with its environmental and social management activities for the 280 MW expansion project, and ADB waived the negative pledge clause in the loan for the Theun-Hinboun project, ADB will monitor the environmental and social mitigation activities for compliance with the environment monitoring plan during the construction period. Also, for the Nam Leuk project, ADB has addressed the identified and agreed outstanding environmental and social issues in selected villages by reallocating funds from the NARPDP; ADB also closely monitored the implementation of such facilities until completion in March 2010.

The data for estimating the FIRR of the NARPDP at completion was not available, but it is noteworthy that ADB approved the loan even though the estimated FIRR at appraisal (2.7%) was lower than the weighted average cost of capital of 4.8%. ADB still approved the loan as the project showed a good EIRR, the estimated impact on EdL's overall financial situation was projected to be minimal as it was estimated to have only 8% of the domestic sales in 2010, and the cost recovery ratio was 95%, which is considered adequate for rural electrification projects.

**Development impacts.** The overall development impacts of ADB's energy sector assistance are likely to be *satisfactory*. With ADB support, the Nam Theun 2 project is designed to make a multifaceted contribution to development impacts that impinge on institutional, financial, environmental, and social aspects. Through providing a basis for setting up of the Lao Holding State Enterprise (LHSE), the Nam Theun 2 project has contributed to the objective of creating an organization in the energy sector that is not hampered by financial problems (as EdL is). Nonetheless, given the limited financial resources given to the LHSE, the government needs to reassess LHSE participation in public-private partnership hydropower projects.

The ADB assistance program has also contributed significantly to recognizing the need to mainstream management of environmental and social issues. On many aspects, the experience gained from the Nam Theun 2 project can be useful for other development sectors (notably mining and other infrastructure). The government's ability to move towards mainstreaming the management of environmental and social issues has been facilitated at least in part by ADB through its Environment and Social Program loan and other interventions that supported the issuance of environmental impact assessment guidelines and preparation of third-party monitoring arrangements. However, it appears that, as yet, there is limited progress by the Water Resources and Environment Administration to store and disseminate the learning from the Nam Theun 2 project to its own staff or to other hydropower project developers. For instituting third-party monitoring arrangements for hydropower projects, much depends on the extent to which the Environmental Protection Fund is able to raise the necessary resources. The repertoire of skills required of the project developers and the government also clearly shows the inadequacy of the skill set and experience available within the Lao PDR, as well as the need for a stream of interventions to upgrade environmental and social management capacity.

By extending the grid to increasingly remote areas, the NARPDP has also enhanced EdL's institutional capacity to plan and implement such projects while continuing to reduce

transmission and distribution losses, and helped improve the quality of life of a large number of rural dwellers.

**Overall assessment.** The overall rating of ADB's program is *successful*. This rating reflects several factors, most saliently that (i) the interventions have been consistent with government policies, programs, and priorities; and (ii) the assistance program has enabled positive outcomes at the national level (e.g., boosting foreign exchange earnings and recognizing the need to mainstream environmental and social mitigations) and the local level (e.g., increasing electricity access).

**ADB performance.** Being a prominent development partner in the Lao PDR energy sector, ADB has gathered extensive knowledge of the sector over the years, and its performance is rated *satisfactory*. With increased activity in the Lao PDR energy sector in the past few years, ADB anticipates increased assistance requirements, as evident from the project pipeline for 2010–2012 stated in the 2009 midterm review. To facilitate more intensive interface with the government, other enterprises, and other development partners, ADB increased its staff strength in the Lao PDR Resident Mission towards the end of the SAPE period, and a power sector expert from the Viet Nam Resident Mission also works closely with the Lao PDR Resident Mission. By mid-2010, an experienced energy sector expert had also joined Lao PDR Resident Mission.

### Recommendations for Future Assistance

Against this background, recommendations for ADB assistance over the next few years are summarized below.

Recommendation	Responsibility
Focus ADB's capacity development interventions on the need to increase electricity access, improve the operational and financial efficiency of the power utility, and better manage the development of large hydropower projects in coordination with other development partners (para. 110).	Southeast Asia Department
Work with development partners towards designing a knowledge management framework and delivering knowledge management solutions given the need for capacity development on several aspects (para. 111).	Southeast Asia Department
Continue to offer financial assistance, particularly for (i) hydropower projects with a view to better comply with environmental and social safeguards, and (ii) electricity access projects (paras. 112–113).	Southeast Asia Department and Private Sector Operations Department
Conduct policy dialog to accelerate moves towards formulating a comprehensive energy policy and accelerating power systems integration across the Greater Mekong Subregion (para. 114).	Southeast Asia Department

H. Satish Rao  
 Director General  
 Independent Evaluation Department

## I. INTRODUCTION

### A. Objectives and Scope

1. The objectives of this sector assistance program evaluation (SAPE) are to (i) provide an independent assessment of the performance of lending and nonlending energy sector interventions of the Asian Development Bank (ADB) in the Lao People's Democratic Republic (Lao PDR) during 2000–2009, and (ii) derive lessons and recommendations for ADB's future energy sector operations in the Lao PDR. The SAPE findings will feed into the country assistance program evaluation (CAPE) for 2000–2009.

2. During the SAPE period (2000–2009), the energy sector accounted for (i) \$5.6 million in technical assistance (TA), or about 11% of the total TA of \$48.7 million, and (ii) \$100 million of loans plus grants,<sup>1</sup> or nearly 17% of total ADB support of \$593.9 million, and was the only sector to receive ordinary capital resources financing. During this period, ADB approved loans for two new energy projects, comprising one power transmission and distribution project and one major hydropower project, and six project preparatory TA projects and one advisory TA project (Appendix 1). As the 2006 CAPE<sup>2</sup> identified outstanding issues regarding compliance with certain environmental and social safeguards for two hydropower projects that were supported in the 1990s,<sup>3</sup> the SAPE also includes an updated assessment of their impacts and the associated impact mitigation measures. The SAPE also refers to a transmission and distribution project and some TA projects supported in the 1990s. Energy sector interventions evaluated (or referred to, as necessary) are about \$246.0 million (loans), plus \$7.2 million in TA. In addition, the SAPE also refers to (i) energy-related components of TA aimed at capacity building for management of environmental and social implications of energy and other projects, as well as the multisector Environment and Social Program (ESP) loan;<sup>4</sup> and (ii) the energy projects pipeline listed in the 2009 country strategy midterm review.<sup>5</sup>

### B. Evaluation Framework and Methodology

3. The SAPE framework draws on the revised guidelines for preparing CAPE reports. The SAPE analyses cover energy sector issues and development challenges such as (i) sustainable hydropower development, (ii) private sector participation, (iii) improving the financial and operational efficiency of Electricité du Laos (EdL), (iv) improving access to electricity and meeting rural electrification targets, and (v) institutional strengthening and capacity development for maintenance of physical infrastructure as well as social and environmental safeguards implementation. The main information sources for the SAPE are (i) desk review of completed ADB reports including the CAPE, project completion reports, project completion validation reports, project performance evaluation reports, etc.; (ii) desk review of sector studies and project documents, as well as other external sources; (iii) discussions conducted with staff in

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<sup>1</sup> In addition there was a political risk guarantee cover of up to \$50 million to facilitate mobilization of commercial debt for the Nam Theun 2 hydropower project.

<sup>2</sup> ADB. 2006. *Country Assistance Program Evaluation: Lao People's Democratic Republic*. Manila.

<sup>3</sup> ADB. 1994. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Lao People's Democratic Republic for the Theun-Hinboun Hydropower Development Project*. Manila (Loan 1329, for \$60 million, approved in November, post-evaluated in 2002); and ADB. 1996. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Lao People's Democratic Republic for the Nam Leuk Hydropower Project*. Manila (Loan 1456, for \$52 million, approved on 10 September, post-evaluated in 2004).

<sup>4</sup> ADB. 2001. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Lao People's Democratic Republic for the Environment and Social Program*. Manila (Loan 1867(SF), for \$20 million, approved on 6 December).

<sup>5</sup> ADB. 2009. *Lao PDR: Country Strategy and Program Midterm Review, 2007–2011*. Manila.

ADB headquarters; and (iv) discussions with and information collected from executing agencies and other stakeholders and key informants during the independent evaluation mission. In particular, the evaluation mission met stakeholders that include: (i) relevant government departments, ministries and enterprises; (ii) selected hydropower project developers; (iii) multilateral and bilateral development partners; and (iv) key nongovernment organizations in Lao PDR. Besides, the evaluation mission also conducted site visits to three hydropower projects and one transmission and distributed project supported by ADB, where they held consultations with project and executing agency officials, local government officials, and key informants (including affected households). The evaluation mission also reviewed relevant documents and videos available on the internet. Further details on the consultations conducted by the evaluation mission are provided in Appendix 1. SAPE consultation missions were held in April 2010 and July 2010 to discuss the key findings with relevant government agencies. Comments received from both government and ADB have been addressed to the extent possible in finalizing the report.

### **C. Organization of the Report**

4. Section II describes the institutional backdrop and performance of the energy sector. Section III presents the energy sector's development challenges and government's policy response to these challenges. Section IV outlines ADB's energy sector assistance during the SAPE period, as well as other energy sector assistance referred to in the evaluation. Section V discusses the evaluation of ADB's energy sector assistance program. Section VI presents the key findings, learnings, and recommendations for improving ADB's role as a development partner to the Lao PDR energy sector.

## **II. SECTOR DEVELOPMENT CONTEXT**

### **A. Background and the Institutional Context**

5. The Lao PDR is a natural-resource-rich and landlocked country that is in transition from a centrally planned to a market-oriented economy, from a rural/agrarian to a more urbanized society, and from a subsistence economy to one that is becoming integrated with the Greater Mekong Subregion (GMS). The high degree of political stability in recent years has facilitated real economic growth of around 7% per year since the turn of the century. With a population of 6.2 million people as of the end of 2009, the overall population density is very low at about 25 people per square kilometer (km<sup>2</sup>). About 73% of the population lives in rural areas, and about 40% belong to small ethnic groups that live in remote and mountainous regions with very limited access to services and markets.

6. In addition to the traditional forms of energy (fuelwood, wood shavings, sawdust, and charcoal), the two main sources of energy are petroleum products and hydropower-based electricity. All petroleum products consumed within Lao PDR need to be imported. In keeping with the objectives of successive 5-year national socioeconomic development plans, including the sixth plan (2006–2010),<sup>6</sup> improving access to electricity has been a key development objective for several years. Sustainable development of the Lao PDR's vast hydropower resources—estimated

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<sup>6</sup> Government of the Lao PDR. 2004. *Sixth Socio-Economic Development Plan, 2006–2010*. Vientiane.

at about 18,000 megawatts (MW)<sup>7</sup>—has occupied center stage for several years, and the government has formulated a policy for sustainable development of hydropower projects.<sup>8</sup>

7. Several government ministries and departments are involved in the oversight and management of the electricity and petroleum subsectors.<sup>9</sup> The Ministry of Energy and Mines (MEM) under the Prime Minister's Office includes two departments and three state-owned enterprises that, along with the Water Resources and Environment Administration (WREA) and the Ministry of Planning and Investment, are responsible for electricity supply and power sector development. Oversight responsibilities for the oil and gas subsector are shared between the Ministry of Commerce that oversees imports of petroleum products, and MEM that is responsible for upstream petroleum activity (Appendix 1).

## B. Sector Performance

8. In 2002, the most recent year for which total energy consumption data is available, the traditional energy sources (mostly fuelwood and charcoal) accounted for 69% of total energy consumption. In the same year, petroleum products (primarily liquefied petroleum gas, gasoline, kerosene, diesel, and fuel oil) consumption, estimated at about 300,000 tons (t), accounted for less than 17% of total energy consumption, and hydropower-based electricity accounted for less than 12% (Appendix 1). No further updates are readily available for traditional fuels.

9. **Petroleum products.** The Lao PDR has no proven oil and gas reserves and no oil refinery. All refined petroleum product requirements for transport, household, industrial, commercial, and other applications are imported. In recent years, consumption of petroleum products has outpaced gross domestic product (GDP) growth and increased by more than 8% per year, from about 0.3 million t in 2002 to 0.5 million t in 2008. More than 15 companies (comprising Lao PDR subsidiaries of international oil companies, and local companies) import petroleum products, and many of these also retail the products.

10. **Power capacity and generation.** For its size (about 1,800 MW of total installed capacity) the electricity industry's generation mix is quite complex. Some capacity is owned by the government and/or EdL, while some is through a public–private partnership arrangement. The target markets of specific hydropower projects vary widely—primarily for export, or primarily for sale within the Lao PDR, or only for sale within the Lao PDR. EdL has payment settlement mechanisms with the various independent power producers as well as with the utilities in Thailand and Viet Nam.

11. Although the government considers hydropower export as an important source of foreign exchange earnings, it is noted that in 2007 and 2008 electricity imports exceeded hydropower exports. This essentially reflects reduced hydropower generation during 2006–2008 because of lower than normal rainfall, but also that (i) only the small (40 MW) Nam Mang 3 hydropower plant had been commissioned since the Nam Leuk plant came on stream in 2000, and (ii) EdL

<sup>7</sup> Excluding the potential along the Mekong River.

<sup>8</sup> Relative to the hydropower subsector, the environmental and social implications of production, import, processing, transportation, and use of other commercial energy sources (notably coal/lignite and refined petroleum products) has been relatively small thus far.

<sup>9</sup> Fuelwood and other traditional forms of energy are under the purview of the government's Ministry of Agriculture and Forestry. In ADB, forestry is classified under the agriculture and natural resources sector. For this reason, the forest-related issues are not addressed in this SAPE, which is focused on the energy sector. It should suffice to note, however, that the government has plans to reverse the decline in forest cover, which has gone from nearly 70% in the 1970s to about 42% in 2005.

was not in a position to off-take all its entitled energy from the two export independent power plants (the 210 MW Theun-Hinboun plant and the 150 MW Houay Ho plant) as its transmission system could carry power to consumers only in neighboring districts at medium voltage. However, with the commissioning of one hydropower project in 2009 and three large hydropower projects in 2010, as well as transmission system augmentation, the Lao PDR is expected to become a net power exporter again.

12. The hydropower sector in the Lao PDR has attracted many developers and project sponsors; as of mid-2008 (i) the Department of Energy Promotion and Development (DEPD) had signed memoranda of understanding for the conduct of feasibility studies and environmental and social assessments and studies for a further 12,500 MW of capacity; and (ii) having completed the feasibility studies and the initial string of environmental and social assessments and studies, project agreements were at various stages of negotiations for about 4,100 MW of capacity. The long list of export-oriented power projects (which includes the 1,860 MW Hongsa Lignite plant) is in keeping with the government's objective of positioning the Lao PDR as the subregion's power battery. Nonetheless, the government has not been able to adopt a transparent process of awarding concessions to hydropower developers; however, it has identified the need to better screen project developers, improve project agreement negotiation capabilities, and manage a competitive tendering process.

13. **Transmission and distribution.** The EdL transmission system comprises four separate power grids in four operational areas comprising 115 kilovolt (kV) and lower-voltage lines and substations. Each of the four operational areas is also connected to the transmission systems of Thailand and/or Viet Nam and/or Yunnan province in the People's Republic of China (PRC) for power import at the 22 kV, 35 kV, or 115 kV levels.<sup>10</sup> There are medium-voltage connections to neighboring countries that are not connected to the 115 kV grids but provide power to isolated demand centers in the Lao PDR. EdL succeeded in quickly reducing transmission and distribution losses from 27% in 1994 to about 18% by 2000 and 12% in 2009. The focus thus far has been on reduction of technical losses, through (among other things) a system whereby electricity access to a village community uses the minimum length of low-voltage (220 volts) lines. The introduction of energy meters on outgoing feeders of 22 kV lines from substations has also enabled EdL to keep nontechnical losses in check. To reduce transmission and distribution losses further, more sophisticated technical options for technical loss reduction will be required, and electricity tariffs should remain affordable to rural households to encourage legal use of electricity.

14. **Power sales.** During 2002–2008 electricity consumption more than doubled, from 767 gigawatt-hours (GWh) to 1,578 GWh. Overall access to electricity increased rapidly, from 17% of households in 1995 to 44% in 2005 and more than 60% in 2009—although it still remains low compared to some of its neighbors.<sup>11</sup> Increasingly, remote and smaller rural settlements are being given electricity access. By the end of 2008, EdL served about 630,000 customers, about 95% of which were residential. Power sales remain supply constrained and in line with investment in the power system. As per available data, billable electricity sales have increased at more than 13% per year since 1990. During 2006–2008 (the most recent 3-year period for which data is available), billable electricity sales increased by 19% per year; the share of sales

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<sup>10</sup> A 115 kV transmission line from Lao PDR to Cambodia, supported by the World Bank, is also expected to be commissioned by the end of 2010.

<sup>11</sup> For instance, in Viet Nam electricity access was more than 90% of all communes in rural areas by 2007, and the 2010 target for electricity access was set at 100% of all rural communes and 95% of all households.



to households decreased from 51% to less than 45%, sales to commercial consumers rose from about 13% to more than 21%, and sales to industry were virtually unchanged at 22%–23%.

15. **Tariffs and financial performance.** EdL's power sales tariffs (in both kips/kilowatt-hour [kWh] and US cents/kWh) have been raised each year for over 10 years. EdL became profitable in 2006. Nonetheless, the massive investment requirement calls for continued efforts to raise and rationalize tariffs further. Given the pressing concerns that arise from affordability considerations, other avenues of improving financial performance have also gained momentum. One such measure is to reduce accounts receivable to within reasonable and manageable limits.

### III. DEVELOPMENT CHALLENGES AND GOVERNMENT STRATEGIES

16. At present, the government has a hydropower development policy that aims for environmental and social sustainability of hydropower projects,<sup>12</sup> and a power sector policy that aims to provide affordable electricity to all.<sup>13</sup> There is no integrated energy policy that addresses certain emerging issues, such as net foreign exchange earnings from the energy sector as a whole,<sup>14</sup> and environmentally and socially sound lignite mining practices.

17. In keeping with the national development goal of graduating out from a least-developed country status by 2020, the government has ambitious plans for the electricity subsector. The salient power sector objectives to 2020 are (i) expanding access to low-cost, reliable, and sustainable electricity; (ii) for so doing and earning foreign exchange,<sup>15</sup> tapping the country's rich hydropower potential; and (iii) becoming the power battery of the GMS. These government policy and program objectives have remained essentially unchanged through the SAPE period—although specific priorities have undergone some change, due to, for instance, (i) successful structuring and completion of the Nam Theun 2 project, increasing reliance on imported electricity to the point that the Lao PDR was a net electricity importer in 2007 and 2008, and (ii) increasing experience in deploying certain renewable energy technologies in off-grid applications.

18. In recent years there has also been an increased emphasis on management of environmental and social impacts of hydropower projects, which has posed significant institutional and financial challenges.

#### A. Pacing Hydropower Development

19. For hydropower development, the build–own–operate–transfer public–private partnership framework is by now well established.<sup>16</sup> Even before the Nam Theun 2 project had begun commercial operations, its perceived success had made the Lao PDR hydropower sector attractive to a vast number of developers and investors, and a large number of memoranda of

<sup>12</sup> Science, Technology and Environment Agency (now absorbed into WREA). 2006. *National Policy on Environmental and Social Sustainability of the Hydropower Sector in Lao PDR*. Vientiane.

<sup>13</sup> Ministry of Industry and Handicrafts (now Ministry of Energy and Mines). 2001. *Power Sector Policy Statement*. Vientiane. March.

<sup>14</sup> In 2008 and 2009, the oil import bill exceeded hydro export earnings. For instance, in 2008, even if average oil price is assumed to be a conservative \$65/barrel, the oil import bill is estimated to exceed \$225 million (compared to hydropower export earnings of \$98 million). In 2010, with the coming on stream of the Nam Theun 2, Nam Ngum 2 and Nam Lik 1/2 hydropower projects, the oil import bill (estimated at about \$250 million, assuming a conservative oil price of \$65/barrel, and oil consumption increase of only 5% per year) would nullify over two-thirds of the hydropower export earnings of about \$370 million.

<sup>15</sup> In 2008, electricity export earnings reached \$98 million and accounted for about 30% of total export revenue.

<sup>16</sup> The ADB-supported Theun-Hinboun Hydropower Project was the first public–private partnership in the Lao PDR.

understanding had been signed for development of specific hydropower sites. The large number of memoranda of understanding reflect one of the major weaknesses of the hydropower policy—that of a lack of clear guidelines on the transparent award of hydropower project development concessions to private players. Beyond the hydropower plants already operating or under construction since 2008, some preconstruction development work (such as preparing feasibility studies and environmental and social studies, and negotiating various project agreements) has been attempted for 55 sites with a combined capacity estimated at over 16,000 MW. While this level of interest from the investor/developer community serves the purpose of gathering useful site-specific data for most hydropower sites,<sup>17</sup> the hydropower projects can be developed only in a phased manner, and to the extent bankable project agreements can be firmed up.

20. The fact that there is no immediate market for an additional 16,000 MW of generating capacity in the Lao PDR plus its GMS neighbors to at least 2020 suits the government's perspective.<sup>18</sup> It gives the government the time to develop the requisite expertise to enhance its capabilities to better manage the public–private partnership process, the project-level environmental and social aspects, as well as strategic and cumulative dimensions and transboundary environmental and social impacts of hydropower project development. In the meantime, the government needs to send the right signals to the interested long-term hydropower investors and developers. For the seven projects on the Mekong mainstream in Lao PDR, for which the government has signed memoranda of understanding, the government needs to seriously consider delaying the projects until such time that their environmental activity and social impacts, which are a subject of a detailed strategic environmental assessment by the Mekong River Commission, are fully understood.<sup>19</sup>

21. **Screening prospective hydropower developers.** Given the environmental and social sensitivities involved in developing large hydropower projects, the MEM's DEPD would like to screen the prospective developers better.

22. **Negotiating hydropower project agreements.** The DEPD has made some progress in this direction, as evident from the recently negotiated tariff agreement with the Electricity Generating Authority of Thailand (EGAT) that would make it possible to meet the environmental and social mitigation costs of the 440 MW Nam Ngum 3 hydropower project from project

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<sup>17</sup> Useful site-specific data is gathered from technical feasibility studies, as well as the mandated environmental and social impact assessment and management studies. The information so gathered augments the previously available archived data on the basis of which initial estimates are made (i.e., data compiled in the 1960s and 1970s with development partner support, including contour maps on a 1:50,000 scale that provide some idea of power plant site, capacity, reservoir area, etc.; no information on environmental and social aspects is available from the data archives). It is also noted that, at the time the Nam Theun 2 project was approved, the government had identified only 33 hydropower sites for development on the basis of archived data.

<sup>18</sup> The Government of the Lao PDR currently has memoranda of understanding with the Government of Thailand for power exports of 7,000 MW by 2020, and with the Government of Viet Nam for power exports of 2,000 MW.

<sup>19</sup> Mekong River Commission. 2010. *Strategic Environmental Assessment for Hydropower on the Mekong Mainstream: Impacts Assessment (Opportunities and Risks)*. Vientiane (14 May, discussion draft). The implications on fisheries, livelihoods, sediment flows, and delta stability are still being examined in detail. The seven Mekong mainstream hydropower projects in Lao PDR, for which MOUs were signed are the 2,330 MW Ban Koum, the 1,410 MW Luangprabang, the 1,320 MW Pak Lay, the 1,300 MW Pakbeng, the 1,260 MW Xayaboury, the 800 MW Lat Sua, and the 500 MW Sanakham. Their combined capacity is nearly 9,000 MW.

revenues.<sup>20</sup> Recognizing that this is an exception, the DEPD considers it useful to strengthen the capabilities of its personnel to negotiate project agreements (such as power purchase agreements [PPAs] and concession agreements) in all relevant disciplines, including legal, regulatory, commercial, financial, technical, environmental, and social matters. Among other benefits, this will enable the negotiating team to better understand, and incorporate into their negotiating strategies, the (changing and unique) situations and perspectives of the power importer from time to time.<sup>21</sup>

23. **Tendering of hydropower projects.** The government recognizes that it could boost its revenue share significantly if it were to grant concessions for large hydropower projects on the basis of a competitive and transparent bidding process, rather than depend upon the existing developer- and investor-driven system. For this, however, the DEPD is required to conduct (with inputs from experienced consultants) the necessary studies and manage the bidding process. The DEPD would thus also require significant institutional capacity strengthening for bid process management.

24. **Power transmission from export-oriented independent power projects.** Given the government ambition to make the Lao PDR the power battery of the GMS, and the impeccable logic of power system integration within the GMS, the government would like to ensure that investment in high-voltage (230 kV and 500 kV) transmission systems is in line with an agreed GMS-wide power system master plan (which does not yet exist). Although the electricity establishment in the Lao PDR considers capacity building in high-voltage transmission system planning, construction, and operations to be a priority area, it is expected to be achieved only in the medium term of 5–10 years.

## **B. Meeting Future Energy Requirements**

25. The government's ambitious target to provide electricity to 90% of all households by 2020 would increase electricity demand, as would the government's initiative of encouraging investment in mining, commercial, and industrial enterprises. The increased power flows through its network, increased number of consumers, the imperative to draw electricity from an increasing number of domestic and export-oriented hydropower projects, and the need to integrate the four essentially isolated grids, point to the need for EdL to raise its operational performance. EdL expects that, by 2020, the four grids will be integrated at 115 kV and 230 kV levels, with some 500 kV lines also being introduced. This calls for, among other things, upgraded capacity in EdL to plan, install, and operate a transmission system of more than 115 kV.

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<sup>20</sup> The negotiated tariff for the Nam Ngum 3 hydropower project may be an exception. For the 322 MW Xekhaman hydropower project, Electricité de Vietnam is insisting on a levelized tariff, which along with zero royalty, makes the project nonbankable and unable to meet the social costs of displacing and resettling 2,500 people.

<sup>21</sup> For instance, given that Electricité de Vietnam sells power to Cambodia at \$0.10/kWh, the Lao PDR negotiating team should be able to adapt its negotiating strategy accordingly. The negotiating team should also be able to respond to changing Thailand perspectives as Thailand's options for purchasing electricity from the PRC, Malaysia, and Myanmar evolve in the future.

26. EdL's investment requirement for 2007–2016,<sup>22</sup> estimated at \$1.26 billion,<sup>23</sup> presents a formidable challenge given that EdL's net profits were less than \$30 million per year during 2007 and 2008. Among the necessary steps required in the coming years are tariff adjustments and management of accounts receivable. The Department of Electricity (DOE) has a plan that incorporates the key aspects of EdL's power development plan as well as other measures such as deployment of appropriate renewable energy technologies where grid extension is not cost effective.<sup>24</sup> EdL also intends to pursue demand-side management and further transmission and distribution loss reduction.<sup>25</sup>

27. **Reducing transmission and distribution losses.** EdL has been successful in reducing its overall (technical plus nontechnical) transmission and distribution losses thus far. Even though the DOE identifies the more remote, distant, and small villages that would not be connected to the grid but be fed by off-grid power sources, it is clear that the utility grid would be more extended from concentrated load centers by 2020 than it is today. It will therefore be increasingly challenging for EdL to continue reducing transmission and distribution losses in the coming years to reach the targeted transmission and distribution loss level of less than 10%.

28. **Deploying renewable energy technologies.** Although the government is in the process of formulating a renewable energy policy, significant experience in the use of certain renewable energy technologies has already been accumulated. The government's perspective is that renewable energy technologies can contribute towards reaching the 90% electrification target by 2020, reversing the trend of forest cover loss, and meeting transport fuel needs. The government has also set a target of 30% penetration for renewable energy technologies by 2025, but the basis for setting this target is not clear. Sufficiently reliable and long-term resource data needs to be gathered, procedures for private participation need to be streamlined and simplified, incentives to encourage private participation put in place,<sup>26</sup> and new business models developed. (For further details, refer to Appendix 2.)

29. **Increased demand-side management measures.** EdL has made a small beginning in introducing demand-side management measures.<sup>27</sup> As of the end of 2009, EdL has plans to increase such efforts. EdL is also planning to establish a baseline for household lighting, with the objective of designing a suitably targeted demand-side management program on introducing compact fluorescent lamps to replace incandescent bulbs.

30. **Adjusting tariffs.** Although tariff adjustments since 2006 have been accompanied by a reduction in cross-subsidies between customer categories, it is clear that, as opportunities for

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<sup>22</sup> Electricité du Laos. 2008. *Power Development Plan (2007–2016)*. Vientiane.

<sup>23</sup> Includes \$600 million for generating plant (EdL owned and operated, plus domestic independent power projects), \$460 million for transmission systems (including lines for grid strengthening, control facilities, substations, and lines to evacuate power from domestic independent power projects), \$160 million for rural electrification extensions of 22 kV and 35 kV, and \$30 million for distribution system reinforcement. This excludes investment in export-oriented hydropower projects and associated transmission facilities.

<sup>24</sup> The DOE's plan was originally drafted in 2008, has been revised and updated since then, and is to be submitted to the prime minister for approval in the second half of 2010.

<sup>25</sup> EdL also intends to make a beginning with other end-use energy efficiency measures (such as setting performance standards, and increasing user awareness), but the modalities remain to be firmed up.

<sup>26</sup> The Small and Mini Hydroelectric Development Project starts the process for hydropower projects of less than 5 MW.

<sup>27</sup> Spurred by the need also to reduce accounts receivable from government consumers, EdL conducted energy audits in about 50 government buildings, and followed up with implementation of no-cost or low-cost energy efficiency measures in four such buildings. Energy savings of about 4%–8% have thus been achieved.

cross-subsidy reduction are exhausted in the coming years, EdL will need to adopt a more sophisticated tariff regime to enable it to manage the overall capital investment requirements.<sup>28</sup>

31. **Managing accounts receivable.** The government and EdL consider it important to reduce EdL's accounts receivable from the government and agriculture consumers to manageable levels. EdL has agreed on an action plan with the Ministry of Finance (MOF) and the World Bank to reduce accounts receivable and not allow them to re-accumulate.

### C. Managing the Environmental and Social Implications of Energy Projects

32. The sustainable hydropower policy (2005) encourages economic, ecological, and socially sustainable development of hydropower projects. Through the implementation of ADB's ESP loan, the government demonstrated its strong commitment to policy, legal, and institutional reforms for improved environmental and social management of hydropower projects.<sup>29</sup> However, there remain three broad classes of barriers to managing environmental and social implications of hydropower projects: (i) shortcomings of the existing policy, regulations, standards, and procedures in place; (ii) lack of clarity regarding organizational roles and responsibilities; and (iii) insufficient budgetary support and human resource allocations to address such barriers. The first two barriers are a manifestation of the third, which poses the biggest challenge of building capacity in all relevant environmental and social disciplines, and attracting sufficient number of people with the requisite education and training. Nonetheless, over the past several years, the institutional capacity has improved, albeit at a slow pace. However, given the acceleration of the hydropower development effort in recent years, the gap has most likely widened.

33. **Updating environmental and social laws to meet sustainability requirements for hydropower development.** Although the government has put in place basic laws for management of the physical environment, some revisions are becoming increasingly necessary as hydropower-related experience accumulates and pressures to develop more hydropower projects rise. Some issues that need to be appropriately addressed in the Water and Water Resources Law (1996), the Environmental Protection Law (1999), and the National Policy on Environment and Social Sustainability of the Hydropower Sector (NPSSH, 2005) are discussed in Appendix 3. As of January 2010, the process to amend the Environmental Protection Law was under way.<sup>30</sup> Appendix 3 also provides a brief overview of policies, laws, and regulations in the Lao PDR on involuntary resettlement and compensation.<sup>31</sup>

<sup>28</sup> The lifeline tariff rate, which had already exceeded \$0.02/kWh in 2008, was considered to be high by poor households.

<sup>29</sup> A total of 48 policy tranche conditions were achieved and 22 nontranche requirements were fully met. The salient achievement of the ESP included (i) issuance of environmental impact assessment (EIA) guidelines, the Environmental Protection Law, and the national policy on involuntary resettlement and compensation; (ii) formulation of a policy statement on watershed management; (iii) institutional measures such as the high-level Environmental Coordination Committee; (iv) establishment of the Environment Protection Fund (EPF); and (v) preparation for third-party monitoring arrangements.

<sup>30</sup> The changes incorporated in the first draft of the amended Environmental Protection Law include some that are identified in Appendix 3, and relate to (i) preparation of strategic environment assessments, cumulative impacts assessments, and provincial waste management plans; and (ii) greater transparency and public involvement through environmental information disclosure. As of January 2010, it was expected that the amended Environmental Protection Law draft would be submitted to the Ministry of Justice by February 2010. It would be ready for submission to the National Assembly by June 2010 at the earliest.

<sup>31</sup> The Decree on Involuntary Resettlement and Compensation is not entirely consistent with the National Policy on Environment and Social Sustainability of the Hydropower Sector, 2005. For instance, it does not recognize the ethnic minorities as a vulnerable group. Besides, economic rehabilitation is defined only in physical terms (such as housing, income generating activities, etc.) that do not recognize cultural preferences and social capital.

**34. Institutional links and capacity development to facilitate sustainable development.**

The WREA acknowledges that it is best positioned to carry out macro or higher-level studies, such as cumulative impacts assessments and strategic environmental assessments, for which it needs continued development partner support. The WREA also recognizes the need to: (i) institute a knowledge management system as knowledge accumulates in the coming years; and (ii) have formal links with concerned line ministries for sharing information and findings. Necessary efforts to institute such links are in the process of being developed with development partner assistance. Although the WREA has more resources than other line ministries to work on macro-level studies, its in-house skills base, databases, and software are inadequate for such work, and it has thus far worked on such studies only with development partner support.

35. Project-level studies are reviewed by the MEM (DOE) and certified by the WREA. Both the WREA and DOE recognize the considerable potential for improving the review process and certification criteria. However, the precise division of expertise or level of effort required from the DOE and WREA (at the central and provincial levels) remains unclear, and their combined capabilities fall short of requirement. As a result, in some instances the WREA has not been able to provide timely certifications before dam construction begins, or monitor dams during construction or operation, or ensure that dam builders allocate sufficient funding to address adverse impacts on affected human settlements.<sup>32</sup> The WREA has made efforts to increase staff strength since 2008, but its inability to find adequate personnel with the requisite education and experience is for reasons that go beyond the realm of the energy sector; among other initiatives, this calls for an improved university education system on environmental sciences, and a new degree program on relevant social sciences. The DOE also recognizes the need to have personnel with a background and education in environmental and social sciences, and is similarly constrained. (Further details are given in Appendix 4.)

36. Established in 2005 under the ESP project, the Environment Protection Fund (EPF) is intended to be a financially autonomous organization that helps to strengthen environmental protection, sustainable natural resources management, biodiversity conservation, and community development in the Lao PDR. While the EPF has supported small studies routinely for several years, it has not financed long-term activities such as for environmental and social impact mitigation of hydropower projects due to limitations in its own funds (Appendix 4).<sup>33</sup> Against this background, it is important to note that the WREA and MOF have recently found a workable solution that allows hydropower projects to contribute a certain portion of their annual revenue receipts directly to the EPF.<sup>34</sup> The merits of instituting a benefit-sharing mechanism and the criteria to be used to identify the level of support from EPF are issues that may need to be considered.

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<sup>32</sup> International Rivers. 2008. *Power Surge: The Impacts of Rapid Dam Development in Laos*. Berkeley.

<sup>33</sup> Such long activities may include (i) capacity building and human resource development for environmental management and social safeguards, (ii) third-party monitoring of environmental and social implications of complex and sensitive hydropower and other infrastructure projects, (iii) planning frameworks for integrated resource management, and (iv) participatory natural resource management activities.

<sup>34</sup> As of December 2009, of the 13 hydropower projects that had concession agreements, none were interested in contributing to the EPF, as the MOF did not agree to their request that their contributions to the EPF be deducted from royalties that they pay to the government. This issue is now resolved, which paves the way for all hydropower projects to contribute to the EPF. The Theun-Hinboun Extension Project (THXP) is likely to be the first one to begin contributing to the EPF when it comes on stream in 2012; its annual contribution is to be about \$200,000.

## IV. ADB ENERGY SECTOR ASSISTANCE

### A. ADB's Hydropower Support Strategy

37. The key elements of ADB's support for the Lao PDR hydropower subsector development are (i) financing hydropower projects including those through public–private partnership, coupled with TA that focuses on legal and financial matters; and (ii) necessary technical and financial assistance to better manage the environmental and social implications of large hydropower projects. The second point reflects the need to ensure that the Lao PDR should not struggle to manage the cumulative environmental and social impacts of hydropower development while neighboring countries benefit from cheap power imports.

38. Table 1 shows the gradual build up of ADB support to the hydropower sector. In the pre-SAPE period of 1994–1999, ADB approved two Asian Development Fund loans for hydropower projects: the 210 MW Theun-Hinboun Hydropower Project and the 60 MW Nam Leuk Hydropower Project, plus TA support on legal and financial matters to facilitate investment and completion of the two projects. During the early part of the SAPE period (2000–2009), it became clear that, although the Theun-Hinboun and Nam Leuk plants were operating without any technical glitches, some of the associated adverse environmental and social implications were not being managed well. ADB's response during the SAPE period included TA to understand the legal, regulatory, institutional, and other barriers to improved environmental and social management,<sup>35</sup> and the multisector ESP loan.<sup>36</sup>

39. During the SAPE period, ADB approved financial support for the 1,088 MW Nam Theun 2 Hydropower Project, as a direct ordinary capital resources loan to the project company, a political risk guarantee, and a public sector ordinary capital resources loan to the government. Various TA projects that focused on commercial, financial, environmental, and social aspects of the Nam Theun 2 Hydropower Project were also approved. ADB also approved TA to study cumulative impacts of the expected sector developments in the Nam Ngum River Basin in preparation for the Nam Ngum 3 Hydropower Project—one of the projects in the pipeline for ADB approval in the post-SAPE period.

**Table 1: Evolution of ADB's Hydropower Strategy**

Strategic Period	Intended Development Outcomes	Actual Approvals during Strategic Period (1994–2000, 2001–2009) or Planned Pipeline during 2010–2012
1994–1999	Facilitating the establishment of two hydropower plants: financial assistance plus advisory services support essentially on legal and financial matters (including finalizing the power purchase agreement for the Theun-Hinboun project)	Theun-Hinboun Hydropower Project (Loan 1329-LAO) Nam Leuk Hydropower Project (Loan 1456-LAO) Theun-Hinboun Power (small scale TA) (TA 2054-LAO) Analyzing and Negotiating Financing Options for the Nam Leuk Hydropower Project Cost

<sup>35</sup> ADB. 2000. *Technical Assistance to Lao People's Democratic Republic for the Energy and Transport Socio-Environmental Management*. Manila (Project Preparatory TA 3535, for \$150,000, approved on 10 November); and ADB. 2001. *Technical Assistance to Lao People's Democratic Republic for the Capacity Building for Environment and Social Management in Energy and Transport*. Manila (Advisory TA 3746, for \$600,000, approved on 22 October).

<sup>36</sup> At the time of approval of the multisector ESP loan, its executing agency was the Science, Technology and Environment Agency. In 2007, the Science, Technology and Environment Agency's environmental mandate was combined with the water resources mandate when the WREA was created.

Strategic Period	Intended Development Outcomes	Actual Approvals during Strategic Period (1994–2000, 2001–2009) or Planned Pipeline during 2010–2012
		Overruns (TA 3225-LAO)
2000–2009	Facilitating the set up of a large hydropower plant (the Nam Theun 2) which embodies many outcomes that the government, the Lao PDR power industry, and the development community have been working towards (commercial and financial viability, environmental and social acceptability, etc.). Introducing increased sophistication (e.g., cumulative impacts from more than one project) to enhance informed decision making regarding investment in large hydropower projects.	Nam Theun 2 Hydroelectric Project (Loan 2162-LAO) Nam Theun 2 Power Company Limited (Loan 2161/7210-LAO) Nam Theun 2 Hydropower Development (TA 4213-LAO: GMS) Nam Theun 2 Hydropower Development (Phase II) (TA 4323-LAO: GMS) Cumulative Impact Assessment for the Nam Ngum 3 Hydropower Project (TA 4921-LAO) Nam Theun 2 Hydroelectric Project Social Safeguards Monitoring (TA 7094-LAO: GMS)
2010–onwards	Facilitate private participation in hydropower projects while retaining high standards of compliance with environmental and social safeguards	Nam Ngum 3 Hydropower Project (Loan: GMS) Nam Ngiep 1 Hydropower Project (Loan: GMS)

ADB = Asian Development Bank, GMS = Greater Mekong Subregion, PDR = people's democratic republic, TA = technical assistance.

Source: Independent Evaluation Mission.

## B. ADB's Strategy to Increase Electricity Access

40. ADB's strategy to increase electricity access includes the traditional support for transmission and distribution network expansion as well as grid-connected small hydropower plants and other off-grid renewable energy technologies.<sup>37</sup> Table 2 shows the evolution of ADB's strategy to raise energy access levels in the Lao PDR. In the pre-SAPE period, the approved TA projects and the loan were for extending the grid and electrifying additional rural areas in northern Lao PDR. During the SAPE period, the trend basically continued, and another loan was approved to support transmission and distribution system expansion in the northern parts of the country. The difference, however, was the TA support to facilitate the development of grid-connected small and mini hydropower projects. In the post-SAPE period, this trend appears to be intensifying; in addition to TA, there will also be loans for grid-connected small hydropower generation and off-grid renewable energy. Other broad categories of support (TA and loans for transmission and distribution system expansion) will continue.

**Table 2: Evolution of ADB's Strategy to Increase Electricity Access**

Strategic Period	Intended Development Outcomes	Actual Approvals during Strategic Period (1994–2000, 2001–2009) or Planned Approvals during 2010–2012
1994–1999	Facilitating increased electricity access through financing support for 115 kV transmission lines and selected villages in northern Lao PDR. Technical assistance for facilitating planning, feasibility study, environmental, and	Power Transmission and Distribution (Loan 1558-LAO) Power Transmission and Distribution (TA 2479-LAO) Northern Area Rural Power Distribution (TA 3087-LAO)

<sup>37</sup> The Small and Mini Hydroelectric Development Project will lead to the set up of small hydropower plants (of less than 5 MW capacity), which are connected towards the end of long transmission and distribution lines. They will contribute to reducing transmission and distribution losses and stabilizing power supply.



Strategic Period	Intended Development Outcomes	Actual Approvals during Strategic Period (1994–2000, 2001–2009) or Planned Approvals during 2010–2012
	social impact assessment capabilities for further electrification expansion. Also assistance towards private sector partner selection.	
2000–2009	With a focus on the Lao PDR's northern areas and building on previous transmission system expansion (grid extension) and rural area distribution efforts	Northern Area Rural Power Distribution (Loan 2005-LAO) Northern Power Transmission (TA 4816-LAO: GMS) <sup>a</sup>
2000–2009	Facilitating the development of small and mini hydropower projects with private sector participation	Small and Mini Hydropower Development (TA 7227-LAO)
2010–onwards	Intensifying support for grid-connected and off-grid renewable energy technologies through financial assistance, as well as continued TA support	Small and Mini Hydropower Development Project (Loan) Renewable Energy Development Project (Loan) Renewable Energy Development Project (TA) Small Hydroelectric Development Project (TA)
2010–onwards	Intensifying grid extension and rural electrification effort in the northern areas of the Lao PDR to meet government targets.	Northern Power Transmission (Grant/Loan: GMS) <sup>b</sup> East–West Economic Corridor Power Transmission Project (Grant/Loan: GMS) <sup>b</sup> East–West Economic Corridor Power Transmission Project (TA: GMS) <sup>b</sup>

ADB = Asian Development Bank, PDR = people's democratic republic, GMS = Greater Mekong Subregion, kV = kilovolt, TA = technical assistance.

<sup>a</sup> Focused on extending the transmission and distribution system in northern Lao PDR.

<sup>b</sup> Very likely to also include components for increasing electricity access within the Lao PDR. Replaces the Second GMS Northern Power Transmission Project, following discussions with the government. The transmission line will be in Savannakhet area in southern Lao PDR.

Source: Independent Evaluation Mission.

### C. ADB's Strategy for Energy Cooperation within the Greater Mekong Subregion

41. ADB's thrust for subregional cooperation related to the power sector is characterized as follows: (i) providing assistance to large hydropower projects which are set up with the intention of exporting power, (ii) providing technical or financial assistance to set up transmission facilities with cross-border connections (as components for transmission and distribution projects and for evacuation of power from large hydropower plants), and (iii) providing TA to ultimately facilitate a regional power trading regime. ADB assistance up to the end of the SAPE period has focused on large hydropower projects and specific transmission interconnects/facilities. With the strategic thrust provided by the GMS Forum, ADB also plans to support activities aimed at facilitating a subregional power trading system. (Table 3 lists ADB interventions.)

**Table 3: Evolution of ADB's Strategy for Energy Cooperation within the Greater Mekong Subregion**

Strategic Period	Intended Development Outcomes	Actual Approvals during Strategic Period (1994–2000, 2001–2009) or Planned Approvals during 2010–2012 <sup>a</sup>
2000–2009	Facilitating the identification of specific transmission system interconnect arrangements	Northern Power Transmission (TA 4816-LAO: GMS) <sup>b</sup> Bong-Udon Thani Power Transmission (TA 7026-LAO) GMS Power Interconnection between Project (TA 6147-GMS)
2010–	Intensifying assistance aimed at	Nabong-Udon Thani Power Transmission and

Strategic Period	Intended Development Outcomes	Actual Approvals during Strategic Period (1994–2000, 2001–2009) or Planned Approvals during 2010–2012 <sup>a</sup>
onwards	facilitating rapid and sustained growth of subregional power interchange, through financing specific cross-border transmission system projects, and technical assistance on selected institutional and regulatory aspects	Interconnection (MFF) (Grant/Loan: GMS) <sup>c</sup> Power Interconnection (Ban Sok-Pleiku) (Loan: LAO-VIE) Northern Power Transmission (Grant/Loan: GMS) <sup>d</sup> East–West Economic Corridor Power Transmission Project (Grant/Loan: GMS) <sup>d</sup> East–West Economic Corridor Power Transmission Project (TA: GMS) <sup>d</sup> Sustainable, environment friendly regional power trading in the GMS, Phase 2 (TA: PRC–LAO–CAM) Developing the regional transmission and regulatory authority (TA) Enhancing capacity of institutions for regional power trading (TA)

ADB = Asian Development Bank, CAM = Cambodia, PDR = people's democratic republic, GMS = Greater Mekong Subregion, MFF = multitranche financing facility, PRC = People's Republic of China, TA = technical assistance, VIE = Viet Nam.

<sup>a</sup> Excludes export hydropower projects (Table 1).

<sup>b</sup> Includes a component to strengthen power interconnections with Thailand.

<sup>c</sup> Being renegotiated.

<sup>d</sup> Further to facilitating export, likely to also include components for increasing electricity access within the Lao PDR.

Source: Independent Evaluation Mission.

42. Hydropower projects that have fostered regional cooperation include (i) the Theun Hinboun power project, which provides low-cost and clean energy to Thailand;<sup>38</sup> and (ii) the Nam Theun 2 Hydropower Project, from which power will be exported through 500 kV lines for the first time. Among its other components, the Northern Power Transmission Project,<sup>39</sup> approved in January 2010, is to replace existing 22 kV lines used to import power in the dry season with two-way 115 kV interconnections that make use of the seasonal variations in hydropower.<sup>40</sup> As per the Vientiane Plan of Action for GMS development,<sup>41</sup> by or before 2014 ADB is expected to provide assistance for several specific projects for power interconnections with Thailand and Viet Nam, and assistance towards a regional power trading system.<sup>42</sup> However, one TA project that was to originally examine the feasibility of a 500 kV cross-border transmission facility to connect four hydropower plants in the Lao PDR to the Thailand grid is undergoing change.<sup>43</sup> Another TA project that examined the feasibility of a 500 kV cross-border transmission facility from Lao PDR to Viet Nam, as Viet Nam is planning to build eight

<sup>38</sup> To the extent the Nam Leuk exports power, this applies to it as well. Both the Theun Hinboun and Nam Leuk hydropower plants also help meet the Lao PDR's growing power requirements.

<sup>39</sup> ADB. 2009. *Report and Recommendation of the President to the Board of Directors: Proposed Asian Development Fund Grant to the Lao People's Democratic Republic for the Greater Mekong Subregion Northern Power Transmission Project*. Manila (December, approved in January 2010).

<sup>40</sup> The two-way 115 kV line between Thailand's Loei province and the Lao PDR's Xaignabouli province (Paklay district) is part of a wider expansion of the Lao PDR–Thailand interconnection plan developed in EdL's Power Development Plan 2007–2016.

<sup>41</sup> GMS Forum. 2008. *Vientiane Plan of Action for GMS Development*. Vientiane.

<sup>42</sup> Through support for formulation of transmission regulations, standardized metering arrangements, grid code, and power trading rules.

<sup>43</sup> The four hydropower projects are the 615 MW Nam Ngum 2, 440 MW Nam Ngum 3, 523 MW Nam Theun 1, and 278 MW Ngiep 1. Among the factors that have impeded the closure of the proposed 500 kV transmission line are issues related to transmission line ownership and its operation as a common carrier, different timelines for the coming on stream of the four hydropower projects, and sharing of power wheeling charges before all four hydropower projects begin commercial operations. It is noted that the Nam Theun 1 and Nam Ngiep 1 are delayed. A 220 kV line is being discussed.

hydropower projects in southern Lao PDR, is making slow progress.<sup>44</sup> Such projects that link multiple export-oriented projects are more likely to be implemented when transmission planning is done on a GMS-wide basis, and a common grid code and power trading rules have been agreed upon by the GMS countries.

## **V. EVALUATION OF ADB ENERGY SECTOR ASSISTANCE PROGRAM**

### **A. Strategic Positioning**

#### **1. Relevance of Country Partnership Strategy's Energy Sector Objectives and Strategic Priorities**

43. ADB's portfolio during the SAPE period is in keeping with the government's strategic objectives and evolving priorities to meet these objectives. During this period, ADB's energy sector strategy and operations in the Lao PDR also followed closely the directions provided by the prevalent energy policy and the long-term strategic framework (2001–2015).<sup>45</sup> Among the key themes that the strategic framework advocated were the improvement of developmental impact through a combination of (i) private participation in infrastructure accompanied by good governance of public institutions, (ii) clarity of rules and regulations and other capacity building aspects for public service delivery, (iii) putting environmental considerations in the forefront of development decision making and planning, and (iv) regional cooperation and integration. Similarly, the 2000 review of ADB's energy policy of 1995<sup>46</sup> recommended increased emphasis on ADB energy sector support, among other things, towards promoting private sector participation, facilitating commercialization and improved financial viability of utilities, addressing regional and global environmental impacts, and promoting regional cooperation.

44. Towards the end of the SAPE period in 2008 and 2009, ADB's interventions and pipeline of planned interventions show a close alignment with the newly formulated long-term strategic framework for 2008–2020 (Strategy 2020),<sup>47</sup> and the 2009 energy policy.<sup>48</sup> Strategy 2020, which is essentially in line with the 2001–2015 strategic framework, embodies three distinct but complementary development agendas: inclusive economic growth, environmentally sustainable growth, and regional integration. The updated energy policy is aligned with Strategy 2020 and seeks to address the difficult challenges of environmentally sustainable (and climate friendly) growth coupled with structural reform, regional cooperation, and improving quality of life.

#### **2. Selectivity and Ownership**

45. The ADB energy sector assistance program has been consistent with the development needs of the country. Given that large hydropower projects entail long gestation periods and transmission lines are set up to serve for several decades, ADB has taken a long-term view in defining its loan and TA program for the energy sector. ADB's assistance has centered on themes that are consistent with the intended sector outcomes and outputs as articulated in various country assistance programs and partnership strategies during the SAPE

<sup>44</sup> One of the eight hydropower projects (Xe Kaman 3) already has a dedicated 220 kV line to Da Nang in Viet Nam; Xe Kaman 1, another of the eight projects is also under implementation; there is little progress on the other projects.

<sup>45</sup> ADB. 2001. *Moving the Poverty Reduction Agenda Forward in Asia and the Pacific: The Long-Term Strategic Framework of the Asian Development Bank (2001–2015)*. Manila.

<sup>46</sup> ADB. 2000. *Energy 2000: Review of the Energy Policy of the Asian Development Bank*. Manila.

<sup>47</sup> ADB. 2008. *Strategy 2020: The Long-Term Strategic Framework of the Asian Development Bank 2008–2020*. Manila.

<sup>48</sup> ADB 2009. *Energy Policy*. Manila.

period.<sup>49</sup> In particular, these include: (i) facilitating private participation for large and small hydropower projects; (ii) facilitating compliance with requisite environmental and social safeguards for large hydropower projects; (iii) supporting a mix of grid extensions, grid connected small hydropower plants and off-grid renewable energy for meeting the Government's electrification access targets; (iv) providing capacity building support for the above; and (v) promoting GMS regional grid interconnections. The results framework in the country strategy and program (2007–2011) defines performance indicators for many of these themes, and the road map sets targets against these indicators at five-yearly intervals to 2020. ADB has been monitoring the targets as well (para. 49). However, some aspects—most notably regarding EdL financial performance and comprehensiveness of assessment of environmental and social impacts of hydropower projects—are included in the results framework as constraints. Besides, target dates for some sector outputs (such as establishment of a regulatory body by 2010) need to be more realistic.

46. ADB's focus on transmission grid expansion and increased rural electrification in the poor northern provinces is in line with the government's priority to develop the power sector. ADB has approved a range of projects in the northern parts of the Lao PDR, including the Northern Area Rural Power Distribution Project (NARPDP) approved during the SAPE period, to set up transmission lines and substations, as well as electrify about 30,000 households in about 400 villages.<sup>50</sup> Both the government and ADB recognize the benefits of gradually extending the power system to increasingly remote areas (while the option for small hydropower and other renewable energy technologies is explored), developing mutually reinforcing projects across infrastructure sectors as well as necessary ancillary services to trigger economic benefits.<sup>51</sup>

47. In line with the stated government objective of developing hydropower potential for earning foreign exchange through power exports and meeting increasing energy demand, ADB supported the 1,088 MW Nam Theun 2 project. In keeping with the government recognition that a significant number of potential hydropower development sites would adversely affect areas of significant biodiversity value and the livelihoods of a large number of people in upstream catchment and downstream areas, ADB also began supporting capacity building for social and environmental protection.

48. In the interest of boosting foreign exchange earnings through hydropower energy exports (or reducing foreign exchange outflow from electricity imports), the government has encouraged transmission system interconnections across the border with Thailand. Large hydropower projects and transmission and distribution projects include such components. However, a holistic energy sector view is also required. There are some emerging energy issues that have become important in recent years (such as environmentally and socially sound lignite mining practices), for which ADB has not provided assistance thus far.

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<sup>49</sup> ADB. 1999. *Country Assistance Plan: Lao People's Democratic Republic, 2000–2002*. Manila (December); ADB. 2002. *Country Strategy and Program: Lao People's Democratic Republic, 2003–2005*. Manila (July); ADB. 2003. *Country Strategy and Program Update: Lao People's Democratic Republic, 2004 – 2006*. Manila (July); ADB. 2006. *Country Strategy and Program: Lao People's Democratic Republic, 2007–2011*. Manila (September); and the 2009 Midterm Review (footnote 5).

<sup>50</sup> A similarly scoped project was approved in 1997 (before the SAPE period), and another in early 2010 (after the SAPE period).

<sup>51</sup> For example, in the transport sector during the SAPE period, ADB approved support for the northern economic corridor project. The project aims to improve the road from Houayxay to Boten in the Lao PDR, so as to create an international north–south corridor that links Thailand and the PRC.

### 3. Internal Coherence

49. The overall size of ADB's lending and nonlending portfolio has remained small and reflects limited absorptive capacity, specifically because of EdL's generally weak financial performance through much of the SAPE period,<sup>52</sup> and weak institutional capacity for environmental and social impact management. Although the Lao Holding State Enterprise (LHSE) was set up as planned in 2005 (para. 75), certain aspects of the power sector regulation need further attention, including tariff revisions to improve cost recovery. Nonetheless, continuity from a long-term perspective is evident in all core areas of ADB energy sector support, which has contributed to meeting or exceeding some of the targets set in the results framework, such as exceeding of overall electrification rate to over 60% by 2010 (compared to the targeted 55%), and (with the coming on stream of the Nam Theun 2 plant) coming close to achieving the 2010 target of 1,500 MW of power exports in the first half of the year itself. Transmission and distribution loss reduction targets for 2010 have also been exceeded; and these losses have reduced to 12%, which was the target set for 2020.

50. During the SAPE period, ADB energy sector interventions included support for two projects—the Nam Theun 2 Hydropower Project and the NARPDP. There was also a general trend of offering support for some TA for necessary advisory and preparatory work prior to loan or grant financing approval. This trend is also evident for grid-connected and off-grid renewable energy projects, for which TA support during the SAPE period is expected to lead to a loan beyond the SAPE period.

51. The SAPE period shows an increasing sophistication in the terms and scope of projects and TA. ADB support for the Nam Theun 2 Hydropower Project was the first ordinary capital resources loan extended to any project in the Lao PDR, included a political risk guarantee to provide comfort to commercial lenders, and incorporated appropriate attention to management of environmental and social implications. The need to study cumulative impacts of development projects was also recognized, and resulted in ADB support for a cumulative impact assessment for the first time for the Nam Theun 2 project.<sup>53</sup> Later, ADB also supported a cumulative impact assessment for the Nam Ngum River Basin as project preparatory TA for the Nam Ngum 3 Hydropower Project. For transmission and distribution projects, the sophistication is due to the need to strike a balance between grid extensions to increasingly remote and thinly populated rural settlements and the local off-grid alternatives. In this context, the recently approved GMS Northern Power Transmission Project includes grant assistance for a senior policy advisor who will advise EdL and the government on strategic policy issues concerning the long-term energy sector development in the country.

52. Through assurances and covenants, ADB has also sought—with mixed results—to improve EdL's financial health and ensure compliance with environmental and social safeguards. While the specific targets for financial performance have become more stringent, the parameters on which targets are set have remained unchanged. These include periodic tariff revisions to reduce cross-subsidies, selected financial performance indicators,<sup>54</sup> and transmission and distribution loss reduction targets. For the NARPDP, the specific list of assurances also included

<sup>52</sup> For instance, EdL became profitable only in 2006. Since then, accounts receivable have been mounting.

<sup>53</sup> Includes a study of the effects that other future developments in the project area could have on the type and magnitude of Nam Theun 2 impacts, and impacts of developments in other sectors that are induced by Nam Theun 2 activities and supplementary components.

<sup>54</sup> For instance, the debt service coverage ratio to be at least 1.5, a debt–equity ratio of 1.5 or less, generate internal cash of 30% or more of 3-year average of planned capital expenditures, and accounts receivable limited to 2 month's average domestic sales or less.

an offset arrangement, whereby EdL need not pay the government its tax and other financial liabilities if accounts receivable (from government consumers, presumably) exceed the targeted level of 2 months of average sales.

#### 4. External Coherence

53. In addition to the World Bank and ADB, various bilateral development partners have contributed to the development of the Lao PDR energy sector. On certain matters related to energy sector assistance, ADB has preferred to let the World Bank provide thought leadership. For instance, with leadership provided by the World Bank, in 2005 ADB supported the construction of the Nam Theun 2 hydropower plant. Along with the World Bank and other development partners, ADB also supported good governance and an effective public expenditure management strengthening program.<sup>55</sup>

54. Through an ADB-supported project and four projects funded by the International Development Association, Norwegian Agency for Development Cooperation (NORAD), and the Global Environment Facility, EdL's planning and implementation capabilities for conventional rural electrification have markedly improved since the 1990s, although scope for significant further improvement remains. ADB's coordination with the World Bank has also been exemplary in this regard—ADB has focused on rural electrification efforts in the country's north while the World Bank has provided similar assistance in the south.<sup>56</sup>

55. In keeping with the need to consider off-grid technologies as increasingly remote areas are to be electrified, the World Bank Group and NORAD assisted the government in setting up the Rural Electrification Fund in 2007.<sup>57</sup> As ADB is moving towards supporting deployment of small and mini hydropower plants and other off-grid technologies, it is in the process of reviewing the fund's operations to synergize with it. With assistance from Finland, the DOE is also in the process of firming up a policy and plan for renewable energy technologies, which will provide a basis for ADB's assistance (beyond the SAPE period) aimed at scaling up deployment of small and mini hydropower plants as well as other renewable energy technologies.

56. EdL's accounts receivable management is another area where the World Bank has led the way. EdL has agreed on an action plan with the World Bank and MOF to reduce accounts receivable to reasonable levels and not allow them to grow.<sup>58</sup> ADB supports the reduction of accounts receivable. With a view to helping EdL manage accounts receivable in the coming years, the World Bank has also supported the introduction of demand-side management measures to reduce electricity use in government buildings. Along the same lines, ADB has held some preparatory dialogue towards offering support for energy end-use efficiency improvements.

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<sup>55</sup> The public expenditure management strengthening program is supported by the World Bank, ADB, International Monetary Fund, the United Nations Development Programme, and some bilateral development partners. It is a program that aims to strengthen the capacity of the MOF and provincial financial departments in fiscal planning and budgeting, budget execution, accounting, and reporting, as well as financial legislation and the regulatory framework.

<sup>56</sup> Through the Power Transmission and Distribution Project (PTDP) and NARPDP, ADB assisted in the rural electrification effort in the northern provinces, with cofinancing from the Nordic Development Fund and the Korean Export Import Bank.

<sup>57</sup> With grant support from the Independent Development Agency and Global Environment Facility, and parallel financing from NORAD through the Rural Electrification Project.

<sup>58</sup> As per available information, EdL's outstanding accounts receivable from the government had mounted to KN113 billion from October 2005 to September 2009, and from irrigation consumers they were about KN57 billion by December 2009. The total receivables of about \$20 million is very high for EdL, whose annual net profits have not exceeded \$30 million since it became profitable in 2006.

57. ADB's capacity building support for meeting environmental and social impact mitigation requirements includes (i) the multisector ESP loan approved in 2001; (ii) the Nam Ngum watershed development project; and (iii) TA (cofinanced with the Australian Agency for International Development [AusAID]) to update the national water policy and strategy, which included support for the design document for the National Integrated Water Resources Management Support Program.<sup>59</sup> In the meantime, the WREA's capacity building effort has been led by the Strengthening Environmental Management program financed by the Swedish International Development Agency in the first two phases beginning in 2001, and the Government of Finland for the third phase beginning in 2010. The Strengthening Environmental Management program has helped to build the WREA's capacity gradually (as per its rather limited absorptive capacity), both in Vientiane and selected provinces. In its third phase, the program is to include (among other aspects), support to enable the WREA to work on strategic environment assessments. On the basis of this assessment, the strategic positioning of ADB's energy sector assistance is rated *satisfactory*.

## B. Relevance

58. ADB-supported projects and programs for expanding the energy supply-side system (generation, transmission, and distribution) were *highly relevant* to the requirements of the Lao PDR. The Nam Theun 2 project approved during the SAPE period in April 2005 began commercial operations in April 2010. While the Nam Theun 2 project's success since commercial operation began can be evaluated only at a later date, it suffices now to examine key aspects of project design and quality at entry as evident from the various project agreements (such as the concession agreement), the design and monitoring framework, the proposed monitoring and evaluation system, and other documentation. Table 4 shows the lessons learned from other ADB-funded hydropower projects that were incorporated at the design stage of the Nam Theun 2 project, as well as other key design features of the Nam Theun 2 project (Appendixes 5 and 6). Comprehensive coverage of the environmental and social aspects was possible with the findings of the two project preparatory TA projects approved a year or more before appraisal. In addition, as the need to delineate and address issues regarding livelihoods, resettlement, and compensation became clear during project implementation, ADB also supported advisory TA that is adopting the participatory land-use planning approach towards addressing the compensation and resettlement issues in the resettled areas. Although the advisory TA is ongoing, its participatory approach to land-use planning has brought to the fore issues that, if and when addressed, will set a precedent for other large hydropower projects in the future.<sup>60</sup>

**Table 4: Key Design Features of the Nam Theun 2 Hydropower Project**

Item	Design Features
Lessons learned from Theun-Hinboun and Nam Leuk hydropower projects	<ul style="list-style-type: none"> <li>• Conduct an early comprehensive assessment of environmental and social impacts, establish baseline data, allocate up front sufficient funds for environmental and social mitigation activities</li> <li>• Strengthened capacity to effectively monitor progress during implementation on (i) completed physical works, goods, and services against time and budget targets; and (ii) monitoring effectiveness of conservation, resettlement, and livelihood restoration</li> </ul>

<sup>59</sup> The National Integrated Water Resources Management Support Program is a 10-component framework to enable the government (along with development partners such as ADB, AusAID, World Bank, and others) to coordinate the required resources to support the capacity building of the WREA in leading the integrated water resource management program. The whole support program is expected to run for 7–10 years.

<sup>60</sup> The key issue is encroachment into land within village boundaries, to which villagers do not have a clear title.

Item	Design Features
Concession agreement <sup>a</sup>	<ul style="list-style-type: none"> <li>• Incorporates and seeks to address a range of environmental and social issues/risks<sup>a</sup></li> <li>• Recognizes that environmental and social mitigation costs can be unexpectedly high, and provides for "overrun allowance"<sup>a</sup></li> <li>• Recognizes that unforeseen and unanticipated impacts can occur, for which additional budget is provided<sup>a</sup></li> <li>• A multilayered system of monitoring of environmental and social safeguard compliance<sup>b</sup></li> </ul>
PEMSP <sup>a</sup>	<ul style="list-style-type: none"> <li>• Allocation, use, reporting as well as monitoring of government cash flows from Nam Theun 2 for poverty reduction<sup>a</sup></li> </ul>

PEMSP = Public Expenditure Management Strengthening Program.

<sup>a</sup> For details, refer to Appendix 5.

<sup>b</sup> For details, refer to Appendix 6.

Source: Independent Evaluation Mission.

59. The transmission system expansion and rural distribution loans under implementation during the SAPE period,<sup>61</sup> were in line with the government's priority to increase electricity access, establish basic infrastructure in rural areas, and promote economic development. The loans also contributed towards integrating the northern grid with the central 1 grid. PTDP extended the 115 kV grid to Xanakham, Xayaburi, and Xiengkhuang areas in northern Lao PDR, while the NARPD extended the transmission backbone (existing at the time of approval) to include more areas (of Luang Prabang, Oudomxai, Luang Namtha, Xiengkhouang, etc. provinces) in the north.

60. The Nam Theun 2 project and several other ADB-supported energy projects in the Lao PDR have also fostered regional cooperation. The project preparatory TA on small and mini hydropower projects supports the preparation of a feasibility study for two such projects and identifies barriers that need to be addressed to encourage investment in small and mini hydropower projects and contribute to meeting electrification access targets. The project preparatory TA to support a cumulative impact assessment for the Nam Ngum 3 Hydropower Project reflects increased awareness for addressing the additive or multiplicative nature of environmental and social impacts from multiple projects in a river system.

### C. Efficiency

61. ADB's interventions in the Lao PDR's energy sector are assessed *efficient*. It is difficult to justify the Nam Theun 2 project on the basis of a least-cost expansion planning exercise. Its installed capacity is several times larger than the Lao PDR's total power requirements at the planning stage, at approval, and at completion. Most of its power output will be exported to neighboring Thailand, and the project is optimal on the limited basis of a cost comparison with a range of fossil-fuel-based alternatives for Thailand.<sup>62</sup> The Nam Theun 2 project instead derives its strength from (i) a bankable PPA with EGAT for 920 MW of firm power exports, (ii) a strong concession agreement that incorporates the environmental and social safeguards and related concerns of the development community, and (iii) a strong economic internal rate of return (EIRR) of more than 15% at the time of appraisal. The project is anticipated to make the Lao PDR a net energy exporter (in 2010) again, as well as make the hydropower sector a net foreign exchange earner again. The commercial operation date of 30 April 2010, which is less than 5 months after the original target date of mid-December 2009, and a final capital cost that is

<sup>61</sup> The Power Transmission and Distribution Project was approved in September 1997, and closed in June 2004. The Northern Area Rural Power Distribution Project was approved in September 2003 and completed in March 2010.

<sup>62</sup> ADB. 2005. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the Lao People's Democratic Republic for the Greater Mekong Subregion: Nam Theun 2 Hydroelectric Project*. Manila.



slightly above the base cost of \$1.25 billion and well within the contingent amounts raised, indicates that the implementation efficacy far exceeds the average for ADB-supported projects.

62. The Theun-Hinboun and Nam Leuk hydropower projects are efficient from the GMS-wide perspective, although they are not a result of any GMS-wide power system expansion plan. In fact, the Nam Leuk project simply exports power to neighboring Thailand when its generation exceeds EdL's requirements. The economic analyses of the two hydropower projects show that their economic attractiveness increases when power exports to Thailand are considered. As per the findings of the 2008 energy SAPE for the GMS,<sup>63</sup> the Theun Hinboun project's estimated EIRR of 32% from the GMS perspective (in which hydropower sales in Thailand are assumed to replace higher cost thermal sources) is higher than the EIRR of 28.2% if net benefits only in the Lao PDR are considered.<sup>64</sup> While the estimated EIRR for the Nam Leuk project exceeded the threshold 12% level at approval,<sup>65</sup> it is noteworthy that the project provides greater overall benefits when it exports power (although it is not slated as an export-oriented project).

63. The NARPDP that was completed in March 2010 suffered substantive delays. An 18-month delay due to the contractor subsumed other delays of about 12 months. It also included a 3-month delay in completing additional activities: (i) environmental and social mitigation work for the Nam Song and Nam Leuk and (ii) implementation of additional supply contracts. Although EdL's bid management skills (for the 115 kV system) did show a distinct improvement compared to the PTDP, EdL had still not begun to manage comprehensive engineering–procurement–construction contracts. The project EIRR at closure is not yet estimated; it is likely that increased project costs and implementation delays will depress the attractive EIRR of 23.3% estimated at appraisal.<sup>66</sup> (For further details, refer to Appendix 7.)

#### **D. Effectiveness**

64. ADB's assistance program to the Lao PDR energy sector is rated *effective*. The Nam Theun 2 project outcomes regarding energy generation, energy supply to Lao PDR consumers, energy exports, and sales revenues are discussed in the context of sustainability. Outcomes pertaining to the efficacy of mitigating adverse environmental and social implications and deployment of government revenues from project cash flows to meet government's social objectives are discussed in paras. 65 and 66.

65. Continued commitment from the development community during the construction phase of the Nam Theun 2 project suggests a good measure of compliance with environmental and social safeguards. Following completion of the physical resettlement process, the livelihood generation process has also progressed satisfactorily (given that over 80% of resettled households consider themselves much better off following resettlement),<sup>67</sup> although there are

<sup>63</sup> ADB. 2008. *Sector Assistance Program Evaluation of the Energy Sector in the Greater Mekong Subregion*. Manila (December).

<sup>64</sup> EIRR estimates for the Theun-Hinboun hydropower project have consistently exceeded the 12% threshold—at approval (23.6%), at completion (30.8%), and at project performance evaluation (18.5%).

<sup>65</sup> EIRR estimates for the Nam Leuk hydropower project are 13.5% at approval, 10.5% at completion, and 11.8% at project performance evaluation.

<sup>66</sup> It may be noted that the original loan approval was in various currencies that amounted to SDR21.49 million (or \$30 million). Before loan closure and project completion, the precise cost overrun data is not available, but it is understood that the total project cost has increased from \$51.51 million (at appraisal) to over \$62.00 million. A part of this increase reflects the weakening of the dollar against the special drawing right; an increase in project scope, such as the environmental and social mitigations from the Nam Leuk and Nam Song projects, also led to higher project costs.

<sup>67</sup> ADB 2010. *Greater Mekong Subregion Nam Theun 2 Hydroelectric Project Semiannual Update*. Manila (August).

delays in providing irrigation facilities to some resettlers, villagers are not entirely clear of their rights to village forestry association (VFA) lands, non-VFA saw-mills continue to offtake timber from the VFA-area lands (which is not in line with the 70-year exclusivity provided for in the concession agreement), and outsiders continue to do commercial fishing in the reservoir (which is also not in line with the 10-year exclusivity provided for in the concession agreement).<sup>68</sup> However, government policies related to consolidation of ethnic groups into villages of 50 households or more for administrative ease has been followed without due regard to the difficulties encountered by certain ethnic groups. The basic paradigm on which social impact mitigation activities were compiled in the concession agreement itself is also not the most appropriate for some ethnic groups and their resettlement and livelihood generation, and reflects more a perception of the decision makers from the government, the Nam Theun 2 Power Company (NTPC), and the development partners on the requirements of the project-affected people. In particular, the physical or legal sides of the safeguards have been consistently emphasized, so while compensation, housing, and livelihood-generating opportunities (in the physical quantifiable sense) are preeminent, indigenous notions of space and time have been difficult to accommodate, while land tenure security remains a challenge.<sup>69</sup> Appendix 6 provides further details regarding social impact mitigation as well as environmental impacts and mitigation aspects. It is still too early to gauge the outcome of the ongoing ADB-supported TA that is designed to address some of the resettlement and livelihood-generation issues that have come to the fore during the construction phase.<sup>70</sup>

66. As part of the public expenditure management strengthening program, the government has set in place a system to channel into poverty reduction programs the \$1.9 billion contribution expected from the Nam Theun 2 project over the concession period.<sup>71</sup> In addition to the four-pronged system of allocation, funds management, reporting, and monitoring of the funds (Appendix 5), the accounts of the LHSE are also to be audited by one of the private accounting firms and the government's National Audit Organization under the Prime Minister's Office. The effectiveness and efficacy of the revenue management system as planned will become known several months after commercial operations have started when the resource user charges (a royalty of 5.2% on gross sales revenue) are paid by the NTPC to the government.

67. The project company of the Theun-Hinboun hydropower project is addressing its outstanding environmental and social issues along with environmental and social management activities for the 280 MW Theun-Hinboun Expansion Project (THXP). The effectiveness of the approach will be known largely after the THXP comes on stream in 2012. One of the environmental and social issues that merits specific attention at this point in time is the water

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<sup>68</sup> *Nam Theun 2 Hydroelectric Power Project Concession Agreement (2005 Financial Close) Consolidation between the Government of the Lao People's Democratic Republic and Nam Theun 2 Power Company Limited*, Sydney, Australia, 25 April 2005. Refer to Schedule 4, Part 1: Social Component (other than Downstream Areas) of this concession agreement.

<sup>69</sup> For instance, the Western-style arrangement of houses in straight lines does not incorporate the inputs of either social scientists or villagers. And moving agriculture from an extensive system with open access to land for cultivation and grazing to an intensive system where access to land is strictly controlled requires new methods that are both time and labor intensive. Nonetheless, the resettlement program also attracted many people from outside the project impacts areas to move in to the resettled villages, which suggests that at least some aspects of the resettlement program have been attractive.

<sup>70</sup> ADB. 2008. *Technical Assistance to the Lao People's Democratic Republic for the Greater Mekong Subregion Nam Theun 2 Hydroelectric Project – Social Safeguards Monitoring*. Manila (TA 7094, for \$400,000 approved on 7 July).

<sup>71</sup> Government accruals from royalty and tax payments are estimated to be about \$1.2 billion over the 25-year concession period. Another \$700 million is estimated to accrue to the government during the concession period (from dividends to LHSE less LHSE's operating expenses and debt service obligations).

discharge rates, which will be higher upon commissioning of the THXP. While this is expected to lead to higher incidence of flooding, the erosion of the Nam Hai river is expected to be less. Continuous monitoring over long periods is required, which is likely to happen given that the THXP's environmental management plan runs through to 2017. The resettlement action plan also includes relocation of project-affected people to higher ground to avoid exposure to flooding (while their agricultural farmlands remain at the same place). The higher incidence of flooding is also likely to impact fish populations (and consequent livelihood and nutrition aspects), but more will be known only after the THXP is operational. The ADB due diligence mission of April 2010 noted that implementation of environmental and social safeguards of THXP were satisfactory, progressing well, and that at the current rate of spending, the indicative budget of \$3.4 million on impact mitigation is likely to be spent by end of 2011. (Further information is given in Appendix 8.)

68. Despite delays, the completed PTDP is effective, as actual project outcomes (in terms of providing rural electricity access and EdL's capacity building) exceeded expected levels.<sup>72</sup> As per information available for the NARPD that was completed in March 2010, it is also likely to be effective, as (i) it dovetailed investments in the 115 kV transmission lines and substations with the investments made through the PTDP and other EdL projects; and (ii) more villages that were remote, distant, and sparsely populated were actually provided access than originally planned, because villages along the main road that tend to be larger got electrified through locally financed projects.<sup>73</sup> The project preparatory TA approved during the SAPE period has already resulted in approval of a transmission project in January 2010.<sup>74</sup> Following approval of other project preparatory TA projects, necessary work on policy dialog, advisory TA, capacity building, and loans and grants is also in progress. For instance, the study of the cumulative impacts of the Nam Ngum 3 Hydropower Project<sup>75</sup> appears to have contributed to successful tariff negotiations for the Nam Ngum 3 Hydropower Project with EGAT (wherein the leveled tariff over the concession period is set at an attractive.

## E. Sustainability

69. Sustainability of ADB's energy lending and nonlending portfolio is rated *likely*. The Nam Theun 2 project is likely to be technically and financially sustainable. The head construction contractor is experienced in establishing large hydropower projects, and the dam safety review panel has ascertained the safety aspects. Commercial operations of the four 250 MW units began on 5 April 2010, and it is likely that, given normal rainfall conditions, the targeted annual energy generation of 5,354 GWh (for export) and 200 GWh (for in-country sales) will be achieved in the coming years. The Nam Theun 2 project's financial analysis at appraisal shows impressive returns on equity to the LHSE (38%) and the government (21.1%), and the real financial internal rate of return (FIRR) for the project at 12.4% was comfortably above the weighted cost of capital (WACC) of 10.1%. The long-term financial sustainability of the Nam

<sup>72</sup> At appraisal, about 22,700 consumers were expected to be connected in three provinces, but more than 25,600 consumers were actually connected. Transmission line lengths and the number of substations also exceeded the levels envisaged at appraisal. Among the factors that contributed to this high outcome is the fact that a 115 kV line connected the Nam Leuk power plant to Xiengkhuang along a new rural access road that enabled five more villages to have electricity access.

<sup>73</sup> More specifically, the Northern Area Rural Power Distribution Project provided electricity access to more villages than originally envisaged (443 versus 342) and fewer households (approximately 27,300 versus 33,800). In so doing, it laid more 34.5 kV and 22 kV medium-voltage lines (968 kilometers [km] versus 796 km) and needed less low-voltage line (479 km versus 608 km).

<sup>74</sup> Footnote 39.

<sup>75</sup> ADB. 2007. *Preparing the Cumulative Impact Assessment for the Nam Ngum 3 Hydropower Project* Manila (financed by the Japan Special Fund, February).

Theun 2 project is evident from the NTPC's cash flow stream that provides a natural hedge to its debt repayment obligations, and long-term PPAs with EGAT and EdL that include take-or-pay clauses at agreed tariffs—the tenor of the PPA is beyond the final repayment date of the Nam Theun 2 project's debt. The Nam Theun 2 project has come on stream at a time when power requirements within the Lao PDR are anticipated to rise rapidly with increased investment in mining (gypsum, copper, and gold) and industry (cement production and quarrying).

70. It is likely that the Nam Theun 2 project will also be environmentally and socially sustainable. Both the government and the NTPC recognize the contributions made by the environmental and social panel of experts to the success of the project. The panel's recommendations to the government and the NTPC have in general been accepted, yet there are instances where certain specific recommendations have not been followed.<sup>76</sup> Both anticipated and unforeseen environmental and social impacts are likely to be tended to in the coming years (Appendixes 5 and 6). In particular, the concession agreement provides for (i) mitigation of a large number of foreseeable environmental and social implications identified up front, as budgeted in the concession agreement, along with a system to provide for meeting mitigation cost overruns; and (ii) making available additional budgetary resources to mitigate unforeseen project impacts. However, although letters of credit have not been cashed for either provision thus far, it is important to recognize that the NTPC's liabilities are capped. Nonetheless, during the project construction phase ADB launched an advisory TA project that has supported land use planning to secure resettler land tenure and to address related social and livelihood concerns (Appendix 6).

71. The Nam Theun 2 project is expected to demonstrate that the operations of an organization such as the Nam Theun 2 Watershed Management and Protection Authority (WMPA) can be sustained through project revenues, although the NTPC did contribute up front to set it up.<sup>77</sup> The concession agreement requires the NTPC to provide the WMPA with \$1 million per year (with escalation adjustments) up to the end of the concession period. Whether or not this fund will be adequate is as yet difficult to ascertain. However, its staffing levels at the end of 2009 were not adequate; additional staff will be required to enable the WMPA to perform some of its functions satisfactorily (for instance, the WMPA had only six staff to monitor and research the 3,532 km<sup>2</sup> Nakai Nam Theun National Protected Area, which equals one staff member per 589 km<sup>2</sup>).

72. The financial sustainability of other ADB-supported hydropower projects has been reiterated at various stages since the projects were approved in the 1990s.<sup>78</sup> However, at the time of project performance evaluations of the Theun-Hinboun and Nam Leuk hydropower projects (in 2002 and 2004, respectively), certain environmental and social issues remained to

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<sup>76</sup> As per the concession agreement, environmental and social mitigations are to be achieved by certain milestone dates such as impoundment and completion of resettlement. As a result, the panel of experts does not provide in its successive reports whether its recommendations from previous reports have been implemented. It is therefore difficult to systematically track the status of implementation of the panel's multiple recommendations.

<sup>77</sup> The WMPA is mandated to (i) protect and rehabilitate forest cover in the Nam Theun 2 watershed area, (ii) ensure that the water flows with low sedimentation as it moves towards or away from the reservoir, (iii) preserve and/or promote biological diversity, and (iv) improve livelihoods of multiethnic peoples living in the protected area.

<sup>78</sup> The financial internal rates of return (FIRRs) for the 210 MW Theun-Hinboun project are estimated at 18.7% at approval, 19.5% at completion, 17.0% at project performance evaluation, and 21.7% most recently in 2008 while conducting the energy SAPE for the GMS. In comparison, the WACC is 4.8%. Similarly, for the 60 MW Nam Leuk project, the FIRRs are 9.8% at approval, 3.1% at completion, 7.6% at project performance evaluation, and 4.3% in 2008. The FIRR at the GMS energy SAPE stage falls below the WACC (4.4%), and it is assumed that once the Nam Theun 2, Nam Ngum 2, and Nam Lik 1/2 hydropower projects are operational the Nam Leuk project will no longer export power to Thailand.

be addressed for both. In the case of the Theun-Hinboun project, where the project company is addressing the outstanding issues along with its environmental and social management activities for the 280 MW THXP, and ADB waived the negative pledge clause in the loan for the Theun Hinboun project (to enable the project company to raise additional finances, refinance its long-term debt, and implement the THXP), ADB will monitor the environmental and social mitigation activities for compliance with the environment monitoring plan during the construction period. (Further details are given in Appendix 8.)

73. A positive feature of the Nam Leuk project was that, deviating from past practice, funds for environmental and social mitigation were identified up front as separate line items of the loan. As a result, systematic baseline studies were carried out and environmental impacts were monitored and mitigated during project construction. However, as little attention was given to environmental and social mitigation measures during the operations phase, several issues regarding the Nam Leuk project's sustainability began to emerge, most notably due to its location in a national biodiversity conservation area, the Phou Khao Khouay (PKK) Park. Although building a dam in a nature reserve is difficult to manage in terms of environmental and social impacts, it was expected that, with proper management practices, the project would also help implement the PKK Park management plans for tourism, integrated conservation, and development programs. However, in reality, even though water quality in the rivers has improved after initial years of operations, the fish population has not, and the coordination between EdL and PKK Park management remains weak and little has been done towards integrated conservation and development of the nature reserve. In recent years, ADB has addressed the identified and agreed mitigation requirements arising from the Nam Leuk project by reallocating some funds from the NARPDP to provide compensation to some village communities. (Further information is given in Appendix 9.)

74. The financial viability of the PTDP and NARPDP is expected to be low, as both have sizeable rural electrification components. The estimated FIRR at completion is not available for the NARPDP, but it is noteworthy that ADB approved the loan even though the estimated FIRR (2.7%) at appraisal was lower than the WACC (4.8%).<sup>79</sup> For the PTDP, the estimated FIRR of 10.7% at appraisal reduced to 5.4% at completion, although it remained higher than the WACC of 4%. The financial sustainability aspect from the utility's viewpoint, therefore, should be viewed from a wider perspective that incorporates anticipated tariff changes, reduced cross-subsidies, expenditure versus savings of transmission and distribution loss reduction measures, cash flows from new service connections, and receipts from energy sales. The financial sustainability from the electricity users' perspective may be assessed in the context of the users' avoided expenditure on energy sources prior to getting an electricity service connection. Transmission and distribution projects supported by the two loans were expected to have minor environmental implications, and no significant negative impacts and risks that could not be mitigated.<sup>80</sup>

<sup>79</sup> Nonetheless, ADB still approved the loan as it showed a good EIRR, and the estimated impact on EdL's overall financial situation was projected to be minimal as it was projected to have only 8% of domestic sales in 2010. Besides, as per projected real tariffs at appraisal, the NARPDP's cost recovery ratio was estimated at about 95% (which indicated that 95% of total project capital and operating costs would be recovered directly from sales revenue)—this was considered satisfactory for a rural electrification program.

<sup>80</sup> ADB. 2005. *Completion Report: Power Transmission and Distribution Project in Lao People's Democratic Republic*. Manila (Loan 1558). For the Northern Area Rural Power Distribution Project, refer to EdL. 2009. *Northern Area Rural Power Distribution Project, Quarterly Progress Report*. Vientiane.

## F. Development Impacts

75. The overall development impacts of ADB's energy sector assistance are likely to be *satisfactory*. With ADB support, the Nam Theun 2 project is designed to make a multifaceted contribution to development impacts that impinge on institutional, financial, environmental, and social aspects. Through providing a basis for set up of the LHSE, the Nam Theun 2 project has contributed to the objective of creating an organization in the energy sector that is not hampered by financial problems (as EdL is). Since it was set up, the LHSE has been earmarked to acquire equity stake (on behalf of the government) in eight more projects (Appendix 8), which calls for enhanced LHSE capacity for accounting, financial analysis, contract administration, and liaison and coordination with lenders, etc. Nonetheless, given the limited financial resources available to the LHSE and the government priority to set up more export-oriented hydropower projects to boost foreign exchange earnings, the government needs to reassess LHSE participation in public-private partnership hydropower projects.

76. The program to institutionalize the channeling of government accruals from Nam Theun 2 project revenues to the poverty reduction programs (Appendix 5) remains to be tested. The activity is supported by the government, ADB, and the World Bank. The revenue channeling mechanism, if effective, is likely to contribute towards ensuring that export revenues are not spent simply to meet the power sector's subsidy bill or compensate for its operational inefficiencies. Should the government also plan to extend the revenue channeling mechanism to other power generation projects in which the LHSE is the designated shareholder, it should be willing to refine the mechanism to make them more effective.

77. On environmental and social aspects, a major contribution of the Nam Theun 2 project (and hence of ADB) is the recognition of the need to mainstream management of social and environmental issues: (i) environmental and social issues of large hydropower projects can be substantial; (ii) environmental and social implications can be managed better if they are identified up front, and the findings of stakeholder consultation should be taken into account in the project design stage itself; and (iii) in its pursuit of setting up more export-oriented large hydropower projects, the government should ensure that it does not get saddled with long-term and potentially devastating environmental and social consequences while neighboring countries derive most benefit from imported hydropower. The project is also likely to contribute to the medium-term recognition of the need to engage with experienced developers with a genuine interest in managing environmental and social challenges. On many aspects, the experience gained from the Nam Theun 2 project can be useful for other sectors (notably mining and other infrastructure). The government's ability to move towards mainstreaming the management of environmental and social issues has been facilitated at least in part by ADB through its ESP loans and other interventions that supported the issuance of environmental impact assessment (EIA) guidelines and preparation of third-party monitoring arrangements. However, it appears that thus far the WREA has made limited progress in storing and disseminating the learning from the Nam Theun 2 project to its own staff or to prospective hydropower, mining, and other infrastructure project developers. Third-party monitoring arrangements have thus far been implemented for the Nam Theun 2 project, with the cost being borne by the NTPC; for other projects, much depends on the extent to which the EPF is able to raise necessary resources (para. 36).

78. Nonetheless, the repertoire of skills required from the NTPC, the WMPA, and the government also clearly shows the inadequacy of the skill set and experience available within the Lao PDR, as does the need for a stream of interventions to upgrade environmental and social management capacity. While efforts to successfully comply with the environmental and social safeguards are anticipated to continue, and the panel of experts is likely to remain until the end of

the concession period, it is by no means certain that the positive experience from the Nam Theun 2 project regarding safeguards compliance will or can be replicated easily across all hydropower projects.<sup>81</sup> For instance, it is known that construction of at least one hydropower plant (the 615 MW Nam Ngum 2 plant) began even before the WREA had certified the project environmental and social assessments and studies. Similarly, construction of the 120 MW Nam Ngum 5 hydropower plant also began a few months before the environmental and social assessments and studies were certified in June 2008; its EIA is considered weak as it cites certain impacts as insignificant without any supporting discussion.<sup>82</sup>

79. The PTDP helped to enhance EdL's skills sets for high-voltage grid extensions (Appendix 7). By extending the grid to increasingly remote areas, the NARPDP also enhanced EdL's institutional capacity to plan and implement such projects while continuing to reduce transmission and distribution losses.

80. While the two Nam Theun 2 project loans approved during the SAPE period have some subregional power system implications (as do other loans in the pipeline, and some loans supported in the 1990s), ADB and other development partner support for a GMS-wide power system is still considered to be in its initial stages. Much further work is required beyond the few transmission interconnections that have been supported as part of a loan for a hydropower project or a grid extension system, or the periodic update of the GMS master plans. Although the GMS Forum and the Regional Power Trade Coordination Committee have provided a start, their premier objective should be to steer a convergence of the diverse perspectives of the GMS member countries. This is expected to be a long drawn process. The GMS Forum's focus on specific investment projects and the Regional Power Trade Coordination Committee's emphasis on harmonizing technical standards and grid codes should be complemented by efforts to find ways to bring closer the priorities and perspectives of, e.g., a resource-poor country with a strong transmission system, such as Thailand, with a resource-rich country with a weak transmission system, such as the Lao PDR. Until significant headway is made towards such convergence, it will be difficult to have common carrier transmission lines for multiple hydropower projects.

## **G. Overall Assessment of ADB Energy Sector Assistance**

81. Table 5 shows that ADB's energy sector assistance program to the Lao PDR is *successful*. To a great extent, Table 5 reflects the ratings for the Nam Theun 2 project, in particular because 70% of loans and more than 50% of TA approvals during the SAPE period were linked directly to the Nam Theun 2 hydropower project. Moreover, the Nam Theun 2 project (i) introduced new approaches in the Lao PDR which have brought the management of adverse environmental and social impacts to the forefront, (ii) helped to substantially increase the government's awareness on environmental and social impacts and mitigation approaches, and (iii) provided learning experience to the developer and financier communities and in the process changed their perception of the Lao PDR hydropower sector. The ratings are based on the current information available and may change when the efficacy of environmental and social mitigation measures and revenue channeling arrangements are known some months after the commercial operations date. Other ADB interventions approved before and during the SAPE period influence the ratings marginally. Nonetheless, the ratings do reflect several factors, most saliently that the interventions have been consistent with government policies, programs, and priorities, and the assistance

<sup>81</sup> Due largely to the fact that there is little mainstreaming of the processes adopted in the project development and construction phase towards management of adverse environmental and social implications.

<sup>82</sup> For example, the environmental and social assessments and studies for the Nam Ngum 5 hydropower project cited impacts on fisheries, aquatic habitats, wildlife and wildlife habitats, and water quality as being insignificant but provided no rationale for this assessment.

program has enabled positive outcomes nationally (e.g., boosting foreign exchange earnings and recognizing the need to mainstream environmental and social mitigations) and locally (e.g., increasing electricity access and improving quality of life).

**Table 5: Rating of ADB's Energy Sector Assistance**

Evaluation Criteria	Rating Scale	Weight	Rating Level	Rating	Score
Strategic Positioning	0–3	0.10	Satisfactory	2	0.2
Relevance	0–3	0.10	Highly Relevant	3	0.3
Efficiency	0–3	0.20	Efficient	2	0.4
Effectiveness	0–3	0.20	Effective	2	0.4
Sustainability	0–3	0.20	Likely	2	0.4
Development Impacts	0–3	0.20	Satisfactory	2	0.4
<b>All Criteria</b>	<b>0–3</b>	<b>1.00</b>			<b>2.1</b>

Note: The overall rating covering all criteria is *highly satisfactory* if the weighted rating score is 2.7–3.0, *satisfactory* if the weighted rating score is 1.6–2.6, *partly satisfactory* if the weighted rating score is 0.8–1.5, and *unsatisfactory* if the weighted rating score is 0–0.7.

Source: Independent Evaluation Mission.

## H. ADB Performance

### 1. ADB's Role in Aid Coordination and Harmonization

82. As one of the prominent development partners in the Lao PDR electricity sector, ADB has gathered extensive knowledge and understanding of the sector over the years. ADB's lending and nonlending program has been synchronized particularly well with that of the World Bank, as evident from ADB's focus on extending the grid and expanding rural electrification in the northern provinces, while the World Bank focuses on the south.<sup>83</sup> On many other matters, ADB has preferred to let the World Bank lead; for instance, in its support to the Nam Theun 2 project and setting up a multilayered monitoring and evaluation program. The World Bank has also provided the lead in policy dialogue that includes tariff rationalization, accounts receivable management, demand-side management, and energy efficiency programs. On the other hand, ADB has financed three hydropower projects compared to one by the World Bank.

83. With other development partners, ADB has coordinated TA related to water resource management and capacity building for management of environmental and social implications of hydropower projects. Along with other development partners, ADB's support to the WREA has enabled the WREA to gradually build its capacity for environmental and social management, although it still falls short of requirement.<sup>84</sup> However, given that the WREA is not able to attract sufficient professionals with good educational background in relevant social and environmental disciplines, it would be useful for ADB to coordinate with other development partners to advise the government on a suitable human skill enhancement policy and action plan.

### 2. ADB's Role in Building Client Ownership

84. ADB's assistance program has remained in line with the government's priorities and plans before and during the SAPE period. In addition to increasing sophistication of terms and scope of certain assistance, issues on which sufficient progress has been achieved have been

<sup>83</sup> The East–West Economic Corridor Power Transmission Project, which is to be funded by ADB (Table 2) is in the south; the World Bank is aware of this planned project.

<sup>84</sup> ADB may further support the development of capacity to strengthen safeguard systems in the Lao PDR. Such support may come from a trust fund that ADB is in the process of establishing.



dropped from ADB's assistance portfolio,<sup>85</sup> and other issues that have become relevant or are becoming relevant—such as participatory land use planning for the Nam Theun 2 project, and off-grid power development—are being included in the assistance program. From the indicative pipeline of assistance, it appears that ADB's assistance program will continue to have government support during the coming years. Financial assistance has normally been preceded by project preparatory and advisory TA projects. In particular, lessons learned from previous operations have been incorporated into assistance packages approved at a later date, and assurances and covenants appear to be consistent across various projects approved before and during the SAPE period.

85. ADB has also been sending consistent signals to EdL to improve its financial health by (among other measures) rationalizing tariffs and reducing transmission and distribution losses in order to reach certain minimum thresholds for selected financial indicators. By seeking the same assurances each time a new loan or grant is to be sanctioned, ADB has sent clear, unambiguous, and unmistakable signals to EdL and the government. With complementary effort from the World Bank, EdL has revised tariffs periodically, reduced transmission and distribution losses to about 12% by 2009, and generated a financial surplus since 2006.

86. It is noted that quite early in the development of the Lao PDR power sector,<sup>86</sup> a spectacular world-class hydropower plant—the Nam Theun 2 hydropower plant—has come on stream. Through environmental and social safeguards sought by the World Bank and ADB, the overall benefit to the government and its agencies and civil society at large—in terms of recognition of the need to manage adverse and unintended impacts of hydropower projects—can not be underestimated. Awareness levels have certainly risen. That the ability to tackle and resolve the often sensitive environmental and social concerns remains weak is well appreciated by the government, which recognizes that such challenges can be effectively addressed only in the medium term.

### **3. ADB's Responsiveness to Client Needs**

87. Government objectives and energy sector issues as such have remained essentially unchanged for more than a decade. To effectively respond to EdL's requirements, ADB also maintains up-to-date information on EdL's financial and operational performance indicators. However, although the rise in expertise requirements within the WREA and DOE in a variety of environmental and social disciplines for identifying and mitigating environmental and social implications of hydropower projects was anticipated several years ago, ADB has yet to begin providing support for any suitable needs assessments or even identifying roles for WREA and DOE at the central, provincial and local levels. The independent evaluation mission is given to understand that the World Bank has taken the first steps in this direction.

88. With increased activity in the Lao PDR energy sector over the past few years, ADB anticipates increased assistance requirements, as evident from the project pipeline (for 2010–2012) stated in the 2009 midterm review. Even if some of the pipeline projects do not get implemented,<sup>87</sup> ADB's portfolio will still have expanded considerably. To facilitate more intensive interface with the government, EdL, other enterprises, and other development partners, ADB also increased its staff in the Lao PDR Resident Mission towards the end of the SAPE period, and a power sector expert from the Viet Nam Resident Mission works closely with the Lao

<sup>85</sup> Such as improvement in EdL's power system planning and corporate development planning.

<sup>86</sup> In the sense that the total installed capacity is about 1,800 MW, and that the four operational areas of the power grid are not yet integrated, although the hydropower sector began to be developed in the early 1970s.

<sup>87</sup> For instance, EGAT is not in a position to firm up a PPA for the Nam Ngiep 1 hydropower project.

Resident Mission. In June 2010, an experienced power system expert also joined the Lao Resident Mission.

89. ADB is aware that the government recognizes the need to better manage the energy sector's foreign exchange earning capabilities. ADB prefers to wait until the government is ready to take specific steps in this direction.

90. Although ADB supports the Lao PDR objective of exporting power and becoming the regional power battery, ADB support thus far has been limited to export-oriented hydropower projects and the associated transmission lines, and other specific high-voltage lines and substations that enable power interchange between the Lao PDR and Thailand. In support of this objective, it is necessary that ADB also pursues policy dialog with other GMS member countries to facilitate the convergence of their diverse perspectives.

#### **4. Value Addition from ADB's Interventions**

91. The best indication of a good and constructive policy dialog comes from the policy-related achievements associated with the Nam Theun 2 hydropower project, in particular, the institution of a system of channeling tax, royalty, and LHSE profits into eligible poverty reduction programs.

92. The implementation arrangements instituted by the time assistance for the Nam Theun 2 project was approved were exemplary, and reflected the risk mitigation and safeguards compliance concerns of the major financiers, including ADB. The concession agreement outlined the sharing of responsibilities between the government and the NTPC in implementing all activities along the following lines: (i) the NTPC was to be fully responsible for implementing the infrastructure works for the Nam Theun 2 project; and (ii) with the government, the NTPC was to be jointly responsible for implementing environmental and social mitigations. The project monitoring arrangements include a multilayered complementary system comprising a dam safety review panel, a panel of experts, the International Advisory Group, an independent monitoring agency for environment and resettlement, lenders' advisors, government engineers, and owner's engineers, in addition to supervision by staff from the multilateral and bilateral development partners as well as commercial banks. Such implementation arrangements reflected the experience gathered from supporting other hydropower projects in the Lao PDR; more specifically, (i) the basic knowledge that environmental and social issues and concerns do not vanish when construction gets completed; and (ii) monitoring of environmental and social implications should continue well beyond the commercial operations date of a hydropower project, and a panel of experts should be in place during the construction and operation phases. On the basis of this assessment, ADB's performance is rated *satisfactory*.

## **VI. KEY FINDINGS, LESSONS LEARNED, AND RECOMMENDATIONS**

### **A. Key Findings**

#### **1. Consistency between ADB's Energy Sector Assistance Program and the Country's Needs**

93. **ADB's energy sector assistance program has been consistent with the country's development needs.** The ADB energy sector assistance program has been consistent with government policies and programs, has adopted a long-term view of sector needs (even though the assistance program is normally defined for a 3–5 year period), and has addressed issues

pertaining to hydropower development, power exports, and increasing electricity access. The quantum of assistance has remained in line with the relatively low absorptive capacity (e.g., EdL's financial performance does not allow it to accelerate its transmission and distribution expansion program).

94. **Experience with renewable energy technologies thus far is mixed.** Several renewable energy technologies have been tried in the Lao PDR, with varying experiences in terms of unit size, unit sourcing, scale of deployment, safety aspects, and ease of maintenance. Imported pico hydropower systems (of up to 1 kilowatt) have flourished, even though they are not entirely safe to operate and are difficult to maintain. Problems faced by developers of small and mini hydropower projects, such as the cumbersome task of finalizing various project agreements, and lack of requisite expertise in provincial and local governments that are authorized to approve such projects, are being addressed with ADB support.

95. **ADB's energy sector assistance program addresses some emerging issues.** ADB has begun assistance to address some of the priorities that have emerged in the recent years (such as increasing electricity access through renewable energy technologies). However, ADB is yet to provide technical assistance or other inputs on some emerging issues, such as environmentally and socially sound lignite mining.

96. **Creative models are needed to mitigate risks to sustainability and effectiveness.** Some of the outstanding environmental and social issues arising from the Nam Leuk hydropower project have been addressed by allocating funds from another energy sector loan, which had the same executing agency. For the Theun-Hinboun project, ADB facilitated the project company to raise funds for its expansion project by waiving the negative pledge in the loan agreement for the Theun-Hinboun project and will field due diligence missions during the construction phase of the expansion project to monitor the compliance with planned environmental and social mitigations for both (the Theun-Hinboun project and the expansion project).

## 2. Harmonization of Assistance Program with Other Development Partners

97. **Harmonization with other development partners is good.** Although there is no energy forum where development partners meet periodically to discuss their energy intervention strategies and approaches, a good measure of coordination is nonetheless achieved. In certain instances, particularly regarding EdL's financial and operational performance improvement (e.g., tariff revisions and receivables management), the World Bank has taken the lead. Regarding environmental and social impact management aspects, WREA capabilities have been built over a period of time through support provided by various bilateral development partners as well as ADB and the World Bank. This trend is expected to continue.

## 3. Incorporating Lessons Learned from Assistance in the Past

98. **ADB interventions have incorporated some lessons from the past.** Experience from the Theun-Hinboun and Nam Leuk hydropower projects has clearly shown that project impacts can go on for several years after hydropower plants start operating, and may even lead to irreversible changes. With the benefit of hindsight from these projects, as well as on the basis of experience of ADB and the World Bank in the Lao PDR and other countries, this learning was incorporated into the design of the Nam Theun 2 project. In particular, (i) compliance with ADB and World Bank environmental and social safeguards was built in to the project design; and (ii) a strong and multilayered monitoring and evaluation system was instituted, and is expected to

go on for several years beyond the end of the construction period. It is noteworthy that in spite of some shortcomings, the resettlement program did attract many people from outside the project impact areas to move into the resettled villages, which suggests that at least some aspects of the resettlement program have been good. With project implementation delays of no more than a few months at any stage, the controversies surrounding the Nam Theun 2 project in the early stages gave way to recognition that the project had provided a great learning opportunity to the government, the financiers, the joint venture partners, and the business community.

#### **4. Capacity Building Requirements**

99. **The government is strongly committed to managing environmental and social impacts of large hydropower projects, but it may only be achieved in the medium term.** Necessary environmental and social safeguards are not being followed by some of the hydropower projects under construction. The government is clearly pleased with the successful commissioning of the Nam Theun 2 project, where the developers have sincerely attempted to address various environmental and social aspects, with largely positive results. Although the government does not want to adopt again the process of multilayered monitoring and evaluation, it recognizes the need to strengthen its capabilities in managing environmental and social aspects, ensure that certain procedures are followed for all hydropower projects (e.g., not allowing construction to begin before the necessary certifications have been obtained), and ensure that certain minimum environmental and social safeguards are complied with at every stage in the project cycle. Although some requisite skills and expertise do indeed exist in the WREA, DOE, and EdL, they are insufficient to meet the requirements. These inadequacies are more severe at the provincial and district levels. The major impediments relate to the facts that (i) the Lao PDR university education system has only recently included an undergraduate degree program in environmental sciences, (ii) there is no similar degree program in social sciences in all of the Lao PDR, and (iii) students returning to the Lao PDR after studying abroad generally prefer to work outside the government.

100. **The government recognizes the need to enhance the skills base to better manage hydropower development.** With the experience that indiscriminate signing of memoranda of understanding does not necessarily lead to better prospects for project development, the government recognizes that it should be in a position to screen the prospective developers and engage with those that have requisite hydropower experience and share the government's commitment towards managing environmental and social implications. With the objective of trying to maximize economic (and financial) benefits to the Lao PDR, the government has also recognized that it should work towards tendering out a project and making the prospective developers compete against each other, as well as improve its skills at negotiating project agreements.

101. **ADB support to Electricité du Laos to build up technical capacity for Transmission System Expansion and Strengthening needs to continue.** One of the outcomes of continued ADB support to EdL has been the improvement in EdL's technical capabilities to plan, construct, and operate the 115 kV transmission system. The most important indicators are a reduction in the time required by EdL to manage the bidding process and evaluate bids for the 115 kV system, as well as the move in the GMS Northern Power Transmission Project, approved in January 2010, towards an engineering–procurement–construction type of contracting regime which calls for more sophisticated bid management skills. EdL recognizes the need to enhance skills to project manage transmission system expansion at the 220 kV and 500 kV levels.

## 5. Meeting Electricity Access Targets

102. **Expansion of electricity access calls for a multifaceted approach.** The government's ambitious target to provide electricity access to 90% of the population by 2020 will be achieved through a judicious mix of: (i) expanded and intensified coverage of the transmission and distribution and rural electrification network, and (ii) deployment of selected renewable energy technologies in the more remote and sparsely populated areas. In addition, EdL's objective should also be to off-take all its entitled electricity requirements from export-oriented power projects, and to facilitate increased power off-take by integrating the four isolated grids.

103. **Not all rural households find the electricity tariffs and connection charges affordable.** A survey of selected villages that were electrified in 2008 and 2009 provides anecdotal evidence that (i) the poorest households in an electrified village do not always have access to electricity, (ii) some households do not obtain a service connection but have illegal access to electricity. The stated reasons essentially are the high electricity tariffs (including high life-line rates) and service connection charges, as well as limited opportunities to use electricity to generate an income. To facilitate meeting the government's electricity access targets, such issues need to be considered if tariffs are to be further increased for small and poor households.

## 6. Power Systems Integration within the Greater Mekong Subregion

104. **Greater Mekong Subregion-wide integration is a major facilitator of growth and development but may only be achieved in the medium-term.** The government's perspective is to develop hydropower potential to export power and earn foreign exchange. This strategy has been in place since the 1990s, and ADB has provided financial and technical assistance towards setting up some export-oriented hydropower projects and associated transmission facilities. However, the full potential for GMS-wide power system integration will be realized only when the perspectives of the GMS member countries begin to converge, and technical standards are harmonized across countries, which may only be achieved in the medium term.

### B. Lessons Learned

105. **One-off and stand-alone interventions are ineffective for capacity building related to environmental and social mitigation.** A continued stream of interventions is necessary to improve the environmental and social impact identification and management capabilities of the WREA at the central, provincial, and local levels. The underlying purpose of such interventions should be to enable the WREA to certify only well-prepared environmental and social studies, ensure that the findings from stakeholder consultations are properly taken into account in the proposed environmental and social impact mitigation plan, ensure that the developer allocates sufficient budget to manage environmental and social risks, and provide inputs into negotiating the concession agreement, etc. It is useful to begin with a diagnosis of the specific needs of the WREA and DOE in various environmental and social disciplines at the central, provincial, and local levels. Where necessary, it is also useful to engage with WREA personnel on a medium-term basis and provide on-the-job training (paras. 35 and 99).

106. **Some allowance must be made for unforeseen environmental and social impacts.** Even with the deployment of the most experienced experts for preparation of EIAs, social impact assessments, and other necessary documentation up front, there is a chance that some environmental and social impacts will not be foreseen. Therefore, it is useful if the project agreement(s) provide for a certain minimum budgetary allocation for the management of such

unforeseen impacts during the entire project cycle. This was done for the Nam Theun 2 project (para. 58, Table 4).

**107. Monitoring and evaluation of environmental and social aspects needs to be appropriately designed.** Specifically during the operating period, the environmental and social aspects span a large number of issues and parameters spread across several stakeholders and interest groups over a large geographical area. To enable sustained performance in terms of compliance with environmental and social safeguards, it is useful to divide the responsibilities between the government and the developer or sponsor in line with their capabilities and natural advantage, as attempted for the Nam Theun 2 project (para. 92).

**108. ADB oversight is useful to ensure that hydropower projects comply with applicable environmental and social safeguards.** The Theun-Hinboun and Nam Leuk hydropower projects experience shows that ADB must continue—even after loan closure—to ensure that the requisite environmental and social safeguards are being complied with. In the particular case of the Nam Theun 2 project, this is possible due to the various provisions of the concession agreement, and the fact that the panel of experts is required to continue to function until beyond the commercial operations date (paras. 72, 73, and 92).

**109. A multifaceted approach must be adopted to ensure that power tariffs remain affordable in the coming years.** The government's rural electrification and 90% electricity access programs will be successful only if consumers perceive that the electricity service is affordable. Towards this objective, the EdL needs to pursue measures that will ultimately help to reduce the cost of supply (to avoid the need to raise tariffs) by further reducing technical and nontechnical transmission and distribution losses, managing accounts receivable, implementing demand-side management measures, and extending credit for payment of service connection costs (paras. 102 and 103).

### **C. Recommendations**

**110. Focus ADB's capacity development interventions on the need to increase electricity access, improve the operational and financial efficiency of the power utility, and better manage the development of large hydropower projects in coordination with other development partners.** As a matter of priority, the capacity development support needs to focus on the following: (i) assessment of solar and wind energy resource potential in selected areas; (ii) structuring of new business models for enhancing private investment in renewable energy sources; (iii) analysis of viable technical options for further reduction of technical transmission and distribution losses; (iv) improvement of the financial and operational performance of EdL through tariff revisions, strengthened project management capabilities to reduce time and cost overruns, etc.; (v) management of a transparent tendering process for large hydropower projects, better screening of project developers, and improvement of project negotiations capabilities; and (vi) augmenting and enhancing capabilities for managing environmental and social impacts of large hydropower projects (paras. 21, 23, 25, 27, 28, 74, 77, and 78).

**111. Work with development partners towards designing a knowledge management framework and delivering knowledge management solutions given the need for capacity development on several aspects.** The first step would be to assist in devising a knowledge management framework that provides clarity on the type of knowledge, information, and data that is to be stored, and the taxonomy and hierarchy for storage and retrieval rights and other protocols. The knowledge management framework should be designed keeping in view the

prospective users (through a knowledge dissemination framework) as well as the expected uses of this knowledge, information, and data (paras. 34 and 35).

112. **Continue to offer financial assistance, particularly for (i) hydropower projects with a view to better compliance with environmental and social safeguards, and (ii) electricity access projects.** ADB should continue to support hydropower projects until the capabilities of the WREA and DOE have been developed sufficiently to mainstream environmental and social safeguards in the hydropower sector in the Lao PDR. It is recognized however, that given the underlying causes for WREA's limited absorptive capacity (Appendix 4), such support would be required over an extended period of time. Given the significant interest from the developer and investor community for hydropower development, ADB should consider a judicious mix of financing instruments and structures (that include sovereign loan, nonsovereign loan, political risk guarantee, other guarantees, and possibly other financial mechanisms). Nonetheless, until such time that the adverse cumulative impacts of the hydropower dams on the Mekong mainstream are better understood, ADB should not encourage support for such projects (paras. 19 and 20).

113. For electricity access projects, ADB's approach to providing financial support for transmission system extension and grid connected small hydropower plants (with necessary covenants and assurances) should continue. Where relevant, the platform provided by the "Energy for All Partnership" can also contribute (paras. 25, 26, and 74).

114. **Conduct policy dialog to accelerate moves towards formulating a comprehensive energy policy and accelerating power systems integration across the Greater Mekong Subregion.** Along with efforts to address emerging energy sector issues (such as environmentally and socially sound lignite mining practices), a policy dialog regarding the formulation of a comprehensive energy policy should take place. To the extent the perspectives of the GMS countries begin to converge and propel the planning and development of an integrated system along with hydropower projects, ADB should also intensify the policy dialogue and enhance capacity development support (paras. 16 and 80).

## ENERGY SECTOR OVERVIEW

### A. Background and Institutional Context

1. Since 1990, gross domestic product (GDP) growth in the Lao People's Democratic Republic (Lao PDR) has been impressive, averaging more than 6% per annum during 1990–2008. During 2003–2009, GDP growth averaged more than 7% per annum, when industrial growth (led by mining and hydropower development) was more than 11% per year, and growth in services (led by tourism activities) was about 9% per year. Agriculture also grew during this period, albeit at less than 4% per year. Per-capita GDP more than doubled from about \$430 in 2004 to \$910 in 2009, and poverty incidence fell from 33.5% in 2003 to about 27.0% in 2008.<sup>1</sup>

2. The Lao PDR's total population, estimated at about 6.1 million in 2009,<sup>2</sup> comprises 73% that lives in rural areas,<sup>3</sup> a vast majority that relies on agriculture for its livelihood, and about 30% that belongs to minority groups concentrated in the upland areas. Although the population has been growing at over 2% per year since the early 1990s, population density still remains very low, at about 25 persons per square kilometer (in 2007).

3. Several government ministries and departments are involved in the oversight and management of electricity and petroleum subsectors.<sup>4</sup> The Ministry of Energy and Mines (MEM) under the Prime Minister's Office includes two departments and three state-owned enterprises that, along with the Water Resources and Environment Agency (WREA) and the Ministry of Planning and Investment, are responsible for electricity supply and power sector development. The two departments, that focus nearly exclusively on the electricity subsector,<sup>5</sup> are (i) the Department of Electricity (DOE) that develops national energy policy and plans (including tariff policy), monitors the energy sector's compliance with applicable policies and regulations, and develops strategic plans (for generation, transmission, distribution, rural electrification, renewable energy, and energy exports); and (ii) the Department of Energy Promotion and Development (DEPD), which interfaces with prospective hydropower developers and/or investors, and negotiates the necessary project agreements and other legal and binding documents for hydropower development. The Ministry of Planning and Investment, which is tasked to enter into binding commitments on behalf of the government, actually signs the projects agreements with the developers and/or investors. The WREA, which is the main coordinating agency for environmental planning and management across all sectors and formulates environmental policy, is responsible for certifying the environmental and social impact assessments for hydropower projects, as well as working on broader assessments such as cumulative impact assessments, integrated water resource management, and strategic environmental assessments.

4. The three state-owned enterprises that are functionally under the MEM are (i) Electricité du Laos (EdL), the public electricity utility with a focus on power generation, transmission, and

<sup>1</sup> ADB. 2010. *Key Indicators*. Manila.

<sup>2</sup> See Footnote 1.

<sup>3</sup> World Bank. 2009. *Rural Electrification Phase II Project of the Rural Electrification (APL) Program, Project Information Document (Revised)*. Washington, DC.

<sup>4</sup> Fuelwood and other traditional forms of energy are under the purview of the government's Ministry of Agriculture and Forestry. In ADB, forestry is classified under the agriculture and natural resources sector. For this reason, forest-related issues addressed in this sector assistance program evaluation (SAPE) focused on the energy sector. It should suffice to note, however, that the government has plans to reverse the decline in forest cover, which has declined from nearly 70% in the 1970s to about 42% in 2005.

<sup>5</sup> Most of the Department of Electricity's (DOE) work on renewable energy is electricity related; DOE's attention towards biofuels is an exception.



distribution; EdL also manages electricity imports to its grids and electricity exports from its generating plants; (ii) the Lao Holding State Enterprise (LHSE),<sup>6</sup> which is a special-purpose company to hold the government's share in export-oriented independent power projects, the first one being the Nam Theun 2 project; and (iii) the Electrical Construction and Installation Company, essentially a construction contractor for EdL's distribution and transmission facilities.

5. The Ministry of Commerce oversees the import of petroleum products by more than 15 oil companies.<sup>7</sup> The MEM's Department of Mines is responsible for upstream oil and gas exploration activity, although the know-how, techniques, and technologies for prospecting for and extracting oil and gas are very different from those for other mineral resources (such as coal, lignite, copper, and gold). The Department of Mines is also responsible for awarding and negotiating concessions for coal and lignite mine development.

6. This SAPE report incorporates the findings from many of the above-mentioned government ministries, departments and other enterprises, other stakeholders, internet searches and field surveys (Table A1.1).

**Table A1.1: Consultations for the Energy SAPE**

This report incorporates information based on discussions with executing agencies and other stakeholders that include:

- Agence Francaise de Developpement
- AusAID
- Electricite' du Lao
- Electricity Generating Authority of Thailand
- Environmental Protection Fund
- Finnish Aid (Embassy of Finland)
- German Technical Cooperation
- Hinboun District Government
- International Union for Conservation of Nature
- International Water Management Institute
- Institute of Research for Development
- Japan International Cooperation Agency
- Lao Holding State Enterprise
- Mekong River Commission
- Ministry of Planning and Investment
- Ministry of Energy and Mines
- Nam Theun 2 Power Company Limited
- Nam Theun 2 Watershed Management Protection Authority
- Swedish International Development Agency
- Theun Hinboun Power Company Limited
- United Nations Development Programme
- Water Resources and Environmental Administration
- World Bank
- World Wildlife Fund Greater Mekong

<sup>6</sup> The government's Ministry of Finance holds 100% of LHSE shares.

<sup>7</sup> The companies are Bouasavanh Energy Company, Shell (Laos) Company, Indochina Fuel Company, Phonesiri Group Company, New Lao Fuel Company, Phetsamai Fuel Company, Darasavanh Fuel Company, Chevron (Laos) Company, Lao TOYOTA Service Company, Union Petroleum Company, Technical Equipment-Oil Supply Import-Export Company, Lanxang Fuel Company, Asia Fuel Company, Lao MML Import-Export Company, Houankong Trading Company, Vientiane Fuel Company, and Nouang Loung Fuel Company.

<p>Relevant documents and video-clips on the internet from:</p> <ul style="list-style-type: none"> <li>• International Rivers,</li> <li>• Multilateral Investment Guarantee Agency,</li> <li>• Government of Lao PDR</li> </ul>
<p>Site visits in November–December 2009 and February–March 2010 to:</p> <ul style="list-style-type: none"> <li>• Nam Leuk, hydropower plant</li> <li>• Nam Theun 2 hydropower project</li> <li>• Theun Hinboun hydropower plant</li> <li>• ADB supported transmission and distribution project are also incorporated.</li> </ul>
<p>ADB staff in the headquarters and the ADB Resident Mission in Vientiane were consulted and have reviewed this report.</p>

ADB = Asian Development Bank, AusAID = Australian Agency for International Development PDR = people's democratic republic, SAPE = sector assistance program evaluation.

Source: Independent Evaluation Mission.

## B. Energy Consumption

7. It is not surprising that traditional fuels—mostly fuelwood—comprise the bulk of primary energy consumption. Reliable data on consumption of fuelwood and other biomass is not readily available; in 2002 (the most recent year for which data is available), fuelwood comprised about 57% of the total final energy consumption, and charcoal about another 12% (Table A1.2). Fuelwood, however, is not a sustainable option; the government recognizes that continued logging and shrinking forest cover have an adverse impact on the environment.<sup>8</sup> In 2002, hydropower-based electricity accounted for 12%, coal and lignite for less than 3%, and petroleum products for about 17%. Renewable energy—including solar, wind, and pico and small hydropower—still accounts for an insignificant share of the overall energy consumption mix.

**Table A1.2: Energy Consumption by Fuel Type**  
(‘000 tons of oil equivalent)

Year	Electricity	Petroleum Products <sup>a</sup>	Coal and Lignite	Fuelwood	Charcoal	Sawdust	Total
1996	84.38	592	21.75	847.46	179.40	4.12	<b>1,729.17</b>
1997	96.33	898	11.34	868.65	183.70	3.83	<b>2,062.16</b>
1998	114.00	563	13.76	890.36	187.90	3.56	<b>1,772.80</b>
1999	125.65	341	16.33	912.60	192.40	3.31	<b>1,590.92</b>
2000	179.70	303	53.03	930.80	197.10	(..)	<b>1,663.20</b>
2001	199.00	327	30.45	949.80	201.60	(..)	<b>1,707.62</b>
2002	212.50	303	53.03	1,031.50	211.40	(..)	<b>1,811.81</b>

(..) = not available.

<sup>a</sup> Includes liquefied petroleum gas, kerosene, gasoline, diesel, and fuel oil.

Source: Workshop on Utilization of Biomass for Renewable Energy. 2006. *Country Paper: Lao PDR*. Kathmandu, Nepal. 11–15 December.

8. Fuelwood, charcoal, and other biomass (such as sawdust) are used essentially by residential consumers; only a small share is commercially traded. Coal and lignite are used

<sup>8</sup> ADB. 2010. *Key Constraints to Sustainable Growth and Poverty Reduction in Lao PDR*. Manila (preliminary draft report, 19 January). As per this report, the forest cover is estimated to have reduced from 70% of the total land area in the 1970s to about 42% in 2005. The annual loss of forest cover is estimated at about 134,000 hectares.

mostly in industry (including one large cement factory and several smaller industrial enterprises) and for household energy consumption. All refined petroleum products for transportation, industrial, and residential uses are imported. Hydropower-based electricity is supplied mostly by the public utility, EdL, for consumption in various consumer categories in urban and (increasingly) rural areas. From about 17% of households having electricity access in 1995, and 44% in 2005, the Government of the Lao PDR has set an ambitious target to provide electricity access to over 90% of households by 2020, with intermediate targets of 70% by 2010 and 80% by 2015.

9. The residential sector was the largest energy consumer (nearly 58%) in 2006, the most recent year for which estimates of sector energy consumption are available.<sup>9</sup> The transport sector accounted for about 22% of energy consumption in 2006, commercial establishments for about 13%, industry for about 7.5%, and agriculture about 0.2%. As more households get electrified and pressures to reduce fuelwood consumption mount in the decade to 2020, the resulting shift from traditional energy to the more efficient modern energy forms will lead to a reduction in the residential sector's share of energy consumption.

### C. Power Sector

10. **Legal and regulatory aspects.** At present, the government's power sector policy objectives are to: (i) expand the generation, transmission, distribution and off-grid power to increase the domestic electrification ratio for the country to 90% (or more) by 2020; (ii) increase government revenues from independent power producers' export-oriented investments and honoring power export commitments with neighboring countries by promoting public-private partnership in hydropower development; and (iii) promote a 500 kilovolt (kV) grid development within the GMS to integrate the power systems of Lao PDR and its neighbors. The government also has a hydropower development policy that aims for environmental and social sustainability of hydropower projects; this is discussed in Appendix 3. The Electricity Law was first promulgated in 1997.<sup>10</sup> A key aspect of the Electricity Law is that, with a view to augmenting generating capacity that is developed by EdL or other government entities, it encourages investment in power generation capacity through the public-private partnership mode.

11. The investors may be wholly private (or domestic cooperatives) or be in joint venture with a state or government entity. The generating plants may be developed on a build-operate and transfer or build-operate-own and transfer or similar basis. The enterprise is to obtain a concession for a specified period. The law does not specify a preferred method for selecting investors or developers; thus far, interested developers have signed memoranda of understanding. However, the government would like to be in a position whereby it can select developers through a bidding process.

12. The developer selection process presently followed is: (i) the Government and the interested party sign a memorandum of understanding for a specific site for an 18-month period, during which the developer is required to conduct technical and financial feasibility studies as

<sup>9</sup> K. Kouphokham. 1999. Recent Developments in the Lao PDR Energy Sector. Presentation at Department of Electricity, Ministry of Energy and Mines, Government of the Lao PDR. Vientiane. March.

<sup>10</sup> National Assembly, Lao PDR. 1997. *Law on Electricity*. Vientiane.

well as necessary environmental and social impact assessments and studies;<sup>11</sup> and (ii) if towards the end of 18 month, the private party has completed the necessary studies and the specific site is found to be sufficiently attractive for development, then a project development agreement is negotiated. Tariff negotiations follow that culminate in a tariff agreement. Where a government entity is to be a shareholder in the project (as is normally the case), a shareholders' agreement is also firmed up. A concession agreement is also negotiated and finalized, which takes in to consideration the environmental and social mitigation imperatives as found from the assessments and studies conducted for the site. In the event the necessary studies are not complete at the end of the 18-month Memorandum of Understanding (MOU) period, the government has the option to extend the term of the MOU. In case however, the government is of the view that the private party has made little or no progress in completing the required studies and has not displayed sufficient interest in doing the preparatory work to develop the site, the government retains the right not to extend the MOU.

13. Generation projects of more than 50 megawatts (MW) capacity are to be approved by the National Assembly; projects in the 5 MW to 50 MW range are approved by the national government (ministries and departments); and projects up to 5 MW size are approved by provincial or local governments.

14. **Power capacity and generation.** For its size—about 1,800 megawatts (MW) of total installed capacity—the generation mix of the electricity industry is quite complex: (i) some capacity is government or EdL owned, while some is through a public–private partnership arrangement; and (ii) the target markets of specific hydropower projects vary widely (primarily export, or primarily for sale within the Lao PDR, or only for sale within the Lao PDR). EdL has payment settlement mechanisms with the various independent power projects as well as the utilities in Thailand and Viet Nam. Table A1.3 gives an overview of the power plants operating in the Lao PDR as of December 2009; the existing capacity is mapped as per their location (grid) and the market(s) they serve. Of the total capacity of 766 MW, EdL owns and operates an all-hydropower generation system of about 385 MW for the Lao PDR market. Some of these plants have also exported power to neighboring Thailand.<sup>12</sup> Two export-oriented independent power projects with a combined capacity of 360 MW projects mostly export power to Thailand as per power purchase agreements (PPAs) with Thai off-takers, and also serve Laotian consumers in keeping with their PPAs with EdL.

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<sup>11</sup> For large hydropower projects, an environmental impact assessment and social impact assessment are required along with an environmental management plan, a social action plan framework and a watershed management plan. For projects that may not have significant impacts, an initial environment examination is required in addition to an environmental management plan, a social action plan framework, and a watershed management plan.

<sup>12</sup> The 155 MW Nam Ngum 1, 60 MW Nam Leuk, and 40 MW Nam Mang 3 hydropower projects in the Central 1 grid, and the 45 MW Xeset 1 hydropower project in the southern grid export power when possible.

**Table A1.3: Operating Power Plants in the Lao People's Democratic Republic**  
(as of December 2009)

Ownership/ Modality	Location (Grid)	Power Plant Name	Market	Capacity (MW)
EdL	Central 1	Nam Dong	Lao PDR only	1.0
EdL	Northern	Nam Ko, Nam Ngai	Lao PDR only	2.7
EdL	Southern	Selabam	Lao PDR only	5.0
EdL	Central 1	Nam Ngum 1, Nam Leuk, Nam Mang 3	Lao PDR (export if surplus)	255.0
EdL	Southern	Xe Set 1	Lao PDR (export if surplus)	45.0
IPP	Central 2	Theun-Hinboun	Export primarily	210.0
IPP	Southern	Houay Ho	Export primarily	150.0
EdL	Southern	Xe Set 2	Lao PDR (export if surplus)	76.0
Provincial <sup>a</sup>	Within and beyond four grids		Lao PDR only	21.1
<b>Total</b>				<b>765.8</b>

EdL = Electricite du Laos, IPP = independent power producer, PDR = people's democratic republic

<sup>a</sup> Includes power plants operated by provincial electricity departments that operate about 85 mini-grids that are served by diesel generators (14.34 MW in 48 locations) and micro hydropower capacity (6.59 MW in 37 locations). Also includes 0.17 MW of solar photovoltaic capacity in 106 locations across the country.

Source: Electricité du Laos.

15. Although the government considers hydropower export to be an important source of foreign exchange earnings, it is noted that in 2007 and 2008 total electricity imports exceeded hydropower exports. This essentially reflects reduced hydropower generation during 2006–2008 because of lower rainfall than normal, but also that by the end of 2008 (i) only the small (40 MW) Nam Mang 3 hydropower plant had been commissioned since the Nam Leuk hydropower plant came on stream in 2000; and (ii) EdL was not in a position to off-take all of its energy entitlement from the two independent export power projects (the 210 MW Theun-Hinboun and the 150 MW Houay Ho plants) as the transmission system was not strong enough to carry the entitled energy to consumers. However, with the commissioning of the Xe Set 2 hydropower plant in September 2009 and three large hydropower plants in 2010, as well as transmission system augmentation, the Lao PDR is expected to become a net power exporter again. The hydropower plants scheduled to be commissioned in 2010 are (i) the 1088 MW Nam Theun 2 hydropower plant, with about 84 MW earmarked for off-take by EdL; (ii) the 615 MW Nam Ngum 2 hydropower plant, with about 60 MW earmarked for off-take by EdL; and (iii) the 100 MW Nam Lik 1/2 hydropower plant, which is a domestic independent plant. In addition, five more hydropower plants with a combined capacity of 655 MW are under construction.<sup>13</sup>

16. The hydropower sector in the Lao PDR has attracted many developers and project sponsors; as of mid-2008 (i) the DEPD had signed memoranda of understanding for conduct of feasibility studies and environmental and social assessments and studies for a further 12,500 MW of capacity; and (ii) with the feasibility studies and the initial string of environmental and social assessments and studies complete, project agreements are at various stages of

<sup>13</sup> In addition to the three hydropower projects scheduled for commissioning in 2010, are the 280 MW Theun-Hinboun Expansion Project, the 250 MW Xekaman 3 hydropower project, the 120 MW Nam Ngum 5 hydropower project, the 3.2 MW Tad Salen hydropower project, and the 2.4 MW Nam Nhone hydropower project.

negotiations for about 4,100 MW of capacity.<sup>14</sup> The long list of export-oriented power projects (which includes the 1,860 MW Hongsa Lignite plant) is in keeping with the government's objective of positioning the Lao PDR as the subregion's power battery. Nonetheless, the government has not been able to adopt a transparent process of awarding concessions to hydropower developers; however, it has identified the need to better screen project developers, improve project agreement negotiation capabilities, and manage a competitive tendering process.

17. As of late 2009, players from various countries (People's Republic of China, Japan, Malaysia, Russia, Thailand, and Viet Nam) are aiming to have a bankable PPA with the Electricity Generating Authority of Thailand (EGAT) as the main off-taker. Not all memoranda of understanding signatories have sufficient previous experience or long-term interest in the hydropower sector; they simply view the Lao PDR hydropower sector as a lucrative business opportunity.<sup>15</sup> However, as of late 2009, for about 40 of the 55 sites the feasibility studies were either still being prepared or had been suspended upon memorandum of understanding expiry (renewable upon expiry after 18 months). For all such sites, the DEPD will at some stage have the option to renew the memorandum of understanding with the original signatory. As part of the renewal process, the DEPD intends to better screen the developers.

18. **Power transmission and distribution.** The EdL transmission system in four operational areas comprises four separate transmission systems consisting of 115 kV and lower-voltage lines and substations. In all operational areas, EdL also operates local grids not connected to the main transmission systems, but sometimes connected to neighboring countries at medium-voltage levels. The following are the four transmission systems:

- (i) The Nam Ngum 1 115 kV Transmission Line System, supplying the Central 1 operational area and now (with completion of the NARPDP) also part of the northern operation area. It serves the most number of consumers in the country, including the Vientiane capital area. It has six hydropower plants with a combined capacity exceeding 256 MW.
- (ii) The Khammouane 115 kV Transmission Line System that imports power from Nakhon Phanom in Thailand at Thakek at 115 kV, and extends eastwards into part of the central 2 operation area to the Sepon gold and copper mine via Mahaxai (where it connects to the Nam Theun 2 project and receives 84 MW).
- (iii) The Savannakhet 115 kV Transmission Line System which imports power from Mukdahan in Thailand at 115 kV to parts of the central 2 operational area and extends eastward at medium voltage along the east–west corridor towards Viet Nam (the Thakek and Savannakhet 115 kV Transmission Line Systems are not yet interconnected).
- (iv) The Xeset 115 kV Transmission Line System supplying the southern operational area where it has 126 MW of installed hydropower capacity for local generation (it is also connected to Thailand at 115 kV).

<sup>14</sup> Prospective (mostly private sector) investors/developers sign a memorandum of understanding with the government (DEPD) for a specific site, and then prepare a feasibility study and other necessary documentation regarding environmental and social impacts assessment and management. Upon satisfactory completion and after obtaining necessary certifications for these studies, the investors/developers pursue with the government to extend the memorandum of understanding, following which they conduct detailed feasibility studies, which are then used as a basis for finalizing various project agreements as per a build–operate–transfer framework.

<sup>15</sup> Some memorandum of understanding signatories simply disappeared after signing the memoranda, and surfaced again only when it was time to seek extension to the memorandum for another 18 months. In other cases, where preliminary investigations had revealed that the sites were not sufficiently lucrative (i.e., have a financial internal rate of return that matches their ambitious hurdle rate), the signatory simply gave up.

19. The 210 MW Theun-Hinboun hydropower plant<sup>16</sup> is in the central 2 operational area, and the 150 MW Houay Ho hydropower plant is in the southern operational area; both export power to Thailand on separate 230 kV transmission lines. There is a 115 kV transmission line (financed by the Japan Bank for International Cooperation) being built from Paksane, thus linking all four 115 kV transmission line systems. In addition to the 230 kV transmission lines that link existing export-oriented independent power projects to the Thai grid, a dedicated 500 kV transmission system from the Nam Theun 2 plant has been set up for power exports to Thailand, and 500 kV or 230 kV systems are also planned for other export hydropower plants such as the Xekaman 1 and other hydropower plants in the south, and the Nam Ngum 3 hydropower plant in the central 1 operational area. Each of the four Lao PDR operational areas is also connected to the medium-voltage systems of Thailand, Viet Nam, and/or Yunnan Province in the People's Republic of China for power import at 22 kV or 35 kV levels. Despite substantial differences in the cost structure and demand mix across the four grids, the power tariff for each distinct customer category is the same across the country.

20. **Transmission and distribution losses.** EdL quickly reduced transmission and distribution losses from 27% in 1994 to about 18% by 2000. Progress in system loss reduction since then has remained impressive, as losses were 12% in 2009. The focus thus far has been on reducing technical losses, through (among other things) a system whereby electricity access to a village community requires minimal low-voltage (220 volts) lines. The introduction of energy meters on the outgoing feeders of 22 kV lines from substations has also enabled EdL to keep nontechnical losses in check. To reduce transmission and distribution losses further, more sophisticated technical solutions would be required to reduce technical losses, and it would be important to keep electricity tariffs affordable for rural households to enable them to use electricity legally.

21. **Power sales.** During 2002–2008 electricity consumption more than doubled, from 767 gigawatt-hours to 1,578 gigawatt-hours. Overall access to electricity increased rapidly, from 17% in 1995 to 44% in 2005 and over 60% in 2009. Increasingly, remote and smaller rural settlements are being given electricity access. By the end of 2008, EdL served about 630,000 customers, about 95% of which were residential. Power sales remain constrained by supply and are in line with investment in the power system. As per available data, billable electricity sales have increased at more than 13% per year since 1990, and nearly 12% per year during 2000–2008. During 2006–2008, the most recent 3-year period for which data is available, billable electricity sales increased by an average of 19% per year, the number of customers increased by less than 10% per year, and the average sale per customer increased from about 2,100 kWh/year in 2006 to more than 2,500 kWh/year in 2008. This largely reflects the reduction in share of billable energy sales to households (from nearly 51% in 2006 to less than 45% in 2008), accompanied by a rise in sales to commercial consumers from about 13% to more than 21%. The share of billable sales to industry remained virtually unchanged at around 23% during the 3-year period.

22. **Tariffs and financial performance.** EdL's power sales tariffs (in both kips/kWh and cents/kWh) have been raised each year for over 10 years. EdL became profitable in 2006. Although average tariffs have progressively increased by about 1% per year (in nominal terms) beginning in 2006 (in line with the tariff adjustment formula agreed in 2005), it is unlikely that, with such tariff increases until 2011, EdL will be able to meet its financial covenants of a self-financing ratio of at least 30%, debt service cover of 1.5 or more, and a debt–equity ratio of less

<sup>16</sup> The Theun-Hinboun hydropower project supplies a small amount of power locally at 22 kV or 35 kV levels as far as Laksao, close to the Viet Nam border.

than 1.5. Although the tariff adjustments since 2006 have been accompanied by a reduction in cross-subsidies between customer categories,<sup>17</sup> it is clear that as opportunities for cross-subsidy reduction are exhausted in the coming years, EdL will need to adopt a more sophisticated tariff regime in order to manage the overall capital investment requirements.<sup>18</sup>

23. Given the pressing concerns that arise from affordability considerations, other avenues of improving financial performance have also gained momentum. One such measure is to reduce accounts receivable to within reasonable and manageable limits of 2 months of average sales revenue to Lao PDR consumers. The present level is about KN170 billion (about \$20 million) of outstanding arrears from the government and irrigation consumers,<sup>19</sup> which although about 2 months of average sale revenue, represents over 4 months of sales revenue to government customers and over 30 months of sales revenue to irrigation consumers. EdL has agreed on an action plan with the Ministry of Finance and the World Bank towards putting in place a system to reduce the outstanding arrears as well as to ensure that the arrears do not mount again. Management of the accompanying social dimensions of reducing accounts receivable may yet pose a significant challenge.

24. ADB approved nearly \$250 million of financial assistance for energy sector projects since 1994, of which \$100 million was approved during the SAPE period (Table A1.4). Notably, OCR loans were offered for the first time in the SAPE period, along with a guarantee facility to provide comfort to commercial lenders. ADB also approved over \$9.5 million in technical assistance since the late-1980s, of which over \$5.6 million was approved during the SAPE period (Table A1.5).

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<sup>17</sup> Traditionally, low electricity usage households and agricultural consumers have been subsidized by industrial and commercial enterprises.

<sup>18</sup> Tariff structures that may need to be introduced include (i) a demand charge on a kip/kW/month basis to encourage consumers to improve their load factor, (ii) a demand charge on a kip/kilovolt-ampere/month basis to encourage consumers to improve their demand factor as well as power factor, and (iii) a time-of-use tariff to help reduce peak loads. This tariff structure helps reduce investments in the power system (be it generating capacity or capacitor banks) but requires additional investment in meters.

<sup>19</sup> According to EdL, accumulated outstanding arrears due from the government were KN113 billion (from October 2005 to September 2009) and from irrigation consumers KN57 billion (as of December 2009).



**Table A1.4: ADB Approved Loans for the Energy Sector in Lao PDR, 1994–2009**

Project No.	Project Name	Fund Type	Subsector	Amount Approved (\$ million)	Date Approved	Closing Date	PCR Rating <sup>a</sup>	PPAR/PPER Rating
1329	Theun-Hinboun Hydropower	ADF	Hydropower Generation	60	08-Nov-94	14-Oct-98	S	S
1456	Nam Leuk Hydropower	ADF	Hydropower Generation	52	10-Sep-96	13-Mar-03	S	S
2162	Greater Mekong Subregion (GMS): Nam Theun 2 Hydroelectric	OCR	Hydropower Generation	20	04-Apr-05	02-Feb-11		
2161/ 7210 <sup>b</sup>	Nam Theun 2 Power Company Limited	OCR	Hydropower Generation	50	04-Apr-05			
1308	Nam Ngum-Luang Prabang Power Transmission (Supplementary)	ADF	Transmission and Distribution	4	30-Aug-94	15-Aug-98	PS	S
1558	Power Transmission and Distribution	ADF	Transmission and Distribution	30	30-Sep-97	01-Jun-04	S	
2005	Northern Area Rural Power Distribution	ADF	Transmission and Distribution	30	18-Sep-03	31-Mar-10		
<b>Total (1994–2009)</b>				<b>246</b>				
<b>Total (2000–2009)</b>				<b>100</b>				

ADF = Asian Development Fund, OCR = ordinary capital resources, PCR = project completion report, PPAR = project performance audit report, PPER = project performance evaluation report.

PCR/PPAR/PPER Rating: S = successful, PS = partly successful

PPR Rating: S = Satisfactory

<sup>a</sup> In 2000, the rating system was changed from three categories (generally successful, partly successful, and unsuccessful) to four categories (highly successful, successful, partly successful, and unsuccessful).

<sup>b</sup> In addition, there was a political risk guarantee cover of up to \$50 million to facilitate mobilization of commercial debt for the Nam Theun 2 hydropower project.

Source: ADB database on approved loans and grants.

**Table A1.5: ADB Approved Technical Assistance for the Energy Sector in Lao PDR, 1988–2009**

Subsector/ TA No.	TA Name	TA Type	Amount Approved (\$'000)	Date Approved	Status	Closing Date	TCR Rating <sup>a</sup>	TPER Rating
<b>A. Energy Sector Development</b>								
1	2569	Corporate and Financial Development of Electricite Du Lao	AD	340.0	15-May-96	Closed	09-Jun-07	S
2	2583	Power System Planning in the Ministry of Industry and Handicraft	AD	600.0	07-Jun-96	Closed	06-Feb-98	S
3	2728	Study for Establishing the National Grid Company	AD	600.0	23-Dec-96	Closed	06-Apr-98	PS
4	3374	Power Sector Strategy Study	AD	800.0	23-Dec-99	Closed	30-Sep-03	S
<b>Subtotal</b>				<b>2,340.0</b>				
<b>B. Hydropower Generation</b>								
5	2054	Theun-Hinboun Power (SSTA)	AD	100.0	04-Jan-94	Closed		S
6	3225	Analyzing and Negotiating Financing Options for the Nam Leuk Hydropower Project Cost Overruns	AD	140.0	16-Jul-99	Closed	31-Aug-04	
7	4213	GMS: Nam Theun 2 Hydropower Development	PP	700.0	09-Nov-03	Closed		

Subsector/ TA No.	TA Name	TA Type	Amount Approved (\$'000)	Date Approved	Status	Closing Date	TCR Rating <sup>a</sup>	TPER Rating
8	4323	GMS: Nam Theun 2 Hydropower Development (Phase II)	PP	1,000.0	29-Mar-04	Closed		
9	4921	Cumulative Impact Assessment for the Nam Ngum 3 Hydropower Project	PP	983.0	21-Feb-07	Closed		
10	7094	GMS: Nam Theun 2 Hydroelectric Project -Social Safeguards Monitoring	AD	400.0	07-Jul-08	Active	09-Aug-10	
11	7227	Small and Mini-Hydroelectric Development	PP	1,000.0	14-Jan-09	Active	28-Feb-10	
<b>Subtotal</b>				<b>4,323.0</b>				
<b>C. Transmission and Distribution</b>								
12	2479	Power Transmission and Distribution	PP	250.0	18-Dec-95	Closed		
13	2926	Nam Ngum 500 KV Power Transmission	PP	580.0	28-Nov-97	Closed		
14	3087	Northern Area Rural Power Distribution	PP	510.0	14-Oct-98	Closed		
15	4816	GMS Northern Power Transmission	PP	800.0	19-Jul-06	Active	31-Jul-09	
16	7026	Na Bong-Udon Thani Power Transmission	PP	760.0	12-Dec-07	Active	30-Aug-09	
<b>Subtotal</b>				<b>2,900.0</b>				
<b>Total (1979–2009)</b>				<b>9,563.0</b>				
<b>Total (2000–2009)</b>				<b>5,643.0</b>				

AD = advisory and operational, IP = implementation progress, JSF = Japan Special Fund, PP = project preparatory, TA = technical assistance, TASF = Technical Assistance Special Fund, TA Obj = technical assistance objective, TCR = technical assistance completion report, TPER = technical assistance evaluation report, TPR = technical assistance performance report.

TCR/TPER Rating: HS = highly successful, PS = partly successful

TPR Rating: S = Satisfactory

<sup>a</sup> In 2000, the rating system was changed from three categories (generally successful, partly successful, and unsuccessful) to four categories (highly successful, successful, partly successful, and unsuccessful).

Source: ADB database of approved TAs.

## D. Energy Resources

25. **Hydropower.** The Lao PDR has vast hydropower potential. On the tributaries that feed into the Mekong River, the technical potential for hydropower is assessed as being approximately 18,000 MW. However, this technical assessment is based on archived data gathered in the 1960s and 1970s with development partner support, on the basis of contour maps on a 1:50,000 scale, and provides some idea of power plant site, capacity, reservoir area, etc. No information on environmental and social aspects is available from the data archives. Consequently, the assessed potential of 18,000 MW does not take into account the cumulative economic, social, and environmental impacts of cascading hydropower projects, or the necessary integrated watershed management aspects. As of November 2009, eight hydropower plants were operational with a combined capacity of 745 MW, consisting of six EdL-operated hydropower plants with a combined capacity of 385 MW for electricity supply within the Lao PDR, and two export-oriented independent power projects with a combined capacity of 360 MW (Table A1.3). More than 2,500 MW of hydropower plant capacity was under construction as of November 2009, which includes 2,309 MW of export-oriented projects and 225 MW capacity for power off-take by EdL and sale within the Lao PDR. The MEM had also signed memoranda of understanding for the development of the remaining technically feasible capacity, including 14 sites for which feasibility studies were completed by November 2009, and 41 sites for which

feasibility studies were either in progress or had been suspended because the memoranda of understanding had lapsed.

26. **Coal and lignite.** The Lao PDR's known coal reserves are meager and are estimated at about 600–700 million tons, mostly as lignite. The largest known reserves of about 400 million tons are at Hongsa in Xayaboury province in northern Lao PDR. The mid-grade lignite is considered suitable for power generation and other direct thermal applications in industry. Other known deposits are smaller and found in various provinces. Bituminous coals and anthracite have also been mapped through various studies in recent years.

27. **Oil and gas.** There are no proven oil and gas reserves in the Lao PDR, and no petroleum refinery. All petroleum product requirements are imported. Exploration and production activity was stopped in 1997 when the investment programs of the United Kingdom and United States oil companies that had been awarded exploration concessions from 1989 to 1996 were affected by the Asian financial crisis. Exploration and production activity resumed in 2009 with the government award of a production-sharing contract to an international oil company.<sup>20</sup> Salamander Energy, a British company engaged in prospecting for oil and gas, has indicated the likelihood of finding some natural gas resources in Champassak and Savannakhet provinces. However, as yet, no reserves have been proven; if and when reserves are proven, it will have to be established whether or not they are commercially exploitable. Even if the exploratory phase yields commercially exploitable oil and/or gas, it will be several years before indigenous oil and/or gas can be produced.

28. **New and renewable energy options.** The key influencers of the renewable energy program in the Lao PDR are (i) the stated government goal to provide electricity access to 90% of households by 2020, coupled with the fact that extension of power transmission lines to remote areas to feed small communities would be a suboptimal and high-cost approach; (ii) the need to reduce dependence on imported oil; and (iii) the need to reduce fuelwood consumption, in recognition of the need to limit deforestation. Some experience has already accumulated in the Lao PDR to pilot and deploy an array of energy options, including some to (i) use biomass more efficiently (biogas plant, biomass gasification for power generation, and efficient cook stoves); (ii) complement transport fuels (biodiesel from *Jatropha* plantations); (iii) use micro and pico hydropower and wind power technologies to generate electricity in off-grid or localized grid or a grid-connected mode; and (iv) use solar home lighting systems for off-grid power supply.

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<sup>20</sup> The contract covers more than 19,000 square kilometers in Savannakhet province in western Lao PDR and stipulates that the government's profit share is 45% from oil and 37% from gas.

## OVERVIEW OF RENEWABLE ENERGY TECHNOLOGIES EXPERIENCE IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC

1. As of April 2010, the government's Renewable Energy Policy was still being formulated, as was the strategy to implement this policy under the direction of the Ministry of Energy and Mines (MEM). The government's perspective is that renewable energy technologies can contribute to reaching its 90% electrification target by 2020, reversing the trend of forest cover loss, and meeting transport fuel needs to reduce vulnerability to international oil market shocks. The government has also set a target of 30% penetration for renewable energy technologies by 2025, but the basis for setting this target is not clear. For instance, with regard to meeting the 90% electrification access target by 2020, although the Department of Electricity (DOE) has identified the villages that are to be supplied off-grid electricity based on renewable energy technologies, it is acknowledged that (i) sufficiently reliable and long-term resource data (e.g., wind speeds, solar radiation, river flows, biomass availability, etc.) needs to be gathered; (ii) challenges in ensuring safety in operation and maintenance need to be overcome for the 0.3–1.0 kilowatt (kW) pico hydropower generators and other renewable energy technology systems; and (iii) approval requirements for at least small hydropower projects need to be streamlined and simplified to encourage investment, as does a system of incentives to encourage private participation.

2. The agencies primarily responsible for renewable energy technologies are the MEM through the DOE, and Electricité du Laos, the premier public power utility. The renewable energy sector is further supported by the Technology Research Institute<sup>1</sup> and the National University of Laos. Among other activities, the Technology Research Institute implements research and development projects related to renewable energy technologies. The National University of Laos is mainly involved with research and issues on renewable energy technologies. Other institutions engaged in renewable energy include the SunLabob, a private company; the Lao Institute for Renewable Energy, an independent nonprofit center for applied research; and the Renewable Energy for Sustainable Development Association.

3. **Biomass.** In addition to being used in solid form, biomass can be gasified for thermal applications or for generating power or mechanical energy. Wastes from wood, rice husks, and sugarcane bagasse are among the identified potential biomass sources. In 2007, rice production in the Lao PDR was about 2.7 million tons.<sup>2</sup> Rice husk accounts for about 20% of rice by weight, and experience from Thailand suggests that about 33 tons of rice husk can generate 1 megawatt of power.<sup>3</sup> The first rice-husk-based biomass gasifier was implemented by the Technology Research Institute with a capacity of 200 kW, and with support from the New Energy Development Organization, an affiliate organization of the Japan Ministry of Economy, Trade and Industry.<sup>4</sup> In 2008, the country produced 211,500 tons of sugarcane over an area of about 5,900 hectares (ha).<sup>5</sup>

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<sup>1</sup> The Technology Research Institute is under the Water Resources and Environment Administration, which is the government's main coordinating agency for environmental planning and management across all sectors.

<sup>2</sup> ADB. 2008. *Key Indicators for Asia and the Pacific 2008*. Manila.

<sup>3</sup> Chungsangunsit, Thipwimon, Shabbir H. Gheewala, and Suthum Patumsawad. *Environmental Assessment of Electricity Production from Rice Husk: A Case Study in Thailand*. Bangkok. 14–16 January 2004.

<sup>4</sup> Dr. Phonekeo, Daovong (presenter and deputy director general, DOE, MEM). 2008. Overview of Energy Subsector Activities in the Lao PDR, presented in DOE, MEM. Vientiane, Lao PDR. 22 November.

<sup>5</sup> ADB. 2009. Cited in *Integrating Biofuel and Rural Renewable Energy Production in Agriculture for Poverty Reduction in the Greater Mekong Subregion: An Overview and Strategic Framework for Biofuel Development*. Manila: Food and Agriculture Organization.

4. Methane gas released by rotting biomass can be captured and used as fuel in cooking stoves and for lighting homes. Stichting Nederlandse Vrijwilligers (the Dutch development agency) supported the demonstration of a biogas project for electricity and cooking (footnote 3). The Technology Research Institute is actively promoting biomass and biogas technology, especially in rural areas. However, the institute notes the high investment cost and the complexity of constructing biogas facilities, which limits the replication potential.

5. Biodiesel derived from plants such as *Jatropha* is also being promoted. In 2007, Kolao Farm and Bio Energy Company (a Korean company) had plans to plant and propagate *Jatropha* over 71,231.16 ha. However, the total planted area covered only around 22,094 ha, as the labor requirements for land preparation, planting, and harvesting were massive.<sup>6</sup>

6. The Asian Development Bank (ADB) is preparing a project—that brings in the experience and perspectives from some other countries—to support the Lao PDR in various biomass related aspects. ADB is to examine the feasibility of a biomass gasifier, and recognizes the need to map the quality and quantity of biomass available in the country. Given that agricultural activity can not be readily replaced with biofuel plantations, ADB prefers that *Jatropha* be planted as a fence or hedge around agricultural land holdings. ADB is to also examine the feasibility of a small-scale bio-diesel processing plant. ADB also plans to adapt some cookstove designs—from United States Agency for International Development supported work in Thailand in the 1960s, and adapted for use in Cambodia—for use in Lao PDR as well. ADB also has plans to support the set up and use of small biogas plants that will be fed with livestock waste, produce biogas for household use and slurry as manure for agriculture.

7. **Pico hydropower.** Pico hydropower has played an important role in rural electrification thus far, where grid electricity supply has not reached. As per Lao Institute for Renewable Energy estimates, about 60,000 units of pico hydropower plants (imported from the People's Republic of China and Viet Nam, and with capacities of 300–1,000 watts) had been installed in the country by 2008. Pico hydropower units and spare parts are sold in small shops in remote areas, and the units range in price from \$35 to \$200 and may last up to 5 years if properly serviced. It is noted that, even though no instruction materials are available, users have installed the units by learning from the experiences of others. While the proliferation of pico hydropower exemplifies the entrepreneurial abilities of the Lao people, the safety and quality of the units remain areas of concern. For instance, in some of the units sold in the Lao PDR, the cable that connects the pico hydropower unit to the consumption point is not insulated. Some cables are hung very low from improvised poles and so are within easy reach. Besides, due to insufficient control systems, the quality of electricity is very poor and often damages lamps and other electrical equipment. The technology may also be inconvenient as it entails daily maintenance (e.g., taking out of the water and removing garbage and leaves trapped in the unit). In November 2008, Lao Institute for Renewable Energy and the National University of Laos Faculty of Engineering, along with ETC Energy (a Dutch enterprise) began collaborating on the Pico-Hydropower Innovation and Capacity Building Program in order to improve the technology features, facilitate technology dissemination for pico hydropower products, and identify bottlenecks in the supply chain, among other things.<sup>7</sup>

<sup>6</sup> Sysaneth, Souklaty and Dr. Linkham Duangsavanh. 2009. *Impacts of Jatropha Plantation on Smallholders* (draft report), Lao PDR: National Agriculture and Forestry Research Institute, Ministry of Agriculture and Forestry (February).

<sup>7</sup> Rietzler, Jakob and Thongsanti Vongsaly. 2009. SMEs and Renewable Energy in Laos – Perspective from the Lao Institute for Renewable Energy. Lao PDR. 6–7 April. No updates are available on the status of the capacity building program, which is supposed to end in November 2010.

8. **Solar.** Solar photovoltaic systems were first introduced into the Lao PDR in 1980 to supply electricity for telecommunications systems and vaccine storage in remote areas. Over a period of time, photovoltaic systems also began to be used for meeting residential and other energy requirements. From 1997 to 2004, with development partner support, the Technology Research Institute installed solar home systems, battery charging stations, and water pumps to demonstrate photovoltaic applications for rural electrification. Between 1998 and 2000, the Japan International Cooperation Agency through its Study on Rural Electrification Project by Renewable Energy in the Lao PDR piloted in Vientiane and Borikhamxay provinces solar home systems in 12 villages (440 households) and battery charging stations in two villages, providing a total capacity of 37 kW.

9. From 1999 to 2004 the Southern Province Rural Electrification Project helped developed management systems for off-grid areas.<sup>8</sup> The off-grid rural electrification component of the project, by means of a hire-purchase arrangement, allowed villagers to install solar home systems. Users could lease solar home systems for 5 or 10 years with an upfront payment of about \$20, becoming owners at the end of the period on condition that all payments have been made. This delivery system involved the private sector—provincial energy service companies as the implementing body in the case of solar home systems. It proved to be sustainable, as the lease payments generated surpluses (over cost of supervision, management, installation, and maintenance). After credit closing in 2004, a total of 4,974 households were connected and paying compared to an initial target of 4,600 households. Prices were set at semicommercial levels, with face-value subsidy at 4% for 20-watt solar home systems, 14% for 30-watt systems, 18% for 40-watt systems, and 29% for 50-watt systems. The overall repayment rate was 98%; the 2% shortfall was mostly due to permitted payment postponement to the succeeding month.<sup>9</sup>

10. The World Bank's Rural Electrification Project is a continuation of the Southern Province Rural Electrification Project. The Rural Electrification Project involves a two-phased implementation. The solar home system delivery model under the Southern Province Rural Electrification Project and phase 1 of the Rural Electrification Project (2006–2009) provided electricity to almost 15,000 households. Phase 2 of the Rural Electrification Project (2010–2013) will provide electricity to another 10,000 households (solar home systems and pico hydropower) in the project provinces.<sup>10</sup>

11. Capital subsidy is an integral part of the rural electrification program in order to achieve the program's social objectives. During the implementation of phase 1 of the Rural Electrification Project, the International Development Association and the Global Environment Facility provided a grant, and the Norwegian Agency for Development Cooperation provided financing for MEM to lay the foundation of the Rural Electrification Fund, which was established in August 2005. Private sector players that invest in rural electrification projects can access the fund, which is capitalized through the repayments of all off-grid consumers electrified under the Southern Province Rural Electrification Project, phase 1 of the Rural Electrification Project, and other off-grid projects financed by development partners.<sup>11</sup>

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<sup>8</sup> Funded by the International Development Association and Global Environment Facility, the project concluded on 31 December 2004.

<sup>9</sup> World Bank. 2005. *Implementation Completion Report for the Southern Provinces Rural Electrification Project in Lao PDR* (14 June).

<sup>10</sup> World Bank. 2009. *Project Information Document for Rural Electrification Phase II* (14 December).

<sup>11</sup> World Bank. 2009. *Project Information Document on Rural Electrification Phase II of the Rural Electrification (APL) Program* (14 December).

12. The DOE manages the Rural Electrification Fund with support from provincial departments, and is guided by an advisory committee from various ministries. Thus far, the fund has assisted the deployment of solar home systems through a uniquely tailored business model. The DOE is also working out the modalities for off-grid micro (less than 100 kW) hydropower systems. As ADB is moving towards supporting deployment of small and mini hydropower and other off-grid technologies, it is in the process of reviewing the Rural Electrification Fund's operations to synergize with it.

13. **Small and mini hydropower.** In recognition of the difficulties experienced in setting up small and mini hydropower projects, ADB provided project preparatory technical assistance that supports the preparation of a feasibility study for two small and mini hydropower projects and identifies barriers that need to be addressed to encourage investment in small and mini hydropower projects. The barrier analysis is expected to contribute towards increasing investment in small and mini hydropower projects and meeting rural electrification targets. Issues related to streamlining procedures as well as providing incentives to private developers are being addressed. The most important barriers to accelerating small and mini hydropower development are (i) the complex regulations that require a case-by-case power purchase agreement negotiation, while there is limited clarity on power purchase agreement off-take tariffs, taxes, royalties, and duties;<sup>12</sup> (ii) inadequate institutional capacity at the provincial government level, which is empowered to approve up to 5 megawatts of small and mini hydropower capacity; and (iii) financial barriers that result from the need for developers to take longer-term loans than commercial banks normally offer.<sup>13</sup>

14. **Wind.** The Technology Research Institute cited the Wind Energy Resource Atlas prepared by the World Bank–Asia Alternative Energy Program (2001) which considers the central region of the country for potential large-scale wind power generation; however, a detailed assessment of wind energy potential is yet to be carried out.<sup>14</sup>

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<sup>12</sup> Although as per the amended Electricity Act whereby developers are no longer required to negotiate a concession agreement, developers have reportedly been facing hurdles as they are now required to seek clearances pertaining to water use, land use, environmental impacts, forest, irrigation, and resettlement (if any) impacts from different provincial government departments.

<sup>13</sup> As bank deposits have terms of up to 2 years, commercial banks in the Lao PDR prefer to give loans for terms that are significantly shorter than developers would like.

<sup>14</sup> Theuambounmy, Houmpheng (presenter and deputy director, RE Technology Center, TRI). 2007. Status of Renewable Energy Development in the Lao People's Democratic Republic. Bangkok. 5–7 June.

## **LAO PEOPLE'S DEMOCRATIC REPUBLIC ENVIRONMENTAL AND SOCIAL REGULATIONS TO MEET SUSTAINABILITY REQUIREMENTS FOR HYDROPOWER DEVELOPMENT**

### **A. National Policy on the Environmental and Social Sustainability of the Hydropower Sector**

1. Learning from the experience gained in preparing the Nam Theun 2 hydropower project where huge efforts were exerted in comprehensively addressing the environmental and social safeguards issues, the National Policy on the Environmental and Social Sustainability of the Hydropower Sector (NPESHHS) was issued by the government in 2005. It aims to adapt and tailor the principles developed under the Nam Theun 2 hydropower project to the hydropower sector as a whole. It cites the project preparation and design process for the Nam Theun 2 project as unprecedented for a single development project in the Lao People's Democratic Republic (Lao PDR) in terms of its comprehensiveness and transparency. The policy therefore encourages sustainable development of the hydropower sector based on the principles of economic sustainability (maintenance of the renewable resource base), social sustainability (based on the principles of mutual understanding and consensus), and ecological sustainability (avoidance of irreversible environmental impacts).

2. The policy stipulates specific measures to be undertaken by project owners and government agencies on the following aspects: environmental assessment, project-affected people, watershed management and conservation, consultation, disclosure, compliance, revenues, existing hydropower projects, institutionalization, and reporting. It applies to projects built after 1990 that are larger than 50 megawatts or inundate more than 10,000 hectares. The Science, Technology and Environment Agency (STEA, now the Water Resources and Environment Administration [WREA]) and the Department of Electricity (DOE) lead in the implementation of the policy.

3. One of the major weakness of hydropower policy in the Lao PDR is lack of clear guidelines on the award of concessions to private sector investors to transparently develop hydropower projects. This has resulted in lack of transparency in the negotiations between the government and private developers on the terms and conditions of concession agreements, including the terms applicable to royalties and corporate income tax.

4. A notable feature of this policy is its reinforcing statements on the need to produce full environmental impact assessments (EIAs) and environmental management plans for all large hydropower projects with requirements that are presently considered as international good practice, including the use of third-party monitoring. It is commendable for requiring developers to offset any loss of natural terrestrial habitat and cites the need to enhance the productivity and sustainability of aquatic resources within the reservoir and its tributaries. It also requires a participatory planning strategy in watershed management.

5. The experience of several countries in hydropower developments has shown that environmental and social impacts tend to disproportionately affect the poor and always raise concerns about long-term sustainability. Similar experience has been seen in the Lao PDR. Adoption of the policy is undoubtedly a positive step and shows the government's recognition of the need to raise the standards in the hydropower sector towards international good practice.



This move is also reflected in the National Socio-Economic Development Plan (2006–2010),<sup>1</sup> which included calls to streamline the procedures for managing the social and environmental impacts in hydroelectricity and mining development, and implementing the NPESHHS as part of the strategies to achieve the objectives of the draft National Environment Strategy 2003–2020.

6. When the government issued the NPESHHS in 2005, the secretariat of the Lao National Committee for Energy stated that the government had carried out several works and written pertinent legal documents in order to implement the NPESHHS. These included a decree on resettlement, an environment strategy and action plans at the provincial level, setting up an environment protection fund, setting up a water resources committee, developing a capacity building project for STEA personnel, and making preparations for third-party monitoring arrangements. Some of these efforts have fallen short of what is required for a full policy implementation.

7. Full implementation of the policy is still a big challenge. The WREA and DOE have limited qualified staff, and legal and institutional instruments are still lacking. There are areas that need clear regulations and institutional mechanisms such as watershed management, revenue sharing, and mandatory contributions to the Environmental Protection Fund. While the policy positively addresses the issues of consultation and disclosure, their implementation in some hydropower projects remains a concern.

## **B. Water and Water Resources Law**

8. The Water and Water Resources Law recognizes eight different categories of water sources according to purpose, including water sources allocated for the production of electrical power (Article 9). Protection of water and water resources is a declared policy (Article 7) and mandates water users to comply with water and water resources management regulations. The law lays down some good principles to consider in conducting water source development activities, such as complying with socioeconomic and environmental development plans (Article 22).

9. The Water and Water Resources Law has features that help ensure sustainable hydropower development. These include (i) requiring environmental and social impact assessments for large-scale hydropower reservoirs (Article 18), (ii) requiring approval for small-scale hydropower reservoirs (Article 18), (iii) prohibiting activities that can cause erosion (Article 41),<sup>2</sup> (iv) specific environmental requirements for hydropower dams (Article 25), (v) monitoring and inspection (Article 43), and (vi) requiring project developers to contribute funds for the preservation of headwaters and water sources (Article 24).

10. In requiring hydropower developers of large projects to consider environmental and social safeguards, the law is quite explicit that the feasibility study must be accompanied by an environmental and social impacts assessment and the corresponding detailed measures to deal with such impacts. Requiring project developers to contribute funds to the preservation of headwaters and water sources is a notable feature since the government has been short of funds for conservation works.

<sup>1</sup> Committee for Planning and Investment of Lao PDR. 2006. *National Socio-Economic Development Plan (2006–2010)*. Vientiane.

<sup>2</sup> In prohibiting activities that can cause erosion, the law does not provide quantitative levels of erosion rates, but simply cites examples of prohibited activities such as construction, cutting trees, and quarrying.

11. In keeping with the growing requirements to effectively manage the Lao PDR's water resources, the present Water and Water Resources Law needs to be revised. Areas that need special attention while revising the law are the system of classifying water bodies based on water quality standards, environmental flows, and sediment transport changes. The flow of water and sediments in a river makes it a dynamic system. Changes to the quantity and natural patterns of these flows will cause adverse impacts to the downstream areas. The law should be clear on how to deal with these flows in order to minimize the downstream impacts attributed to development projects (such as hydropower).

12. **Classification of water bodies on the basis of water quality standards.** Water quality management should be viewed in a holistic manner and must be anchored on the principle that it cannot be separated from concerns on water source sustainability, ecological protection, water supply, public health, livelihoods dependence, and quality of life. An obvious gap in the present water law is the lack of a clear framework for defining a system of classifying water bodies based on water quality standards with quantitative parameters. Article 32 (Water Quality Standards) of the present water law narrowly focuses on standards for drinking water and used water.

13. Water quality standards would help to rationally define designated uses of water bodies, water quality criteria for protecting the designated uses, an antidegradation policy to maintain and protect the approved existing uses, and general policies for addressing implementation issues. The main objective of the water quality criteria is to maintain the minimum conditions necessary to assure the suitability of water for its designated use or classification. It may have the barest minimum water quality parameters such as dissolved oxygen, biochemical oxygen demand, pH, and total coliform organisms. The system of classifying water bodies based on water quality standards shall also be a basis for developing water quality standards to be applied to all types of discharges to water bodies, such as the water quality standards for hydropower discharges.

14. By applying a system for classifying water bodies on the basis of water quality standards, the government can effectively designate rivers and lakes intended for supply of drinking water, biodiversity conservation, recreation, fishery, agricultural uses, and industrial uses. On a broader scale, it will help the government determine which river basins should be preserved for biodiversity conservation and which ones earmarked for infrastructure development. A participatory approach is necessary since designating water use for a water body shall also consider the existing water use of various stakeholders. The decision on preservation will not be based purely on water quality but shall also consider the basin's socioeconomic situation, particularly the communities that are dependent on the water body for socioeconomic benefits, most importantly for aquatic resources and fisheries-dependent livelihoods.

15. In future hydropower prefeasibility and feasibility studies, the water classification system should guide the government on what to require from developers in terms of water quality protection. For example, a proposed transbasin hydropower project cannot simply discharge to a river in another basin without treating its discharges and will be required to institute sufficient mitigation measures on water quality as the poor water quality of the reservoir will persist during its initial years of operations. The issue can easily be settled since the hydropower discharges have quantitative water quality parameters that can be measured and predicted through modeling.

16. **Environmental flows.** Environmental flows refer to the amount of water needed to meet the existing water needs of ecosystems, downstream communities, etc. This means that river

flows should be managed so that enough water is left in rivers to ensure sustenance of downstream environmental, social, and economic benefits.<sup>3</sup> The importance of environmental flows thus can not be overemphasized. However, this is often a contentious issue for hydropower plants with reservoirs, as more water released during the dry months means revenue loss for the power facility. Therefore, it becomes important to balance the needs of the power facility and the needs of downstream stakeholders. Although the Water and Water Resources Law provides for regulation of water use in hydropower plants (Article 13), it has no specific provision to mandate the use of environmental flows.

17. The objectives of environmental flows may include maintaining the water requirement for domestic water use, irrigation, fish passage, fishery activities, passage for navigation, sediment transport, waste assimilation, water supply, and significant ecological elements of the river. These items are generally important in hydropower feasibility studies and operations.

18. **Sediment transport changes.** Although the Water and Water Resources Law mentions sediments (stones, gravel, sand, mud, and minerals) as part of water resources (Article 2), it has no specific provision to address the issue of sediment transport changes in development projects such as hydropower. The law should have provisions that require hydropower developers to monitor and check changes in sediment transport of the rivers. During the feasibility study for a hydropower project, its long-term effect on erosion and sediment deposition in the downstream reaches should be assessed. Specialists on river hydraulics and geology should prepare a first estimate of the changes that could be expected in the downstream reaches.

19. Rivers are dynamic and sediments play an important role in this dynamism. The rivers' habitats and species are a function of the flow, the quantity and character of the sediment in motion through the channel, and the character or composition of the materials that make up the bed and banks of the channel. The environmental issues of the downstream areas are closely linked to the established water and sediment balances of the river. Riparian zones depend directly on the water, sediments, and nutrients from the river. Modifications of water and sediment flows of the river from the dam to the downstream reaches will trigger changes to the downstream aquatic and riparian ecosystems. Changes in sediment load can induce changes in the form and dimensions of alluvial downstream channels.

20. Ideally, sediment transport in rivers should not be altered by capture in reservoirs. With a dam, the closest situation to unimpeded sediment transport is the regular release of sediments. Dam design and operation should therefore include regular downstream release of sediments. The most common methods of releasing sediments from reservoirs are sluicing and flushing.<sup>4</sup>

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<sup>3</sup> Changes in the hydrological regime of a river can lead to adverse ecological and socioeconomic consequences that are so great that the affected elements have difficulty recovering.

<sup>4</sup> Sluicing is the prevention of new sediments settling in the reservoir, while flushing is the removal of previously deposited sediments in the reservoir. In sluicing, the sediments carried by the water flowing into the reservoir during a flooding season will be prevented from settling by allowing the water to pass through the dam for a few weeks. The idea is to pass through the reservoir the high sediment loads carried by flood flows. Flushing will erode previously deposited sediments in the reservoir by releasing water at the low-level outlets in dams. This technique requires the emptying of the reservoir. The release of a large volume of water during flushing will increase the flow velocities in the reservoir, thereby increasing the water's erosive force on the previously deposited sediments. Water escaping from the dam's low-level outlets will carry the eroded sediments downstream. If site topography permits, construction of flood bypass tunnels going around the reservoir may also be considered in rivers with heavy sediment loads. During the flooding season, flood flows with high sediment loads will be directed to the bypass tunnels to avoid sending the sediments into the reservoir.

### C. Environmental Protection Law

21. Since 1999, the Environmental Protection Law has been the main legislation and instrument for environmental protection and management in the Lao PDR. It specifies necessary principles, rules, and measures for managing, monitoring, restoring, and protecting the environment in order to protect public natural resources and biodiversity, and ensure the sustainable socioeconomic development of the nation. It broadly covers the areas of prevention of environmental degradation; pollution control; environmental mitigation and restoration; the Environment Protection Fund, international relations, and cooperation on the environment; environment management and monitoring; and awards and sanctions.

22. This law is a good instrument for ensuring that hydropower development is sustainable and for making developers accountable for their actions on the environment. The Environmental Protection Law stipulates that anyone engaged in production or service has a responsibility to protect the environment (Article 4), and whoever causes damage to the environment is responsible for the impacts under the law (Article 5). It sends a message of proactive environmental management by giving priority to environmental protection over mitigation and restoration. Provisions for protection include biodiversity resources and cultural, historical, and natural conservation sites (Articles 15 and 16). The law also supports the establishment of the Environment Protection Fund to support various environmental activities.

23. The law outlines the EIA process (Article 8) and mandates the STEA (now in WREA) with issuing general EIA regulations on procedures and methods for EIA. This process requires the submission of an EIA report and the issuance of environment compliance certificate prior to the construction activities of a project. It also requires those development projects operating prior to the enactment of the law and causing environmental damage to propose measures, procedures, and actions for mitigating such damage to the concerned environment agency for issuance of an environmental compliance certificate.

24. These provisions can help in ensuring sustainable hydropower development because it covers not only proposed projects but also those already operating. This retroactive application can be used to legally compel old hydropower projects to mitigate their ongoing adverse environmental impacts such as severe erosion and fishery decline in downstream areas.

25. The present Environmental Protection Law can be further strengthened to help ensure sustainable hydropower development and further refine requirements for environmental safeguards in the sector by introducing additional provisions. Areas that need special attention during revision of the law are strategic environmental assessment, transboundary and global issues, and natural and critical habitats.

26. **Strategic environmental assessment.** The Environmental Protection Law needs to include provisions for evaluating the environmental consequences of proposed policy, plan, or program initiatives in order to ensure they are fully included and appropriately addressed at the earliest appropriate stage of decision making. This type of assessment is referred to as strategic environmental assessment, and needs to be used when a project involves the development of or changes to policies, plans, or programs that are likely to have significant environmental impacts and are regional or sectoral in nature. Its inclusion in the list of proposed changes (and among the changes actually effected, albeit at some future date) is particularly meaningful as the Lao PDR is part of the Greater Mekong Subregion (GMS) where large-scale investments with potential cumulative and multiplier impacts are being promoted. The Mekong River

Commission is also using strategic environment assessments in addressing the hydropower developments of the Mekong River.

27. **Transboundary and global issues.** Although the Environmental Protection Law's EIA provisions reflect good practices, they lack any requirement to assess potential transboundary impacts and global issues of development projects (such as greenhouse gas emission of hydropower reservoirs). Transboundary impacts are important concerns considering the geographical reality of the Lao PDR as a landlocked country. Any large-scale changes to river flows and sediment transport will have impacts on the downstream riparian environments in neighboring countries. These assessment requirements need to be reflected, and the law provide that the government shall implement all international or bilateral conventions or treaties on the environment to which the Lao PDR is a party (Article 33).

28. **Natural and critical habitats.** The Environmental Protection Law has no specific provisions on environmental management and protection of natural habitats and critical habitats, although it is mentioned that the law also aims to protect natural resources and biodiversity. Natural habitats refers to land and water areas where the biological communities are formed largely by native plant and animal species, and where human activity has not essentially modified the area's primary ecological functions. Critical habitats refers to a subset of both natural and modified habitat that deserves particular attention, such as habitats with high biodiversity value, including habitat required for the survival of critically endangered or endangered species.<sup>5</sup> Natural and critical habitats are important concerns in the environmental safeguards of hydropower projects. These are also not covered by the Water and Water Resources Law. These items deserve particular mention as the Lao PDR is a country with important intact biodiversity and primary forest cover that will surely be affected by poorly sited development projects.

#### **D. Decree on Involuntary Resettlement and Compensation (2005)**

29. A draft resettlement decree, the Decree on Resettlement and Compensation dated June 2003, was one of the outputs of the advisory technical assistance (TA) on Capacity Building For Environment and Social Management in Energy and Transport.<sup>6</sup> The decree was signed 2 years later, on 7 July 2005. A key reason for such delay related to the ongoing resettlement of upland people to lowland areas, ostensibly to foster economic development and in keeping with the government's forest area allocation, village consolidation, and opium eradication policy objectives. Little assistance was being provided to resettlers in the form of social services or public welfare, such as might be found in infrastructure projects assisted by development partners. Hardships of policy-driven resettlement are no less severe than those generated by infrastructure projects, so the enactment of the decree effectively created a double standard. In any event, the law is labeled in English as the Decree on the Compensation and Resettlement of the Development Project, but what specifically is meant by "development project," as distinct from, say, a government policy, is not defined.

30. Comparing the draft with the signed decree, a number of discrepancies are noticeable. The draft is also accompanied by the 186-page Technical Guidelines for Resettlement and Compensation document, a certain version of which has been recognized in March 2010. In general, the decree leaves more issues open to interpretation than the draft. The first is the

<sup>5</sup> ADB. 2009. *Safeguard Policy Statement*. Manila.

<sup>6</sup> ADB. 2001. *Technical Assistance to the Lao People's Democratic Republic for Capacity Building For Environment and Social Management in Energy and Transport*. Manila (TA 3746, for \$600,000. approved on 22 October).

obvious simplification, for lack of a better term. Many of the omissions in the decree pertain to terms such as “social” and “ethnic”.

31. **Compliance with safeguards.** In the draft the STEA (now the WREA) is assigned to “issue” guidelines, and in the decree it is assigned to “provide guidance.” The requirement as per the draft has given way to authority in the decree. But as skills sets within the STEA (WREA) remain inadequate, it is not in a position to fulfill its mandated oversight role to ensure compliance with social safeguards.

32. Article 15.2 of the decree states that “the project owner shall implement correctly the recommendations made by responsible government authorities.” STEA (WREA) and the DOE (of the Ministry of Energy and Mines [MEM]) have insufficient expertise to provide specific recommendations to project developers. Furthermore, the initial social assessment, social assessment, ethnic minority development plan, etc. must all be approved by “government authorities” as well, i.e., by the STEA (WREA), which does not have sufficient expertise. Article 15.3 also calls for procedures and methodologies for social impact assessments as per the “detailed regulations and guidelines,” which have never emerged officially in the 5 years that have passed since the decree was signed. It is also noted that in the NPESHHS (Clause 6), safeguard compliance is to be ensured through regular monitoring, reporting, and oversight from third-party agencies. So while the decree and the NPESHHS are not contradictory on this count, the NPESHHS is a much stronger document.

33. **Consultations.** Although Article 12 in the decree and Article 13 in the draft on public consultation are identical, both essentially allow developers to carry out pro forma consultations where projects are described and announced with little participation. Clause 4 of the NPESHHS on consultation is much more specific and calls for “free, prior, and informed consultations” and for consultations that are “meaningful, balanced, and transparent”. The technical guidelines are also quite thorough, and if applied can provide for a better consultative process.

34. **Ethnic minorities.** In the draft resettlement decree, ethnic minorities are one possible category of vulnerability. However, the possibility that some ethnic groups are vulnerable while others are not, or that vulnerability can be based on ethnicity, is considered neither in the decree nor in the technical guidelines. It is clear that if the technical guidelines on involuntary resettlement are to be actually applied in support of the decree, there would be no benefit to the hunter-gatherer populations of the Nam Theun 2 project or the Theun-Hinboun Hydropower Project.

35. Although the decree does mention ethnic minorities, it offers no definition; ethnic minority development plans are also mentioned, but what triggers the need to prepare such plans remains unclear. The technical guidelines are also deficient as they allow for the ethnic minority development plan to be optional, for instance, “where some ethnic minority groups are integrated socially and economically with the mainstream population, and such is confirmed by the initial social assessment and subsequent social assessment studies, a separate ethnic minority development plan will not be necessary.” The meaning of social and economic integration is not defined—the judgment is left to the developer or their contractors. For example, in the watershed documentation for the Nam Theun 2 project, villagers there were said to be socially integrated, when in fact inequality between groups and ethnocentrism were well attested to.

36. **Cultural preferences.** Cultural preferences finds mention in Article 11 of the decree, which states that project owners shall consider local culture and religious practices and beliefs

(i.e., with no other action implied), and that project owners shall define mitigation measures which shall be decided in consultation with affected communities. As a result, the degree to which the cultural preferences and customary practices will be acted upon in the tasks of compensation and economic rehabilitation remains ambiguous.

37. In the decree and the draft, compensation and economic rehabilitation are defined only in physical terms (in terms of providing housing and other means of earning a livelihood). But even here, capacity to monitor and evaluate economic studies is lacking at the STEA (WREA). Although the decree, draft, and involuntary resettlement safeguards all call for the improvement or maintenance of pre-project living standards, in practice the mechanics of a before-and-after comparison are not well established, and can largely be adjusted to meet developer needs.<sup>7</sup> Furthermore, such issues as level of effort, length of work time, and quality of life are not considered in the technical guidelines. In any event, the psychological and mental aspects of resettlement are not considered. For instance, the decree does not recognize the trauma faced by project-affected peoples that results from “space intensification”.

38. Finally, the decree is only an outline of the parameters of resettlement and compensation. The essence of the work to be undertaken is contained in the technical guidelines. The government has amended the guidelines and published them as late as in March 2010. Thus, for hydropower projects in which Asian Development Bank has been involved, safeguard policies of Asian Development Bank and other financiers have formed the basis of practice.

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<sup>7</sup> For example, how can a non-timber forest product-based livelihood be compared to one based upon wet rice paddy cultivation without imposing ad hoc assumptions of value?

## INSTITUTIONAL STRENGTHENING FOR MANAGING THE ENVIRONMENTAL AND SOCIAL IMPLICATIONS OF HYDROPOWER PROJECTS

### A. Organizations and their Mandates

#### 1. Government Bodies

1. For implementing environmental and social safeguards in the hydropower sector, the government institutions involved are the Department of Electricity (DOE) of the Ministry of Energy and Mines (MEM); Electricité du Laos (EdL), the public utility; the Ministry of Agriculture and Forestry; and the Water Resources and Environment Administration (WREA), as the regulator.

2. **Water Resources and Environment Administration.** Previously, various ministries, agencies, and provincial and district authorities were involved in the water sector. The government addressed this fragmentation in May 2007 by the issuance of a prime minister's decree<sup>1</sup> on the creation of the WREA. This was considered an institutional strengthening step in environmental protection and the management of water resources. The WREA was established following the reorganization of the Science, Technology and Environment Agency. It comprises the following departments: Water Resources, Meteorology and Hydrology, Environment, Environment Impact Assessment, Water Resources and Environment Research Institute, and Lao National Mekong Committee Secretariat. The creation of the WREA at the central level was also accompanied by the formation of its provincial units.

3. The WREA is an authority under the Prime Minister's Office and has the mandate to act as an advisory body to the government for macro-management on water resources, environment, meteorology, and hydrology activities throughout the country (Article 2 of WREA decree). It has wide-ranging duties and jurisdiction related to these aspects and has the power to issue or terminate the operating licenses related to water resources, environment, meteorology, and hydrology.

4. The WREA's duties, as defined in Article 3 of the prime minister's decree, include (i) developing, and proposing to the government for approval, plans for sustainable water resources and environmental management, protection, and rehabilitation; (ii) auditing, certifying, and adopting reports on social and environment impact assessments before approving development projects and other activities; and (iii) coordinating with sector and local authorities to ensure that the proposed developments are aligned with water resource management and environmental protection objectives in the whole country.

5. With its wide mandate, the WREA is a powerful and important institution in the hydropower sector. It is the main institution for the implementation of both the Water and Water Resources Law and the Environmental Protection Law. Its jurisdictions include monitoring projects that cause negative impacts to water resources and environment. It may use measures to compel project owners to comply with the laws and may terminate the operating licenses if warranted (Article 4).

6. However, some entities such the International Rivers have expressed doubts on whether the WREA can effectively perform its function, and provide the following observations: (i) the

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<sup>1</sup> Prime Minister's Office. Lao People's Democratic Republic (Lao PDR). 2007. *Decree on the Establishment and Activities of the Water Resources and Environment Administration*. Vientiane.



WREA often has not approved the social and environmental plans for dams before construction begins, (ii) dam builders are not being required to provide sufficient funding to address negative impacts on villages, and (iii) the WREA does not have the funding and staff to monitor dams during construction or operation.<sup>2</sup>

7. **Ministry of Energy and Mines.** The DOE within MEM has overall responsibility for power sector development. Its primary responsibility for policy formulation and strategic planning is undertaken jointly with the WREA and other agencies. As the responsible line ministry for hydropower, the MEM issues guidelines or regulations for the environmental impact assessment (EIA) mechanism on the basis of the Environmental Protection Law. However, the DOE monitors environmental impacts and implementation of the environmental management plans only in cooperation with the WREA and other relevant ministries, agencies, and local authorities. At a broad level, the roles and responsibilities of the MEM and WREA regarding environmental and social issues are quite clear. While the WREA has the mandate to enforce the Environmental Protection Law, the MEM has the mandate, as provided for by the Electricity Law (1997),<sup>3</sup> to ensure that the electricity enterprises are productive, technically safe, protect the environment, and are in compliance with existing laws and regulations. The inspections conducted by the MEM on hydropower facilities and operations are therefore within the context of conducting an overall inspection. Consequently, the inspections for the environmental aspects are jointly conducted with the WREA, since Article 49 (Technical Inspection Committee) of the Electricity Law provides that the government may create a technical inspection committee comprising the MEM and other agencies and ministries. The law further provides, under item 8 of Article 43 (Rights and Duties), that the MEM shall coordinate with other parties and local administration authorities in the administration and inspection of electricity enterprises.

8. However, the precise division of expertise or level of effort required from the DOE and the WREA remains unclear. The World Bank is reportedly working on delineating the roles of the DOE and WREA at the center (and their corresponding bodies at the provincial and local levels). The findings from this work are not yet known.

9. **Electricité du Laos.** Under the MEM, EdL is the premier state-owned public electricity utility in the Lao People's Democratic Republic (Lao PDR). It also manages electricity imports to its grids and electricity exports from its generating stations. It is the implementing agency for the government's main generation, transmission, and distribution projects. It holds the government's shares in independent power project investments such the Theun-Hinboun Power Company and Houay Ho Power Company. A review of the Lao PDR's independent power project institutional restructuring in 2006 revealed that the power sector institutions, including EdL, generally lack the resources, skills, and experience to manage the upsurge in independent power project activity.<sup>4</sup> EdL has very little coordination with the Department of Water Resources (DWR) of the WREA. The DWR has the overall mandate on water resources management, while EdL has a project development role and is the implementing agency for several government hydropower power projects. With this role, EdL needs to interact with the DWR on issues concerning evaluation and monitoring of water resources, a database system for water resource management, and integrated water resource management. These areas are part of the mandated duties of the DWR. EdL, with its project development role, needs to interact with the DWR on the evaluation and monitoring of the water resources where its hydropower plants are located. Data generated by EdL's water resources monitoring can be shared with the DWR

<sup>2</sup> International Rivers. 2008. *Power Surge – Executive Summary*, Berkeley, September.

<sup>3</sup> National Assembly. Lao PDR. 1997. *Law on Electricity*. Vientiane.

<sup>4</sup> Maunsell-AECOM. 2006. *Lao IPP Development and Institutional Restructuring*. Final Report. Vientiane.

for its water resources database system. Similarly, EdL can benefit from the outputs of DWR's database system. The information will be useful for the operations of EdL's hydropower plants. In integrated water resource management, EdL needs to interact with the DWR since, in river basins where it has hydropower plants, it is an important stakeholder and will be part of river basin committees to be established.

10. **Ministry of Agriculture and Forestry.** One of the general functions of the Ministry of Agriculture and Forestry is to develop policies and plans in water-related sectors and to manage watersheds. It has the following departments: Forestry, Irrigation, Livestock and Fisheries, Planning, National Agriculture and Forestry Extension Service, and National Agriculture and Forestry Research Institute. The Department of Planning has the Integrated Watershed Management Unit, which promotes watershed management and rural development planning on a subwatershed areas basis. The unit supports provinces and districts with data analysis and generation of maps for district integrated watershed planning. The management unit has shown its ability to prepare watershed profiles when it prepared the individual profiles of various watershed sub-basins of the Nam Ngum River Basin under the Nam Ngum River Basin Development Sector Project.<sup>5</sup>

## 2. Subregional Body

11. **Mekong River Commission.** An important regional institution that has relevance to the Lao PDR's hydropower sector is the Mekong River Commission. The 1995 Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin<sup>6</sup> provides a legal framework for cooperation between the four riparian countries (Cambodia, Lao PDR, Thailand and Viet Nam). In 1996, Myanmar and the People's Republic of China also became dialog partners of the Mekong River Commission and the six countries now work together within a cooperation framework. The commission's goals for 2006–2010 are to promote and support coordinated, sustainable, and pro-poor development; enhance effective regional cooperation; strengthen basin-wide environmental monitoring and impact assessment; and strengthen the integrated water resources management (IWRM) capacity and knowledge base of the Mekong River Commission bodies, national Mekong committees, line agencies, and other stakeholders.

12. The primary function of the Mekong River Commission is to generate and disseminate information related to hydropower development.<sup>7</sup> Other functions include providing policy advice, carrying out sector plans and studies up to the pre-investment level, monitoring hydropower-related activities in the basin and promoting transparency in the hydropower planning and development process, strengthening the planning and implementation capability of entities in the member countries through training, and serving as a vehicle for promoting cooperation and collaboration among the riparian countries and in the region with respect to hydropower issues.

13. Recognizing that hydropower is an important resource of the Mekong Basin and has the potential to satisfy growing national and regional electricity needs, the Mekong River Commission approved its Hydropower Strategy in 2001 and drafted a concept note for a hydropower program in 2005. It eventually started the crosscutting Initiative on Sustainable Hydropower and prepared a draft work plan with an estimated budget of \$7.3 million for the 4-

<sup>5</sup> Water Resources and Environment Administration. 2008. *Nam Ngum River Basin Profile*. Vientiane.

<sup>6</sup> Mekong River Commission. 1995. *Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin*.

<sup>7</sup> Mekong River Commission. 2009. *Work Plan of Initiative on Sustainable Hydropower (Draft 1)*. Vientiane.

year period 2008–2011. The aim of the initiative is to facilitate implementation of the 1995 Mekong Agreement in the hydropower sector.

14. The Mekong River Commission incorporates two principal types of activities in its proposed work plan: (i) as facilitator of dialogue at different levels on key issues facing the hydropower sector; and (ii) as creator of knowledge relevant to sustained hydropower development. The commission's hydropower initiative is also tackling the issue of how far the physical barrier effect of mainstream dams can be minimized or successfully mitigated. The commission has played an active role by initiating a program to prepare the Basin Development Plan, which aims to identify, categorize, and prioritize projects and programs at the basin level.<sup>8</sup> The program guides the implementation of IWRM at basin, national, and sub-basin levels, and assists line agencies with preparation of plans and projects that are sensitive to resource protection issues. The IWRM-based Basin Development Plan is to be prepared by integrating the development scenarios, IWRM-based basin strategy, and project portfolio into a coherent and consistent plan.

15. In the Basin Development Plan, the Mekong River Commission also considers transboundary impacts. Its study on strategic directions for IWRM considers early identification of environmental consequences of development options using strategic environment assessment and cumulative impact assessment approaches so that mitigation measures can be included in feasibility studies.<sup>9</sup> It also refers to the availability of a shared Mekong River Commission information system to provide reliable information in key areas such as the notification and prior consultation of proposed developments that may have transboundary impacts. The commission will help build links with project developers to promote sharing of hydro-meteorological and reservoir monitoring data for projects having transboundary downstream impacts. The Mekong River Commission information system is part of its information and knowledge management program designed to facilitate access to and use of data, information, and decision support tools. Its hydrological information system monitors a network of measuring stations along the Mekong River which transmit real-time information on water levels for river monitoring and other uses (footnote 8).

16. A specific transboundary impact is sediment transport changes caused by dams. The Mekong River Commission's preliminary design guidance for proposed mainstream dams includes sediment transport as one of the main topics.<sup>10</sup> It highlights the potential for long-term sediment and nutrient flow changes in the downstream Mekong River system in relation to cumulative effects of dams in a cascade, and cites the potential transboundary impacts on the ecosystem functions and productivity in the Tonle Sap basin of Cambodia, as well as the long-term stability of the Mekong delta. Dams in a cascade have the combined potential of reducing the amount of sediments traveling downstream and causing adverse physical and ecological impacts. Dams will also cause transboundary impacts due to flow pattern changes. A cumulative impact study of the Mekong River regarding the impacts of planned hydropower developments in all Greater Mekong Subregion countries showed that the short-term (5 years) transboundary changes in flow pattern will have a small negative impact on floodplain and

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<sup>8</sup> Mekong River Commission. 2010. *Basin Development Plan*. Available: <http://www.mrcmekong.org/programmes/bdp.htm>

<sup>9</sup> Mekong River Commission. 2005. *Strategic Directions for Integrated Water Resource Management in the Lower Mekong Basin*.

<sup>10</sup> Mekong River Commission. 2009. *Preliminary Design Guidance for Proposed Mainstream Dams in the Lower Mekong Basin*. Vientiane.

fisheries of the Tonle Sap basin in Cambodia.<sup>11</sup> However, the long-term (20 years) transboundary changes show that there is a significant negative impact.

## **B. Towards Enhancing Institutional Links and Skills Base**

17. The macro or higher-level studies that are required to better understand project sustainability and viability issues include (i) cumulative impact assessments that analyze the combined impacts of more than one hydropower project or more than one type of investment project (e.g., hydropower plant, highway, mine); (ii) integrated river basin development plans that analyze the combined impacts of development of all/multiple potential hydropower plant sites and other infrastructure projects in a river basin; (iii) IWRM that focuses on the water-related aspects (pre-project and project water uses, quality and flow rates of water discharges, project or cumulative impacts on water use) of hydropower projects and other development projects; and (iv) strategic environment assessments that analyze the impacts of adopting a development policy or initiating a subregional, countrywide, or provincial/area-wide program in a specific sector or subsector. The WREA acknowledges that it is best positioned to carry out such higher-level studies, and recognizes the need for formal links with line ministries for sharing information and findings. Efforts to institute such links are in the process of being developed with development partner assistance.

18. Project-level studies are reviewed by the MEM (DOE) and certified by the WREA. Both the WREA and DOE recognize the considerable potential for improving the review process and certification criteria.

19. At the project level, the DOE has issued guidelines for environmental and social assessments of hydropower projects and other studies to be conducted at the feasibility stage (collectively referred to as environmental and social studies).<sup>12</sup> The WREA's mandate includes the certification of environmental and social studies, for which the DOE is required to contribute to precertification analysis and screening. In conjunction with the DOE, the WREA is also required to do monitoring and evaluation of environmental management plan (EMP) implementation and environmental and social impacts during construction and operation. A decree on environmental and social impact assessment and monitoring, which is based on DOE guidelines, was also issued in early 2010.<sup>13</sup> However, the precise division of expertise or level of effort required from the DOE and WREA remains unclear. The sector assistance program evaluation (SAPE) mission is given to understand that the World Bank is working on clarifying the roles of the DOE and WREA at the central, provincial, district, and village levels. The findings and recommendations of this work remain to be firmed up. In any case, the combined capabilities of the WREA and DOE fall short of requirement. For instance, within the WREA's Department of Environment and Social Impact Assessment, there are 14 personnel (as of January 2010) in the unit responsible for certifying the EIA and social impact assessment studies for hydropower projects. More than 10 of these 14 staff graduated with an undergraduate degree in environmental sciences from the local university in 2008 or 2009, and none of them have a social sciences background. The DOE team designated to work on environmental and social matters comprises eight staff, all of whom are electrical engineers. Moreover, in some instances the WREA has not been able to provide timely certifications before

<sup>11</sup> NORPLAN. 2004. *Cumulative Impact Analysis and Nam Theun 2 Contributions*. Final Report.

<sup>12</sup> In addition to the EIA, a social impact assessment, environmental management plan, social action plan framework, and watershed management plan are also required for large (more than 50 megawatt [MW] capacity) hydropower projects. For projects that may not have significant impacts, an initial environment examination is required along with a social action plan framework, environmental management plan, and watershed management plan.

<sup>13</sup> The decree was not made available to the sector assistance program evaluation mission.

dam construction begins, monitor dams during construction or operation, or ensure that dam builders allocate sufficient funding to address adverse impacts on affected human settlements.<sup>14</sup>

20. In recognition of the increasing requirements for review and certification of project-level studies conducted at the feasibility stage, and monitoring of hydropower plant construction and operations activities, the WREA has made efforts to increase staff strength since 2008. However, the WREA's inability to find an adequate number of personnel with the requisite education and experience is for reasons that go beyond the realm of the energy sector. The WREA has relied extensively on recruiting recently graduated students from the National University of Laos, and realizes that the skills and experience levels of in-house personnel are far short of what is required from certifiers.

21. Nonetheless, the WREA recognizes that it will be possible to appropriately manage in-house, the environmental and social aspects, only in the medium term. Among other initiatives, this calls for an improved university education system on environmental sciences, and the institution of a new degree program on relevant social sciences. The government may also need to attract returning Lao nationals who have foreign degrees in relevant environmental and social science disciplines. Over a period of time, as more people with requisite exposure and education become available, as institutional experience accumulates, and as more information becomes available from line ministries, the WREA will be in a position to aggressively begin building capacity for conducting higher-level studies.

### **C. Environment Protection Fund**

22. In 2007, the Asian Development Bank (ADB)-financed Environment and Social Program (ESP) loan was already closed,<sup>15</sup> but the weak institutional capacity and limited human resources in the Lao PDR continue to persist, despite successive efforts at capacity building, particularly within the energy and transport sectors and institutions. These concerns remain till date. However, the ESP loan made important contributions to strengthening the regulatory framework for environmental management and social safeguards measures of sector agencies. It was instrumental in the review of institutional arrangements for environmental management, made to determine whether adjustments were warranted in institutional mandates, structures, and relationships, and to assess long-term institutional development needs. It resulted in the decision to elevate the STEA (now the WREA) initially to subministry status, to be followed by more reflection on the ultimate role and position of the STEA, possibly elevating it to the status of ministry or separate regulatory body.<sup>16</sup> It also laid the foundation for the longer-term and more comprehensive strengthening of the WREA's provincial units. The WREA is now the main institution for enforcing the water law and Environmental Protection Law.

23. Contributing to the strengthening of the environmental and water sector in general was the establishment of the Environmental Protection Fund (EPF) in the Lao PDR. This is similar to the financing mechanisms used by a large number of developed and developing countries to support their environmental management activities. Environmental funds are essentially financing mechanisms designed to receive funding from a variety of sources and then to channel those resources to support the implementation of environmental projects or activities.

<sup>14</sup> International Rivers. 2008. *Power Surge: The Impacts of Rapid Dam Development in Laos*. Berkeley. September.

<sup>15</sup> ADB. 2007. *Project Completion Report: Environment and Social Program (Lao PDR)*, Manila (Loan 1867-LAO).

<sup>16</sup> ADB. 2005. *Progress Report on the Release of the Second Tranche for the Environment and Social Program to Lao PDR*. Manila (Loan 1867).

24. Chapter V (Articles 30, 31, 32) of the Environmental Protection Law provides for the establishment, funding sources, and use of the EPF to support activities in the field of research and study, preservation, mitigation, and restoration of the environment, including the protection and preservation of natural resources. It also mandates a separate regulation to be issued for the EPF. The EPF shall be funded from the following sources: government budget, development projects and related activities, contributions from international and local agencies, contributions from the private sector and private individuals, and interest and profit accruing from the fund. The WREA has the jurisdiction to establish the EPF as mandated by the decree creating the agency.

25. The Environmental Protection Law mandates that the EPF shall be used for (i) mitigating urgent and pressing environmental issues; (ii) projects related to scientific and technological research on environmental protection, plans concerning the management, monitoring, and control of the environment, and implementing other environmental protection legislation; (iii) promoting education, training, and environmental awareness raising; (iv) supporting campaigns for environmental preservation such as World Environment Day, National Arbor day, and National Fish Release Day; and (v) managing the fund.

26. With support from the ESP loan, the Government of the Lao PDR adopted a decree establishing the EPF in 2005 as an umbrella fund that allows for the establishment of specialized financing windows to support specific objectives related to environmental protection and natural resource conservation.<sup>17</sup> It has been operational since 2006. An executive director and deputy director manage the EPF with 25 staff, including highly qualified technical and environmental professionals.

27. The EPF has been intended to provide long-term targeted support for (i) capacity building and human resource development for environmental management and social safeguards; (ii) third-party monitoring of environmental and social implications of complex and sensitive infrastructure projects; (iii) planning frameworks for integrated resource management; (iv) conservation and sustainable use of biodiversity; (v) participatory natural resource management initiatives; and (vi) enabling measures to ensure that environmental and social mitigation in energy, transport, and other large-scale infrastructure projects are in place and implemented.

28. The ESP initially capitalized the EPF with \$5 million. Interest from this endowment funded three specialized financing windows: pollution control, water resources management, and sustainable land management. The pollution control window funded activities on waste management in various districts. The water resources management window funded a study on riverbank erosion, while the sustainable land management window funded a study of a reservoir for drought protection.<sup>18</sup> Two specialized EPF windows were also established under the World Bank-funded Lao Environment and Social Project with a grant of \$4.0 million and a government contribution of \$0.8 million. Policy implementation and capacity enhancement is the first of the two windows and is intended for implementing policy and enhancing national, provincial, and district capacities to strengthen (i) policy formulation and implementation of environmental and social safeguards; (ii) environmental assessment and monitoring, as well as compliance, by institutions engaged in environmental management; (iii) integrated river basin management of the Nam Theun–Nam Kading River Basin; (iv) hydropower sector sustainability; (v) resettlement management; and (vi) environmental education and awareness. The second window is community and biodiversity investment, intended for community and biodiversity investments to support various initiatives.

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<sup>17</sup> Prime Minister's Office of Lao PDR. 2005. *Decree on the Environment Protection Fund*. Vientiane.

<sup>18</sup> Environment Protection Fund. 2009. *EPF Annual Report 2008*. Vientiane.

29. The EPF prepared a 5-year strategic plan (2006–2010) outlining its support for key priorities identified in the National Strategy on Environment and Action Plan, the National Biodiversity Strategy and Action Plan, the Forestry Strategy and Action Plan, and other strategic programs adopted by the government. The EPF strategic plan, with a total budget of \$6.7 million, focuses on ensuring the following priorities: (i) developing partnerships with different government agencies, development partners, and the private sector to guide and support the EPF; (ii) demonstrating sound financial management of the EPF to create confidence in the EPF by all government and development partner agencies; (iii) developing a mix of instruments to provide financial support to a wide range of stakeholders; (iv) supporting priority concerns for environmental protection in the Lao PDR; and (v) establishing an adequate monitoring and supervision system to ensure compliance with the EPF operating principles.<sup>19</sup>

30. With the problems of weak institutional capacity and limited human resources in the Lao PDR persisting, the EPF will always be an attractive funding source for capacity building and human resource development for environmental management and social safeguards. With more hydropower projects to be implemented and external pressure to be transparent in environmental management and social safeguards, the fund will play an important role in funding the government's third-party monitoring of environmental and social implications of complex and sensitive infrastructure projects. If the Government of the Lao PDR can leverage additional sources of funding, the role of the EPF can be intensified in the future.

31. Since the EPF is allowed by its decree to receive funds from development projects and related activities (Article 12), the government has required new hydropower concession agreements to have provisions for contributing funds to the EPF. The first of such contributions will come from the Theun-Hinboun Hydropower Expansion Project with a contribution of \$200,000 per year. Forty mining concession agreements will also be required to contribute \$10,000 each to the EPF annually. It is also contemplated that the EPF will seek contributions from the private sector and private individuals.<sup>20</sup>

32. However, sustainability is always a concern for any environmental fund—not all environmental funds have been successful, as shown in the experience of other countries. Sustainability of the EPF rests primarily on the continued flows of funds and effective management. There are many pitfalls that an EPF should avoid and some good points to adopt, as cited by the previous study in developing the fund.<sup>21</sup> These include the following:

- (i) most successful environment funds have their boards of management with wide, carefully balanced representation of key stakeholders without any single stakeholder group dominating and keeping the size of the management board to a reasonable number;
- (ii) best practices are based on establishing clear objectives, responsibilities, and performance standards up front, giving fund managers significant operational autonomy for day-to-day decisions and holding them strongly accountable for results and performance;
- (iii) the fund should not always attempt to finance 100% of the cost of a project or activity and should instead seek to leverage additional sources of funding;
- (iv) the fund should aim to require cofinancing by introducing percentage limits on the maximum share of investment expenditure that can be financed by the fund; and

<sup>19</sup> Environment Protection Fund. 2007. *EPF Five-Year Strategic Plan*. Vientiane.

<sup>20</sup> Discussions with the EPF executive director on 27 January 2010.

<sup>21</sup> ADB and STEA. 2002. *Designing the Lao Environment Protection Fund: Issues and Options*. Manila.

- (v) if user and polluter fees are implemented, the environment fund should not be given the responsibility of collecting revenues from users and polluters. This will avoid focusing most of the staff time and resources on collecting revenues.

#### D. Key Identified Needs

33. Compliance with the requirements of environmental impact assessments remains a challenge. This inadequacy was officially acknowledged in 2004, when the implementation of some hydropower projects without prior detailed studies was cited—one of the key issues in the hydropower sector at that time.<sup>22</sup>

34. This situation has persisted and is evident in the Nam Ngum River Basin, where certain hydropower plants under construction are reported<sup>23</sup> to have poor compliance with EIA requirements. For instance, the Nam Ngum 5 project is under construction despite the poor quality of its environmental and social assessments. International Rivers' claim that the Nam Ngum 5 has a poor-quality EIA was based on its review of the project's EIA<sup>24</sup> posted on the website of the Multilateral Investment Guarantee Agency. The EIA's conclusion that the Nam Ngum 5 project will not have any significant impact on aquatic habitats is not supported by evidence.

35. However, the compliance situation for the Nam Theun 2 project is very different, where the project proponents have made major efforts to comply with environmental and social safeguards requirements. A comprehensive approach to social and environmental risk mitigation was adopted in the preparation and implementation phases of the project. Supporting documents for loan processing in ADB<sup>25</sup> and the World Bank<sup>26</sup> for the Nam Theun 2 hydropower project claimed that adequate environmental baseline data on the physical environment, aquatic habitats, fish diversity, terrestrial biodiversity, and protected areas were collected as part of the EIA process with a comprehensive baseline study of aquatic resources in the Xe Bang Fai River, and these are to be continued through the operation phase. Its extensive mitigation, compensation, and contingency measures to address environmental and social impacts are unprecedented in the Lao PDR, if not in the region.

36. **Need to increase human resources.** At the feasibility study stage, the WREA and DOE have to review the hydropower EIAs and EMPs, and expertise is required to assess the quality of these documents. A rigorous review should capture their shortcomings, particularly the inadequacies of baseline studies, impact identification, and mitigation measures. Reviewers should be able to identify the deficiencies and make specific recommendations for supplementary studies to be done.

37. Reviewing EIAs of hydropower projects requires a wide range of expertise due to the complexity of environmental topics that may include environmental impact assessment on the following: ecologies of the rivers and riparian areas, important species habitats, fisheries and fish migration, wildlife and forestry, watershed activities and reservoir sedimentation, sediment transport of the rivers, river erosion, downstream hydrogeology, water quality, risks and safety,

<sup>22</sup> STEA. 2004. *National Biodiversity Strategy to 2020 and Action Plan to 2010*. Vientiane.

<sup>23</sup> International Rivers. 2008. *Power Surge – Case Study Five: Nam Ngum River Basin*. Berkeley.

<sup>24</sup> Dongsay Company. 2007. *Environmental Impacts Assessment – Nam Ngum 5 Hydropower Project*. Available at [http://www.miga.org/news/index\\_sv.cfm?stid=1506&aid=1640](http://www.miga.org/news/index_sv.cfm?stid=1506&aid=1640)

<sup>25</sup> ADB. 2005. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the Lao People's Democratic Republic for the Greater Mekong Subregion: Nam Theun 2 Hydroelectric Project*. Manila.

<sup>26</sup> World Bank and Multilateral Investment Guarantee Agency. 2005. *Project Appraisal Document for the Nam Theun 2 Hydroelectric Project*. Washington, DC.



hydrology and flooding, environmental flows, environmental health, initial water releases from reservoirs, reservoir greenhouse gas generation, transbasin implications, and construction impacts. The reviewers have to examine if the initial and long-term adverse impacts are properly addressed in the EIA and EMP documents. Special expertise in each field is required to perform an adequate review. For example, in impacts to aquatic habitats, the expert is not simply a biologist but someone who has good understanding of the impacts of river flow and water quality modifications to aquatic habitats and organisms.

38. During construction, the environmental management unit of the project developer supervises the construction contractor on matters relating to EMP implementation. The WREA interacts with, and receives reports from, the unit. This interaction requires competent personnel in the WREA, since the staff have to review and verify the reports and shall require the environmental management unit to address issues that are deemed to have been inadequately handled. The WREA also has to monitor the impacts of all existing hydropower projects to ensure that these are within acceptable levels and may require corrective actions. Again, these activities require staff with expertise on environmental monitoring.

39. **Data acquisition and data management needs.** The present situation in water resources data acquisition and management is quite fragmented, as described by the Lao PDR's National Water Resources Profile which contains an overview of the water resources sector.<sup>27</sup> Various agencies perform data acquisition and management activities. No organization is effectively coordinating and compiling data nationally, and no central source (database) for water resources data exists. Water resources data held by different agencies is often dissimilar in terms of quality, format, and other characteristics. Specific and accurate data is difficult to obtain. The general performance of the water resource information system is poor and inefficient, as the responsibilities of agencies for data acquisition and management are poorly defined.

40. With this situation, it is obvious that planning for river basin management would be a daunting task, as it entails a comprehensive assembly and modeling of data from all relevant domains. The process must consider social, economic, and environmental needs using a range of assessment tools. Without the necessary data, this would be very difficult, if not impossible, to do. The difficulty of obtaining good data can be seen in the preparation of the cumulative impact assessment report of the Nam Ngum 3 hydropower project.<sup>28</sup> The report contains phrases describing the data situation as being incomplete, uncertain, not consistent, or even contradictory.<sup>29</sup>

41. **Financial sustainability.** Most funds for public infrastructure come from external sources through soft loans and grants from bilateral and multilateral agencies, and financial sustainability is one of the operational challenges for the WREA. It has a certain budget for staff salaries that is augmented by external financial support for ongoing operations and special activities. Budgetary limitations have also led to poorly equipped departments. Although the EPF in theory can address this problem, it remains to be seen whether it will be sufficient to create a sustainable funding base for environmental and water resource management activities.

<sup>27</sup> Water Resources and Environment Administration. 2008. *National Water Resources Profile*. Vientiane.

<sup>28</sup> Vattenfall Power Consultant AB and others. 2008. TA Consultant's Report for *Preparing the Cumulative Impact Assessment for the Nam Ngum 3 Hydropower Project. Components A, Parts 1 and 2. Final Cumulative Impact Assessment Report (Main Report)*. Manila. ADB.

<sup>29</sup> In calculating for simplified efficiency indicators for the development scenarios in the Nam Ngum basin, incomplete data sets were used and the authors stated that there were many uncertainties in the basic data. The authors also cautioned the readers that all main parameters for the hydropower plants used in the study are very uncertain and most of the plants have multiple studies available, often with contradictory data.

## FINANCIAL, COMMERCIAL, AND INSTITUTIONAL ASPECTS OF THE NAM THEUN 2 HYDROPOWER PROJECT

### A. Capital Cost and Financing Structure

1. Asian Development Bank (ADB) financial support to the Nam Theun 2 Hydropower Project is (i) \$20 million of sovereign loan towards meeting the equity share contribution of Lao Holding State Enterprise (LHSE), the government's nominee; (ii) \$50 million of nonsovereign loan to the project company, the Nam Theun 2 Power Company (NTPC); and (iii) a political risk guarantee for up to \$50 million to mobilize commercial debt. Both the sovereign and nonsovereign loans were from ADB's ordinary capital resources. The sovereign loan of \$20 million has a 30-year term, including a grace period of 6 years.

2. Given the potentially large and adverse environmental and social implications of the Nam Theun 2 Hydropower Project, its financing structure reflects (i) the need for strong commitment from the development community, as evident from dollar debt and political risk guarantees on debt from commercial sources, offered by the World Bank Group, ADB, and Coface; (ii) the small risk-taking appetite of the commercial sources of funding (debt had to be raised from nine international private commercial banks and seven Thai lenders); and (iii) the high risk perception up front, as the financing plan needed to be finalized up front (to reach financial closure), not only for the base cost (tranche A) but also contingent funds (tranche B) of up to \$200 million. While the overall debt–equity ratio in the base cost was 72:28, in the contingency funds it was 50:50 (Table A5.1).

**Table A5.1: Project Cost and Financing Plan**  
(\$ million)

Tranche	Source	Amount
<b>Tranche A (Base) Financing</b>	<b>Equity</b>	<b>350.0</b>
	- Electricité de France International	122.5
	- Lao State Holding Enterprise	87.5
	- Electricity Generating Company (Thailand)	87.5
	- Italian-Thai Development Company (Thailand)	52.5
	<b>Debt</b>	<b>900.0</b>
	- ADB Direct Loan	45.0
	- US dollar commercial lenders (ADB guaranteed)	45.0
	- US dollar commercial lenders (IDA guaranteed)	45.0
	- US dollar commercial lenders (MIGA guaranteed)	45.0
	- US dollar commercial and export finance lenders (Coface guaranteed)	166.5
	- Agence Française de Développement	27.0
	- Nordic Investment Bank	27.0
	- PROPARCO	27.0
- Thai EXIM Bank	22.5	
- Thai commercial lenders (dollar equivalent of baht debt)	450.0	
	<b>Total</b>	<b>1,250.0</b>
<b>Tranche B (Contingency) Financing</b>	Equity	100.0
	Debt, comprising	100.0
	- ADB Direct Loan	5.0
	- ADB Guaranteed Loan	5.0
	<b>Total</b>	<b>200.0</b>
<b>Tranche A + B</b>	<b>Total Financing</b>	<b>1,450.0</b>

ADB = Asian Development Bank, EXIM = Export-Import Bank, IDA = International Development Association, MIGA = Multilateral Investment Guarantee Agency, PROPARCO = Promotion et Participation pour la Coopération Economique.

Source: ADB. 2005. *Report and Recommendations to the President to the Board of Directors: Proposed Loan and Political Risk Guarantee, Greater Mekong Subregion, Nam Theun 2 Hydroelectric Project in Lao People's Democratic Republic*. Manilla (March).

## B. Power Purchase Agreement

### 1. Power Purchase Agreement with the Electricity Generating Authority of Thailand

3. **Duration.** The NTPC and Electricity Generating Authority of Thailand (EGAT) signed a power purchase agreement (PPA) in November 2003 for the sale of 5,354 gigawatt-hours (GWh) of electricity per year for 25 years following the start of commercial operations.<sup>1</sup> As per the PPA, the NTPC's main obligation is to declare and make available generating capacity and electrical energy to EGAT. EGAT's main obligation is to purchase 95% of the electrical energy declared and made available on a take-or-pay basis.

4. **Tariffs.** Tariffs are fixed for each year (including a reasonable provision for inflation), and are divided into primary energy and secondary energy tariffs. The primary energy is the energy that the NTPC delivers from 6 a.m. to 10 p.m. Monday through Saturday. Secondary energy is the energy that the NTPC delivers at any other time. Secondary energy 2 is dispatched in excess of that allocated to primary energy and secondary energy 1. The tariff currency payment mix mirrors the debt repayment profile and thus provides a natural hedge against exchange rate movements.

### 2. Power Purchase Agreement with Electricité du Laos

5. The PPA with Electricité du Laos (EdL) makes available to EdL 200 GWh per year on a take-or-pay basis. An additional 100 GWh is to be made available to EdL at its discretion. The EdL PPA will terminate at the same time as the concession agreement.

## C. Concession Agreement

6. The concession agreement dated 3 October 2002 between the government and the NTPC was amended from time to time until financial close in April 2005. The final concession agreement, that includes Concession Agreement Amendment No. 5 dated 25 April 2005, was finally signed on 11 November 2005. Its salient features are briefly discussed in paras. 7–17.<sup>2</sup>

7. **Rights granted to the Nam Theun 2 Power Company.** The NTPC was granted exclusive rights to plan, design, finance, construct, operate, and maintain the project facilities on project land. The economic life of facilities is deemed to be 100 years for the reservoir and dam, 50 years for underground works and transmission lines, and 30 years for electrical and mechanical plants.

8. To enable the NTPC to meet its obligations it was also granted water rights free of charge, which it may enforce against any person (including the government) that breaches the water rights, except that the government may draw water from the Nam Theun river and its catchment upstream of the reservoir, the reservoir, the regulating pond, and the downstream channel only for the purposes of local irrigation.

<sup>1</sup> The term of the PPA includes 1.5 years for the project to reach financial close, 4.5 years for construction, and 25 years of commercial operations.

<sup>2</sup> *Nam Theun 2 Hydroelectric Power Project Concession Agreement (2005 Financial Close) Consolidation between the Government of the Lao People's Democratic Republic and Nam Theun 2 Power Company Limited*. Sydney, Australia. 25 April 2005.

9. To give full effectiveness to the NTPC's rights of access to, and use and possession of, the project land given to the NTPC by the government, the NTPC was also granted rights to (i) install, operate, and maintain telecommunications systems; (ii) utilize wood obtained from logging trees or clearance from project lands for construction purposes; and (iii) quarry construction materials (including soil, sandstone, limestone, stone, gravel, and any other materials) from the quarry area for the purposes of the project.

10. **Payments to the government.** As compensation for the concession granted by the government to the NTPC, the government's loss of future benefit from the project lands, expenses incurred by the government for residual development, and pre-development expenditures including costs incurred in finalizing the concession agreement, the NTPC was required to pay to the government at the time of financial close \$20 million, plus \$10 million to cover the costs of LHSE overheads and operating costs, as well as contingency (tranche B) contributions under the shareholders' agreement.

11. The NTPC was required to reimburse out-of-pocket expenses (including air travel, local conveyance, boarding, lodging, incidental expenses, etc.) of selected government representatives as per certain normative rates. Such costs would be included as part of project costs.

12. The NTPC was given exemption from payment of land tax, customs duty on imported equipment, withholding tax, and natural resource tax or royalties on the cost of producing electricity for export (if any). Tax rates on taxable income were adjusted so as to make an effective tax rate zero (for 5 years from start of operation), 5% from year 6 through year 12, 15% from year 13 to year 18, and 30% from year 19 until the end of the concession period. During the construction and operations periods, no minimum tax would be imposed.

13. The NTPC is required to pay a resource user charge (royalty), which is applied on gross electricity sales revenue from exports plus domestic sales, at the following rates: 5.2% from start to year 15, 15% from year 16 to year 20, and 30% from year 21 through to the end of the concession period.

14. **Funding for environmental and social mitigations.** The NTPC is required to implement its environmental and social obligations, and ensure that the environmental monitoring and management plans of the head construction contractor and the NTPC do not cause a breach of the NTPC's environmental and social obligations. In the event the government considers (with the NTPC's consent) that some of the NTPC's environmental and social obligations can be implemented by the government, the government shall do so at the NTPC's cost, and the NTPC shall no longer be responsible for meeting those specific objectives. The NTPC's obligations are grouped into four parts: (i) the social component on the Nakai Plateau, the Nakai Nam Theun National Protected Area and other areas except the downstream areas, estimated at \$40.84 million; (ii) environmental management and mitigations, including water quality monitoring, wildlife preservation, erosion, and sediment control outside the Nam Theun 2 watershed area, estimated at \$1.58 million; (iii) compensation and resettlement of project-affected persons in downstream areas, estimated at \$16.00 million; and (iv) other mitigations under the purview of the Nam Theun 2 Watershed Management Protection Authority (WMPA) that include protecting and rehabilitating forest cover in the Nam Theun 2 watershed area, ensuring that the water has low sedimentation levels as it moves towards or away from the reservoir, preserving and promoting biological diversity (including rare or endangered birds and aquatic species), and improving the livelihoods of multiethnic peoples

living within the Nakai Nam Theun National Protected Area by focusing on poverty reduction through environmentally sustainable development.

15. The NTPC was required to pay the WMPA \$1.0 million at the time the concession agreement was signed to cover expenses up to the time construction commences. At the time of construction commencement, the NTPC was required to pay another \$1.5 million, and during the 4-year construction period, another \$1.0 million each year. As per the concession agreement, if the construction phase is extended by more than 6 months, the NTPC will be required to pay \$85,000 per each month of delay. During the operations phase, when the WMPA is required to implement a social and environmental management framework and operation plan, the NTPC is required to pay \$1.5 million (adjusted for inflation) each year.

16. If the NTPC determines that the budgeted amounts are not sufficient to permit implementation of the environmental and social objectives—in particular, that the cost of a specific mitigation activity exceeds the estimated cost—then it is required to draw upon the "overrun allowance." This allowance was initially set at \$2.5 million, with a proviso that at any time the unused amount can be readjusted as per the consumer price index (where the value of the index 6 months prior to the concession agreement date is set as the base). In the event the NTPC does not fulfill some of its obligations, the government may cash letters of credit that the NTPC is required to maintain, to implement those mitigations.<sup>3</sup>

17. If the NTPC or the government becomes aware of any unanticipated project impacts, it must promptly notify the other party as well as the environmental and social panel of experts and the dam safety review panel of experts. The government may also issue a notice (or notices) to the NTPC to further investigate and report further details on, or the status of, any unanticipated project impacts. Upon further investigations (but no later than 60 days), the NTPC is required to provide to the government, the environmental and social panel of experts, and the dam safety review panel of experts the details of the unanticipated project impacts. If the proposed or identified mitigations do not adequately address the unanticipated project impacts or the NTPC and government disagree on the required action, then (i) the environmental and social panel of experts may make comments or recommendations on those actions in respect of their environmental and social impacts; and (ii) the dam safety review panel of experts may also make comments or recommendations on those actions to ensure that the facility, the catchment area, and downstream areas of the Nam Theun and Xe Bang Fai rivers are safe and in compliance with the World Bank's Dam Safety Policy. The NTPC may then take the necessary action to diligently ameliorate and/or remedy the unanticipated project impacts. Unanticipated project impacts are limited to the amount of environmental insurance proceeds plus an aggregate amount of \$10.0 million (of which \$6.5 million is secured by letters of credit with the balance available directly with the NTPC).

#### **D. Public Expenditure Management Strengthening**

18. As per the concession agreement and the PPA, the government is to receive three streams of revenue from the project: taxes, royalties (resource usage charges), and dividends. In keeping with the provisions of the various project agreements and other suitable assumptions, the financial models at appraisal indicated that the Nam Theun 2 project would generate about

<sup>3</sup> No letters of credit have thus far been drawn upon or cashed for mitigation of environmental and social impacts. To draw upon these letters of credit requires the government to have determined that the NTPC has failed to comply with the environmental and social objectives, and the government to declare the termination of the event as such. To remedy this situation, the government has the right to draw upon the letters of credit if the NTPC has not otherwise agreed to remedy the situation to the satisfaction of the government and its advisers.

\$1.9 billion revenue for the government over the 25-year operating period as per the PPA, of which about \$1.2 billion would be royalties and taxes. ADB and the World Bank support for the Nam Theun 2 project also included a comprehensive public expenditure management strengthening program, which is to enable the government to use the three cash flow streams effectively and efficiently towards achieving the goals outlined in the National Growth and Poverty Eradication Strategy.

19. At appraisal in 2005, the government planned to put in place an elaborate system (Table A5.2) to ensure that its share of cash flows from the Nam Theun 2 project are actually channeled into eligible poverty reduction programs. Until commercial operations began at the end of April 2010, relatively minor amounts were transferred for such poverty reduction programs.<sup>4</sup> The first cash flows were resource usage charge payments (that become due to the government 15 days after the NTPC receives first payment from EGAT and EdL). It is not quite clear as yet whether the system will function as intended or need to be modified and streamlined over time.

**Table A5.2: System to Channel Government Cash Flows from the Nam Theun 2 Project into Poverty Reduction Programs**

<p><b>Allocation of government cash flows from the Nam Theun 2 project to eligible poverty reduction programs</b></p> <ul style="list-style-type: none"> <li>• The eligible programs may pertain to basic education; basic health care; rural roads; local development initiatives identified through a participatory planning process, including the poverty reduction fund; and environmental protection initiatives.</li> <li>• All eligible programs included in the list prepared by the government to meet the following main criteria: the program (i) is identified as a priority in the National Growth and Poverty Eradication Strategy, (ii) has a significant and verifiable poverty reduction impact, and (iii) has a significant and verifiable conservation or environmental impact.</li> <li>• Government cash flows from the Nam Theun 2 project are to provide additional resources to support eligible programs, and not substitute financing from other sources (additionality of budgeted and actual expenditures should be verifiable for eligible programs).</li> </ul>
<p><b>Flow of funds</b></p> <ul style="list-style-type: none"> <li>• Government cash flows from the Nam Theun 2 project are to be deposited in a dedicated account held at the Bank of the Lao PDR (the Nam Theun 2 Revenue Account), which will be managed by the Treasury.</li> <li>• The Treasury is to transfer funds from the Nam Theun 2 Revenue Account to the central Treasury account on a monthly basis for disbursement to implement the selected programs. The MOF may reallocate the transferred Nam Theun 2 Revenue Account funds between eligible programs.</li> <li>• The MOF is to prepare an annual statement of balances, receipts, and transfers for the Nam Theun 2 Revenue Account.</li> </ul>
<p><b>Reporting</b></p> <ul style="list-style-type: none"> <li>• Starting in FY2008, the MOF is to prepare and publish quarterly reports that provide information on expenditures for each eligible program.</li> <li>• The MOF's Inspection Department and other relevant departments are to conduct internal audits of eligible programs and, from FY2008, publish a summary report that outlines the financial management, control weaknesses and irregularities identified, noncompliance in terms of proper use of funds for eligible purposes, recommendations made to address such concerns, and management actions taken.</li> <li>• Starting in FY2008, the State Audit Organization is to publish annually an audit opinion on the statement of receipts and transfers of the Nam Theun 2 Revenue Account, as well as an audit opinion on the financial statements of eligible programs.</li> </ul>

<sup>4</sup> As per NTPC estimates (as of March 2010), the NTPC transferred \$270,000 as resource usage charge to the government in 2009. In 2010, this is projected to increase to about \$8.063 million.

**Monitoring and consultation**

- The PER and PETS, to be implemented collaboratively between the MOF and the LHSE, are to be an ongoing process.
- PERs and PETS are to be undertaken once every 2 years to assess (i) progress in implementing the expenditure management arrangements, (ii) progress in strengthening the public expenditure management system, (iii) efficiency and effectiveness of spending, and (iv) the impact of the eligible program expenditures.
- Annual consultations between the MOF and the LHSE on such matters will also continue.
- The government may also request support for PERs and PETS from ADB and other development partners.

ADB = Asian Development Bank, LHSE = Lao Holding State Enterprise, MOF = Ministry of Finance, PDR = people's democratic republic, PER = public expenditure review, PETS = public expenditure tracking survey,

Source: ADB 2005. *Report and Recommendations of the President to the Board of Directors: Proposed Loan to the Lao People's Democratic Republic for the Greater Mekong Subregion Nam Theun 2 Hydroelectric Project*. Manila (15 March).

**E. Lao Holding State Enterprise**

20. To improve the transparency of the government's investments in the Nam Theun 2 project, the government established the Lao Holding State Enterprise (LHSE), which was nominated as the government shareholder in the NTPC. The LHSE is owned 100% by the Ministry of Finance, and functionally works with the Ministry of Energy and Mines. Through its shareholding in the NTPC, the LHSE is entitled to 25% of the total dividends declared by the NTPC. The LHSE is required to transfer to the Nam Theun 2 Revenue Account (Table A5.2) the surplus it has after withholding tax, debt service payments, operating costs, and reserve fund accumulation requirements have been taken care of.

21. Financial projections prepared for the LHSE at appraisal to assess the LHSE's sustainability from NTPC dividend income showed that the LHSE would be able to manage its debt service payment obligations on the ADB and other loans; that, along with certain grants, enabled the government to contribute \$87.5 million, or 25% of the Nam Theun 2 project tranche A (base) equity.<sup>5</sup> If it is assumed that LHSE revenues will consist entirely of NTPC dividends, the financial modeling exercise at appraisal showed that the LHSE's return on equity would be a very attractive 38%. The return on equity computation took into account a 10% withholding tax to be paid to the government for any dividend receipts, the LHSE's operating costs, and debt service on the ADB and European Investment Bank loans.<sup>6</sup>

22. At the time of the Nam Theun 2 project appraisal, the total dividends paid to the LHSE over the concession period were projected to be \$640 million (in current prices), total debt service was projected to be \$124 million, and total operating expenses were projected to be less than \$4 million. Closer to the commercial operations date, during February 2010 the reworked and updated financial models indicated that the LHSE would transfer to the Nam Theun 2 revenue account a total of \$700 million (i.e., post-withholding tax dividends less debt service and operating costs, and less reserve fund accumulations) over the 25-year concession period.<sup>7</sup>

<sup>5</sup> The government/LHSE share of tranche A (base) equity came from an ADB loan (\$20 million), a European Investment Bank loan (€40 million), an Independent Development Agency grant (\$20 million), and an Agence Française de Développement grant (€5 million).

<sup>6</sup> Annual operating expenses were estimated (at time of Nam Theun 2 project appraisal) at about \$100,000, and included staff salaries, legal services, financial advisory service, accounting services, office rental, office supplies and services, and vehicle rental.

<sup>7</sup> In addition, it is also assumed that the LHSE will create a reserve fund by holding back 5%–10% of the amount available after meeting debt service payment obligations and operating costs. This is allowed as per domestic and foreign investment promotion laws.

During 2010, the total amount transferred is expected to be less than \$1 million, but this will rise to a maximum of \$45 million during the concession period.

23. Over a period of time, the LHSE is envisaged to take on equity interests in eight other projects (Table A5.3). However, of these projects, the Nam Ngiep 1 project as well as the three projects with Russian partners (Xekong 4, Xekong 5, and Nam Kong 1) are moving very slowly. For others, some progress is reported towards finalizing a PPA with the EGAT. The 440 MW Nam Ngum 3 project has reportedly made the most progress, and has negotiated a levelized off-take tariff with EGAT over a 25-year PPA period. Nonetheless, in each of the eight projects, the LHSE is expected to hold 20%–25% of the equity share.

24. Although the LHSE is envisaged to acquire a 25% stake in the lignite mine from which the 1,878 MW Hongsa Lignite plant is to source fuel, it is not clear whether the LHSE will acquire equity stakes in independent mining concessions, even though they fall under the purview of the same ministry as power plants (the Ministry of Energy and Mines).

25. A part of the LHSE equity contributions are expected to come from the reserve fund that LHSE plans to create from the Nam Theun 2 dividends. However, LHSE's own financial resources are limited, and LHSE would need to raise financing from commercial banks or development partners or other available sources. The government therefore needs to reassess LHSE participation in public-private partnership projects.

**Table A5.3: Lao Holding State Enterprise Investment Plan**  
(beyond Nam Theun 2 project)

<b>Project</b>	<b>Capacity (MW)</b>	<b>LHSE Shareholding (%)</b>	<b>Debt–Equity (%)</b>	<b>LHSE Equity (\$ million)</b>
Nam Ngum 3	440.0	23	70:30	72.38
Nam Theun 1	523.0	20	70:30	69.72
Nam Ngiep 1	282.0	25	70:30	54.75
Hongsa Lignite <sup>a</sup>	1,878.0	20	75:25	229.00
Xekong 4	300.0	20	70:30	45.30
Nam Kong 1	75.0	20	70:30	11.94
XePian-XeNamnoy	392.5	24	70:30	43.71
Xekong 5	330.0	20	70:30	34.92
<b>Total</b>	<b>4,220.5</b>			<b>561.72</b>

LHSE = Lao Holding State Enterprise.

<sup>a</sup> 20% equity in the power plant, and 25% equity in the attached lignite mine.

Source: Lao Holding State Enterprise.



## ENVIRONMENTAL AND SOCIAL ASPECTS OF THE NAM THEUN 2 HYDROPOWER PROJECT

### A. Environmental and Social Safeguards Embedded in the Concession Agreement

1. The concession agreement dated 25 April 2005 between the government and the Nam Theun 2 Power Company (NTPC) contains a number of clauses pertaining to environmental and social safeguards.<sup>1</sup> The concession agreement outlines the environmental and social obligations of both parties, management of identified and unanticipated environmental and social impacts, and use of panels of experts.

2. Environmental and social activities and obligations of the government and the NTPC are clearly set out in the various concession agreement clauses including those requiring the NTPC to ensure that the necessary environmental documents are prepared (for approval by the government), such as the environmental monitoring and management plans of the NTPC and of the head construction contractor. Proposed environmental and social mitigation measures identified during preparation of the environmental impact assessment are included in the concession agreement, thus making them binding on the NTPC and the government. The vast number of mitigation measures may be summarized as follows:

- (i) Mitigating the hydrological impacts, such as providing a minimum 2 cubic meters per second (m<sup>3</sup>/s) (weekly average) flow into the Nam Theun river downstream of the Nakai dam to help sustain the riparian environment; including the regulating pond in the project design to enable a more constant and controlled release of water into the Xe Bang Fai River, and restricting outflow from the regulating dam in periods when the Xe Bang Fai is in flood or is threatened by flooding.
- (ii) Mitigating water quality impacts, such as removing some biomass in the inundation area prior to reservoir filling, discharge into the Nam Theun through an aerating structure (a cone valve), constructing an aeration weir in the downstream channel, and managing erosion and sedimentation on the construction sites.
- (iii) Mitigating erosion and sedimentation impacts that include restricting construction to the dry season to the extent possible, implementing soil protection measures in construction areas, protecting and/or stabilizing river banks in the Xe Bang Fai, monitoring erosion in the Xe Bang Fai; protecting exposed sections of the downstream channel and its confluence with the Xe Bang Fai, and including the regulating pond in the project design to facilitate more constant and controlled release of water into the Xe Bang Fai.
- (iv) Mitigating impacts on aquatic habitats and fish diversity that include diverting the river away from the Nakai dam site during construction, stabilizing roadsides and other areas to reduce erosion, and clearing some vegetation in the inundation area to remove biomass and reduce the likelihood of adverse water quality developing.
- (v) Mitigating terrestrial biodiversity impacts, such as designating the Nakai Nam Theun National Protected Area and provision by the NTPC of funds toward its management and protection. Mitigating the impacts on endangered species include conservation programs for the Asian elephant and the white-winged duck, survey of some key wildlife species and development of management programs if these species are found to be present, management and financial support of

<sup>1</sup> Government of the Lao People's Democratic Republic (Lao PDR) and Nam Theun 2 Power Company. 2005. *Nam Theun 2 Hydroelectric Power Project Concession Agreement (2005 Financial Close) Consolidation*. Sydney.

- the Nakai Nam Theun National Protected Area, and research and associated planning to minimize the impacts of inundation on wildlife.
- (vi) For resettlement, livelihood development, and community development of households that inhabited the reservoir area, a series of important pre-relocation planning activities to be carried out include (a) surveying resettlement areas to assess suitability for agriculture and irrigation, availability of water year-round, risk of erosion, and proximity to reservoir (as per resettlers' stated preferences); (b) analyzing village location options showing houses, plots, and infrastructure facilities; (c) setting up a demonstration farm to teach project-affected persons how to improve their agricultural and forestry yields; (d) relocating three households on a pilot basis on three farms and plots established to enable the relocated households to live and generate a livelihood; (e) planning for sustainable forestry, livestock improvement, agricultural development, and fisheries development and management programs,<sup>2</sup> and (f) planning for community development activities deemed necessary in their habitats where people pursue new livelihoods, such as health care and special measures for vulnerable households. Further to planning, to go through the necessary administrative procedures, construction, physical relocation, training, etc. towards ensuring successful resettlement and livelihood development.
  - (vii) Mitigating social implications in the downstream areas, related to restoring livelihood protein and fisheries income losses, restoring domestic water supply and river crossing access, repairing and replacing irrigation pumps when needed, flood management, and mitigating other physical impacts.
  - (viii) Monitoring and ensuring compliance by the head construction contractor with the health and safety plan relating to the occupational health and safety of the construction workforce, and the health program offered to contractor employees.

3. The fact that the project could cause significant environmental impacts is clearly acknowledged in the concession agreement, which raises the need to address those impacts by avoidance or mitigation. The NTPC shall be responsible for addressing and alleviating or remedying those impacts at its cost to the reasonable satisfaction of the government. The concession agreement also cites the preparation of a preliminary environmental assessment and management plan, a preliminary social and environmental management framework and operational plan, and an environmental assessment and management plan.

4. One of the excellent features of the concession agreement is the appointment of a panel of experts (POE). The concession agreement provides that the government must maintain the panel of experts as a standing body from the concession agreement date until the end of the construction demobilization period and the end of the concession period. The panel of experts shall be engaged to facilitate ongoing independent review of, and guidance to the parties on, (i) mitigating project impacts, (ii) implementing each party's obligations under the environmental and social objectives, (iii) addressing unanticipated project impacts, and (iv) appropriateness and relevance of the environmental and social objectives. The POE's mandate is to determine whether the project's environmental and social goals are being met. The POE's recommendations to the government and NTPC are made on the basis of findings during their

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<sup>2</sup> The sustainable forestry program incorporates logging, making timber products, controlling forest grazing, as well as conservation of soil, water, biodiversity, and scenery. The livestock improvement program includes improving quality of animal feed; improving animal health care, disease diagnosis, and treatment; and upgrading breeding stock. The agricultural development program includes soil fertility improvement, increased use of leguminous crops into rotation, and cultivation of fruits and vegetables and other cash crops as per market demand. The fisheries development and management program includes provision of fishing equipment and boats.

monitoring visits; in general, its judgment has been accepted. To ensure adequate attention is given to environmental aspects, the concession agreement provides that one panel member has expertise in environment and development trade-offs, while another panel member shall be an expert in tropical forest and biodiversity conservation, utilization, and management.

5. Another important feature of the concession agreement is its attention to unanticipated project impacts. Although the NTPC represents and warrants that the expected project impacts will be reasonably mitigated or compensated, it acknowledges that there may be unintended or unforeseen project impacts that should be addressed. Under the concession agreement, both parties are required to promptly notify the other party and the panel of experts of the unanticipated project impacts as soon as a party becomes aware of them. The POE submits its findings to the Ministry of Energy and Mines and the Standing Deputy Prime Minister, addresses recommendations to the government, NTPC and international financial institutions, and is required to assess the extent to which the project meets the requirements of the safeguard policies of the World Bank and the ADB on such issues as environment, indigenous peoples and resettlement. As per the concession agreement, environmental and social mitigations are to be achieved by certain milestone dates such as completion of resettlement. As a result, the POE does not provide in its successive reports whether its recommendations from previous reports have been implemented, and it is difficult to systematically track the status of implementation of the POE's multiple recommendations on a year-to-year basis.

6. In line with the sector assistance program evaluation (SAPE) period (2001–2009), the SAPE reports the status of mitigation of environmental and social issues up to December 2009. Certain issues that had been identified until December 2009 have been resolved or are in the process of being resolved at the time of publishing this report. Besides, as is normal, additional impacts of hydropower projects emerge as the power plant begins operations; and since Nam Theun 2 began commercial operations in April 2010, the situation has become quite fluid. Information available to the Independent Evaluation Department on these dynamic conditions is rather limited. To the extent reliable information is available on actions taken after December 2009, it has been incorporated.

## **B. Overview of Achievements in Environmental Safeguards**

7. Activities for the environmental and social safeguards of the Nam Theun 2 project were initiated in the 1990s, and the first series of environmental and social safeguards documents were produced in 1997. Massive efforts have gone into the Nam Theun 2 project's effective safeguard implementation. In 2005, the panel of experts claimed that, even with their long years of experience on large dams in late-industrializing countries, they were unaware of any safety net plans that were more "state of the art" than those of the Nam Theun 2 Hydropower Project.<sup>3</sup>

8. **Nakai Plateau.** The Nakai Plateau is at the heart of the Nam Theun 2 Hydropower Project area. It is the location of the hydropower reservoir that is approximately 450 square kilometers at full supply level and 108 square kilometers at minimum operating level. This was a secondary forest before project implementation. Its inundation will adversely affect the wildlife population and its habitats. The important environmental concerns for the Nakai Plateau are the adverse impacts on the wildlife population and their habitats and the potential poor water quality of the reservoir. The NTPC has been adequately addressing the issues of terrestrial wildlife, fish, and aquatic habitat. Its wildlife management program on terrestrial and wetland biodiversity,

<sup>3</sup> Scudder, J. and Talbot, L. 2005. *Eighth Report of the International Environmental and Social Panel of Experts for the Nam Theun 2 Hydro Project in Lao PDR*. Vientiane.

aquatic biodiversity, and the elephant program has been progressing satisfactorily. However, a formal adaptive management committee for the wildlife program, as required by the concession agreement, has not been convened. Nevertheless, the Watershed Management and Protection Authority (WMPA) has been involved in the NTPC's wildlife management program for a smooth handover during the transition period from the NTPC to the WMPA. (Further details are in Box A6.1.)

9. Poor water quality of the reservoir is being addressed by the provision of aeration devices before discharging water from the reservoir, and the removal of biomass (trees, shrubs, and grasses) in the reservoir. A submerged structure at the intake also favors the top layers of the reservoir water being drawn into the tunnel. Discharges to the Xe Bang Fai and Nam Kathang rivers would first be aerated by sending the discharges from the powerhouse to aeration weirs, while environmental discharges from the Nakai dam to the Nam Theun will pass through an aeration cone valve. Biomass removal was partially done and plenty of dead trees were left standing in the water. Under the concession agreement, the government was responsible not only to do salvage logging during construction, but also fuelwood collection in the reservoir area. (For further details, see Box A6.2.)

#### **Box A6.1: Terrestrial and Aquatic Biodiversity Management on the Nakai Plateau**

The summary environmental and social impact assessments have identified environmental impacts on terrestrial biodiversity, threatened species, and aquatic habitats and fish diversity.<sup>a</sup> Direct impacts on terrestrial biodiversity will occur as a result of reservoir inundation, including approximately 28,000 hectares (ha) of forest on the Nakai Plateau. All forests, savannah, grasslands, and wetlands within a 450 square kilometer area (40% of the Nakai Plateau) would be inundated and vegetation would be lost. The seasonal migration of large mammals, such as elephants, from the Nakai Nam Theun National Protected Area to the Phou Hin Poun National Protected Area would be disturbed by the presence of the reservoir. Creation of the Nakai reservoir would also affect aquatic habitats and fish diversity. The loss of habitats plus the changes in water quality in the reservoir would displace many pre-impoundment species unable to adapt to the new conditions. It was estimated that 35% of the 68 fish species recorded in the Nam Theun basin will not adapt to the new aquatic conditions, and a further 17% would be unlikely to adapt.

Consequently, the concession agreement requires the NTPC to implement the following mitigation measures: (i) pre-impoundment species and habitat inventories and development of a post-impoundment species management program; (ii) Asian elephant management program; (iii) wetland conversion and formation program for fish, birds, reptiles, and mammal species; (iv) a transitional strategy for reservoir impoundment; (v) a program for monitoring critical fish species and aquatic habitats in the Nam Theun basin; and (vi) an adaptive management program for the wildlife. An independent monitoring team for environmental impacts and measures reported the NTPC's compliance with these requirements.<sup>b</sup> The panel of experts has noted that the NTPC's wildlife management program on terrestrial and wetland biodiversity, aquatic biodiversity, and elephant program are progressing satisfactorily.<sup>c</sup>

Required measures for wildlife management are the conduct of pre-impoundment species and habitat inventories and develop a post-impoundment species management program. The inventories are designed to collect information on distribution and movements of animals on the Nakai Plateau and interactions between species. The NTPC addressed these requirements with the completion in 2006 and 2007 of baseline surveys on wildlife,<sup>d</sup> fish and aquatic habitats,<sup>e</sup> and elephants,<sup>f</sup> and preparation of the management plan for the transition phase. The NTPC is developing a post-impoundment species management plan, including handbooks, to be handed over to the WMPA a year after the start of the operating phase.

The required measure for the Asian elephant (an endangered species) is the implementation of a program for managing the elephant population affected by the project, taking into account their seasonal

movements and habitat requirements. The NTPC addressed this requirement with the implementation of an Asian elephant program in June 2007 and scheduled to be completed by December 2009. The study gathered baseline data on human–elephant conflict on the Nakai Plateau, which was expected to worsen as the animals became displaced. As the plateau is important to the elephants due to the natural mineral licks, the elephant program has focused since August 2008 on installing mineral licks at the release sites, monitoring human–elephant conflict, and trialing a crop protection system against elephants foraging on farmlands.

The required measure for loss of wetlands is the implementation of a wetland conversion and formation program for fish, birds, reptiles, and mammal species associated with the swamps and rivers. The program includes pre-impoundment species and habitat inventories and development of a post-impoundment species management program. The NTPC addressed this requirement with the completion in 2008 of a baseline inventory and preparation of a management and monitoring plan for fish, birds, reptiles, and mammals. The NTPC also constructed and planted 30 wetlands in 2008 and planned to construct more wetlands above the full supply level in 2010.

The required measure for aquatic habitats and fish diversity is the implementation of a program to monitor critical fish species and aquatic habitats in the Nam Theun basin to detect possible declining populations and to help provide recommendations for appropriate mitigation measures. The program was developed and implemented before and after the impoundment of the reservoir and will eventually include species and habitat inventories, monitoring of fish migrations, fish productivity, and other project impacts on fish. The NTPC addressed this requirement with a pre-inundation fish survey in 2007, while a post-inundation fish survey was undertaken in May 2009. The NTPC has commissioned a team to monitor the evolution of fish species and productivity in the reservoir.

The required measure to avert drowning and stranding of animals is the implementation of a transitional strategy for reservoir impoundment in order to minimize impacts on animal populations during impoundment of the reservoir, especially animals stranded on islands. The NTPC addressed this requirement with a wildlife rescue program operational since April 2008 and extended to March 2009. Some 268 individuals of 49 species, including 38 individuals of the large antlered muntjac, were rescued and released at sites located in the Nakai Nam Theun National Protected Area. It was considered to be a successful program.<sup>9</sup> Release sites of rescued animals are located in the protected area and patrolled by the WMPA.

The concession agreement requires the NTPC and the government to develop and implement an adaptive management program for wildlife by establishing a committee comprising competent and expert persons to oversee the implementation and review the effectiveness of the wildlife program. The processes for adaptive management programs shall involve proactive experimentation, monitoring effectiveness of management measures, reevaluation and experimental design, making recommendations, decision making by the government and the NTPC, and referring any disputes between the parties to the panel of experts. As of June 2009, a formal adaptive management committee for the wildlife program had not been convened (note g).

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NTPC = Nam Theun 2 Power Company.

<sup>a</sup> ADB. 2004. *Summary Environmental and Social Impacts Assessment for the Nam Theun Hydropower Project in Lao PDR*. Manila.

<sup>b</sup> Halcrow. 2009. *Independent Monitoring of Environmental Impacts and Measures – Mission Report 3*. Manila.

<sup>c</sup> Panel of Experts. 2008. *Thirteenth Report of the International Environmental and Social Panel of Experts for the Nam Theun 2 Hydro Project in Lao PDR*. Vientiane.

<sup>d</sup> Dersu and Associates. 2006. *Wildlife Program Phase I – Inception Report*. Vientiane.

<sup>e</sup> Nam Theun Power 2 Power Company. 2006. *Fish and Aquatic Habitats Survey in NTPC Area - Final Report*. Vientiane.

<sup>f</sup> Wildlife Conservation Society. 2007. *Determination of the Size and Distribution of Populations of Elephants, Assessment of Habitat and Resource Use, and Assessment and Management of Human-Elephant Conflicts on the Nakai Plateau and Surrounding Areas*. Final Draft of Final Report. New York.

<sup>g</sup> Halcrow. 2009. *Independent Monitoring of Environmental Impacts and Measures – Mission Report 3*. Manila.

### Box A6.2: Management of Reservoir Water Quality and Discharges

The environmental and social impact assessment identified water quality changes that the Nakai reservoir would have during filling and storage of water. This had the potential to affect water quality in the Nam Theun (downstream of the Nakai dam), Xe Bang Fai, and Nam Kathang rivers, and possibly the Mekong River. Aquatic life and people who depend on the rivers for their domestic water consumption and aquatic products could in turn be affected. During the initial years of operation, the volume of biomass inundated was anticipated to greatly affect the reservoir's water quality. Decomposition of inundated biomass can quickly lead to very low dissolved oxygen concentration since microbes consume the oxygen in the water, which eventually results in anoxic (no oxygen) conditions, as demonstrated during the rainy season of August 2007 (when the reservoir was partially filled for about 3 weeks). Dissolved oxygen concentration in the reservoir water had reduced to nearly zero for a few days from Ban Thalung down to the Nakai dam site.<sup>a</sup>

Consequently, the concession agreement stipulates that, to improve water quality of the reservoir and its discharges to the receiving rivers, biomass must be removed and aeration devices provided. Towards this objective, the concession agreement stipulates that the government shall implement the following mitigation measures: (i) encourage salvage logging from the inundation area during the construction phase, and (ii) undertake a program to collect fuelwood from the inundation area. The concession agreement also mandates the NTPC to implement the following mitigation measures: (i) undertake a water quality monitoring program to determine conditions in the reservoir, and (ii) provide aeration devices for the discharges in the downstream channel and the Nam Kathang. The NTPC has implemented a water quality monitoring program and constructed aeration devices for the discharges to the downstream channel and the Nam Kathang.

The POE repeatedly raised the issue of potential anoxic conditions. In February 2008 before the start of the water filling, the POE raised a concern that the government's contractor was planning to clear only 1,500 hectares (ha) out of the 3,000 ha of biomass identified for clearance.<sup>b</sup> The independent monitors of water quality also cited in June 2009 concerns for partial clearance of biomass from the reservoir and further reported the NTPC's failure to implement the proposed "fill and flush" strategy to remove the poorer quality water due to the delayed and slow filling of the reservoir in 2008 and the prohibition on water releases during the dry season.<sup>c</sup> A visit by the SAPE mission confirmed the partial clearance of biomass; dead trees had been left standing in the water. The intention of the concession agreement was that most of the biomass in the inundation area was to be removed by stipulating that vegetation in areas which will be permanently flooded shall be cleared. Under the concession agreement, the government is responsible not only to do salvage logging during construction, but also collecting fuelwood in the reservoir area. Fuelwood collection was also not successful and the NTPC has been collecting floating debris.

Villagers believe that the Xe Bang Fai River's water quality has changed since the NTPC began releasing water from the reservoir. The NTPC has carried out regular water quality tests and has reported that discharges to the Xe Bang Fai River are of acceptable quality and within prescribed standards, as monitored by its environmental unit.<sup>d</sup> The villagers' views were revealed from the interviews conducted by the SAPE mission with key informants at the Xe Bang Fai River downstream in the villages of Nong Sone, Palai, Hat Phak, and Dangsavanh. Some claimed itchiness of the skin when bathing in the river; medical evidence that skin itchiness is a result of bathing in the river has been confirmed; expert advice has been sought and the NTPC has since distributed an ointment to the villagers to relieve them of their itchiness.

<sup>a</sup> NTPC = Nam Theun 2 Power Company, SAPE = sector assistance program evaluation. World Bank and Asian Development Bank. 2007. *Update on the Lao PDR: Nam Theun 2 Hydroelectric Project*. .

<sup>b</sup> Panel of Experts. 2008. *Thirteenth Report of the International Environmental and Social Panel of Experts for the Nam Theun 2 Hydro Project in Lao PDR*. Vientiane.

<sup>c</sup> Halcrow. 2009. *Independent Monitoring of Environmental Impacts and Measures – Mission Report 3*. Manila.

<sup>d</sup> Nam Theun 2 Power Company. 2009. *Monthly Progress Report Covering Activities in November 2009 – Part C: Environmental and Social Report*. Vientiane.

10. **Protected areas.** The Nakai Nam Theun National Protected Area has been an important area for the Nam Theun 2 Hydropower Project since it forms 88% of the Nam Theun 2 catchment and is the main watershed of the Nakai reservoir. To effectively address the project impacts, the government established the Nam Theun 2 WMPA in 2001 and included clauses in the concession agreement for funding its operation. The WMPA has operated for several years and has steadily worked on the various threats to the watershed despite limited financial and human resources. It has recently moved from its set-up phase to its long-term operations phase. It has a staff of 71 with a director and three deputies for law enforcement; participatory integrated conservation and development; and personnel, administration, planning, and finance. However, staffing and other resources need to improve considerably to enable the WMPA to meet its objectives. (For further details, refer to Box A6.3.)

**Box A6.3: Environmental Impact Mitigation in Protected Areas**

Poor land use practices in the Nakai Nam Theun National Protected Area (NPA) will result in increased sedimentation and shortening of the life of the reservoir. It has been under threats from (i) communities in the national protected area, (ii) peripheral impact zone communities, (iii) transboundary incursions, (iv) uncontrolled access, (v) unsustainable extraction of wildlife and nontimber forest products, (vi) uncontrolled increase of the population in the national protected area, (vii) lack of a zonation system with clear rules and regulations, and (viii) pressure posed during Nam Theun 2 hydropower plant construction.<sup>a</sup>

Apart from the Nakai Nam Theun NPA, two other NPAs surround the immediate project area: the Phou Hin Poun NPA, a region of karst limestone; and the Hin Nam Nor NPA, located to the south of the Nakai Nam Theun NPA. The government established a series of corridors to connect the three NPAs to enable wildlife to migrate between them. The project itself is expected to have minimal negative impact on these NPAs.<sup>b</sup> The summary environmental and social impact assessment only cited that the Nakai Nam Theun NPA will be more easily accessible, particularly for hunting, due to the presence of the Nakai reservoir. This will increase the vulnerability of wildlife.

Although the concession agreement did not include specific environmental mitigating measures for the Nakai Nam Theun NPA in the list of detailed environmental measures to be required from the Nam Theun 2 Power Company (NTPC) and the government, it has separate clauses for the establishment of the Watershed Management Protection Authority (WMPA) and its operation. To effectively address the threats to the Nakai Nam Theun NPA, the government established in February 2001 the Nam Theun 2 WMPA through the issuance of a prime ministerial decree and prepared the Social and Environmental Management Framework and Operational Plan (SEMFOP).

The decree mandates the WMPA to be responsible for coordination and management of all activities designed to further the following objectives: (i) protecting and rehabilitating forest cover in the Nam Theun 2 watershed area to assure adequate water (with low sedimentation) flows to or away from the reservoir; and (ii) conserving, protecting, and promoting biological diversity of the watershed area with particular attention to conserving and enhancing habitat for rare or endangered birds and aquatic species. The concession agreement requires the NTPC to provide adequate financing to the WMPA for these activities in the watershed.

The WMPA has operated for several years and has been implementing the SEMFOP. The purpose of the SEMFOP is to ensure the effective long-term protection of the biodiversity and watershed values of the Nam Theun 2 catchment, while at the same time safeguarding the well-being, traditional livelihoods, and culture of its human inhabitants. This SEMFOP document describes the baseline setting, institutional arrangements, management planning, program activities, and budget framework for the first 7 years of operation of the Nam Theun 2 WMPA. The WMPA's biodiversity and monitoring is presently focused on wildlife survey and monitoring through the installation of camera traps in several locations and survey by line-transect method in wide areas. Its conservation activities include demarcation survey between the watershed and the reservoir areas, conservation awareness

campaign, and zoning of protected and controlled-use areas.

The activities required to effectively address the long-term protection of biodiversity and values of the watershed are adequately presented in the SEMFOP. However, with the Nakai Nam Theun NPA's large area of 353,200 hectares, it appears that the WMPA needs more staff to do the required work. For example, it has only six staff on the biodiversity research section which is equivalent to an average of one staff member per 589 square kilometers. Biodiversity monitoring and research is one the main areas to be addressed by the WMPA considering the various threats to biodiversity in the watershed. The reservoir patrol unit also needs more staff to be effective in its work; it has only 10 persons. The WMPA claimed that it is short of funds and has therefore requested the NTPC to advance the release of future annual funds in order to finance more activities in the watershed. The panel of experts has noted that, in spite of the WMPA's efforts, poaching remains a critical—and probably increasing—threat to biodiversity in the Nakai Nam Theun NPA. Consequently, the panel of experts supported the idea of taking a portion of the funds allocated for the last years of NTPC funding for the WMPA and using them for the immediate patrolling needs which are critical.

Undoubtedly, there is still a long way to go for the WMPA, and there are more challenges to overcome. The WMPA needs to improve its information campaign regarding its role. The panel of experts has frequently observed that there is still no uniform understanding of the purpose and mission of the WMPA on the part of other government agencies, but more importantly, on the part of WMPA board members and even WMPA staff.

Following the midterm review of the Social and Environmental Management Framework and Operational Plan (SEMFOP) in February–June 2009, the WMPA has taken further steps to improve its performance. Most notably, WMPA has: (i) drafted a new five-year management plan, which includes macro-zoning into protection, controlled use and tourism zones; and (ii) created a priority patrolling plan to increase patrolling for protecting the NPA.

<sup>a</sup> Nam Theun 2 WMPA. 2009. *Report on the Results of the Implementation of the Workplan and Budget for the Year 2008–2009*. Vientiane.

<sup>b</sup> Nam Theun 2 WMPA. 2005. *Social and Environment Management Framework and Operational Plan*. Vientiane.

11. **Project lands.** Project lands are those lands where structures are constructed plus lands associated with the performance of constructions activities. Environmental issues associated with project lands during construction are the management of construction spoils and disturbed or exposed soil. These have been addressed by implementation of the head construction contractor's environment monitoring and management plan. Environmental issues of project lands during the operation phase are those associated with operating the various facilities. These shall be addressed by the NTPC's environmental management system. The system will allow the NTPC to systematically manage its environmental and health safety matters. The concession agreement requires the NTPC to have in place and implement the company's environment monitoring and management plan upon expiry of the head construction contractor's plan. Both plans are important environmental safeguards documents. (Further details are in Box A6.4.)



#### **Box A6.4: Environmental Mitigation on Project Lands**

Project lands include the Nakai dam, Nakai saddle dams, headrace channel, power conduit intake structure, power station, regulating pond and dam, operator's village, quarry areas, spoils disposal areas, construction work camps, corridors for transmission lines, downstream channel, and roads to be upgraded or constructed. The concession agreement defines an area of about 5,500 hectares (ha), excluding transmission lines. The estimated area required for the construction phase was 2,565 ha and 760 ha during the operation phase.<sup>a</sup>

Environmental issues of project lands during the operation phase are essentially pollution and waste generation, which shall be addressed by the NTPC's environmental management system (EMS). The concession agreement requires the NTPC to have in place and implement the CEMMP upon expiry of the HCCEMMP. The CEMMP must provide for an EMS that is compliant with ISO 14001.<sup>b</sup> An EMS allows an organization to systematically manage its environmental and health safety matters. The CEMMP is further required to contain (i) details of capabilities, support mechanisms, and resources necessary to achieve the NTPC's environmental policy, objectives, and targets; (ii) details of how the NTPC will measure, monitor, and evaluate its environmental performance, including corrective and preventive action procedures; (iii) details of how the NTPC will develop, review, and improve its EMS with the objective of improving its overall environmental performance, and details of its auditing policies and programs; and (iv) the plans and subplans addressing the environmental measures which are to be addressed by the company. With the CEMMP, the NTPC will adequately address the environmental issues of project lands during the operation phase.

The concession agreement also requires the NTPC to address the environmental impacts on project lands during construction by describing a series of requirements for site environmental management on (i) construction water quality; (ii) erosion and sediment control; (iii) air quality control, including at quarry sites and road construction and work camps; (iv) noise control, including at quarry sites and road construction and work camps; (v) waste management; (vi) landscaping and revegetation; (vii) on-site traffic and access management; and (viii) environmental training for construction workers. The NTPC complied with these requirements by implementing the HCCEMMP. In general, there is a high degree of correspondence between the text in the subclauses of the concession agreement and the information in various components of the HCCEMMP. The independent monitor has noted that the level of inspections undertaken by the NTPC's EMO is considered to be more than sufficient to determine whether the head contractor is complying with its obligations under the concession agreement.

Particularly important environmental issues associated with project lands during construction are the management of construction spoils and disturbed or exposed soil.<sup>c</sup> Due to the large quantity of spoils, deciding where the spoil materials will be placed is a major consideration in construction planning. Excavation and tunneling activities should not start without designated sites for spoils. The EMP addressed this issue before the construction with a requirement that the HCCEMMP shall include a spoil disposal plan and the head construction contractor will conduct consultation and studies at least 6 months prior to construction of each area to determine suitable sites for disposal areas. Nearing construction completion, the panel of experts also preempted a situation whereby some construction spoils are left behind, by recommending early detailed planning for the gradual handover of project lands associated with the construction requirements such as labor camps, workshops, quarries, borrow pits, and spoil disposal areas. The panel of experts suggested that spoils areas could be developed as sports fields and for other purposes.<sup>d</sup>

Another environmental issue associated with project lands during construction is the management of disturbed or exposed soil. Land clearing and construction activities involving the movement of earth will expose the bare soil of construction sites for a long period, making such sites susceptible to erosion during rainy periods. Soil is disturbed when vegetation is removed from a construction site. Rain and surface run-off will dislodge the soil particles and carry them off-site. These soil particles could pick up pollutants and other substances from the construction sites. Without any mitigating measures, the exposed bare soil will send tons of sediment to the waterways during rainy periods, drastically increasing

turbidity. Nearing the end of the construction period, the POE also recommended that excavated areas should be stabilized;<sup>e</sup> the head construction contractor is implementing a landscaping and re-vegetation program in the (previously) construction areas.

<sup>a</sup> CEMMP = Company's Environmental Monitoring and Management Plan, EMO = environmental management office, EMP = environmental management plan, HCCEMMP, = Head Construction Contractor's Environmental Monitoring and Management Plan, NTPC = Nam Theun 2 Power Company. ADB. 2004. *Summary Environmental and Social Impacts Assessment for the Nam Theun Hydropower Project in Lao PDR*. Manila.

<sup>b</sup> ISO 14001 is a standard of the International Organization for Standardization (ISO) which specifies the actual requirements for an environmental management system. It aims to reduce the environmental footprint of a business and to decrease its pollution and waste generation.

<sup>c</sup> Large amount of construction spoils may come from site grading, soils excavations, and rock tunneling. Large quantities of spoils will also be generated during construction of long project components such as headrace channels, intake tunnels, and downstream channels. Without proper planning, spoils disposal could affect surface water quality during the rainy periods and generate dust during the dry period. It may also adversely affect wildlife habitats.

<sup>d</sup> Panel of Experts. 2008. *Thirteenth Report of the International Environmental and Social Panel of Experts for the Nam Theun 2 Hydro Project in Lao PDR*. Vientiane,

<sup>e</sup> Panel of Experts. 2009. *Fifteenth Report of the International Environmental and Social Panel of Experts for the Nam Theun 2 Hydro Project in Lao PDR*. Vientiane.

12. **Downstream in the Xe Bang Fai River.** The summary environmental and social impact assessment had identified environmental impacts for the Xe Bang Fai concerning increased flooding, riverbank erosion, water quality changes, and aquatic habitats and species changes. Downstream areas from the Upper Xe Bang Fai River down to the confluence of the Mekong River had anticipated adverse environmental impacts following commencement of operations of the Nam Theun 2 hydropower plant.

13. Flooding naturally occurs at Mahaxai (Upper Xe Bang Fai River) once every 2 years. During the operation phase, the NTPC estimated that it will only stop the outflows of water from its regulating pond during the worst floods for about 4 days per year. The concession agreement requires the NTPC to stop the outflows of water from its regulating pond before the Xe Bang Fai River at Mahaxai overflows its banks. The concession agreement further requires the NTPC to measure and monitor flows in the Xe Bang Fai River to ensure that the operation management system of the power station for flood control is based on a maximum sample of available hydrographic data to be obtained by the NTPC from time to time. This mitigating measure will allow for continual adjustment of operation to ensure that flooding is kept within acceptable levels. The NTPC is collecting additional data on flooding.

14. During the operation phase, discharges from the project into the Xe Bang Fai River will nearly double the annual average flows at Mahaxai. These large fluctuating flows will cause long-term erosion of the Xe Bang Fai River as predicted by the environmental impact assessment study.<sup>4</sup> However, the concession agreement has specific requirements for preventing erosion in the Xe Bang Fai River. It stipulates that the confluence of the Xe Bang Fai River and the downstream channel shall be designed, constructed, and operated by the NTPC so as to minimize scouring. The confluence site has been built with scour protection. The NTPC

<sup>4</sup> The power plant will have variable discharge rates through the turbines in line with dispatch to EGAT. However, the water will first be discharged into a regulating pond, from which more constant discharges into the downstream channel and then into the Xe Bang Fai River will take place. Therefore, the discharge rate variation into the Xe Bang Fai from Monday to Saturday is anticipated to be low, and drop significantly on Sundays should EGAT decide not to take power from the Nam Theun 2 hydropower plant on Sundays.

also monitored erosion in the Xe Bang Fai River prior to project implementation. (Box A6.5 provides further details on flooding and erosion-related issues.)

15. Fishery changes in the Xe Bang Fai River during the operation phase are inevitable. Species composition and productivity of the river might change. Several habitats will disappear due to increased water levels; some will be displaced, while others will be altered. The main cause of these changes will be the large fluctuating discharges to the Xe Bang Fai River which will change the natural volume and timing of river flows. The proposed mitigating measure is only for improving the dissolved oxygen of the discharges from the powerhouse with the use of the aeration weir. This is not enough to protect aquatic biodiversity because a number of factors other than dissolved oxygen determine the composition of aquatic species. However, the concession agreement requires the NTPC and the government to develop and implement an adaptive management program for the regulating pond, including releases into the downstream channel and the Nam Kathang river to minimize adverse environmental impacts to aquatic ecology. (Further details on water quality and fishery impacts are in Box A6.6.)

#### **Box A6.5: Flooding and Erosion Management on the Xe Bang Fai River**

In a worst-case scenario, river modeling suggests that overall flood levels in the Xe Bang Fai River and its floodplain could increase by approximately 0.5 meters (m) in the upper reaches, 0.4 m in the middle reaches, and 0.2 m in the lower reaches. When natural Xe Bang Fai River flows reach 1,970 cubic meters per second ( $m^3/s$ ), the flooded area is estimated to increase by 3.75%, i.e., from 324 square kilometers ( $km^2$ ) without the project to 335  $km^2$  with a maximum project discharge of 315  $m^3/s$ .

It is anticipated that the Xe Bang Fai River will experience increased erosion as a result of considerably higher flows than the present hydrological regime, lower sediment load of project waters entering the Xe Bang Fai River, and the pore pressure in riverbanks due to weekly changes in discharge. It is estimated that the Xe Bang Fai River channel could widen on average between 10.7 m and 15.9 m along the length of the river, with maximum widening of no more than 20 m before the river adjusts to its new regime and morphology. This new morphology is not expected to reach equilibrium until at least 2 years after the start of the operation phase. The extent of widening will decrease as the distance from the confluence with the downstream channel increases. By the time the river reaches the bridge on Road 13, the loss of land is predicted to be negligible.

During initial years of operation, it is anticipated that water quality of the discharges from the powerhouse reaching the Xe Bang Fai River will cause adverse changes to its water quality. These changes in water flow, quality, and temperature might alter the species composition and productivity of the river. Several habitats will disappear due to increased water levels. Some will be displaced, while others will be altered.

Consequently, the concession agreement stipulates that the NTPC shall implement the following environmental mitigating measures: (i) outflows of water from the regulating pond during operation shall be restricted when the flow in the Xe Bang Fai River at Mahaxai approaches 1,970  $m^3/s$ , and be stopped before the flow in the Xe Bang Fai River at Mahaxai reaches 2,270  $m^3/s$  and in any event before the Xe Bang Fai River at Mahaxai overflows its banks; (ii) the confluence of the Xe Bang Fai River and the downstream channel shall be designed, constructed, and operated so as to minimize scouring; (iii) where scouring occurs to the confluence which would put at risk its structural stability, the NTPC shall in a timely manner protect the affected areas with appropriate stabilization or protection measures; (iv) the NTPC shall ensure that the water stored in the regulating pond is released on a controlled basis to lessen water level fluctuations; (v) a monitoring program shall be put in place to determine the natural rate of erosion of the banks of the Xe Bang Fai River below the proposed confluence area, beginning in 2002 and until the downstream channel first becomes operative; (vi) a monitoring program shall be put in place to determine water quality conditions in the Xe Bang Fai River and the downstream channel; (vii) an oxygenation weir with an overflowing nape shall be constructed in

the downstream channel and approximately 8 kilometers downstream of the regulating dam to add dissolved oxygen and remove dissolved methane and hydrogen sulfide from the water; and (viii) a monitoring program shall be put in place to monitor critical fish species and aquatic habitats in the Xe Bang Fai basin to detect possible declining populations and to help provide recommendations for appropriate mitigation measures.

**Xe Bang Fai River flooding.** Natural flooding occurs at Mahaxai (Upper Xe Bang Fai River) once every 2 years. In the Lower Xe Bang Fai River at Road 13, hydraulic modeling showed that the duration of overflows of the flood levees will increase by 3.6 days per year on average.<sup>a</sup> The SAPE mission's discussions with the NTPC's Environmental Protection and Social Division revealed that the NTPC is considering stopping the outflows of water from its regulating pond during the worst flooding for about 4 days per year as it is required under the concession agreement to stop the outflows of water from its regulating pond before the Xe Bang Fai River at Mahaxai overflows its banks.

However, interviews by the SAPE mission with key informants at some downstream villages (Nong Sone, Palai, Hat Phak, and Dangsavanh) revealed that longer flooding periods (15–45 days) have been experienced in the area. This raises the need to reevaluate the expected flooding situation by further validating the flooding occurrence information. This can be done since the concession agreement allows the NTPC to adjust its operating procedures where necessary by adapting the timing of trigger levels for cessation of power generation based on accumulated operational experience.

Schedule 4 Part 2 (Environmental Component) of the concession agreement requires the NTPC to do the following as part of its CEMMP: (i) measure and monitor flows in the Xe Bang Fai River to ensure that the operation management system of the power station for flood control is based on a maximum sample of available hydrographic data to be obtained by the NTPC from time to time; and (ii) review the effects of the flood control operating procedures during periods of natural flooding of the Xe Bang Fai River to determine if any residual adverse impacts occur. These environmental mitigating measures required under the concession agreement allow for continual adjustment of operation to ensure that flooding will be within acceptable levels. The NTPC is collecting additional data on flooding. As of June 2009, the operating rules were being modified and a review of flood operating procedures is ongoing.

**Erosion of the Xe Bang Fai River.** During the operation phase, flows into the Xe Bang Fai River from the project will increase by an average of 220 m<sup>3</sup>/s and a maximum of 315 m<sup>3</sup>/s compared to current calculated mean annual flows of 265 m<sup>3</sup>/s at Mahaxai. Discharge into the downstream channel from the regulating dam on Sundays will be lowered to about 80 m<sup>3</sup>/s due to low power demand.<sup>b</sup> These fluctuating flows will cause long-term erosion of the Xe Bang Fai River banks as predicted by the EIA study.

The SAPE mission site visit to the lower Xe Bang Fai River confirmed that the riverbanks have silty-sand soil. This type of soil is susceptible to erosion by repeated weakening, particularly when flows are fluctuating. When the river's water level is high for a sufficient length of time, water will seep into the riverbank. As the water level drops quickly, the riverbank cannot drain fast enough. This water in the riverbank's face will weaken the soil's cohesion. When the next cycle of increased water level occurs, water will carry away the loosened soil. This may also cause riverbank failure where large portions of bank material collapse and slip into the river.

The NTPC has designed and constructed the confluence of the downstream channel with the Xe Bang Fai River so as to minimize scouring, while the other measures are to be complied with during the operation phase. The mission site visit confirmed that the confluence area is built with scour protection in the form of rip-rap banks. Before the downstream channel first becomes operative, to determine the natural rate of erosion of the riverbanks, the NTPC measured natural erosion rates at 43 cross-sections of the Xe Bang Fai River downstream of the confluence area.<sup>c</sup>

During the operation phase, the NTPC closely monitors erosion along the Xe Bang Fai River and has instituted the necessary riverbank protection activities where necessary, since erosion can quickly occur during the initial years given the type of soil and fluctuating flows. Adaptive management using

the monitoring data on erosion will play a crucial role in preventing excessive erosion of the Xe Bang Fai River.

CEMMP = Company's Environmental Management and Monitoring Plan, EIA = environmental impact assessment, NTPC = Nam Theun 2 Power Company, SAPE = sector assistance program evaluation.

<sup>a</sup> Nam Theun 2 Power Company. 2005. *Environmental Assessment and Management Plan of Nam Theun 2 Hydroelectric Project*. Vientiane.

<sup>b</sup> ADB. 2004. *Summary Environmental and Social Impacts Assessment for the Nam Theun Hydropower Project in Lao PDR*. Manila.

<sup>c</sup> Halcrow. 2009. *Independent Monitoring of Environmental Impacts and Measures – Mission Report 3*. Manila.

#### **Box A6.6: Management of Water Quality and Fishery Impacts on the Xe Bang Fai River**

In addition to changes in water flow and water quality, water temperatures will also drop in the Xe Bang Fai River, perhaps by up to 3.5°C due to the cold reservoir water from the powerhouse. In combination with other changes (such as sedimentation, increased discharge, discharge fluctuations, and water quality), this could increase the stress on the aquatic community.<sup>a</sup> The NTPC has been monitoring the water quality conditions of the Xe Bang Fai River and the downstream channel.

A fish and habitats study revealed that habitat quality in the Xe Bang Fai River has been degraded already, with slightly less diverse fish fauna, and lower fish density. The study concluded that habitats degradation was not project related but rather due to increasing human populations, land-use, and livestock. Increased turbidity and organic pollution was noted.<sup>b</sup> The NTPC is monitoring critical fish species in the Xe Bang Fai River, and this will continue during the operation phase.

Fishery changes in Xe Bang Fai River during the operation phase are inevitable. Stimulated out-of-season upstream migration could occur during the initial months of operation in the dry season. Some species may take the additional flows as the beginning of the wet-season rise in water level. But the main cause of the changes will be the large fluctuating discharges to the Xe Bang Fai River, which will change the natural volume and timing of river flows. It is widely known that flow variability controls all physical, chemical, and biological phenomena in a river. Flow modifications affect water quality, water depth and velocity, substrate composition, food production and transport, stimuli for migration and spawning, survival of eggs, spatial requirements, and eventually fish species composition.<sup>c</sup>

Despite knowing the inevitable changes to fishery, the proposed mitigating measure is only for improving the dissolved oxygen of the discharges from the powerhouse with the use of the aeration weir. This is not enough to protect aquatic biodiversity because a number of factors other than dissolved oxygen determine aquatic species composition (as discussed earlier). Mitigations for sustaining fish populations and minimizing adverse environmental impacts to habitats and species could be developed during the operation phase.

NTPC = Nam Theun 2 Power Company.

<sup>a</sup> ADB. 2004. *Summary Environmental and Social Impacts Assessment for the Nam Theun Hydropower Project in Lao PDR*. Manila.

<sup>b</sup> Nam Theun Power 2 Power Company. 2006. *Fish and Aquatic Habitats Survey in NTPC Area - Final Report*. Vientiane.

<sup>c</sup> Miranda, L. 2001. *A Review of Guidance and Criteria for Managing Reservoirs and Associated Riverine Environments to Benefit Fish and Fisheries*. In *Dams, Fish, and Fisheries*. Edited by Gerd Marmulla. Rome: Food and Agriculture Organization.

16. **Downstream of the Nakai dam.** Another downstream impact zone is the Nam Theun stretch immediately after the Nakai dam and down to the Theun-Hinboun hydropower plant head pond approximately 50 kilometers downstream. Due to the relatively long distance to the

head pond, the riparian issue downstream of the Theun-Hinboun hydropower plant depends on the water releases at that point and not really the water release from the Nam Theun 2 hydropower plant. The summary environmental and social impact assessment has identified environmental impacts on (i) significant reduction in river flow releases to the Nam Theun river downstream of the Nakai dam, (ii) potential poor water quality of releases from the dam to the Nam Theun, and (iii) aquatic habitats downstream in the Nam Theun river. During the operation phase, this stretch will experience significant reduction in flow since releases from the dam will be a minimum of 2 m<sup>3</sup>/s (weekly average) compared with its present mean annual discharge of 238 m<sup>3</sup>/s. The significantly reduced flow will not be suitable to most of the species presently living in the river. Their natural habitat will be lost and eventually fish species composition will change.

17. This change in river hydrology needs further research and the concession agreement requires the government and the NTPC to develop and implement an adaptive management program for the riparian releases into the Nam Theun River. In 2009, a temporary adaptive management committee was formed without a chair but with two vice-chairs representing both the government and the NTPC. The committee does not have a fisheries expert or representatives of local communities. It is operating on an ad hoc basis and does not have a planned program of meetings. There is an urgent need to improve the set up, planning, operation, and funding of the adaptive management committee since a lot of work is required in an adaptive management approach. (Further details are in Box A6.7.)

#### **Box A6.7: Environmental Management Downstream of the Nakai Dam**

During the operation phase, releases from the dam will be a minimum of 2 cubic meters per second (m<sup>3</sup>/s) (weekly average as stipulated in the concession agreement). This is a very low figure compared to the least mean monthly flow rate of about 32 m<sup>3</sup>/s in April, the maximum mean monthly flow rate of 735 m<sup>3</sup>/s in August and the present mean annual flow rate of 238 m<sup>3</sup>/s.<sup>a</sup> This very low flow volume will instantly transform the river into a creek. Since flow modifications affect the aquatic ecology, the significantly reduced flow will not suit most of the species presently living in it. Their natural habitat will be lost<sup>b</sup> and eventually fish species composition will change. However, it is estimated that only the first 12 kilometers (km) of the Nam Theun river downstream from the dam will primarily be affected,<sup>c</sup> because after this point a major tributary—the Nam Phao—joins the Nam Theun, which then flows in to the Theun Hinboun hydropower head pond commissioned in 1997. Similar to the issue earlier discussed in the Nakai reservoir, there is also concern over potential releases of poor quality water from the Nakai dam to the Nam Theun river.

As part of the environmental mitigating measures for reduction in river flow and releases of poor-quality water, the concession agreement stipulates that the Nam Theun 2 Power Company (NTPC) shall (i) design, construct, and operate the dam so that the intake structure for the release at the dam site provides for adaptive management of the riparian releases through a variable intake structure from the reservoir surface to 2 meters below the minimum operating level, which is able to discharge an average of 2–10 m<sup>3</sup>/s, with a capacity for variation of up to 20 m<sup>3</sup>/s to be discharged intermittently through radial gates in limited circumstances; (ii) effect a constant minimum water release of 2 m<sup>3</sup>/s from the reservoir into the Nam Theun river; (iii) make riparian releases through an aerating structure, a hollow jet valve, into the stilling basin to increase dissolved oxygen levels; (iv) include facilities to avoid debris and fish entering the intake structure and blocking the aeration facilities; and (v) provide a relatively shallow spill-pool to receive the spills exiting the dam to reduce the likelihood of creating supersaturation that could be lethal to fish species. The NTPC complied by incorporating the required dam features into the design. The NTPC has been releasing a minimum of 2 m<sup>3</sup>/s from the reservoir into the Nam Theun river.

To address the impacts on aquatic habitats, the concession agreement stipulates that the NTPC shall conduct a study regarding the possibility of modifying the river morphology in sections of the 12-km reach of the Nam Theun between the dam and the Nam Phao confluence to enhance wildlife adaptation. If

deemed appropriate by the study, and subject to obtaining government consent, the NTPC shall modify the morphology of the Nam Theun in the 12-km reach. The NTPC complied with this requirement with a research study conducted in 2006.<sup>d</sup> The study recommended that river morphology should not be modified as any activity in the river may only further disturb the present aquatic community.

The concession agreement also stipulates that the government and the NTPC shall jointly establish an adaptive management committee for the Nam Theun comprising representatives from each party, experts, and stakeholders. The committee shall review results of studies and monitoring programs and oversee the proactive experimentation approach to refine the flow and habitat management approaches.

Both the government and the NTPC addressed this requirement by establishing the adaptive management committee in 2009 through a prime ministerial directive authorizing the Water Resources and Environment Authority (WREA) to issue a decision appointing members of a temporary committee for managing water releases from the Nakai dam. The WREA's decision listed representatives from both government and the NTPC and did not include an independent chair. Two vice-chairs, representing both the government and the NTPC, are therefore leading the committee. There is no budget allocated to fund the independent chair. The committee does not have a fisheries expert or representatives of local communities. It is operating on an ad hoc basis and does not have a planned program of meetings.<sup>e</sup>

There is a need to improve the set up, planning, operation, and funding of the adaptive management committee since a lot of work is required in an adaptive management approach. It uses experimental methods to test clearly formulated hypotheses about uncertain components of the aquatic ecology, in this case impacts to fishery and habitats. After measures are taken, it is necessary to conduct follow-up studies to evaluate their effectiveness and to institute any corrective actions. The process is repetitive until the objectives are met.

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<sup>a</sup> ADB. 2004. *Summary Environmental and Social Impacts Assessment for the Nam Theun Hydropower Project in Lao PDR*. Manila.

<sup>b</sup> Nam Theun Power 2 Power Company. 2006. *Fish and Aquatic Habitats Survey in NTPC Area - Final Report*. Vientiane.

<sup>c</sup> Nam Theun 2 Power Company. 2005. *Environmental Assessment and Management Plan of Nam Theun 2 Hydroelectric Project*. Vientiane.

<sup>d</sup> Nam Theun Power 2 Power Company. 2006. *Fish and Aquatic Habitats Survey in NTPC Area - Final Report*. Vientiane.

<sup>e</sup> Halcrow. 2009. *Independent Monitoring of Environmental Impacts and Measures – Mission Report 3*. Manila.

### C. Overview of Achievements in Social Safeguards

18. It appears that the mitigation of social impacts is going more-or-less as per the requirements listed in the concession agreement, and that through further technical assistance support attempts are being made to address problems that have emerged since resettlement.<sup>5</sup> Surveys carried out by NTPC<sup>6</sup> indicate that more than 85% of the resettled households report that life compares much more positively than with their lives before resettlement. Another 10-12% of the resettled households report being better-off; with the remaining households reporting being about the same level or worse-off than before the resettlement. A comprehensive approach to livelihood development has been underway for some time, and is being accelerated during the operations phase.

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<sup>5</sup> ADB. 2008. *Technical Assistance to Lao People's Democratic Republic for the Greater Mekong Subregion Nam Theun 2 Hydroelectric Project: Social Safeguards Monitoring*. Manila (July, TA 7094); and additional World Bank TA for livelihoods assessment.

<sup>6</sup> ADB. 2010. *Greater Mekong Subregion Nam Theun 2 Hydroelectric Project Semiannual Update*. Manila (August).

19. All of the ethnic groups in the Lao PDR that traditionally inhabited the Nakai Plateau and the Nakai Nam Theun NPA are considered to be indigenous peoples as defined in the World Bank Indigenous Peoples safeguard policy (Operational Directive 4.20), and are accepted as such by the government and the NTPC for purposes of complying with social safeguards requirements.<sup>7</sup> Some particularly vulnerable hunter-gatherer households, such as the Vietic Ahoie, merited special attention. The basic cultural paradigm of these more vulnerable ethnic minorities is so different that it required special efforts by the project to address their specific needs. For all resettlers generally, the physical or legal side of safeguards has been consistently emphasized in resettlement, compensation, and housing, as are livelihood-generation opportunities (in the physical quantifiable sense). However, the hunter-gatherer notions of space and time are often difficult to accommodate with cultural perspectives of other ethnic minority groups. Safeguard planning can often be formulaic and not flexible enough to account for the multiple social, ethnic and socio-economic differences within and between ethnic groups, or for the adjustments needed when implementing a development process.

20. **Nakai Plateau.** Social issues with respect to the Nakai Plateau involve both resettlement and indigenous peoples. All villages resettled are considered as ethnic minorities.<sup>8</sup> Resettlement matters normally focus on issues relating to land, space, livelihood restoration, vulnerable groups, local administration, and human resources—the Nam Theun 2 is no exception. Livelihood standards of the resettlers on the Nakai Plateau declined in 2008 immediately after final relocation, but rose subsequently, facilitated in large measure by a boom in reservoir fisheries. Although the initial move to better housing and access to infrastructure such as health centers was considered by resettler households as an increase in standard of living,<sup>9</sup> they also point to lack of access to land and their fears about uncertain rice supply as their most important current concerns. These concerns illustrate there is some way to go before most resettled households feel they have been adapted to their new circumstances.

21. According to the POE, other social issues remain, which could best be addressed with: NTPC's engagement of a Lao social scientist. A key concern of both the POE and the international financial institutions relates to the forest resources in the resettlement area, which are for the exclusive use and benefit of the plateau resettlers for 70 years from the establishment of the Nakai Plateau village forest association; as well as protection of the fisheries resource in the reservoir for a period of 10 years after commercial operations begin. Securing the natural resource base for resettlers is important to ensure their livelihoods and long term food security in the resettlement area. The ongoing technical assistance on Nam Theun 2 Hydroelectric Project Social Safeguards Monitoring<sup>10</sup> is an attempt to address some of the outstanding issues.

22. The arrangement of houses in straight lines does not incorporate the inputs of either social scientists or villagers. Moving agriculture from an extensive upland rotational system with open access to land for cultivation and grazing to an intensive system where access to land is strictly controlled requires new methods that are both time and labor intensive. The lack of

<sup>7</sup> As per World Bank practice, groups belonging to the Mon-Khmer, Hmong-Mien and Sino-Tibetan ethnolinguistic families are considered to be ethnic minorities; only the Lao-Tai groups are not considered minorities.

<sup>8</sup> The main ethnic groups on the Nakai Plateau are the Bo/Frou (just under 42%) and the Makong/So (just under 37%). The Ahoie (Vietic hunter-gatherers) are less than 5% of the resettled households.

<sup>9</sup> As indicated by improved housing, sanitation, electricity supply, domestic water supply, and all-weather roads. And as also indicated by the acquisition of hand tractors, TVs, satellite receivers, and motorcycles by those temporarily employed during the construction phase.

<sup>10</sup> ADB. 2008. *Technical Assistance to the Lao People's Democratic Republic for the Greater Mekong Subregion Nam Theun 2 Hydroelectric Project, Social Safeguards Monitoring*, Manila, (TA 7094, for \$400,000 approved on 7 July).



grazing land for buffalo and cattle that are viewed as important households assets and status symbols has also caused distress to the resettlers. In certain instances, they have preferred to defy the law and let their cattle graze on NPA land rather than allowing them to starve or sell them off.

23. The ongoing technical assistance on Nam Theun 2 Hydroelectric Project Social Safeguards Monitoring attempts to address some of the outstanding issues, particularly related to land use planning, so as to enhance resettlers' access to productive agricultural land and grazing land. Additional agricultural and grazing land for the two pilot villages of Ban Done and Khon Kaen has been identified and change of land use formally approved by the project's Resettlement Committee. The project is now undertaking the same land use planning exercise in the remaining resettlement villages. Another change is to shift the focus of the resettlement process from income targets (that may well be suited to measuring standard of living but is not a top priority for some ethnic minorities) to maximizing the overall well-being of the resettlers.

24. The need to address the concerns of the Vietic-speaking ethnic minorities (the hunter-gatherers) also merits specific mention. By consolidating villages to become multiethnic entities, the more vulnerable ethnic groups may become marginalized, and find it difficult to have any representation in the consolidated village communities. The POE has continued to point out the problems of vulnerable peoples in the NPA, the peripheral impact zone (PIZ) and the Nakai Plateau, and continues to persuade the government to act on those recommendations.

25. The process and status of resettlement, problems encountered and the efforts made thus far to overcome these problems have been observed and commented upon by various stakeholders, including but not limited to the multilateral development banks and non-government organizations. The differences in their perspectives are evident.<sup>11</sup>

26. **Protected areas.** The Nakai Nam Theun NPA is a 3,500 square kilometer (km<sup>2</sup>) area of mostly mountains and forest. It comprises five main river valleys, each with its own history of settlement patterns.<sup>12</sup> It is notable that in each river valley, there were some type I–III Vietic-speaking hunter-gatherers, who continue to be marginalized in consolidated villages by other ethnic groups.<sup>13</sup>

27. The policy of discouraging swidden cultivation is widely applied in the environmentally and/or ecologically sensitive Nakai Nam Theun NPA. Swidden cultivation as practiced traditionally is carried out in rotational cycles of 10 years or more, i.e., fields are cleared and planted for 1–2 years, and then allowed to regenerate. The resultant forest types in the fallow areas enhance biodiversity—a fact well recognized by wildlife biologists and anthropologists. It is also known that, when measured as a return on labor, swidden systems are about 100 times more productive than paddies. The normally used indicator in agriculture—paddy yield per hectare of land area—does not capture the labor efficiency of swidden.<sup>14</sup>

<sup>11</sup> For instance, refer to: (i) World Bank and ADB, 2010, *Update on the Lao PDR Nam Theun 2 (NT2) Hydroelectric Project*, 7 July; and (ii) International Rivers, 2009, *Risky Business*, October; <http://www.youtube.com/watch?v=l2zChrpYu74>

<sup>12</sup> The Nam Sot valley, the Nam Theun valley, the Nam Noy valley, the Nam Pheo valley, and the Nam One valley.

<sup>13</sup> Type I Vietic-speaking peoples are foraging nomads who move in small groups. Type II Vietics were originally collectors and traders, who have become swidden based sedentists; and Type III Vietics are swidden cultivators who move every few years between pre-existing village sites.

<sup>14</sup> Michael Dove, P Sajisa, A. Doolittle (eds.), 2005, *Conserving Nature in Culture: Case Studies from Southeast Asia*, New Haven: Yale Southeast Asian Studies, Monograph 54.

28. The WMPA's work in implementing the Social and Environmental Management Framework and Operational Plan (SEMFOP) has been constrained by the lack of an "ethnic advisor", which was required by the original plan document. In 2009, the POE pointed out that there was no uniform understanding of the purpose and mission of the WMPA between WMPA personnel, the WMPA board, and other government agencies. It also pointed out that there was no Lao version of the SEMFOP document, and recommended that at least the key parts be translated. The absence of a Lao version may explain why government policy (e.g., regarding village consolidation and stopping swidden forms of cultivation) is accorded more importance than the SEMFOP in the management of the WMPA. Following the midterm review of the SEMFOP in February–June 2009, the WMPA has: (i) drafted a new five-year management plan, which includes macro-zoning of the watershed in to a total protection zone, a controlled use zone and tourism zones; and (ii) created a priority patrolling plan to increase spatial and temporal presence.

29. **The peripheral impact zone.** Buffer zones to the north and south of the NPA are collectively referred to as the PIZ. Both the buffer zones include some Vietic hunter-gatherers, along with numerous other ethnicities. The villages located in the PIZ predate the establishment of the NPA, and so have traditionally used and relied upon the area (now the NPA) for hunting, fishing, and collecting forest products. The hunter-gatherers were moved out of the NPA forest area as far back as the 1970s and up until at least 2002. The resettled hunter-gatherers in the PIZ also rely on the NPA forest. As the PIZ residents utilize NPA resources, any restrictions on that use places them firmly in the category of project-affected people. There remains some confusion within the WMPA about entitlements of villages in the PIZ; the SEMFOP for the watershed proclaims that the principles of the ethnic minority development plan apply to PIZ residents, but also that PIZ residents can not be considered project beneficiaries.

30. **Project lands.** The main issue for project lands on the power station side was compensation for land impacted by the civil works in the immediate vicinity of the power station (i.e., for the regulating pond, downstream channel, and the aeration weir). Resettlement compensation for these areas has largely been completed. During a site visit to the west side of the civil works, the SAPE mission team tried to understand how compensation levels had been computed, but got the impression that the method had not been communicated properly to the villagers.<sup>15</sup>

31. As construction of the downstream channel had diverted water from the Nam Gnom river, and irrigation water for dry season paddy could not be supplied to the villagers along the Nam Gnom. A siphon was therefore constructed below the downstream channel and water was made available through a temporary earth channel to irrigate the paddy fields in question.<sup>16</sup>

32. The SAPE mission also discovered an unintended consequence of the compensation program and temporary jobs during project construction—that some people had bought motorcycles with the cash they had received, which they in turn used to smuggle valuable hardwood out from the nearby Khammouane NPA.

33. **Downstream below the power station on the Xe Bang Fai River.** For analytical purposes on the social side, the Xe Bang Fai River can be divided into three main areas: (i) the

<sup>15</sup> Apparently, wet season paddy land was compensated for in cash using production as the basis for calculation, but the villagers were not aware of any details.

<sup>16</sup> An irrigation rehabilitation project for the entire Tat Thod area is under design. NTPC is to contribute up to 40% of the cost of the irrigation project, and the remaining 60% is to be provided by the Khammouane Development Project. The NTPC contribution will cover the cost of irrigation rehabilitation in the project affected area.

innermost districts of Boualapha, Xaybouathong, and eastern Gnommalat; (ii) the middle portion of Mahaxai (where the downstream channel enters the river) and western Gnommalat; and (iii) the portion nearest the Mekong River, along Route 13, and downstream Nakhon Phanom in Thailand, the districts of Xe Bang Fai, Nong Bok, and Xaybouly. There are three ethnic groups within each area: Lao, Phou Thay, and Brou. About 75,000 people in 223 villages are estimated to be affected in varying degrees by the Nam Theun 2 project.<sup>17</sup>

34. The innermost area is considered at least risk of impact, though fish populations that migrate upstream to spawn in these upper reaches of the river will be affected. The area nearest the Mekong River is by far the most developed, and will no doubt cope with the impacts more effectively. Many villages in the middle Xe Bang Fai River, for which livelihood restoration programs are most required, are accessible by road only in the dry season.

35. During the SAPE mission's field visit, when power generation (and water release) had already begun from some of the large turbines, the villagers had gone in to a wait-and-watch mode, not knowing what the impacts would be. It was also observed that the river was moving fast enough to render traditional fishnets difficult to use, leading to a move to tributaries and creeks for fishing, and that Xe Bang Fai had become more muddy than before. Some fish were also reported to be disappearing. Although the full impacts will be felt over a period of time, difficulties in access to some of the villages in the wet season poses a problem to the extent that enhanced livelihoods require land transportation to access markets.

36. Riverbank gardens with potential to be affected have all been mapped, owners registered, and a compensation program is under way. Livestock raising is being promoted through the project's credit scheme. In selected villages, fish ponds have been dug and credit made available to purchase necessary supplies and fingerlings. In most villages, boreholes and pumps have been provided to ensure a reliable source of clean water suitable for domestic use. In some villages, groundwater remains a problem, as water from some newly dug wells has naturally occurring turbidity, salinity or heavy lime content. Where these problems exist, new boreholes are being constructed.

37. In general though, it is clear that integrated development activities in the villages visited by the SAPE mission are indeed taking place. Over a longer period of power plant operation, the need for and extent of additional integrated development efforts (if required) will become clearer.

38. **Downstream from the dam on the Nam Theun river.** Downstream from the dam, the Nam Theun river will be heavily impacted by the project. A series of flushes aimed at clearing decomposing biomass and contaminated water is the first impact, followed by a sharp reduction in flow levels when water is diverted to the Xe Bang Fai basin. There will be four annual "spills" in the wet season.<sup>18</sup>

39. The area downstream from the Nakai dam is primarily affected by loss of fish to villages on tributaries and on the Nam Theun river between the Nam Theun 2 project dam site and the head pond of the Theun-Hinboun project. There are 37 impacted villages identified, though the

<sup>17</sup> Panel of Experts. 2007. *Eleventh Report of the International Environmental and Social Panel of Experts, Nam Theun 2 Multipurpose Project*. Vientiane.

<sup>18</sup> Panel of Experts. 2007. *Twelfth Report of the International Environmental and Social Panel of Experts, Nam Theun 2 Multipurpose Project*. Vientiane.

degree of impact varies between households.<sup>19</sup> For 21 of the villages, fish from the Nam Theun comprise 15%–70% of their overall consumption.<sup>20</sup>

40. Mitigation is also provided via the Emergency Contingency Protein Replacement Program to be triggered by immediate and long-term food consumption monitoring, which was under way in 2009.<sup>21</sup> The plan calls for delivery of emergency supplies when protein levels are considered too low. The downstream program will also implement livelihood income restoration programs in the same 37 target villages. The exact form that this initiative will take will depend upon the results of a consultation process that will be the first step in the program.

#### **D. Multilayered Supervision**

41. The concession agreement outlined the sharing of responsibilities between the government and the NTPC in implementing all activities along the following lines: (i) the NTPC is to be fully responsible for implementing the infrastructure works for the Nam Theun 2 project; and (ii) with the government, the NTPC is to be jointly responsible for implementing the environmental and social program. Three independent panels comprising internationally recognized experts scrutinized the project during the preparatory and design stages: the government's environmental and social panel of experts, the dam safety review panel of experts for design and safety aspects, and the World Bank's International Advisory Group. The panels continued to be involved during construction and implementation of the Nam Theun 2 project. An additional monitoring layer was added with an independent monitoring agency. In the operations phase, the environmental and social panel of experts is expected to remain active for as long as necessary during the concession period.

42. Further to the monitoring arrangements described above is a multilayered complementary system comprising lenders' advisors, government engineers, and owner's engineers, in addition to supervision by staff from the multilateral and bilateral development partners as well as commercial banks. Such implementation arrangements reflected, among other things, the experience gathered from supporting other hydropower projects world-wide; more specifically the following: (i) a basic learning that environmental and social issues and concerns do not vanish when construction is completed; and (ii) monitoring of environmental and social implications should continue well beyond the commercial operations date of a hydropower plant, and a panel of experts should be in place during construction and operation phases.

43. Including its last visit in February 2010, the environmental and social panel of experts thus far has made 16 visits during the project design, development, and construction phases. The environmental and social panel of experts submits a report to the government after each visit that presents a clear picture of the status of environmental and social issues and mitigations. The POE reports also include recommendations to both the NTPC and the government. These recommendations are based on an assessment of findings and feedback gathered during a project site visit (including the project-affected area and watershed), as well as discussions with various stakeholders and participants, and are in general have been accepted.

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<sup>19</sup> However, as per the 12th report of the panel of experts in 2007 (footnote 18), there are 51 impacted villages. Figures have been updated annually since then.

<sup>20</sup> Nam Theun 2 Power Company. 2008. *Downstream Implementation Plan*. Vientiane. 8 April.

<sup>21</sup> Panel of Experts. 2009. *Fifteenth Report of the International Environmental and Social Panel of Experts, Nam Theun 2 Multipurpose Project*. Vientiane.

## **E. Monitoring During the Concession Period**

44. Environmental units established under concession agreement requirements have been carrying out environmental monitoring of the Nam Theun 2 hydropower project. Various project lenders also have their monitors carrying out external monitoring. The concession agreement stipulates that external monitoring will be undertaken during the construction phase and for the first 5 years of the operating phase. Monitoring of the operating phase will be extended under terms and conditions to be mutually agreed upon by the government and the NTPC, if either the NTPC, the government, or the panel of experts recommends that further external monitoring is required because the project impacts are not fully mitigated.

45. The concession agreement stipulates the setting up of environmental monitoring units for both the government and the NTPC; third-party monitoring is also stipulated. The government, in compliance with the concession agreement, has established the Environmental Management Unit, under the direction of the WREA, to monitor the implementation of the environmental measures of both the government and the NTPC. The Environmental Management Unit's responsibilities include reviewing and giving approval to the environmental component of the construction contracts and the head construction contractor's environmental management and mitigation plan, and field monitoring of the NTPC's compliance with its obligations on environmental measures.

46. Similarly, in compliance with the concession agreement, the NTPC has established within its organization the Environmental Management Office. The office is responsible for implementing and monitoring the environmental obligations of the NTPC under the concession agreement. The Environmental Management Office prepares monthly reports for submission to both the NTPC and the government. These monthly reports include progress made in implementing the environmental measures against the implementation program agreed with the government, and the schedule of works under way and planned with regard to the environmental measures.

47. Under the concession agreement and as agreed with the NTPC, the government established a POE to facilitate the independent review and guidance to both parties on (i) mitigating against and remedying project impacts, (ii) implementing each party's obligations under the environmental and social objectives, (iii) ameliorating and remedying unanticipated project impacts, and (iv) the appropriateness and relevance of the environmental and social objectives. The POE is required to act independently of both the NTPC and the government and is required to assess the extent to which the project meets the requirements of the safeguard policies of the World Bank and ADB.

48. In addition, the concession agreement stipulates that the government, in consultation with the NTPC, shall engage an independent monitoring agency to externally monitor and evaluate measures implemented to address the environmental and social aspects on an annual basis and at other times as required by the government. The independent monitoring agency shall report to the both the government and the NTPC on its findings. The NTPC shall be responsible for funding the costs associated with appointment of the independent monitoring agency. Presently, the government has engaged Halcrow, an international consulting firm, as the independent monitoring agency for the environmental and social measures.

49. For monitoring WMPA activities, the concession agreement stipulates that the WMPA engage an independent monitoring agency to conduct regular (annual) monitoring missions to the Nam Theun 2 watershed area. The monitoring agency shall also review each new or

amended management plan, operational plan, and annual budget of the WMPA. The independent monitoring agency shall certify that the management plans and operational plans are consistent with WMPA objectives and functions. The independent monitoring agency has been engaged since 2007.

## **F. Concluding Remarks**

50. The government is proud of the fact that a world-class project such as the Nam Theun 2 project has been successfully implemented in the Lao PDR, and widely recognizes the contribution of the multilayered supervision system towards continued attempts to manage the adverse environmental and social implications of the project. However, government also recognizes the need to strengthen its capabilities in managing environmental and social aspects and the need to internalize the processes and implement them for all future hydropower projects. (Further details are in Appendixes 3 and 4.) The NTPC also acknowledges the good work done by the environmental and social panel of experts as well as the entire system of multilayered supervision. However, the additional work involved in responding to a large number of monitoring, evaluation, and/or supervision agencies, and the expenses on the multilayered supervision system have been significant.<sup>22</sup>

51. NTPC has done a commendable job in complying with the requirements of the concession agreement and with ADB's environmental and social safeguards. However, whether or not the concession agreement and the lenders' safeguards are able to fully capture the essence of social sensitivities in a consolidated (for administrative ease) multiethnic or minority village is a different matter.

52. It is also recognized that some of the problems encountered in the resettled areas have arisen because development of the resettlement areas created circumstances attractive to outsiders—including relatives of some of the resettled families who preferred to move into the resettled villages—that in turn increased the pressure on available resources.

53. However, the key elements for continued sustained attention to impact mitigation are in place. These include the continuation of the work of the WMPA (whose capabilities should improve with time) during the concession period, continued development work of the project addressing livelihoods of resettlers for the duration of the Resettlement Period as well as in the downstream areas, and the continuation of the environmental and social panel of experts to the extent it is necessary. The provisions of the concession agreement also make it possible to marshal further financial resources to address hitherto identified impacts as well as some unforeseen impacts, should that be required.

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<sup>22</sup> For instance, as per NTPC sources, each visit of the environmental and social panel of experts costs the NTPC more than \$170,000.

## PERFORMANCE OF TRANSMISSION AND DISTRIBUTION PROJECTS

### A. Power Transmission and Distribution Project

Date Approved	30 Sep 1997
Date Effective	27 Mar 1998
Date Closed	1 Jun 2004 (extended)
Approved Amount	\$30 million
Last Revised Allocation	\$29,105,971
Amount Disbursed	\$28,730,508
Amount Balance	\$375,463
Attached Advisory Technical Assistance	Power Transmission and Distribution Project (TA 2479, for \$250,000)
Executing Agency	Electricité du Laos

1. **Project objectives.** The immediate objectives of the project are to (i) supply electricity to Xieng Khouang, Xaisomboun, Xayaburi, and Xanakham areas involving about 22,700 consumer connections in 150 villages and provincial towns; (ii) extend Vientiane Plain Rural Electrification by providing 8,000 additional consumer connections, and associated medium- and low-voltage distribution in 200 more villages; and (iii) rehabilitate power distribution facilities in Vientiane City. The long-term objective is to provide the necessary power infrastructure capable of meeting the power demand of around 60,000 consumers in outlying villages by 2015.

2. **Project components.** The project has the following components:

- (i) 158 kilometers (km) of 115 kilovolt (kV) transmission line from Nam Leuk to Xieng Khouang, extension of Nam Leuk hydropower station switchyard, 115/22 kV substation at Xieng Khouang, shield-wire distribution along the transmission line, and conventional distribution in Xieng Khouang and Muang Cha towns and the surrounding areas;
- (ii) 73 km of 115 kV transmission line from Xieng Ngeun to Xayaburi, 115 kV connection at Xieng Ngeun, 115/22 kV substation at Xayaburi, shield-wire distribution along the 115 kV line, and conventional distribution in Xayaburi town and the surrounding areas;
- (iii) 94 km of 115 kV transmission line from Nam Ngum via Hin Heup to Muang Feuang, 115/22 kV substations at Hinheup and Muang Feuang, shield-wire distribution along the line, 70 km of 34.5 kV or 22 kV line from Muang Feuang to Xanakham, and conventional distribution in Hinheup, Muang Feuang, and Xanakham;
- (iv) about 200 km of 22 kV distribution lines, 120 distribution transformer substations, and about 8,000 low-voltage connections in the Vientiane Plain;
- (v) rehabilitation of Vientiane City power distribution facilities including replacement of overloaded conductors, deteriorated wood poles, and old distribution panels, installation of power factor correction capacitors and switchgear, and the provision of maintenance equipment;
- (vi) miscellaneous works such as a benefit monitoring program, clearing of unexploded ordnance, assisting in loss reduction program of Electricité du Laos (EdL), and environmental monitoring; and
- (vii) consulting services for detailed project design and implementation supervision.

3. **Assessment at project completion.** The project completion report rated the project *successful*. The project implemented more than envisaged at appraisal through increases in the

length of high-voltage transmission lines, the number of substations and extensions, and the length of medium- and low-voltage lines.

4. EdL could not comply with any of its financial loan covenants until 2002 (the fifth year of implementation). The cost of connection to the electric system for rural households was too high, resulting in fewer connections than envisaged at appraisal. The overall performance of EdL with regard to environmental and social aspects was considered satisfactory. The project completion review mission interviewed the project-affected people in the villages, and none complained about the compensation they received.

5. The Power Transmission and Distribution Project (PTDP) suffered delays of about 18 months due to various reasons that can be attributed to the executing agency (EdL), the consultant, and the Asian Development Bank (ADB). Due to EdL's inadequacies and the consultant's unfamiliarity with ADB procurement processes, EdL had to submit bid evaluation reports for the 115 kV lines thrice to ADB before they were considered satisfactory and could be approved. Reportedly, ADB also took a considerable amount of time to review and clear the bid evaluation reports. However, after all contracts had been awarded, implementation progressed smoothly and project costs were lower than anticipated at appraisal.

6. The economic internal rate of return (EIRR) is estimated to have increased from 16.9% at appraisal to 19.1% at completion. This increase does not reflect the project itself, but the fact that at completion the expanded transmission and distribution system was assumed to supply hydropower-based electricity rather than oil-fired electricity from diesel generators (as was the case at appraisal).

**B. Northern Area Rural Power Distribution Project**

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Date Approved	18 Sep 2003
Date Effective	8 Mar 2004
Date Closed	31 Mar 2010 (extended)
Approved Amount	\$30 million
Amount Disbursed	\$28.528 million
	(as of 28 February 2010 Project Performance Review)
Executing Agency	Electricité du Laos

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7. **Project objectives.** The project’s objectives are to (i) extend the transmission and distribution system in northern areas to provide electricity to rural low-income communities, and improve their living standards and local economic conditions; and (ii) help the government restructure the power sector, and strengthen project management capacity and operational efficiency of EdL.

8. **Project components.** The project consists of the following components:

- (i) extension of high-voltage (115 kV) transmission lines totaling 303 km, including a 173 km line from Luang Prabang to Oudomxai, and a 79 km line from Oudomxai to Louang Namtha, a 46 km line from Hin Heup to Vang Vieng, and a 5 km line from Nam Ngum to Thalat;
- (ii) construction of 115 kV, 34.5 kV, and 22 kV substations at Oudomxai, Louang Namtha, and Luang Prabang (extension); “T” tap junction at Hin Heup substation; “interface” at Sayaburi and Phonsavanh substations; and some minor extension work at Vang Vieng, Thalat, and Nam Ngum substations;



- (iii) erection of 796 km of medium-voltage (34.5/22 kV) distribution lines, 237 distribution transformers, and 609 km of low-voltage (380 V) distribution lines; and connection of 33,800 households in 342 villages;
- (iv) clearance of unexploded ordnance in project areas;
- (v) miscellaneous works, including benefit monitoring, resettlement, and compensation programs;
- (vi) consulting services to help EdL in detailed project design, implementation supervision, and other capacity building support; and
- (vii) consulting services to the government to further study the separation of its existing shareholdings and future independent power producer investments from EdL, and development of independent power project selection and implementation procedures.

9. **Implementation progress.** The project was completed on 27 March 2010 and the loan closed on 31 March 2010. Connection and electrification of rural households was also completed. Smaller rural settlements were actually electrified than was envisaged at appraisal, as evident from the fact that the average number of households in the electrified villages was 50–60 rather than the 90–100 expected at appraisal. As of January 2010, 443 villages (approximately 27,000 households) were connected.<sup>1</sup> Pak Mong substation was added as there was an increase in the Nordic Development Fund credit. Interface at Sayaburi and Phonsavanh was not included as it was constructed under the PTDP.

10. **Preliminary assessment of the project.** The project is generally compliant with ADB's social safeguards policy. Environmental and social mitigation work for Nam Song and Nam Leuk hydropower projects was added in the scope of work. EdL's technical performance was enhanced through increased investment in technical improvement and reorganization. Loss reductions registered were 19.30% in 2005, 17.86% in 2006, 15.83% in 2007, 13.17% in 2008, and 12.52% in 2009. EdL implemented tariff adjustment, effective from mid-2005 with subsequent annual adjustments up to 2011. The government's compliance with loan covenants is generally *satisfactory*. EdL will carry out socioeconomic surveys to measure progress towards poverty reduction at project completion and 3 years after completion.

11. The Northern Area Rural Power Distribution Project closed in March 2010, a delay of about 24 months. A delay of 21 months was due to (i) the contractor, who was unfamiliar with local working conditions and who preferred to wait until the currency market situation improved to make the exchange rate more favorable,<sup>2</sup> and (ii) EdL's financial constraints that made it difficult to meet tax and duty payment obligations on imported equipment, as well as compensation to project-affected peoples for involuntary resettlement.<sup>3</sup> Nonetheless, the 21-month delay due to the contractor subsumed other delays of about 12 months. To this was added a three month delay in completing additional environmental and social mitigation works for the Nam Song and Nam Leuk hydropower projects, which entailed additional supply contracts.

12. Although EdL's bid management skills (for the 115 kV system) did show a distinct improvement compared to under the PTDP, EdL had still not begun to manage comprehensive engineering–procurement–construction contracts. Project EIRR at closure remains to be

<sup>1</sup> At appraisal, electrification targets were 33,800 households in 342 villages.

<sup>2</sup> In fact, the contractor from the People's Republic of China bid very low to win the contract. At that rate, most local contractors were too expensive to be subcontracted. This led to delays in (among other items) loading tests for towers because of inadequate construction plant, difficult site conditions, and insufficient labor.

<sup>3</sup> This was no doubt made more difficult by the fact that, during implementation, surveys were conducted over several routes, and route selection and target villages were not finalized for several months.

estimated; it is likely that the increased project cost and time overruns will depress the attractive EIRR of 23.3% estimated at appraisal.<sup>4</sup> Estimation of project EIRR at completion will also call for a detailed assessment of the benefits of electrification to more remote settlements with fewer households than originally envisaged. On the basis of a survey of selected villages conducted by the independent evaluation mission in January 2010, it is noted that less than 10% of the households are using electricity to generate an income.

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<sup>4</sup> It may be noted that the original loan approval was in various currencies that amounted to SDR21.49 million (or \$30 million). Before loan closure and project completion, the precise cost overrun data is not available, but it is understood that the total project cost increased from \$51.51 million (at appraisal) to more than \$62.00 million. Part of this increase reflects the weakening of the dollar against the special drawing right.

## ENVIRONMENTAL AND SOCIAL ASPECTS OF THE THEUN-HINBOUN HYDROPOWER PROJECT

### A. Safeguards of the Theun-Hinboun Hydropower Project

1. At the time of loan processing and approval of the first hydropower project of the Theun-Hinboun Power Company (THPC)—the 210 megawatt (MW) Theun-Hinboun Hydropower Project (THHP) in Bolikhamxai and Khammouane provinces in November 1994—the Asian Development Bank (ADB) had in place an environmental categorization system for projects it supported. Environmental categorization was carried out through project screening during project preparation. It was undertaken to reflect the significance of potential impacts or risks that a proposed project might have, and to gauge the level of assessment and institutional resources that would be required for the safeguard measures.

2. ADB's 1993 environmental guidelines were then used to guide the environmental screening of proposed projects.<sup>1</sup> The guidelines focused on the following biophysical issues in hydropower projects: encroachment into precious ecology, silt runoff from watershed erosion, effects on groundwater hydrology, migrating valuable fish species, inundation of mineral resources, reservoir bank stability, reservoir management, reservoir fishery, reservoir eutrophication, insect vector disease hazards, downstream flow variations, downstream erosion, downstream fisheries, downstream water quality, estuarine and marine fisheries impacts, endangering of fish species, transmission line impacts, and construction-related impacts.

3. The guidelines employed three environmental categories (A, B, and C) based on the type of environmental impacts of proposed projects. Environmental category A projects were those with potential for significant adverse environmental impacts. An environmental impact assessment (EIA) was then required for category A projects to address significant impacts. Environmental category B projects were those judged to have some adverse environmental impacts, but of lesser degree and/or significance than those for category A projects. An initial environmental examination (IEE) was required for category B projects to determine whether or not significant environmental impacts warranted the preparation of an EIA. If an EIA was not needed, the IEE was regarded as the final environmental assessment report. Environmental category C projects were those unlikely to have adverse environmental impacts. No EIA or IEE was required for category C projects, although environmental implications were still reviewed (there were no specific guidelines for such review).

4. The guidelines were intended for both the borrower and ADB staff. These were applied in evaluating the potential environmental impacts of hydropower projects during construction and operation on the basis of their proposed designs. If project proponents followed the guidelines, potential environmental impacts of a proposed hydropower project would be examined adequately during preparation of its EIA or IEE. The guidelines provided more specific guidelines on what items needed more attention during the conduct of the EIA or IEE study. Such environmental concerns were presented as a checklist and organized into sections of environmental problems: (i) due to project location, (ii) associated with design, (iii) due to construction, and (iv) relating to project operations. The checklist also contained potential environmental enhancement measures. In addition, a matrix of environmental parameters for analysis of dams and reservoirs was presented, and provided information that a dam can have significant impacts on fisheries, aquatic biology, terrestrial wildlife, erosion and sedimentation, and surface water.

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<sup>1</sup> ADB. 1993. *Environmental Guidelines for Selected Industrial and Power Development Projects*. Manila.

5. During loan processing in 1994, the THHP was classified as a category A project on the basis of the screening for likely impacts. This implied that the project was likely to have significant adverse environmental impacts. An EIA, not simply an IEE, was required to study the significant environmental impacts. The EIA of the Theun-Hinboun Hydropower Project was completed in April 1994, and a summary EIA was circulated to the ADB Board in June 1994.<sup>2</sup>

6. The EIA concluded that environmental impacts would be within acceptable limits. For example, it anticipated a significant environmental impact due to reduction in river flow downstream of the intake dam at Nam Theun, but claimed that, with a minimum flow for the dry season supported by a comprehensive monitoring program, the aquatic system would not suffer species extinction or other irreversible damage, though fish numbers during the dry season were likely to decline downstream. However, due to lack of baseline information, the EIA was inadequate in its coverage and depth of analysis of environmental and social impacts.<sup>3</sup>

7. During project implementation, the THPC established the Environmental Management Committee Office comprising local staff to manage mitigation and compensation issues with support from international and local specialists. While the establishment of the office was a good concept, it did not attain the level of performance required during project implementation because of low staff capacity and inadequate supervision from international specialists. In particular, it failed to expand the environmental management plan (EMP) into a detailed and comprehensive document following the completion of the detailed project design. Although smooth implementation of any EMP is often undermined by unforeseen impacts, in the case of the THHP, the impact of unforeseen circumstances was exacerbated by the failure to revise, elaborate upon, and then implement a comprehensive EMP. As a result, the THPC had to deal with impacts as they occurred rather than in a strategically planned manner. This became a serious issue primarily during project operation, when flows began to be diverted to the Nam Hai–Nam Hinboun system.<sup>4</sup>

8. By time the project was completed in March 1998, ADB still did not have an environmental policy but its loan processing relied on previously issued environmental guidelines. ADB eventually issued an environmental policy in November 2002.

## **B. Outstanding Environmental Issues of the Theun-Hinboun Hydropower Project**

9. During implementation and initial operation of the THHP, it became clear that environmental and social impacts were more extensive than anticipated. A more detailed agreement regarding mitigation measures was signed between the THPC and the government, where the THPC allocated more funds to implement the mitigation measures. Additional independent studies provided better documentation of the baseline conditions and both the THPC and EdL committed to mitigating the impacts caused by the THHP. However, at the time of the project completion review mission in March 2000, some impacts were not yet mitigated to the satisfaction of ADB, and the related loan covenants were not fully complied with. To remedy the environmental and social problems, a 10-year mitigation and compensation plan was agreed upon in June 2000.<sup>5</sup> The plan is comprehensive and ambitious, and tries to adopt best practices in terms of participation.

<sup>2</sup> ADB. 1994. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Lao PDR for the Theun-Hinboun Hydropower Project*. Manila.

<sup>3</sup> ADB. 2002. *Project Performance Audit Report on the Theun-Hinboun Hydropower Project in the Lao PDR*. Manila.

<sup>4</sup> ADB. 2000. *Completion Report: Theun-Hinboun Hydropower Project in the Lao PDR*. Manila.

<sup>5</sup> Resource Management and Research. 2000. *Theun-Hinboun Power Project Mitigation of Project Impacts: a 10-year Mitigation and Compensation Program*. Vientiane. June.

10. Environmental issues outstanding at the time of the project performance audit report of the Theun-Hinboun Hydropower Project in 2002 were the following: (i) studies of erosion, sedimentation, fishery, and other impacts of the THHP should be completed and documented in the next few years before the Nam Theun 2 project is commissioned to ensure that any effects detrimental to THHP operations and any negative environmental impacts are not attributed to the THPC; and (ii) local government authorities, together with the THPC and the villagers in the project area, should develop a watershed management plan by December 2004 for the upstream areas and assign its supervision to an agency with adequate funding and authority.

11. **Impact studies.** The requirement for studies was the result of the preparation of the THPC's 10-year mitigation and compensation plan. When the diversion of river flows started in April 1998, a wide range of impacts caused by the project's operations had been reported, which ultimately led to the preparation of the plan in 2000. The mitigation and compensation plan was a program of measures designed to mitigate and compensate fully for all negative impacts created by the THPC hydropower project. It included a description of (i) studies needed to actually understand better the changes that the project induced; (ii) required monitoring to follow the changes which were still evolving; (iii) required monitoring to verify when a mitigation or compensation measure has been completed, or to fine-tune mitigation measures to meet specific targets; and (iv) mitigation or compensation measures outstanding or ongoing.

12. Under the mitigation and compensation plan, THPC's former Environmental Management Committee Office was renamed the Environmental Management Division in order to send a message that environmental and social management of project impacts is a regular and important business activity with the same need for rationality, accountability, and commercial efficiency as power generation and transmission.<sup>6</sup>

13. When the mitigation and compensation plan was reviewed for the preparation of detailed work plans and budgets, the THPC decided that a logical framework must be established to guide the activities of the Environmental Management Division. In general, the logical framework provided for the following: (i) a logical process for implementing the plan; (ii) flexibility for management control; (iii) participation by concerned stakeholders; (iv) a guide for work planning and budgetary control; and (v) a framework for monitoring, evaluating, and reporting.<sup>7</sup> The logical framework presented the idea that there were environmental impacts for which it was not possible to undertake mitigation measures until further research was undertaken. Examples of such research included (i) erosion in the Nam Hai tributary of the Nam Hinboun caused by increased dry season water flows, thus inducing permanent increases in water sediment loads and losses of farmlands and fish breeding habitats; and (ii) river fish populations.

14. **Watershed management plan.** At the time of the sector assistance program evaluation (SAPE) mission in November 2009, there was no information regarding the proposed watershed management plan for the upstream areas. All the staff of the THPC environmental unit were new personnel and were not aware of the proposed watershed management plan during SAPE mission discussions in November 2009. Discussions with staff of Hinboun Forestry and the Agricultural Extension Office also in November 2009 in the Hinboun District revealed that there are no joint programs on watershed management between the Agriculture Extension Office and the THPC.

<sup>6</sup> THPC management felt at the time that the term "committee" projected an inappropriate image for the company.

<sup>7</sup> THPC. 2002. *Logical Framework: 2001–2006 to Implement the 10-year Mitigation and Compensation Plan of THPC*. Vientiane.

### C. Addressing Outstanding Issues

15. The mitigation and compensation plan described the studies needed to actually understand better the changes which the project induced, while the logical framework presented the idea that there were environmental impacts for which it was not possible to undertake mitigation measures until further research was undertaken. The plan reported that 36 downstream villages along the Nam Hai and Nam Hinboun rivers were adversely affected by the hydropower project. The framework also compressed implementation of the 10-year mitigation and compensation plan to 5 years, between 2001 and 2006. At the time of the SAPE mission in November 2009, 3 years after the closure of the mitigation and compensation plan, there was no information on activities to mitigate erosion and fishery loss. There was no information on the status of the studies on erosion, sedimentation, fishery, and other impacts of the THPC.

16. It appears that the impact management approach followed the idea of the 1996 NORPLAN impact report which recommended to just monitor the erosion development and take appropriate precautions against property damage.<sup>8</sup> The approach effectively was to simply allow the Nam Hai to be eroded. This approach is not in line with the purpose of an environmental assessment, i.e., to protect the environment and quality of life of the people. An environmental assessment is intended to ensure that a project proceeds in an environmentally acceptable manner by minimizing or avoiding adverse environmental effects before they occur. It is not simply identifying the impacts but is an environmental management plan with proposed mitigating measures and monitoring requirements.

17. **Erosion of the Nam Hai river.** The Nam Hai and Nam Hinboun rivers have been experiencing considerable hydrological changes since the THHP began operating. The Nam Hai prior to this facility had an estimated peak flood of around 100 cubic meters per second (m<sup>3</sup>/sec) and dried out naturally for 4–5 months during the dry season, except for some pools. When the THHP powerhouse discharges 110 m<sup>3</sup>/sec for a few hours each day in the dry season, the Nam Hai instantly becomes a river constantly experiencing the annual peak flood event during the dry season. This intermittent high flow has been causing erosion of the Nam Hai riverbanks and consequently adversely affecting water quality with the increase in river turbidity.

18. Erosion of the Nam Hai can be seen easily, as was observed during a site visit by the SAPE mission at the confluence of the Nam Hai and Nam Hinboun rivers in Ban Kongphat. During this site visit, the Nam Hai was brownish (heavy sediment load) in color, while the Nam Hinboun, before it merges with the Nam Hai, was greenish in color. The heavy sediment load of the Nam Hai caused the downstream Nam Hinboun to also have a brownish color up to the confluence with the Mekong River, as observed by the SAPE mission at the Nam Hinboun bridge of Road 13 and at Ban Hinboun Tai near the confluence with the Mekong River. Interviews with key informants in Ban Kongphat revealed that the Nam Hai has widened considerably over the years due to riverbank erosion. Villagers also claimed that the poor water quality of the river, due to high concentration of sediments, have prevented them from using the water for bathing and washing.

19. Erosion of the Nam Hai was anticipated in 1996 by the impact studies for the Theun-Hinboun Hydropower Project. The report concluded that erosion of the Nam Hai was inevitable due to the flow of up to 110 m<sup>3</sup>/sec, and erosion is likely to continue for many years, scouring the riverbed and widening the river by scouring the banks. The report further concluded that erosion

<sup>8</sup> NORPLAN AS. 1996. *Impact Studies for the Theun-Hinboun Hydropower Project*. Vientiane.

protection works are unlikely to be successful with the lack of armoring material (stones and boulders) found in the Nam Hai plain.

20. Interestingly, the report recommended that the only approach to the erosion problem is to monitor the erosion and take appropriate precautions, such as informing the local people of the expected bank and bed erosion, building a flood protection bund on both banks about 1 meter (m) high and at least 50 m from the existing riverbank to allow for future bank erosion, and monitoring the erosion by annual profiling of the river section at certain fixed sections. In effect, the recommended approach of the impact studies at that time was to allow the Nam Hai to be eroded. The EIA of the Theun-Hinboun Expansion Project (THXP) also noted this erosion of the Nam Hai and claimed that river morphology had not yet stabilized even after almost 10 years of operation.<sup>9</sup>

21. Operation of the THXP will bring changes to the present erosion situation. Fluctuating water levels and depths, caused by flow rate changes (a factor in erosion processes) will not be totally eliminated with operation of the THXP, even if it operates as a base-load plant. The THXP EIA claimed that the surge pond will not be able to fully regulate the flow but will buffer the abrupt changes in discharge volumes. This means that increases in flow from 0 m<sup>3</sup>/s to 220 m<sup>3</sup>/s will be seen over a few hours in the Nam Hai and Nam Hinboun rivers. The same phenomenon occurs when the plant is shut down, as the flows gradually decrease to 0 m<sup>3</sup>/s over hours rather than instantaneously. The THXP will double the total maximum flow to 220 m<sup>3</sup>/sec by discharging an additional 110 m<sup>3</sup>/sec to the Nam Hai during most of the wet season, while fluctuating between full discharge and minimum discharge during the dry season. Discharge flows will vary between 220 m<sup>3</sup>/s and 90 m<sup>3</sup>/s for short durations during the latter parts of the wet season.

22. **Increased flooding.** When the THHP discharges 110 m<sup>3</sup>/sec, the Nam Hai becomes a river experiencing the annual peak flood. The 1996 impact study raised the concern for increase flooding as during the rainy season prior to project implementation the peak flood level was already 2–3 m high and spread over the whole plain. The additional flow may cause some lengthening of the period when flooding occurs. With increasing erosion, a large amount of sediment may accumulate in the Nam Hinboun. This will reduce the river channel's capacity to carry floodwaters and will lead to increased flooding.

23. Villagers in Ban Kongphat, Ban Hinboun Tai, and Ban Hinboun Nuane confirmed the increase in flooding to the SAPE mission in November 2009. They claimed that, since the THHP began operating, flood levels and duration during the wet seasons have increased. They further claimed that the THPC provided some assistance to the villagers during the 2003 and 2004 flooding events upon the intercession of the Hinboun District officials.

24. A comparison of the natural river flows and flood flows with the THHP in operation and the proposed implementation of the THXP will provide better clarity in understanding the flooding situation. In the Nam Hai at Ban Namsanam, the THXP EIA predicts that the 100-year natural flow of 490 m<sup>3</sup>/s will increase by 22% with the THHP and by 45% with the proposed implementation of the THXP. The effect is more pronounced when comparing the 10-year flows, when the increase will be 31% with the THHP and 62% with the proposed implementation of the THXP. This gives a scenario of THXP operation where flooding in the Nam Hai downstream of the hydropower facility is expected to significantly increase.

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<sup>9</sup> NORPLAN AS. 2008. *Final EIA/EMMP of Theun-Hinboun Expansion Project*. Vientiane.

25. The THXP EIA predicted that the effects of the present hydropower releases are considerably lower than in the Nam Hai. The mean annual flood is today only increased by around 10% and the 100-year flood by around 5%.

26. For the flooded area around the Nam Hai and Nam Hinboun rivers upstream of Ban Khen (just upstream from a narrow gorge through a mountain ridge), the THXP EIA predicted that a natural (i.e., without the THHP and THXP) 10-year flood will inundate 47.2 square kilometers (km<sup>2</sup>). The increase in flooded area for a 10-year flood will be 24.4% with the THHP operating, and 41.1% more with the proposed THXP also operating. This gives a scenario of THXP operation where the flooded area for floods with a return period of 10 years will increase significantly, i.e., more areas will experience flooding.

27. The THXP EIA predicted that the relative effect of the THHP and THXP releases decreases for the more extreme flood events, such as a 100-year flood. A natural (without the projects) 100-year flood would inundate 76.7 km<sup>2</sup>. The increase in the flooded area will be 7.4% with the THHP and 14.3% with the proposed THXP. The stated reason is that the floodplain areas are confined within the limited space of the steep karstic limestone ridges and much of these areas are already inundated during natural floods.

28. Flood durations will increase with the THHP and the proposed THXP, as per the THXP EIA. At Ban Namsanam, the average 100-year natural flood will last for about 5.5 days, 10.5 days with the present hydropower facility, and 19.5 days with the operation of the THXP. At Ban Kenghot, the average 100-year natural flood will last for about 8 days, 9.5 days with the present hydropower facility, and 13.5 days with the THXP.

29. In the lower Nam Hinboun from Ban Khen down to the Mekong River confluence, the THXP EIA predicted that the impacts of additional release of water from the hydropower facilities are modest compared to the natural flood levels. A 10-year natural (without projects) flood will inundate 144 km<sup>2</sup>, but the increase in flooded area will be 9.2% with the THHP and 19.6% with the proposed THXP. A natural 100-year flood will inundate 187.5 km<sup>2</sup>. However, the increase in the flooded area will only be 4.1% with the present THPC hydropower facility and 8.4% with the proposed implementation of the THXP.

30. **Fishery decline.** The logical framework presented the idea that it was not possible to undertake mitigation measures for impacts on river fish populations until further research has been undertaken. However, at the time of the SAPE mission in November 2009, the mitigating measures for adverse impacts on fisheries remained to be seen.

31. The Nam Hinboun river was found to be even richer in species than the Nam Theun and Nam Kading before the THHP came on stream, with 118 fish species listed (as reported by the THXP EIA). However, river ecology and fishery have already been altered by the several years of THHP operation, with changes having started during the initial years of operation. A fish monitoring study in 1999 cited the incident where considerable numbers of large fish were observed in the waters below the weir of the regulating pond at Nam Hai in March, April, and June 1999. It appeared that the increased flows downstream in the Nam Hai and Nam Hinboun stimulated an out-of-season, upstream migration in March and April 1999.<sup>10</sup> It was likely that many species were attracted to the Hinboun–Mekong confluence area during the dry season as a result of increased flows caused by the THHP, and that some species mistook the additional flows as

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<sup>10</sup> Warren, T. 1999. *A Monitoring Study to Assess the Localized Impacts Created By the Nam Theun-Hinboun Hydro Scheme on Fisheries and Fish Populations*. Vientiane.



the beginning of the wet season rise in water level and continued further upstream to the Nam Hai and Nam Hinboun.

32. Before the THHP came on stream, the Nam Hai dried out naturally in the dry season, except for some pools. With the THHP, the fluctuating discharges to the Nam Hai changed the natural volume and timing of river flows, which altered the river ecology, including fishery. It is widely known that flow variability controls all physical, chemical, and biological phenomena in a river. Flow modifications affect water quality, water depth and velocity, substrate composition, food production and transport, stimuli for migration and spawning, survival of fish eggs, spatial requirements, and eventually fish species composition.<sup>11</sup>

33. Villagers in Ban Kongphat confirmed to the SAPE mission in November 2009 that fish populations had declined considerably over the years. This was also claimed by the villagers in Ban Hinboun Tai and Ban Hinboun Nuane during discussions with the SAPE mission in November 2009. The villagers believed that the cause of the fishery decline is the increase in turbidity of the Nam Hinboun.

34. Village fish yields have significantly declined in the downstream areas of the Nam Hai and Nam Hinboun rivers down to the Mekong River as reported by the THXP EIA. Probable reasons for this decline as cited by the EIA include (i) discharges from the present hydropower facility have caused riverbank erosion, downstream sedimentation, drastic morphologic changes, and extreme water level fluctuation; (ii) high turbidity and high flows which earlier only occurred as a wet season phenomenon are now permanent features of the river; and (iii) increased sediment transport in the Nam Hinboun has filled the deep pools of the river and thus destroyed important fish production habitats and fishing sites. This has resulted in a situation where local people can no longer harvest aquatic vegetation or collect snails, mussels, and shrimps from the main stream of the Nam Hinboun. These items represent important parts of the aquatic food chain and thus there has been a decline in fish productivity and village fish catches.

35. Without controlling the high turbidity concentration due to erosion, river ecology will surely change and fish and other aquatic animals will struggle to survive. Aquatic life can tolerate small changes or pressure to the environment but cannot adjust to new situations brought about by major changes to the environment such as hugely fluctuating flows and large amounts of sediment in the water. Theoretically, with this disturbance fish will move to tributary small streams or river stretches where the natural conditions remain essentially unchanged, such as upstream of the Nam Hinboun–Nam Hai confluence.

#### **D. Environmental Safeguards during Implementation of the Theun-Hinboun Expansion Project**

36. The THPC is implementing the THXP. Its feasibility study was completed in January 2007, while the final EIA and EMP were completed in August 2007. Construction started in November 2008 and is expected to be completed in 2012. The THXP will expand the THPC's present generating capacity to about 500 MW by constructing (i) a 70 meter-high dam and reservoir on the Nam Gnouang upstream from the existing Theun-Hinboun weir, (ii) a 60 MW power station at the Nam Gnouang dam site, (iii) a new intake at the existing weir on the Nam Theun, (iv) a headrace

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<sup>11</sup> Miranda, L. 2001. A Review of Guidance and Criteria for Managing Reservoirs and Associated Riverine Environments to Benefit Fish and Fisheries. In *Dams, Fish, and Fisheries*. Edited by Gerd Marmulla. Rome: Food and Agriculture Organization.

tunnel from the weir approximately parallel to the existing tunnel, and (v) a new 220 MW power station adjacent to the existing THPC power station.

37. The THXP is not funded by ADB. However, its potential environmental impacts in the Nam Hai and Nam Hinboun river systems will change the impact levels compared with those experienced from the existing ADB-funded Theun-Hinboun Hydropower Project alone. The THXP will be discharging to the same point in the Nam Hai where the existing THHP is discharging, and will double the existing discharge from 110m<sup>3</sup>/sec to 220m<sup>3</sup>/sec.<sup>12</sup>

## **E. Towards Managing Environmental and Social Impacts**

38. The general approach appears to be that the environmental and social impact management systems and processes designed and elaborated upon in the environmental monitoring and management plan for the THXP will also address the adverse impacts that arose from the THHP and have remained unaddressed thus far. The other interesting aspect is that during THXP (and THHP) operations, additional monitoring will continue, which will in turn provide inputs into modifying or fine-tuning the ongoing mitigation programs.

39. **Theun-Hinboun Power Company's environmental and social management.** The Environmental Management Division of the THPC was established in 2001 for the social and environmental monitoring and management programs related to the operation of the THHP. Later, the THPC reorganized the Environmental Management Division into the much larger Social and Environmental Division to handle all environmental and social activities for both the THHP and THXP. The Social and Environmental Division comprises an environment unit, a resettlement unit, a social development unit, and a downstream unit. The environment unit has separate sections on water monitoring, fisheries monitoring, river protection, biomass clearance, reforestation, and construction monitoring. As of 2009, the Social and Environmental Division comprised 130 professional and technical staff; the environment unit had a staff of 16 engineers, a biologist, water quality specialists, a hydrologist, and a geographic information system specialist. The resettlement unit had approximately 60 staff comprising THPC personnel and secondees from government agencies; the number is expected to rise until 2011 as resettlement implementation continues.

40. **Mitigation of existing environmental impacts under the Theun-Hinboun Expansion Project's environmental monitoring and management plan.** The intention is to continually revise and update the environmental monitoring and management plan of the THXP on the basis of new information gathered during detailed project preparation, including situations when new project elements might be added and which might change the nature and extent of environmental consequences. The plan includes several subplans; those relevant to the impacts of the existing THHP are the downstream riverbed management plan and the fish monitoring and mitigation plan.

41. The downstream riverbed management plan addresses the issues of altered river hydrology, sediment flow, and erosion in the Nam Hai and Nam Hinboun rivers downstream of the powerhouse. This plan includes monitoring of riverbank erosion and river morphology, and construction of river protection works. The THPC is presently monitoring riverbank erosion and river morphology. This plan will finally provide mitigation for the riverbank erosion caused by the existing hydropower project. However, it calls for a detailed study on river hydraulics, as the THXP will double the discharges to the Nam Hai.

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<sup>12</sup> NORPLAN AS. 2008. *Final EIA/EMMP of Theun-Hinboun Expansion Project*.

42. The fish monitoring and mitigation plan addresses future changes in fish biology and aquatic ecology caused by the THXP, considering the potential for further degradation of fish biodiversity and fisheries in the Nam Hai and Nam Hinboun rivers.<sup>13</sup> The plan therefore includes monitoring the changes in fish and aquatic biodiversity caused by the THXP, and identifying potential measures to reduce or compensate for the expected impacts on fish and aquatic biodiversity. It intends to mitigate the reduction in fish biodiversity and production in the Nam Hai and Nam Hinboun rivers through reduced turbidity in the river. However, how turbidity will be reduced is not clear, and the EIA also does not address plans to tackle other causes of reduction in fish biodiversity and production (such as river flow modifications due to the large volume and variability of the water discharges).

43. **Resettlement and compensation.** There are plans to relocate several villages along the Nam Hai to higher ground by the time the THXP comes on stream. In this way, as per the THPC, the resettlers' homes in the northern parts will not be in flooded areas, and they would be able to grow two crops each year (instead of one crop prior to the THHP and THXP, which is only during the wet season). The THHP has adopted an integrated rural development approach, which means that provision of an access road, water supply, and electricity supply are integral parts of the relocation process. In most cases, the villages are being moved only a short distance (onto higher ground), and multiple and multiethnic villages are not being combined into single villages for administrative ease. However, five villages have been moved further (but onto higher ground to avoid flooding) and perhaps combined into a single village. The inconvenience experienced by these villagers in accessing their agricultural land is not compensated for. The THPC's basic philosophy is to continue supporting the resettled or relocated villages until such time as there is a 15%–20% increase (over baseline) in income of the village households for two consecutive years. The THPC recognizes that the number of years over which support is required for each village may be different, and it is open to the idea of continued support over a longer period.

44. The previous budget presented in the 2007 summary EIA and environmental monitoring and management plan had some gaps, such as the lack of allocation for riverbank stabilization measures which were presented in the environmental monitoring and management plan as proposed mitigations under the downstream riverbed management plan. Specifically, in the environmental monitoring and management plan it was proposed that river protection or training works were constructed to control the erosion of the Nam Hai and Nam Hinboun rivers. The budget related to this activity was only for downstream erosion monitoring and compensation.

## F. ADB Review

45. The loan agreement between ADB and the government, and the project agreement between ADB and the THPC for the Theun-Hinboun Hydropower Project signed in 1994, requires the government to obtain a waiver of negative pledge from ADB to allow the THPC to raise financing for expansion of the THHP and refinance its long-term debt. The THPC wrote to ADB in April 2008 to request such a waiver, which was granted in September 2008, and the THPC achieved financial closure for the THXP in October 2008. However, ADB considered it prudent to undertake due diligence of the THXP's safeguard compliance with government policies and the

<sup>13</sup> As per the THXP EIA, THXP's operations would reinforce the impacts causing present changes in the aquatic ecosystems and biodiversity. It further claimed that there is a risk that the increase in intermittent discharges will increase bank erosion of the Nam Hai and, in particular, will result in further increase in the silting down of bottom organisms. It will also cause damage to the stands of riverine trees which are important providers of organic materials that feed river organisms. The EIA also cited that the most important change has been the loss of benthic (bottom-living) organisms, which are the basis for much of the fish production, as well as being important food sources in their own right.

THXP environmental monitoring and management plan.<sup>14</sup> In fulfillment of this requirement, ADB fielded the first mission in December 2008. Since then, ADB and THPC have agreed to have regular annual social and environmental safeguard due diligence missions.

46. ADB obtained clarity on the following aspects of environmental and social impact mitigations by mid-2009:

- (i) The THPC will prepare annual implementation plans for the THXP, which includes an annual update of the environmental management plan along with budget allocations; the environmental management plan is funded as part of the capital budget for the THXP using funds provided from lenders, shareholder equity, and THPC's operating income; in 2009 budget was also allocated for a water quality testing laboratory, purchase of environmental monitoring equipment, and establishment of a landfill.
- (ii) As the overall budget for EMP implementation remains unchanged at \$3.4 million for the 10-year plan (even though additional budget has been allocated for a water testing laboratory, environmental monitoring equipment, and landfill), the THPC would be required to review the remaining budget and make adjustments.
- (iii) The access road being constructed by the THPC will be subject to the THPC's environmental and social program of mitigations, including compensation arrangements.
- (iv) The THPC has instituted specific contractual mechanisms that impose penalty on the contractor in the event of failure to fulfill obligations related to environmental management, health and safety, local labor training, quality assurance, water treatment, waste management, hazardous wastes, unexploded ordnance, and other obligations. In addition, the THPC can instruct the contractor to comply with such obligations, take necessary action needed to remediate noncompliance (if so required), and charge the cost of remediation to the contractor.
- (v) The environmental management program will continue to develop; in particular, (a) technical programs will be strengthened where necessary; (b) aquatic fisheries have already been reevaluated once at the behest of ADB, and such reevaluation can be repeated in the coming years if necessary; (c) the water quality monitoring program has been reevaluated and measures are being taken to upgrade and improve procedures; (d) a document to illustrate the performance of the regulating pond for the THHP alone, and when the THXP comes on stream, will be prepared; (e) the biomass cleaning program (from the reservoir area), including a reassessment of the alternatives (to burning) to mitigate effects on water quality, will be reviewed; and (f) the option of having a single-chamber septic tank in the resettlers' domestic sewage system will be reconsidered.
- (vi) Resettlement plans are well prepared and generally in accordance with ADB social safeguards and policies.
- (vii) The first stage resettlement at the Nong Xong resettlement area is being implemented well; where in addition to meeting household needs (in terms of aesthetics or cultural or economic requirements), the infrastructure and community needs are also being tended to.

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<sup>14</sup> ADB is not a lender to the THXP and so ADB safeguards do not apply to it. However, the first review mission in June–July 2009 did compare the THXP environmental monitoring and management plan with ADB safeguards for reference purposes. Subsequent review missions, however, will be focusing on the effectiveness of implementation of the THXP environmental monitoring and management plan.

47. Subsequently, the THPC has advised ADB that the figure of \$3.4 million for environmental monitoring and management plan implementation is only indicative, and that the actual budget will be approved annually through an annual implementation plan; the implementation plan for 2010 alone is \$0.8 million.

48. The ADB due diligence mission in April 2010 noted that at the present rate of expenditure on environmental and social mitigations, the budgeted amount of \$3.4 million would be spent by the end of 2011. This due diligence mission also found the implementation of environmental and social safeguard programs of THXP to be satisfactory and progressing well according to plan. The mission made some recommendations that include: (i) that THPC should strengthen the link between environmental performance with contractor payment; (ii) that THPC should submit to ADB semi-annual EMP progress reports that include synthesis of monitoring results, comparison of relevant standards, non-compliance issues and measures to resolve them, environmental penalties and fines received or given by the project, disbursements and major deviations from the annual implementation plan; and (iii) take necessary measures to meet obligations to the relocated households in terms of drinking water supply, and at Nong Xong to make available the requisite agricultural land to the resettled families as per the resettlement plan.<sup>15</sup>

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<sup>15</sup> ADB. 2010. *Theun-Hinboun Hydropower Plant Expansion Project—Due Diligence Mission*. Back-to-office Report. Manila (25–29 April).

## ENVIRONMENTAL AND SOCIAL ASPECTS OF THE NAM LEUK HYDROPOWER PROJECT

### A. Safeguards of the Nam Leuk Hydropower Project

1. The environmental and social safeguards requirements of the Asian Development Bank (ADB) when the Nam Leuk Hydropower Project (NLHP) was approved in September 1996 were the same as those discussed in the context of the Theun-Hinboun Hydropower Project (THHP) (Appendix 8). During loan processing in 1996, the NLHP was then classified as category A based on the screening for likely impacts.<sup>1</sup> This implied that the project was likely to have significant adverse environmental impacts, and that an environmental impact assessment (EIA), was required to study the significant environmental impacts. The EIA of the NLHP was completed in November 1995, and a summary EIA was circulated to the ADB Board in April 1996.

2. The EIA identified impacts and corresponding mitigating measures in hydrology, water quality, fisheries, land use, the Phou Khao Khouay (PKK) Park, forestry, wildlife, soils and erosion, and public health. The summary EIA concluded that with effective mitigation the project's adverse impacts could be kept to acceptable levels, and support for the PKK Park was expected to improve environmental conservation prospects in the area.<sup>2</sup> Approximately 0.75% of the park will be directly affected by the project.

3. The summary EIA anticipated major environmental impacts on fisheries and other aquatic life, primarily along the first 20 kilometers (km) downstream of the dam. This river section would lose a substantial amount of flow during the rainy season, although the flow in the dry season would remain unchanged. Long-term impacts to fisheries in the Nam Mang system, of which the Nam Leuk is a part, were not expected to be significant. The major forest loss would be caused by inundation of the reservoir area where 12.8 square kilometers of forest land would be flooded. The forest loss was not expected to disturb major wildlife populations or habitat significantly, and project support to improve PKK Park management in conjunction with the project's environmental mitigation and monitoring components is expected to lead to an overall improvement in biodiversity conservation in the area over the medium-to-long term.

4. Apart from impact mitigation, environmental monitoring was also one of the important aspects of ensuring compliance with safeguards, and ADB did not hesitate to require additional monitoring activities when there was a need for the Nam Leuk Hydropower Project. In the last week of August 1996, ADB received a letter from an international nongovernment organization raising concerns about potential impacts of the Nam Leuk Hydropower Project. ADB's Board then recommended the hiring of a panel of experts to review project implementation due to the importance of detailed environmental and social mitigation measures to be decided during implementation.<sup>3</sup> It was intended that the panel of experts would provide credible monitoring and review, and allow quick mid-course corrections if problems were identified. ADB eventually approved the project in September 1996.

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<sup>1</sup> ADB. 1996. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to Lao PDR for the Nam Leuk Hydropower Project*. Manila.

<sup>2</sup> ADB. 1996. *Summary Environmental Impacts Assessment for the Nam Leuk Hydropower Project I Lao PDR*. Manila.

<sup>3</sup> ADB. 2004. *Performance Audit Report: Nam Leuk Hydropower Project in the Lao People's Democratic Republic*. Manila.

5. The panel of experts was retained by Electricité du Laos (EdL) for the entire construction period and had its first mission in September 1997 when construction activities had already been under way for several months. Its terms of reference were intended only for the construction period in order to provide an independent review of the project's environmental mitigation and monitoring activities during the construction phase. The panel's visits were brief and usually lasted for only 10 days. During each visit, the panel reviewed the progress and adequacy of environmental mitigation measures undertaken and provided some recommendations on how to improve the environmental safeguards compliance of the construction activities.

6. During the construction period, great effort was exerted to control the environmental impacts. Mitigation measures were effectively managed through the collaboration of all those involved in ensuring safeguards compliance, such as ADB's periodic review missions, advice of the panel of experts, experience of the environmental consultants that EdL engaged, and efforts of EdL.

7. By the time the project started operation in 2000, and also at project completion in March 2002,<sup>4</sup> ADB still did not have an environmental policy but its loan processing relied on previously issued environmental guidelines. ADB eventually issued an environmental policy in November 2002.

## **B. Outstanding Environmental and Social Issues**

8. There were only three outstanding environmental issues identified by the 2004 project performance audit report for the NLHP: (i) fishery resources monitoring, (ii) technical assessment of current and future water quality in the Nam Leuk project area to complete the environmental assessment, and (iii) evaluation by qualified experts on the impact of EdL funds and activities on the PKK Park in the previous 4 years. These concerns were similar to the concerns of nongovernment organizations citing fishery losses and the undesirable precedent of building a dam in a nature reserve.

9. The outstanding issue on fishery was based on the recommendation of the previous environmental completion report that EdL shall monitor fishery resources. Fishery was an issue when the NLHP had operated for several years. There were claims of fishery decline in the Nam Leuk downstream of the dam and in the Nam Xan downstream of the powerhouse.

10. For the water quality, the project performance audit report recommended that EdL provide a technical assessment of current and future water quality in the Nam Leuk project area to complete the environmental and engineering assessments. The assessment was to be initiated by February 2005 using the available data in 2004 and data that will become available during the Nam Mang 3 aquatic ecology and water quality monitoring program.<sup>5</sup>

11. The project performance audit report identified three northern villages—Ban Thamdin, Ban Thaheua, and Ban Don Hom—along the downstream area of the Nam Xan that were affected by the fishery and water quality issues, and another five southern villages—Ban Pakleuk, Ban Phongnam, Ban Gnangkhoa, Ban Hatkai, and Ban Palai—along the downstream area of the Nam Leuk. A few households became vulnerable due to sickness, inadequate labor

<sup>4</sup> ADB. 2002. *Completion Report: Nam Leuk Hydropower Project in the Lao People's Democratic Republic*. Manila.

<sup>5</sup> Nam Mang 3 is a 40 megawatt (MW) hydropower project in Nam Mang; it started operation in 2005. The Nam Leuk joins the Nam Mang in draining down to the Mekong River.

to work the land, and bad decisions in acquiring agricultural property. The project performance audit report recommended that the vulnerable households should be monitored periodically to determine if circumstances have deteriorated further.

12. The project performance audit report's recommendation to evaluate the impact of EdL funds and activities on the PKK Park in the previous 4 years was due to ineffective implementation of the park management plan. Under the project, and due to recommendations of a protected-area adviser, the first park management plan included the establishment of a legal and policy framework and strengthening the capabilities of PKK Park management authorities, EIAs, public awareness, community development, and natural resource research and management. It suggested the establishment of a park advisory committee comprising key PKK Park personnel, district forestry and agricultural officials, and representatives from the Ministry of Defense. It also proposed the use of a trust fund for long-term management of the PKK Park. The first plan focus was on the entire PKK Park.

13. EdL's project management considered the first plan as neither pragmatic nor strategically oriented, and did not adopt it. Consequently, EdL prepared a second management plan that was more focused on the project and it suggested that EdL review PKK Park activities more closely. PKK Park officials claimed they had already begun implementing the first plan, and did not want to adopt the second because of its limited scope. Because of this difference in opinion, the project performance audit report noted that neither plan had been adopted due to conflicting interests. The PKK Park management plan was not implemented effectively, but funds equivalent to 1% of estimated export revenue were disbursed to PKK Park authorities upon submission of periodic expenditure statements. Hence, ADB's evaluation mission in 2004 felt that funding allocated for the PKK Park was not achieving its intended goal, which was to support ecotourism and village-based integrated conservation and development programs.

14. By raising the aforementioned outstanding issues 4 years after the start of operations, the project performance audit report identified an important lesson from the review of the Nam Leuk Hydropower Project—that environmental and social impacts do not end when the power plant begins operation and the project loan closes.

### C. Addressing Outstanding Issues

15. **Fishery decline.** EdL was supposed to monitor river fishery resources according to the 2004 project performance audit report. However, in a meeting with the SAPE mission at the NLHP powerhouse, EdL's staff claimed that they were not aware if such monitoring was done. No monitoring data on fishery resources were available at the powerhouse. There was also no information as to whether EdL will monitor river fishery resources in the future.

16. Monitoring of river fishery resources is very important since the claim of fishery decline is a contentious issue. In the southern area downstream of the dam, along the Nam Leuk, the summary EIA concluded that despite this flow reduction from Tad Leuk down to the Nam Leuk's confluence with the Nam Gngang, the remaining average monthly flow would still be significant and sufficient to support fish populations. Further downstream where the Nam Gngang joins the Nam Leuk, the flow during the rainy season would be 53%–58% of preproject conditions. During the four driest months of the year from January to April, the project would not alter the natural flows and the river would maintain the average monthly flows observed during preproject conditions at Tad Leuk and downstream.



17. Interviews with key informants at both downstream areas of the Nam Xan (Ban Kengsan, Ban Thamdin, Ban Thahuae) and the Nam Leuk (Ban Gngangkhoa, and Ban Phongnam, Ban Hatkai) revealed that fish populations in both rivers have declined over the years. Villagers strongly believed that fishery decline was due to the operation of the project. However, without a fishery study it is difficult to simply attribute this decline to the presence of the dam and reservoir since intensive fishing may also contribute to this situation.

18. The problem of fishery decline along the Nam Xan can be attributed also to the initial 3 years of hydropower project operation when poor-quality water was released from the powerhouse. The water quality changes have affected the fish life cycles and even caused deaths. It will take a long time for the fish populations to recover from this kind of disturbance.

19. Given the dependence of the villagers on fish protein and the contentious issue of fishery decline, there is a need for EdL to do a fishery study and find ways to improve the fishery situation since water quality of the rivers has already improved after the initial years of operation.

20. **Water quality.** The project performance audit report's recommendation that EdL shall provide a technical assessment of current and future water quality in the Nam Leuk project area to complete the environmental and engineering assessments was due to the lack of a report that definitively addresses the water quality impacts of the Nam Leuk Hydropower Project, despite the availability of extensive water analysis data. Available water quality data during the project performance audit report preparation were from the construction water quality monitoring and the Nam Mang 3 water quality monitoring. The Nam Mang 3 data reportedly included monitoring of the Nam Leuk reservoir and the Nam Leuk and Nam Xan rivers from October 2003 to January 2005.

21. The required technical assessment on water quality was still not available during the SAPE mission visit at the Nam Leuk powerhouse. EdL's staff claimed they were not aware if such an assessment was done. They also revealed that, since 2005, no water quality monitoring was done in the Nam Leuk project area.

22. In any reservoir, poor water quality is always anticipated during the initial years of operation, since the decomposition of the inundated trees, shrubs, and grasses will result in water devoid of oxygen, conditions known as anoxic. In addition, the various products of decomposition will mix with the reservoir water. This condition caused the poor water quality of the Nam Leuk reservoir despite the substantial removal of trees, shrubs, and grasses.

23. Given the poor water quality during the initial years of operation, the required technical assessment could provide a good picture of the actual water quality situation during the period when the water quality started to improve. Interviews during SAPE mission field visits with key informants along the Nam Xan in the villages of Ban Kengsan, Ban Thamdin, and Ban Thahuae revealed that after the initial 3 years of operation the water quality of the Nam Xan had improved. The villagers recalled that during the initial years of operation the river water was black and emitted a foul odor so strong that it could be smelled 300 meters away. The farmers claimed that the poor water quality then resulted in fish and livestock deaths.

24. Similarly, interviews during the SAPE mission field visits with key informants along the Nam Leuk downstream of the dam in the villages of Ban Gngangkhoa, Ban Phongnam, and Ban Hatkai revealed the same picture as that of the northern villages in the downstream area of the Nam Xan. Villagers claimed that during the initial 3 years of operation the river water was black and emitted a foul odor. This was the same claim made by villagers at the time of the project

performance audit report preparation in 2004. This claim is baffling since the dam can not release water.<sup>6</sup>

25. The water quality of both rivers has improved considerably. Downstream villagers in both the Nam Leuk and Nam Xan affirmed the improvement of water quality. They claimed that both rivers are now being used for bathing and washing. This is made possible by the small Nam Leuk reservoir with a short water retention time that enables it to renew its water content about four times per year.<sup>7</sup> According to villagers of Ban Thamdin, staff of the powerhouse frequently visit the Nam Xan downstream of the powerhouse to check on the color and smell of the river water.

26. Water quality of both the Nam Leuk and Nam Xan is no longer an issue, and has recovered since 2003. EdL staff at the powerhouse claimed they no longer received complaints about poor water quality, although some interviewed villagers claimed to have experienced skin itchiness when bathing in the river. However, anecdotal evidence points to the cause of the itchiness as a snail that breeds quickly in the water during the dry season.

27. Although the water quality of the rivers has improved, EdL still needs to prepare the required technical assessment on water quality based on the previous data. Such an assessment will be invaluable in predicting future water quality in the Nam Leuk project area. In addition, water quality monitoring should be continued since the hydropower project has already influenced the ecology of both rivers by altering their hydrological regimes. Given the limited resources, at least the physical parameters of the river water should be monitored. EdL can easily implement a low-cost water-quality monitoring program for the physical parameters using a few ordinary instruments that can easily be used by the powerhouse personnel. These may include a thermometer, a turbidity meter, and an oxygen meter to measure the oxygen concentration of the water.

28. **Phou Khao Khouay Park management.** One of the principal objectives of the NLHP was to strengthen the management and protection of the PKK Park, a national biodiversity conservation area administered by the Ministry of Defense. The project was expected to help implement the management plan for the park, which included development plans for tourism and integrated conservation and development programs. Implementation funds for the protection and management of the park come from the 1% of the annual export revenue generated by exporting electricity.

29. During the SAPE mission field visit, staff of the powerhouse and staff from EdL's office in Vientiane who were present in the field claimed that they were not aware of the activities of the PKK Park authorities. No information was available at the site about the evaluation of the impact of EdL funds and PKK Park authority's activities. PKK Park authorities did not have an office at the park site.

30. The presence of a new unpaved road traversing the park raises concerns about park protection. The park's air quality is affected by dust generation, while streams are affected by sediment generated from this unpaved road, which connects the main highway at Ban Thabok (Road 13) and the Thoung Khou–Longsan Road. Park authorities have been operating

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<sup>6</sup> The dam can not release water unless there is a large flood. The only way some water can be released into the Nam Leuk downstream of the dam is through the bottom outlet (so EdL must have a specific reason to do so).

<sup>7</sup> ADB. 1996. *Summary Environmental Impacts Assessment for the Nam Leuk Hydropower Project in the Lao People's Democratic Republic*. Manila.

checkpoints at both ends of this road. Trucks of a mining company have been using this road a lot to transport materials from the Thoung Khoun–Longsan Road to Road 13 and ultimately to Thailand.

31. For community-based tourism, the project performance audit report reported that PKK Park authorities previously selected Ban Na and Ban Hatkai as tourism villages and trained some villagers because they are near the Tad Leuk waterfall. Most of the tourism activities are based at Ban Na. An interview of the head of the tourism association at Ban Na revealed that their ecotourism activities—elephant watching, trekking, and forest camping—did not receive any assistance from the PKK Park authorities.

32. In view of the previous criticism that siting the project in the park was a bad precedent (as cited in the project completion report), evaluating the impacts of EdL funds expended by the PKK Park authority will help promote transparency in managing the park. There is a need for EdL to improve its coordination with PKK Park authorities on how the funds are being used to protect the park and to support ecotourism programs. This coordination is very important for improving park protection given the increasing access to the PKK Park through the new unpaved road.

33. **Environmental management of Electricité du Laos.** At the forefront of the activities addressing the outstanding environmental issues of the NLHP is EdL's Environment Office under its Technical Department. This unit was formerly the Environmental Management Division (EMD) established in 1996 with an initial staff of three to coincide with project implementation, and eventually increased to eight in 2004. The project performance audit report noted in 2004 that the number of EMD staff and its resources were insufficient to effectively implement environmental and social mitigation measures at all of the power plants of hydropower projects under EdL's management.

34. When construction of the NLHP was completed in 2000, the EMD took over from the consultants the ongoing environmental and social mitigation measures. However, it was constrained by meager funds and its project-specific activities had been underfunded (as noted by the project performance audit report). It appeared that there was no dedicated EdL budget allocation for continued monitoring of the project's environmental and social impacts. Ad hoc arrangements for mitigation were made when problems could not be avoided, or when funding from other projects was available.

35. The EMD's constraints in both funding and limited human resources highlighted one of the lessons identified by the project performance audit report—the need to provide funds for environmental and social mitigations during the operation phase in order to support the achievement of all objectives. EdL also needs to allocate sufficient funds for the continued self-monitoring of the project. Hydropower projects need continuous environmental monitoring during operation to ensure the impacts are within acceptable levels and any unanticipated impacts can be addressed expeditiously when they begin to occur.

36. **ADB's recent efforts to address environmental and social concerns.** Given that the executing agency for the Northern Area Rural Power Distribution Project was the same as for the NLHP, ADB was able to divert some funds from this project to address some concerns of some project-affected people in villages downstream of the dam (along the Nam Leuk) and downstream of the powerhouse (along the Nam Xan). A total of \$97,637 was allocated in June 2007 to the management of social impacts arising from the NLHP that included \$39,117, mostly for community water supply and solid-waste management systems, and \$58,520 for fishpond

and livelihood development. An additional \$23,500 was also reallocated in November 2009 from the Northern Area Rural Power Distribution Project for much the same purposes. The funds were deployed at the community level in selected villages as, after several years, it was difficult to ascertain the loss to individual households. The agreed mitigation measures were implemented and the expenditure and physical targets were closely monitored until completion in March 2010.

37. Through follow-up site visits and meetings with concerned villagers in March 2010, ADB confirmed that the mitigation works had been satisfactorily completed and fully functional. All affected villages had formed operation and maintenance committees, comprising 3 to 7 persons (depending on the size of the mitigation and the village).<sup>8</sup> How effective the village level committees would be in ensuring the continued and smooth functioning of the mitigation facilities over an extended time period remains to be seen.

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<sup>8</sup> Each operation and maintenance committee collects KN1,000–5,000 each month from the village households, for meeting operation and maintenance expenses of the facilities. EdL also trained the committee members on operation and maintenance works, provided tools for repair, and established user guidelines. EdL has also assigned its staff to follow-up on the workings of the implementation and maintenance committees and improve their skills and competency.

## MANAGEMENT RESPONSE TO THE SECTOR ASSISTANCE PROGRAM EVALUATION FOR THE ENERGY SECTOR IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC

On 8 November 2010, the Director General, Independent Evaluation Department, received the following response from the Managing Director General on behalf of Management:

### I. General Comments

1. We appreciate IED's comprehensive analysis of ADB's assistance in the energy sector. We concur with the overall assessment that ADB's program has been successful and that ADB's performance has been successful. The Sector Assistance Program Evaluation (SAPE) has identified areas for further development of the sector and has made recommendations for future success and sustainability of ADB's operational program.

2. SERD's future engagement with Lao People's Democratic Republic (Lao PDR) in the energy sector is based on the energy sector assessment and strategy work undertaken early this year. The sector strategy currently being discussed as part of the future country partnership strategy (CPS) indicates ADB's likely future focus to be strengthening transmission and distribution systems to enable grid extensions, thereby widening electricity access and promoting renewable energy and energy efficiency. ADB support will shift away from direct support to Government's equity in hydropower projects following the Nam Ngum 3 Hydropower Project to assisting the Government in building the capacity of Electricite du Laos (EdL) to expand its power transmission grid. The sector work also calls for strengthening EdL's capacity in the operation of high voltage transmission systems, which will help Lao PDR to achieve its target of 90% electrification by 2020.

### II. Comments on Specific Recommendations

3. **Recommendation 1. Focus ADB's capacity development intervention on the need to increase electricity access, improve the operational and financial efficiency of the power utility, and better manage the development of large hydropower projects in coordination with other development partners.** We agree, in principle, with the need to focus ADB's capacity development interventions. While we concur with the six specific areas for capacity building identified in para. 110, our capacity development interventions should be closely related to our program. We would, therefore, like to clarify our activities in these six areas:

(a) Regarding item (i), a new regional technical assistance (RETA) is being formulated for approval. Item (ii) is already being addressed under an ongoing project preparatory technical assistance (PPTA) to examine business models for mini-hydropower plants in off-grid areas; depending on their success, these models could be replicated for other renewable energy projects. Items (iii) and (iv) will be addressed through the proposed technical assistance (TA) for grid extension.

(b) Items (v) and (vi) will be more difficult to commit to as they require support for hydropower development in the longer term to have the necessary impact. ADB currently does not have plans to support large hydropower projects after the Nam Ngum 3 Hydropower Project, and will focus on assisting the Government in building EdL's capacity to own and operate high voltage transmission lines (230 kV/500 kV). This would enable EdL to extend the grid to help the Government achieve its target of 90% household electrification by 2020, provide stable and adequate electricity supply to promote industrial growth, and help to address sustainably system loss reduction. Capacity building of the Water Resources Environmental Administration (WREA) is ongoing through ADB work on river basin management based on an integrated water resource management approach as well as ongoing work under the Regional Power Trade Coordinating Committee.

(c) ADB is already assisting EdL in developing its capacity to operate and maintain the 230 kV and 500 kV transmission systems. Electricity Generating Authority of Thailand (EGAT) is assisting EdL through a management contract for the Nabong-Udon 500 kV transmission line. Viet Nam Electricity (EVN) is similarly assisting EdL on the operation and maintenance of the Ban Sok to Plieku 500 kV transmission line.

(d) ADB, the Mekong River Commission (MRC) and the World Wide Fund for Nature (WWF) have been working together since 2006 to develop Environmental Considerations for Sustainable Hydropower Development (ECSHD). This initiative has developed the Rapid Basin-wide Hydropower Sustainability Assessment Tool (RSAT) to assist decision making for sustainable hydropower development at all stages of the project cycle from planning and design through operations. The RSAT was launched during the ADB Crisis and Choices conference in Manila in October 2010.

(e) We will continue to build capacity of EdL in the monitoring of environmental and social impacts for those hydropower projects where we are involved. While the good practices developed during the Nam Theun 2 (NT2) Project are available to other development partners, including through Government dissemination, ADB cannot assume the responsibility for the social and environmental impacts of projects we do not finance. With respect to NT2, we will continue to monitor the environment and social impacts post-project construction until at least 2014.

**4. Recommendation 2. Work with development partners towards designing a knowledge management framework and delivering knowledge management solutions given the need for capacity development on several aspects.** We agree. ADB is working with other development partners, including on knowledge generation and dissemination through WREA and the technical, environmental and social reports on various ongoing projects. ADB, the World Bank (WB) and Australian Agency for International Development (AusAID) are currently building WREA capacity on river basin management (7-year program), and we will continue to strengthen WREA. We have already provided a TA to WREA for the preparation of the National Integrated Water Resources Management (IWRM) Support Program as a framework for coordination of development partner assistance. The TA also updated the National Water

Resources Policy and Strategy, leading to an implementation plan and monitoring framework for 2011–2015. The TA is supporting the development of the Nam Ngum River Basin Committee (NNRBC) as the key coordinating agency responsible for basin planning and regulation of water use; this TA is also facilitating a pilot demonstration activity (PDA) to test the formation of a Nam Ngum Hydropower and Mining Forum (NNHMF). NNHMF is expected to form a sub-committee or task force of the NNRBC to assist NNRBC on issues related to hydropower and mining development in the Nam Ngum River Basin. NNHMF is expected to include the operators of the large-scale water using sectors (i.e., mining and hydropower) and representatives of the relevant national and provincial government agencies. A follow up capacity development TA is being processed to continue support to NNRBC and strengthen WREA's capacity to provide leadership in the water sector.

**5. Recommendation 3. Continue to offer financial assistance, particularly for (i) hydropower projects with a view to better comply with environmental and social safeguards, and (ii) electricity access projects.**

We agree, subject to the following qualification. While support for hydropower development is important for Lao PDR's sustained economic development and access to electricity, our assistance in this subsector will be limited to the ongoing NT2 and the proposed Nam Ngum 3 Hydropower Project. As mentioned above, we will continue to monitor the social and environmental impacts and encourage application of lessons learned and good practices from ADB's support. ADB's assistance to increasing electricity access will continue through grid extension projects planned in 2012 and through the mini/small hydropower projects planning for off-grid electrification and grid connections (where possible). We will support enhancement of EdL's capacity to operate high voltage transmission lines as well as take over ownership and operation of some of the dedicated 500 kV transmission lines. The latter will enable EdL to extend its grid to connect more households and to provide stable and adequate electricity supply to promote industrial growth.

**6. Recommendation 4. Conduct policy dialog to accelerate moves towards formulating a comprehensive energy policy and accelerating power systems integration across the Greater Mekong Subregion (GMS).**

We agree. We plan to work with the World Bank and the Government in developing a more comprehensive energy policy. With respect to accelerating the integrated power system across the GMS, this will, however, take time as regional power transmission lines will have to be built. As mentioned above, we will assist Lao PDR in building its capacity to own, operate and maintain high voltage transmission lines. We will also assist in putting in place the building blocks for a regional power trade institution as well as a regional regulatory board. These efforts will continue through the ongoing Regional Power Trade Coordinating Committee and Regional Energy Forum activities.

## **DEVELOPMENT EFFECTIVENESS COMMITTEE**

### **Chair's Summary of the Committee Discussion on 10 November 2010**

#### **COUNTRY ASSISTANCE PROGRAM EVALUATION – LAO PEOPLE'S DEMOCRATIC REPUBLIC: SUSTAINABLE GROWTH AND INTEGRATION**

##### **– Sector Assistance Program Evaluation for the Energy Sector in the Lao People's Democratic Republic**

#### **I. Country Assistance Program Evaluation for Lao People's Democratic Republic: Sustainable Growth and Integration (DOC.IN.262-10)**

1. The country assistance program evaluation (CAPE) highlighted Lao PDR's strong macro-economic performance over the CAPE period, 2000-2009. The CAPE suggests that for Lao PDR to sustain and build on its growth, it would need continued and enhanced funding, supported by a strengthened capacity to formulate and implement its projects and programs better, particularly in areas such as governance reforms and public sector financial management, and environmental and social protection. The CAPE also recommends strengthening the role of the Lao PDR Resident Mission (LRM).

2. DEC noted Management's agreement with the main recommendations of the CAPE, and the progress being made to fulfill them. However, DEC members emphasized the need to improve on ADB's approach to various cross-cutting issues. Director General, SERD explained that further specificity in the recommendations would help to make them more useful for further improving performance. One DEC Member was concerned that the aggregation of findings into broader recommendations was reducing their usefulness and that some of the recommendations did not show a close enough relationship to the report's findings. Director General, IED explained that Management and DEC had previously agreed that IED should be less prescriptive in its recommendations. It was agreed further at the time between DEC, IED and Management that the key issues should be highlighted in the reports, with Management being accountable to address the issues in ways it deemed appropriate. Accordingly, IED has been providing less prescriptive recommendations but with options mentioned in the main text of the report for how the recommendations may be implemented. He further explained that CAPE recommendations in the case of the Lao PDR addressed cross-cutting issues straddling various sectors of the economy, while sector-specific recommendations were provided in detail in each of the sector assessments and also reflected in Appendix 3 of the CAPE. Hence, it was upto Management to indicate specific actions in response to the recommendations as required under the Action Plan in the Management Actions Record System (MARS).

3. DEC noted the CAPE's observation that ADB has not fully utilized the benefits of program-based approaches (PBAs) or sector-coordinated approaches. Director General, SERD explained that there are pre-requisites that should be met before applying PBA, based on the OECD policy that the Bank adheres to. Staff, IED clarified that ADB's slow progress in respect of PBA is due to the lack of a strategy and common framework for implementation for all donors to work together (except in the education sector where there is an Education Sector Development Framework). ADB also needs to help build government capacity to own and develop necessary strategies and programs to facilitate PBA, which all the development partners had agreed on under the 2006 *Vientiane Declaration on Aid Effectiveness*



4. DEC noted the recurring problem of implementation delays, including cost overruns, and how this problem has affected ADB's performance in Lao PDR. Director General, IED emphasized that this problem is endemic in most CAPEs, and emphasized the need for more realistic start-up times. Country Director, LRM assured DEC members that project readiness filters are being applied at project processing and design stages.

5. On issues related to LRM, some DEC members inquired on the ratio of Lao PDR projects that have been delegated to LRM, and expressed the view that increased delegation of project implementation to LRM may improve their efficiency. Director General, SERD said that while the capacity of LRM to conduct ESTW and lead high level policy dialogue was limited at the beginning of the CAPE period, SERD has made efforts to strengthen this in recent years and expressed concerns that key areas evaluated to be inadequate needed a substantial evidence base. Staff, IED described the substantial increase in delegation of projects to LRM in the past years, including implementation of Headquarters projects. It was assessed that projects delegated to LRM were rated better than headquarters projects. Country Director, LRM mentioned that LRM staff have been involved in HQ processing and review missions in order to provide support and build their capacity in project processing.

6. Director, IED2 emphasized that included in the CAPE recommendations are certain cross-cutting issues based on specific sector suggestions made in the CAPE and sector assessments. Moving forward, Director General, SERD noted that SERD would continue to identify sector-specific issues, including capacity aspects, and prepare sector assessment strategies and roadmaps to address those issues. DEC members were unanimous that ADB operations in the other sectors, particularly banking and finance, should be strengthened.

#### **Sector Assistance Program Evaluation for the Energy Sector in the Lao People's Democratic Republic (DOC.IN.259-10)**

7. DEC members expressed concern over the proposed disengagement of ADB from hydroelectric power projects in Lao PDR, given that previous engagements in the sector had been successful and the desire of Lao PDR to be the power battery of the region. DEC believed that ADB's engagement should not be limited to the ongoing Nam Theun 2 project and the proposed Nam Ngum 3 Hydropower project in 2011.

8. Director, SEEW explained that there is an urgent need to assist Lao PDR in building its capacity to own and operate the high transmission lines (230 kV and 500 kV), which will enable the extension of the transmission grid to rural areas and achieve the Government's target of 90% electrification by 2020. Currently, these transmission lines are owned and operated by the private sector with no third party access. Lao PDR only has experience with low and medium voltage transmission network and 115 kV transmission lines. Hence, SEEW focus over the next few years will be in assisting Lao PDR to own and operate the high voltage transmission lines and to building their capacity through management contracts with EGAT (Thailand) and EVN (Viet Nam). The Mekong River Commission is of view that constructing hydropower projects on the Mekong mainstream should be deferred for 10 years, with periodic review every three years, so that natural systems can be properly studied and the management and regulatory process strengthened. In the meantime, ADB will continue to support sustainable development of hydropower projects on the Mekong tributaries through PSOD's participation such as in Nam Ngiep 1 Hydropower project in 2012.

## **Sector Assistance Program Evaluation for the Transport Sector in the Lao People's Democratic Republic (DOC.IN.260-10)**

9. DEC members viewed that ADB has been focusing more on regional road projects as compared to rural and provincial roads. Members also inquired as to how ADB has addressed issues on road maintenance and road safety that were raised in previous CAPEs.

10. Director, SETU described how the focus in the past was on national roads to meet the Government's priority to emphasize international linkage and in the future there will be projects for rural roads. On road maintenance, he noted that capacity building programs have been implemented with the objective of delegating road maintenance to provincial governments. Further, in road projects since 2007 road safety aspects have been built in as project components. Road safety is important not only to ADB, but also to co-financiers.

### **Conclusions**

11. DEC members noted with satisfaction the steady progress made by LAO PDR. The Country grew at a compounded rate of 7% per year during 2000-2009, reduced its external public debt as a proportion of GDP from 80% in 2005 to 54% in 2009.

12. There was solid progress in rural electrification. Overall access to electricity increased rapidly from 17% of households in 1995 to more than 60% in 2009.

13. Lao PDR, from being a net energy importer, has become a net energy exporter, and is on its way to achieve its ambition of becoming the regional power battery.

14. Members expressed their satisfaction that certain facilitating laws, like water and water resources law, environmental protection law, environmental and social sustainability of the hydropower sector law, and amendment of the environmental protection law, were under way.

15. Members also noted that Nam Theun 2 has been successfully completed and sufficient progress has been made in implementing environment and social safeguards. It is now a world-class hydropower plant.

16. Members noted that the road network has increased by 78% over the last decade, from 20,000 kilometers in 1997 to 35,558 kilometers in 2009. Roads have had positive impact in ameliorating rural poverty.

17. Members underlined the need for improving implementation of projects and reducing the large delays observed in the past. There was a need for improving coordination, strengthening the LRM, and having a medium to long-term strategy based on policies and programs in various sectors. Furthermore, members noted that given the importance of hydroelectric power in Lao PDR and that hydroelectric power is a renewable energy source, ADB, including through the private sector, should remain engaged in the upstream generation projects.

(signed)

Ashok K. Lahiri

Chair, Development Effectiveness Committee