

PROJECT PERFORMANCE ASSESSMENT REPORT

LAO PEOPLE'S DEMOCRATIC REPUBLIC

Nam Theun 2 Hydroelectric and Social and Environment Projects

Report No. 153963

DECEMBER 16, 2020



IEG
INDEPENDENT
EVALUATION GROUP

WORLD BANK GROUP
World Bank • IFC • MIGA

WHATWORKS

© 2021 International Bank for Reconstruction and Development / The World Bank
1818 H Street NW
Washington DC 20433
Telephone: 202-473-1000
Internet: www.worldbank.org

Attribution—Please cite the work as follows:

World Bank. 2021. Lao People's Democratic Republic—Nam Theun 2 Hydroelectric and Social and Environment Projects. Independent Evaluation Group, Project Performance Assessment Report 153963. Washington, DC: World Bank.

This work is a product of the staff of The World Bank with external contributions. The findings, interpretations, and conclusions expressed in this work do not necessarily reflect the views of The World Bank, its Board of Executive Directors, or the governments they represent.

The World Bank does not guarantee the accuracy of the data included in this work. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment on the part of The World Bank concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

RIGHTS AND PERMISSIONS

The material in this work is subject to copyright. Because The World Bank encourages dissemination of its knowledge, this work may be reproduced, in whole or in part, for noncommercial purposes as long as full attribution to this work is given.

Any queries on rights and licenses, including subsidiary rights, should be addressed to World Bank Publications, The World Bank

Group, 1818 H Street NW, Washington, DC 20433, USA; fax: 202-522-2625; e-mail: pubrights@worldbank.org.



Report No.: 153963

PROJECT PERFORMANCE ASSESSMENT REPORT

LAO PEOPLE'S DEMOCRATIC REPUBLIC

**NAM THEUN 2 HYDROELECTRIC PROJECT
(IDA GUARANTEE B-0080-LA)**

AND

**NAM THEUN 2 SOCIAL AND ENVIRONMENT PROJECT
(IDA GRANT H155-LA)**

AND

**NAM THEUN 2 POWER COMPANY
(MIGA GUARANTEE 5139)**

December 16, 2020

Abbreviations

ADB	Asian Development Bank
CO ₂	carbon dioxide
E&S	environmental and social
GDP	gross domestic product
GWh	gigawatt-hour
ICR	Implementation Completion and Results Report
IDA	International Development Association
IEG	Independent Evaluation Group
IFI	international financial institution
km	kilometer
kWh	kilowatt-hour
Lao PDR	Lao People’s Democratic Republic
M&E	monitoring and evaluation
MIGA	Multilateral Investment Guarantee Agency
MW	megawatt
NNT-NPA	Nakai-Nam Theun National Protected Area
NT2 HPP	Nam Theun 2 Hydropower Project
NTPC	Nam Theun 2 Power Company
PAD	Project Appraisal Document
PDO	project development objective
PPAR	Project Performance Assessment Report
PPP	public-private partnership
RIP	resettlement implementation period
WMPA	Watershed Management and Protection Authority
XBF	Xe Bang Fai

All dollar amounts are US dollars unless otherwise indicated.

IEG Management and PPAR Team

Director-General, Independent Evaluation	Ms. Alison Evans
Director, Financial, Private Sector, and Sustainable Development	Mr. José C. Carbajo
Manager, Infrastructure and Sustainable Development Project Evaluation Unit	Mr. Christopher Nelson
Manager, Finance and Private Sector Project Evaluation Unit	Ms. Beata Lenard
Task Manager	Mr. Migara Jayawardena
<p>This report was prepared by a team led by Migara Jayawardena that included Ichiro Toda, Gurkan Kuntasal, Stan Peabody, Colin Rees, Andres Liebenthal, Peter Choynowski, Gangadhar P. Shukla, and Shenghui Feng. Richard Kraus, Vibhuti Khanna, Thongkham Chanthavong, and Singha Ounniyom provided administrative support.</p> <p>A World Bank Group and Asian Development Bank joint team carried out the evaluation because both institutions financed the project. Houqi Hong led the evaluation at Asian Development Bank. Based on institutional requirements and corresponding evaluation methodologies, each institution prepared its own report, applying the same underlying assessment. This report represents the Bank Group’s evaluation of the project’s performance.</p> <p>The joint Bank Group and Asian Development Bank team conducted a mission to the Lao People’s Democratic Republic and Thailand from September 19 to October 4, 2019.</p>	

Contents

Project Data	v
Summary	vii
1. Background, Context, and Design	1
Objective and Components	2
Costs and Financing	3
Design	4
2. What Worked, What Didn't Work, and Why?	6
Key Results	6
Power Finance and Development	6
Environmental Aspects	10
Social Development Aspects	17
Management of Revenues	22
Transformational Aspects of the NT2 HPP	26
Design and Preparation	29
Implementation and Supervision	31
3. Lessons from the NT2 HPP	36
Strategic Lessons for Development Interventions	36
Operational Lessons for Project Design and Implementation	38
Bibliography	48

Boxes

Box 2.1. Key Principles of "Directions in Hydropower: Scaling Up for Development"	30
Box 2.2. How Transformational was the NT2 HPP?	34

Figures

Figure 1.1. Theory of Change for the Nam Theun 2 Hydropower Project	5
Figure 2.1. Key Milestones in Developing the NT2 HPP	8
Figure 2.2. Electricity Supply from the NT2 HPP to Thailand and Lao PDR	10

Maps

Map 2.1. Nakai Plateau and the NNT-NPA Watershed.....	13
-------------------------------------------------------	----

Photos

Photo 2.1. The Dam for the Nam Theun 2 Hydropower Project.....	6
Photo 2.2. Biomass Remaining in the Nam Theun 2 Reservoir.....	12
Photo 2.3. A Villager Accessing the NNT-NPA Watershed by Boat.....	15
Photo 2.4. A Typical Resettled Dwelling in the Nakai Plateau.....	18
Photo 2.5. A Villager at Work.....	20
Photo 2.6. A Community Discussion in a Village in the Nakai Plateau.....	21
Photo C.1. Nakai Plateau and Partial Nakai-Nam Theun National Protected Area.....	81

Tables

Table 2.1. Nakai Resettlers' Mean Household Income by Source.....	22
Table 2.2. Revenues Generated for the Government from the NT2 HPP (\$, millions).....	24
Table 2.3. Estimated Allocation of Revenues (at the end of 2017).....	25

Appendixes

Appendix A. Project Ratings.....	55
Appendix B. Methods and Evidence.....	71
Appendix C. Fiduciary, Environmental, and Social Aspects.....	79
Appendix D. Economic and Financial Analyses.....	115
Appendix E. Borrower Comment.....	125

Project Data

This is a Project Performance Assessment Report (PPAR) by the Independent Evaluation Group of the World Bank Group on the Nam Theun 2 Hydroelectric Project (P076445), Nam Theun 2 Social and Environment Project (P049290), and Nam Theun 2 Power Company (5139). This PPAR instrument and the methodology for this evaluation are discussed in appendix C. Following standard Independent Evaluation Group procedure, copies of the draft PPAR were shared with relevant government officials for their review and comment.

Basic Data

Country	Lao People's Democratic Republic	World Bank financing commitment	\$20,000,000
Global Practice	Environment, Natural Resources, and Blue Economy; Energy and Extractives	Expected project total cost	\$1,450,000,000
Project name	Lao Nam Theun 2 Power Project	Actual project cost	\$1,308,000,000
Project ID	P049290 and P076445	Actual amount disbursed	\$19,969,077
Financing instrument	Investment project financing	IDA guarantee	Up to \$50,000,000
Financial source		MIGA guarantee	Up to \$200,000,000
Environmental assessment category	IDA and MIGA guarantees, IDA grant A		

Note: IDA = International Development Association; MIGA = Multilateral Investment Guarantee Agency.

Dates

Event	Original	Actual
Concept review	10/30/1997	10/30/1997
Board approval	03/31/2005	03/31/2005
Signing	05/03/2005	05/03/2005
Effectiveness	06/10/2005	06/10/2005
Closing date	12/31/2017	12/31/2017

Key Staff Responsible

Management	Appraisal	Completion
Project team leader	Robert Anton Mertz, Patchamuthu Illangovan	Daryl Fields
Sector manager or practice manager	Junhui Wu, Cyprian Fisiy	Julia M. Fraser, Christophe Crepin

Management	Appraisal	Completion
Sector director or senior Global Practice director	Christian Delvoie, Maria Teresa Serra	Riccardo Puliti, Karin Kemper
Country director	Ian C. Porter	Ellen Goldstein

Summary

Project Background and Description

The Nam Theun 2 Hydropower Project (NT2 HPP) was a major undertaking in the Lao People's Democratic Republic (Lao PDR) when the country's energy sector was nascent, the overall economy was transitioning from central planning to greater market orientation, and private participation was limited in the energy sector. The NT2 HPP was developed primarily to export electricity to Thailand to boost economic growth in Lao PDR in support of the implementation of the country's Growth and Poverty Elimination Strategy. The project was also designed to be catalytic—a model to guide subsequent exploitation of the country's extensive hydropower resources.

The project development objective was to assist the government of Lao PDR in implementing priority poverty-reduction and environmental programs by generating revenues through the environmentally and socially sustainable exploitation of resources. This would potentially be achieved through the construction and operation of the NT2 NPP, a 1,070 megawatt hydropower facility and associated infrastructure, the management of its environmental and social impacts, and the monitoring and evaluation of project activities. The power purchase agreements contracted the NT2 HPP to export 5,354 gigawatt-hours of electricity to Thailand annually and supply an additional 200 gigawatt-hours each year for domestic consumption. The NT2 HPP was estimated at appraisal to cost \$1,450 million in total investments, including contingencies, but the actual overall cost at closing was \$1,308 million.

The NT2 HPP was developed as a public-private partnership (PPP) between the government of Lao PDR and a consortium of private investors. The World Bank Group led the effort to secure financing, together with the Asian Development Bank, other international financial institutions (IFIs), export credit agencies, and 14 international private commercial banks. The total debt raised at appraisal was \$950 million, comprising 72 percent of overall project financing.

The Bank Group approved the NT2 HPP on March 31, 2005. It became effective on June 10, 2005, and was closed as planned on December 31, 2017, without any extensions or formal restructuring during the implementation period.

Key Results

Power finance and development. A qualified and experienced hydropower developer constructed the large-scale and complex NT2 HPP successfully with minimal cost and time overruns. The World Bank influenced the project's strategic approach and design

through a lengthy preparation stage. The support of the Bank Group (and other IFIs) was instrumental in providing confidence to private investors to mobilize financing in a nascent domestic market that had little track record in developing similar projects. The NT2 HPP continues to supply electricity to Thailand and Lao PDR, exceeding, on average, the levels originally envisaged. It is a financially profitable enterprise producing least-cost electricity for its offtakers. The project produces a net economic benefit for Lao PDR, primarily from electricity exports, generates local environmental benefits in Thailand, and contributes to mitigating global climate change by avoiding alternate generation from natural gas.

Environmental aspects. The NT2 HPP placed high importance on environmental management of hydropower development, but despite considerable attention during implementation, the mitigating actions' results were mixed. Important aspects such as dam safety, restoration of construction sites, stabilization of fisheries, and water quality after inundation were managed successfully, but other facets faced ongoing challenges. The NT2 HPP reservoir emits higher-than-expected greenhouse gases caused by uncleared biomass, yet the project continues to have a net positive impact on global climate change. However, the project's inability to protect the biodiversity offset in the Nakai-Nam Theun National Protected Area watershed was of the most concern. Ineffective institutional arrangements, limited capacity, inadequate monitoring, and unrealistic targets all undermined performance. A reform effort partly prompted by the World Bank two years before project closing is showing some progress, but protecting the watershed is still the project's most significant shortcoming.

Social development aspects. The physical aspects of resettlement were largely successful, though the timing of its implementation was not synchronized well with the hydropower facilities' construction schedule. The livelihood restoration program faced substantial difficulties caused by design constraints, ineffective consultation, and poor technical implementation. Effective corrective action was taken well into implementation, mostly after the resettlement program's two-year extension. The project's ambitious income targets were ultimately achieved for most of the affected people, particularly those resettled in the Nakai Plateau. However, sustaining the achievements over the longer term depends on continued support from partners and successfully implementing ongoing efforts to address some of the shortcomings.

Management of revenues. The NT2 HPP is successfully generating revenues for the government through water user charges, taxes, and dividend income from its ownership share in the project. The revenues are fully accounted and in line with what was envisioned, and are used transparently in the government budget. There is evidence that the revenues from the NT2 HPP contributed to the government's priority poverty-alleviation programs, though its additionality cannot be verified. The critical driver in

reducing poverty in Lao PDR appears to be the government's commitment to implementing its overall development program rather than earmarking specific revenue streams within the budget, as was done with funds accrued from the NT2 HPP.

Transformational aspects. The NT2 HPP influenced transformational behaviors in Lao PDR, with some of its features being replicated to varying degrees:

- Evidence is strong that the NT2 HPP played a catalytic role in helping increase hydropower development in Lao PDR, where the industry is now a mainstay.
- The expansion of hydropower is fueling export-led economic growth in Lao PDR, as envisaged in the government's development plans.
- Many power development and financing features of the NT2 HPP, such as the PPP approach and project agreements, served as a model in structuring other subsequent hydropower investments in the country.
- The project helped demonstrate the use of Bank Group guarantees as an instrument for supporting private development of hydropower, especially in cross-border transactions.
- A robust planning process to match the ambition did not accompany the substantial scale-up in hydropower resource development in Lao PDR subsequent to the NT2 HPP. The government also fell short of capitalizing on the growing scale of the industry and market orientation to leverage more efficient sector outcomes. Together, these factors could place the sustained expansion of the sector at risk as it looks to diversify by expanding within the Greater Mekong subregion.
- The government's current environmental and social policies for hydropower development were modeled after the NT2 HPP, but they have been applied inconsistently in subsequent projects and used mainly as guidelines for developers to follow rather than requirements that are consistently monitored and scrutinized for compliance.
- The various skills and expertise that developed from the NT2 HPP experience have resulted in a skilled group of specialists in Lao PDR who have flourished in the growing hydropower sector that followed the project.

Design and Implementation

The NT2 HPP's design, which the Bank Group influenced, incorporated most key principles recommended by the World Commission on Dams for achieving broader

development goals from hydropower development rather than focusing more narrowly on only energy-related benefits. However, the ambitious design went beyond institutional capabilities in some critical aspects of environmental protection and social development. The project included many well-designed and replicable features in power development and project financing. In addition, a 12-year implementation proactively recognized the time needed to achieve the project's environmental and social objectives progressively. However, unclear objectives, unrealistic targets, inflexible design aspects, and inadequate existing capacity among implementing agencies exacerbated the challenge of protecting the biodiversity offset and restoring livelihoods.

The World Bank continued to play a leading role throughout the project's implementation period. The institution effectively coordinated project activities, developing consensus with the government and among IFIs during implementation. Extensive monitoring of investment activities provided timely information about project progress, but the input was not always used effectively to manage activities in the context of the project's results framework. A joint working group of stakeholders was established during the late stages of implementation when key aspects of the project's environmental and social results were progressively falling short. This group was instrumental in helping resolve several critical multiparty issues before closing the World Bank loan. Although the Bank Group provided extensive support to project supervision, concerns arose about the consistency of its own capacity to oversee and guide implementation of this complex project.

Many successful aspects of the NT2 HPP may have even surpassed some of the original transformative intentions. However, the project missed many opportunities when design elements and approaches to implementation and achievements (especially related to specific aspects of environmental protection and social development) did not fully meet the high expectations. Thus, what transpired in the NT2 HPP should be emulated with caution. However, applying the Bank Group's harmonized evaluation criteria methodology, the project's outcome, on balance, is rated satisfactory. This result reflects the project's very high degree of strategic relevance, its substantial achievement of many important outcomes (despite shortcomings in some important aspects), and the relatively high efficiency with which the project achieved substantial net economic benefits. Appendix A describes Independent Evaluation Group project ratings, and appendix B describes the evaluation methodology and evidence sources.

Lessons from the NT2 HPP

The NT2 HPP—given its scale, complexity, and significance—provides many lessons for consideration in future hydropower development initiatives.

Strategic Lessons for Development Interventions

- A project design to capture more comprehensive development outcomes from hydropower, as recommended in the World Bank’s Water Working Note “Directions in Hydropower: Scaling Up for Development,” needs to balance its ambitions with the corresponding implementation capacity, particularly as it relates to experience with environmental protection and social development that may exceed the capabilities of many hydropower developers (World Bank 2009a).
- Strategically catalytic interventions, such as the NT2 HPP, can lead to transformational impacts when there is a commitment to and capacity for implementing follow-on actions such as replicating and mainstreaming its features. In the NT2 HPP, power financing through a PPP was catalytic in helping to develop the sector and fueling export-led growth. However, follow-on efforts by the government to improve strategic planning for sector expansion and mainstreaming good practices in environmental management and social development in subsequent hydropower projects were less effective.
- Bank Group (and other IFI) participation, including the use of guarantees, can be instrumental in mitigating risks and enhancing the private sector’s confidence to mobilize in nascent markets with unexploited potential and scalable investment opportunities. At the time of appraisal, investors had little confidence in the government’s ability to facilitate an expansion at the scale of the NT2 HPP, given its limited experience with private participation. This challenge was significantly overcome with the IFIs’ backing, including the package of cross-border guarantees to backstop the government’s commitment to the project.
- A government’s adherence to its commitment to implement a sound development strategy may be a more significant driver for achieving broader poverty alleviation outcomes than earmarking revenues for specific expenditures that are fungible within a general budget. Although the revenues accrued from the NT2 HPP to the government were accounted for, there is little evidence that their earmarking was effective in channeling the funds as additional resources for priority poverty alleviation and environmental management activities. However, there are indications that the government implemented its overall growth and poverty alleviation program with commitment, and it has achieved considerable success over the years.
- Hydropower can produce sizable global environmental benefits in terms of combating climate change, although the negative impacts that can arise from greenhouse gas emissions from storage reservoirs should also be accounted for.

The greenhouse gas emissions that were avoided because of the NT2 HPP increased the project's net global benefits by more than 70 percent, even after offsetting the higher-than-anticipated emissions from the reservoir caused by biomass decay.

Operational Lessons for Project Design and Implementation

- Unrealistic and poorly crafted results indicators can lead to projects pursuing unachievable goals, give rise to misdirected efforts, and produce unsuccessful outcomes if not rectified expeditiously. Fully preventing all degradation within the biodiversity offset proved to be unrealistic to achieve. Sustainability of livelihoods was undefined, creating ambiguity in interpretation among stakeholders.
- It is important to distinguish clearly up front where a project is expected to meet stretch targets and where safeguard compliance is the measurable standard if a project has ambitions for some environmental and social aspects that extend beyond minimum safeguard requirements. Evidence suggests misunderstandings in rationale or oversight at times when livelihoods should be restored to preproject levels (as policy requires) or when they were ambitious beyond policy as good practice.
- Prescriptive specifications in project agreements may be suitable for areas in which there are clearly defined industry norms and standards (for example, power plant design), but they can be difficult to implement where outcomes require more flexible, adaptive approaches to management (for example, improving livelihoods). The specifications for building the power plant were defined clearly through feasibility and engineering work that were adhered to successfully. Similar compliance with a prescriptive concession agreement that predefined livelihood pillars undermined the restoration program's ability to manage the process adaptively.
- Complex projects with implementation responsibilities spread among different stakeholders can benefit from a preagreed, multiparty coordination and resolution mechanism, even if investments are designed well, and most parameters are agreed to in advance. The joint working group of stakeholders, established toward the end of the project, played an integral role in resolving multiparty issues and facilitating the closure of the resettlement implementation period.
- Independent expert monitoring can complement project implementation capacity and instill stakeholder confidence in complex, multithematic interventions if

findings and recommendations are synthesized for practical application and the process does not overwhelm project teams. The NT2 HPP had a multitude of independent expert monitors that provided valuable and timely feedback. Although some of the feedback was incorporated to improve project performance, inputs were not heeded in other instances.

- Complex, multithematic interventions may be challenging to manage under a single project because it can be difficult to supply the wide range of expertise needed. Combining power sector development, conservation and biodiversity protection, livelihood restoration, and public financial management implemented through multiple implementing agencies under a single project proved to be complex and even stretched the Bank Group's capacity to effectively oversee and guide the operation.

José C. Carbajo
Director, Finance, Private Sector and Sustainable Development
Independent Evaluation Group

1. Background, Context, and Design

1.1 This Project Performance Assessment Report evaluates the performance of the Nam Theun 2 Hydropower Project (HPP) in achieving the intended results. After more than a decade of preparation, construction of the NT2 HPP started in 2005, and the plant has been in operation producing electricity since 2010.

1.2 The Lao People's Democratic Republic (Lao PDR) is a landlocked country in Southeast Asia that had a population of 5.7 million in 2003. At the time, the country's per capita income was only \$340, and poverty was among the highest in the region. Some of the human development indicators were the region's lowest. However, Lao PDR's economy was gradually transitioning from being centrally planned toward a more market-oriented system. Poverty headcounts had declined from 46 percent in 1992/93 to 33 percent by 2003/4. The government of Lao PDR was keen to maintain this momentum and address variations in poverty incidence geographically and among ethnic minority communities. According to the World Bank Group, the country—despite its progress—faced various challenges to growth at the time that included limited government capacity, a fledgling private sector, inadequate infrastructure, and a lack of strong civil society organizations.

1.3 The government developed a National Growth and Poverty Eradication Strategy in 2003, which was a medium-term reform program aimed at sustaining growth and further reducing poverty. Estimates at the time indicated that the average of 6 percent gross domestic product (GDP) growth seen over the previous decade would need to increase to 7 percent on a sustained basis until 2020 to achieve the program's poverty-reduction targets (World Bank 2004b). Exploiting Lao PDR's abundant natural resources, particularly hydropower, was identified as a key solution to give the economy the boost it needed.

1.4 Lao PDR's hydropower potential is estimated at more than 26,000 megawatts (MW), of which nearly 18,000 MW is technically exploitable, according to the International Hydropower Association. In 2003, only a small fraction of this potential was exploited for producing electricity—domestic demand was just 250 MW, and only 43 percent of households were connected to the electricity grid. There was a much larger export market in neighboring Thailand, in particular, but also in other countries that make up the Greater Mekong subregion.¹ Even this larger export market remained largely untapped at the time. There were only two independent power producers operating in Lao PDR that were primarily exporting electricity to Thailand, totaling less than 400 MW of capacity (Theun-Hinboun [220 MW] and Houay Ho [149 MW]).

1.5 The NT2 HPP was an ambitious endeavor designed to kick-start a significant expansion of hydropower in Lao PDR. At 1,070 MW capacity, the NT2 HPP would be the largest hydropower plant in Lao PDR, at a scale that was greater than the total installed power generation capacity in the country at the time. It required the mobilization of private capital and expertise in a market with little track record at the time for successfully developing complex, large-scale hydropower operations. The NT2 HPP was also intended to be a model project that could be emulated in subsequent hydropower developments and help transform the sector in Lao PDR.² Therefore, successfully implementing the NT2 HPP had potential for a wider demonstration effect in the sector.

Objective and Components

1.6 The project development objective (PDO), according to the legal agreement, was to “assist the Recipient to implement priority poverty-reduction and environmental programs by generating revenues through environmentally and socially sustainable exploitation of the resources potentially generated from the Nam Theun 2 Hydroelectric Power facility” (World Bank 2005b, 28). Revenue generation would be through developing the hydrological resources to produce and sell electricity. The recipient in the PDO was the government. The project design and results framework are clear that the NT2 HPP was expected to generate revenues for the government and would “assist the recipient to implement priority poverty reduction and environmental programs” by channeling these funds through the government budget for financing related activities. Developing hydropower in an environmentally and socially sustainable manner were important goals mainstreamed within the project design. Therefore, they feature prominently as subobjectives in the PDO, with ambitious targets that, in some instances, surpassed the minimum requirements of the Bank Group’s safeguard policies.

1.7 The PDO was to be achieved by implementing the following key components:

- **Component 1: Nam Theun 2 Hydropower facility** (estimated cost: \$722.2 million; actual cost: \$736.1 million). This component is for the building of a hydropower facility with a capacity of 1,070 MW, providing 995 MW for export to Thailand and 75 MW for domestic use. The facility comprised the power plant, a 39 meter high dam, and a 450 square kilometer (km) reservoir. It also included 138 km of 500 kilovolt transmission lines to the Thai border and 70 km of 115 kilovolt lines to the Lao PDR national grid.
- **Component 2: Management of environmental and social (E&S) impacts of the NT2 HPP** (estimated cost: \$48.8 million; actual cost: \$78.6 million). This component addresses four main areas: (i) the resettlement of villages for project-

affected people on the Nakai Plateau, initially estimated at 6,200 people (6,289 actual), the design and delivery of livelihood programs to restore and enhance household incomes (including provision of infrastructure and social services), and livelihood compensation and mitigation measures for downstream project-affected people (NTPC 2005b), initially estimated at 70,000 (ex post approximation of 100,000 [NTPC 2018a] to 115,000 [ADB 2019]); (ii) the implementation of an environmental management plan comprising mitigation measures covering wildlife management, water quality monitoring and management, flood control, and supervision of construction (NTPC 2005a); (iii) the implementation of a downstream program for fisheries and fishing impacts of river diversions; and (iv) the implementation of E&S aspects within the Nakai-Nam Theun National Protected Area (NNT-NPA) watershed (including enclave villages with an estimated population of 5,800) that was designated as a biodiversity offset (WMPA 2004). Technical assistance was also provided to strengthen the government's capacity on E&S.

- **Component 3: Monitoring and evaluation** (estimated and actual costs are not available for this component). Arrangements included the design and adjustment of the results framework to ensure compliance with all project fiduciary requirements. It included: (i) supervision of physical implementation; (ii) independent review of key project components such as dam safety, conservation efforts within the NNT-NPA watershed, resettlements, and other E&S aspects; (iii) systematic monitoring of technical and E&S safeguards by a professional firm; (iv) an international advisory group to advise World Bank senior management; and (v) supervision by World Bank staff.

Note that the revenue management arrangements, though not an explicit and specific project component, were agreed to in detail with the government as a part of the NT2 HPP. The aim was to ensure greater accountability and transparency of project revenues to the government and to confirm additionality of revenues from the project that were designated to fund priority expenditure programs for poverty alleviation and environmental management. Concurrent World Bank support to the government management (Poverty Reduction Support Credits, the Financial Management Capacity Building Credit, and expenditure management technical assistance) was expected to contribute as necessary toward this end.

Costs and Financing

1.8 **Project costs, financing, and ownership structure.** The total project cost at appraisal was estimated at \$1,450 million, including \$200 million designated for contingencies, and the actual total project cost at closing was \$1,308 million. The project

was structured as a limited recourse–financed PPP. The project sponsor was the Nam Theun 2 Power Company (NTPC), which provided equity of 28 percent, or \$350 million of base cost, through its corporate shareholders led by Électricité de France International. The government equity in NTPC was held through the Lao Holding State Enterprise, a state-owned enterprise established specifically for the NT2 HPP.³ Bank Group support from the International Development Association (IDA) was \$20 million in grants, plus an IDA guarantee of up to \$50 million that backstopped various risks that the government guaranteed to private lenders. It also included Multilateral Investment Guarantee Agency (MIGA) guarantees of up to \$200 million that covered risks to both equity holders and lenders in Lao PDR and Thailand. The other lenders financing the project included several other international financial institutions (IFIs; including the Asian Development Bank [ADB] and the European Investment Bank), bilateral financiers, export credit agencies, and a consortium of 14 international commercial banks. The total debt raised at appraisal for base costs was \$950 million, or 72 percent of overall financing.

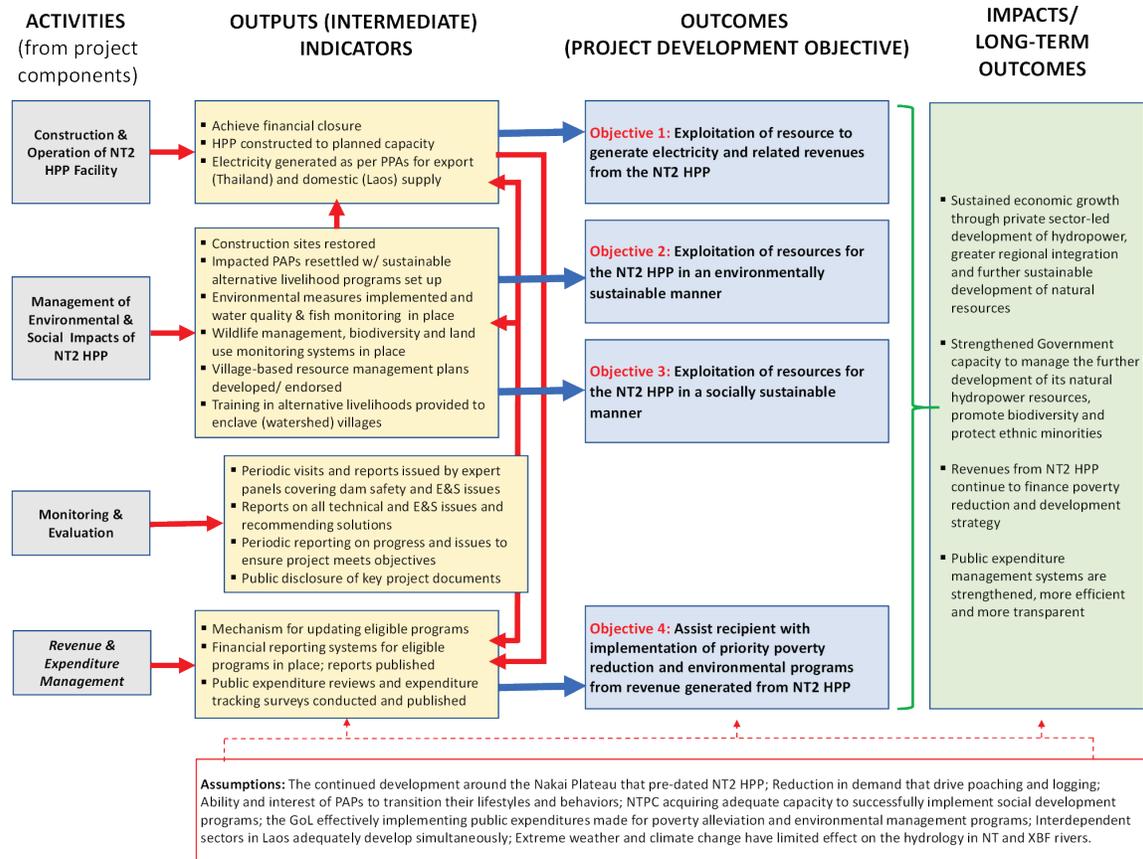
Design

1.9 The NT2 HPP’s design reflected many of the recommendations the World Commission on Dams made in 2000, many of which the Bank Group adopted formally in its Water Working Note “Directions in Hydropower: Scaling Up for Development” (World Bank 2009a). The recommendations generally suggested that hydropower development should aim to foster broader economic development in addition to focusing on addressing specific energy sector improvements. The guidance rests on five key principles for securing broader development impacts, including increasing financing, promoting good E&S practices, strengthening planning to capture the long-term strategic value of using hydropower, leveraging regional development to ensure that investments benefit local communities, and building partnerships. The NT2 HPP was one of the Bank Group’s first attempts to incorporate most of the World Commission on Dams’ recommendations into the design of a hydropower investment. Figure 1.1 provides a project schematic diagram.

1.10 Figure 1.1 illustrates the NT2 HPP’s theory of change. In this, the key activities (inputs) that drive the project are the component activities described previously. The direct results of these interventions (outputs or intermediate indicators) would be to achieve financial closure and construct the project in an environmentally and socially sustainable manner with the benefit of extensive oversight (covering all project aspects) so that revenues generated for the government from the project are accounted for and transparently allocated within the government budget. Successful completion would help Lao PDR exploit its hydropower resources sustainably and use the resulting revenues to fund priority poverty alleviation and environmental management

programs. These outcomes contribute to broader impacts (that is, long-term outcomes) that include economic growth, poverty alleviation, sustained exploitation of natural resources (including protection of biodiversity), and strengthening public expenditure management. Note that achieving these objectives at each stage of the theory of change is interdependent with other important developments that are illustrated as assumptions in figure 1.1.

Figure 1.1. Theory of Change for the Nam Theun 2 Hydropower Project



Source: Independent Evaluation Group.

Note: E&S = environmental and social; NT2 HPP = Nam Theun 2 Hydropower Project; NTPC = Nam Theun 2 Power Company; PAP = project-affected people; PPA = power purchase agreement; NT and XBF = Nam Theun and Xe Bang Fai Rivers.

2. What Worked, What Didn't Work, and Why?

2.1 This chapter assesses the key results that the project achieved in terms of its power finance and development, E&S aspects, management of revenues, and transformational impacts so far. It also covers the NT2 HPP's (see photo 2.1 below) design and preparation before project approval, and the challenges the project faced and how they were addressed during implementation and supervision.

Photo 2.1. The Dam for the Nam Theun 2 Hydropower Project



Source: Migara Jayawardena.

2.2 Many successful aspects of the NT2 HPP may have even surpassed some of the original transformative intentions, but the project also missed a number of opportunities when design elements and approaches to implementation and achievements did not live up to the high expectations. Thus, what transpired in the NT2 HPP should be emulated with caution. With the benefit of insights from a decade and a half of implementation, this evaluation attempts to extract lessons from the NT2 HPP experience and examine what worked, what did not, and the reasons why, to help inform the design and development of future hydropower investments in Lao PDR and around the world.

Key Results

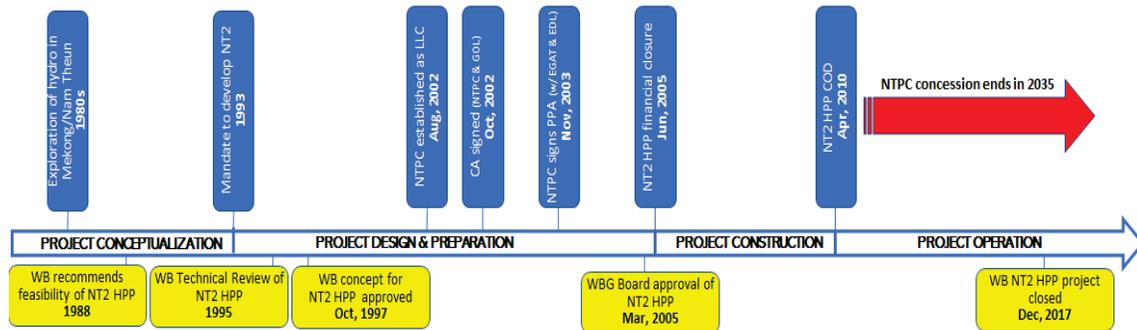
Power Finance and Development

The NT2 HPP was a major undertaking in Lao PDR, and its design was influenced by the World Bank's global experience. An experienced developer constructed the large-scale, complex project successfully as part of a public-private partnership. It has continued to supply electricity to Thailand and Lao PDR since 2010.

2.3 The World Bank played an influential role in the NT2 HPP's strategic approach and design over a lengthy preparation period. With a listed capacity of 1,070 MW, the NT2 HPP remains the largest hydropower project in the country. The estimated

financing requirement of \$1.5 billion at appraisal was substantial, given that the entire country's GDP was about \$2 billion. Furthermore, at project approval, no significant hydropower project had achieved financial closure in nearly a decade (the Houay Ho Hydropower Project and Theun-Hinboun Hydropower Plant I achieved financial closure in 1996). Lao PDR had little experience mobilizing large-scale private investments, despite its ongoing transition toward a more market-oriented economy. Although hydropower development on the Nam Theun river was initially conceptualized as far back as the 1970s,⁴ it was a World Bank recommendation in 1988 to carry out a full feasibility assessment that led to active consideration of a large-scale cross-border export project. The World Bank, through its analytical work and policy dialogue, played an influential role in helping the government determine that mobilizing the private sector was essential because of the project's scale and complexity, which outstripped the existing capacity within the country. Subsequently, the World Bank helped the government secure a qualified lead sponsor when the initial developer (Transfield) withdrew because it anticipated costly delays in securing international guarantees. The World Bank also helped maintain interest in the NT2 HPP through the Asian financial crisis in the late 1990s, when project prospects became uncertain for many participants.⁵ This included the formal inclusion of the NT2 HPP in 1997 as a prospective project for World Bank financing.⁶ Preparation continued for nearly a decade, during which the World Bank played an influential role in shaping the project's contours based on its global experience in hydropower development, according to multiple stakeholders. It included influencing design features such as the concession, construction, and power purchase agreements (PPAs), revenue sharing arrangements, and E&S aspects, as well as incorporating recommendations from "Directions in Hydropower" (World Bank 2009a). The result was a lengthy preparation period because of the project's complex design, including reforming the country's existing legal framework to accommodate some of the proposed project features.

Figure 2.1. Key Milestones in Developing the NT2 HPP



Source: World Bank Group project documents.

Note: The timeline is not to scale. CA = Concession Agreement; COD = commercial operation date; EDL = Électricité du Laos; EGAT = Electricity Generating Authority of Thailand; GOL = government of Lao PDR; NT2 HPP = Nam Theun 2 Hydropower Project; NTPC = Nam Theun 2 Power Company; PPA = power purchase agreement; WB = World Bank; WBG = World Bank Group.

2.4 The Bank Group, together with other IFIs, helped build confidence with private investors to mobilize financing in a nascent market, leading to the development of the NT2 HPP. The Bank Group formally approved its support (grant and guarantees) for the NT2 HPP in March 2005, paving the way for NTPC to achieve financial closure for the project with 26 additional financiers by June 2005. Through two focus groups that the joint Independent Evaluation Group (IEG)-ADB evaluation team organized, financiers confirmed that the involvement of the Bank Group and other IFIs in the NT2 HPP was instrumental in their initial decision to finance the project. Several financiers indicated that uncertainty stemming from the relatively undeveloped market for hydropower in Lao PDR was a key deterrent, and the government’s limited track record supporting the sector, with little history of effective oversight of E&S practices, was another concern. The financiers in the focus groups indicated that these risks would have prevented their participation without the assurances provided by the Bank Group and other IFIs’ involvement in the project.⁷ With limited private insurance available at the time in Lao PDR, the use of IDA and MIGA (and ADB) guarantees was effective in alleviating private sector concerns by backstopping the government’s commitments to the project. Taken together, the focus group feedback shows that the Bank Group’s support was a key factor that facilitated private participation in Lao PDR’s transitional market, which was yet to mature.

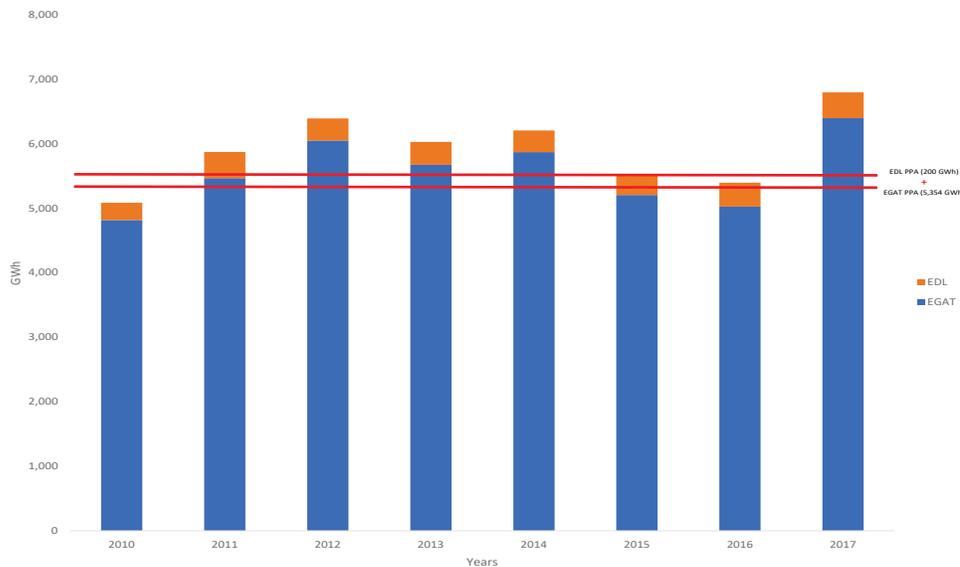
2.5 The selection of a qualified developer and appropriate contractual arrangements led to the successful and efficient construction of a large-scale, complex hydropower project consistent with industry standards. NTPC (the NT2 HPP project company) was established as a consortium under a PPP arrangement. The lead developer, Électricité de France International (and its parent company), had an extensive track record of developing hydropower investments.⁸ As a result, NTPC successfully constructed most

aspects of the hydropower facilities to industry standards. However, the developers faced a significant issue when the downstream channel collapsed during boring because of the discovery of water-absorbent karst limestone geology. Alternate routing would have caused significant delays, had substantially more E&S impacts, and increased project costs. The developer implemented an innovative solution by drilling down several hundred meters to reach a granite formation that would provide better foundational support for the original downstream channel route. Although the late discovery of the karst limestone formation may reflect inadequacy in the initial geological tests, the novel engineering solution that overcame the challenge reflects the developer's expertise. Ultimately, the NT2 HPP was commissioned to operate commercially in April 2010 with only a 4.5 month delay. The physical infrastructure cost overrun was less than 2 percent of the original estimates and well below the allocated contingencies. By comparison, World Bank (2020a) found that Bank Group-supported hydropower projects, on average, cost more than 30 percent over the budgeted contingencies and took 14 more months to complete than planned. NTPC's major achievement was due to both its technical expertise and to prior validation and contractual obligations that incentivized good performance. An independent firm carried out a detailed review to ascertain the "reasonableness" of project costs at appraisal. The NT2 HPP also included a fixed-price PPA for electricity sales to Thailand, placing pressure against overruns and imposing penalties on NTPC for significant delays. Just as important, the primary construction contract was designed to pass the cost of most overruns through to the contractors, creating adequate incentives for diligent project management to stay on budget.

2.6 The NT2 HPP has operated profitably since commissioning and continues to supply low-cost electricity to Thailand and Lao PDR. From 2011 to 2018, the project had an average annual output of 5,912 gigawatt-hours (GWh), exceeding its contracted yearly export volume of 5,354 GWh annually to Thailand, and 200 GWh each year for consumption in Lao PDR. The supply has also been stable, with reservoir silting well within targets and annual fluctuations in production of no more than 10 percent. The successful offtake validates the conclusion reached through in-depth analyses at appraisal that the Thai power market is capable of absorbing electricity imports from the NT2 HPP. Electricity supply from the NT2 HPP continues to be an economical option (least-cost) for the Thai power company (the Electricity Generating Authority of Thailand), with a levelized cost of 2.7 cents per kilowatt-hour (kWh) when the average generation cost in the system in Thailand is much higher at 5.7 cents per kWh (Bucknall et al. 2014). An IEG economic analysis estimated that the net economic benefit to Lao PDR from the NT2 HPP by the end of its concession period will be \$550 million (net present value at a 10 percent economic [social] discount rate), driven primarily by the value of electricity exports. NTPC's financial records confirmed that the company is

generating sufficient revenues from the project to service its debts and remain profitable as an ongoing business entity. NTPC informed the evaluation team that the Electricity Generating Authority of Thailand, which accounts for 95 percent of sales, continues to pay for its purchases promptly and regularly, ensuring sufficient cash flow to fund its operations.⁹ According to NTPC, at no time up to now did they foresee risks that would invoke any of the guarantees, which also confirmed the government’s fulfilment of its commitments. The economic analysis further confirmed that the project’s large investment costs have already been recovered based on the benefits accrued up to 2018. Therefore, it can be reasonably inferred that there is little risk to the continued successful operation of the NT2 HPP.

Figure 2.2. Electricity Supply from the NT2 HPP to Thailand and Lao PDR



Sources: Nam Theun 2 Power Company; World Bank.

Note: 2010 was not a full operating year because of a 4.5 month delay in commissioning. EDL = Électricité du Laos; EGAT = Electricity Generating Authority of Thailand; GWh = gigawatt-hour; PPA = power purchase agreement.

Environmental Aspects

The NT2 HPP placed a high degree of importance on the environmental management of hydropower development, but despite considerable attention during implementation, the mitigating actions’ results were mixed. The watershed that was designated as a biodiversity offset was not successfully protected, as envisaged.

2.7 NTPC and the head construction contractor eventually addressed most environmental aspects adequately. Environmental (and social) sustainability was integral to achieving the NT2 HPP’s objective. Various environmental activities were specified explicitly in several project documents. During project construction, an independent panel reviewed and confirmed compliance with the World Bank policy on

dam safety—an important facet of developing large-scale hydropower. A separate, independent E&S Panel of Experts monitoring overall compliance had some initial concerns that the head contractor paid inadequate attention to environmental issues and occupational health and safety in the early years of construction. The shortcomings that were identified were ultimately resolved, and by the time of commissioning, all 348 construction sites used for the project were decommissioned and restored (including revegetation and regrading land to its natural slope), in line with good practice requirements in the Head Construction Contract Environmental Management Plan. IEG also observed during its site visit that NTPC is adequately managing the power plant with proper storage and disposal of materials and adhering to various occupational health and safety standards.

2.8 Gradually inundating the reservoir enabled the effective translocation of animals and establishment of a wildlife conservation program. However, the stabilization of species in the Nakai Plateau cannot be verified fully because of inadequate monitoring data. Project documents and interviews indicate that NTPC slow-filled the reservoir, resulting in a low impact on wildlife in the plateau. It enabled the rescue of animals that did not translocate on their own (268 individual animals from 49 species) and were trapped (World Bank 2018). One study found the translocation program to be a “great success” (Streicher 2016). NTPC also implemented a wildlife conservation program on the Nakai Plateau focusing on species such as elephants, turtles, and newly discovered species of muntjacs (barking deer). However, the stabilization of species on the plateau post-translocation—an important goal—cannot be fully determined because of limited monitoring and availability of data.

2.9 Uncleared biomass within the reservoir has exacerbated water quality decline, initially affecting fish populations that have since stabilized. It is also contributing to higher levels of greenhouse gas emissions from the reservoir, though the NT2 HPP continues to have a net positive impact on global climate change. At the time of reservoir impoundment in 2008, biomass was not removed adequately in half of the 3,000 hectare (ha) area. The independent E&S Panel of Experts called for removing “as much as possible” from the rest of the area, but ultimately less than 1,900 ha were cleared. The Independent Monitoring Agency reported that NTPC and the government were slow to mobilize capacity and expertise, and the company applied inadequate diligence procedures. Documents and interviews indicate a variety of reasons for the significant uncleared biomass,¹⁰ and it was suggested that the challenges might have been underappreciated at the time of appraisal. Ultimately, because not all of the biomass was removed, it exacerbated the anticipated initial decline in water quality after impoundment, increasing the carbon dioxide (CO₂) and methane emissions from the reservoir.¹¹ This affected fish stocks and water quality in the reservoir. The water quality

stabilized after about three years, and NTPC's efforts to restock the reservoir, and the unplanned introduction of several invasive species, eventually led to increased fish catches.¹² Estimates indicate that fish catches in 2018 were as much as 27 kilograms per ha (NTPC 2018a), substantially exceeding the 21 kilograms per ha assessment in 2009, although the nature of fishing changed.¹³ However, there are concerns about the current sustainability of fisheries because of the lack of an active reservoir management program,¹⁴ continued propagation of invasive species,¹⁵ and illegal fishing in protected spawning grounds.¹⁶ The excess biomass decay has also had a lasting effect on reservoir emissions. A study estimated a global warming potential value of 80–90 grams of CO₂ equivalent per kWh from the NT2 reservoir, exceeding the initial World Bank estimates of 38 grams of CO₂ equivalent per kWh (Zhou 2011). Nevertheless, the NT2 HPP has a net positive impact on global greenhouse gas emissions because it displaces the use of natural gas in the power system in Thailand. Total annual net avoided emissions are estimated at approximately 1.7 million tons of CO₂ equivalent, which is about 25 percent less because of the emissions from the NT2 reservoir. The present value of these global benefits from the NT2 HPP on a life cycle basis is nearly \$400 million, at a 10 percent global economic (social) discount rate (World Bank 2017a).¹⁷

Photo 2.2. Biomass Remaining in the Nam Theun 2 Reservoir

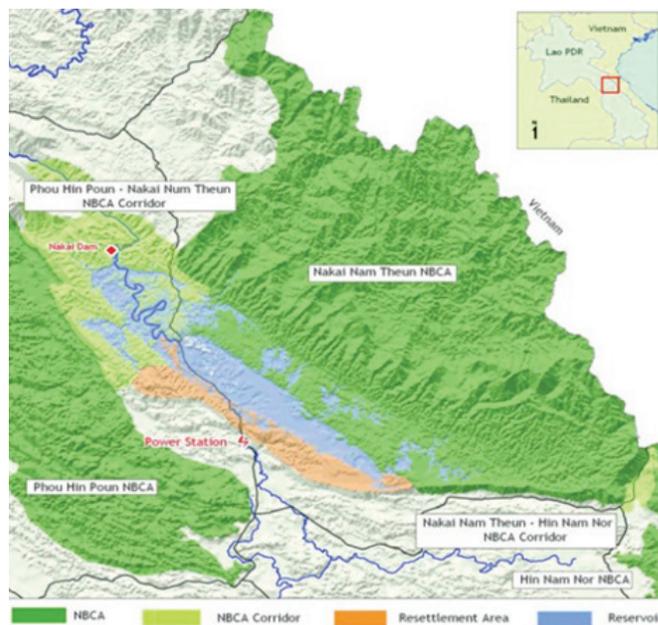


Source: Migara Jayawardena.

2.10 The NT2 HPP altered the flow regime downstream, which will require continuous monitoring and management, including taking into account emerging developments caused by climate change. Downstream flows for the Nam Theun and Xe Bang Fai Rivers are now colder, faster, and higher. Studies indicate that the diversity and abundance of fish that were already in decline decreased further during the initial years after the commissioning of the NT2 HPP because of changes in the flow regime

(Kottelat 2016). The independent E&S Panel of Experts reported that downstream fisheries might have declined by as much as 35 percent. However, Kottelat (2016) indicated that the fish stocks stabilized on the Nam Theun and the Xe Bang Fai Rivers after the initial decline but also cautioned that “no conclusion” can be drawn without more comprehensive monitoring, which had ceased. Increased storms, possibly as a result of climate change impacts, have also amplified the flow changes to the rivers. Data reviewed by the evaluation team indicate that NTPC is monitoring water levels and adjusting operations accordingly to minimize the potential for flooding considering the inundation of downstream villages. Although weather-related flow changes are unrelated to the NT2 HPP, there is a perception among villagers that the project causes an increased incidence and duration of flooding—a view that NTPC is taking steps to address by inviting village heads to visit the power plant when water levels are high so they can directly observe when operations have been ceased. NTPC and others concurred that climate change–related impacts were not assessed fully at the time of project design (World Bank 2017b).

Map 2.1. Nakai Plateau and the NNT-NPA Watershed



Source: Nam Theun 2 Power Company.

Note: NBCA = ; NNT-NPA = Nakai-Nam Theun National Protected Area.

2.11 The NNT-NPA watershed was poorly conceived as an offset, and it lacked adequate human and financial resources to successfully conserve the area as envisaged. The NT2 HPP was estimated to have an environmental footprint of 130,589 ha of total loss or modification of land area,¹⁸ so the project design included an offset in a 338,718 ha area of the NNT-NPA (and adjacent corridors) to protect the watershed and

its biodiversity. The NNT-NPA watershed was recognized as one of the most significant conservation areas remaining in Southeast Asia, according to wildlife experts (World Bank 2005c). Although the environmental assessment and management plan noted that the protected land area exceeded the project's environmental footprint, it failed to recognize that the area lost or degraded because of the project and what was designated for conservation within the NNT-NPA watershed had different biodiversity characteristics and value.¹⁹ Moreover, because of the narrow definition of the project's area of major influence in the plan, except for social dimensions, it failed to address significant impacts and conservation needs, encompassing the southern watershed and the plateau that would connect with neighboring protected areas (Phou Hin Poun and Phou Nam Hin Poun corridors). The area along the reservoir's southern shoreline is subject to intense cultivation and potentially significant environmental impacts generated by resettlements; it also contains remnants of valuable forestry and an escarpment of karst limestone housing significant biodiversity.²⁰ Consequently, because the plan omitted this area, measures were not taken to help protect the entire watershed, create connectivity with protected areas, improve movement of animal populations, or facilitate effective land use planning in the resettlement areas.

2.12 The ambition to protect the NNT-NPA watershed's abundance and diversity of flora and fauna was not achieved during the project implementation period. The NNT-NPA watershed was one of the first areas designated for biodiversity protection in Lao PDR. The Watershed Management and Protection Authority (WMPA), a nascent institution established in 2001, was designated to manage and coordinate all activities in the watershed, including implementing the biodiversity offset in line with the Social and Environmental Management Framework and Operational Plan (WMPA [2004 and subsequent versions]), despite the country's poor record of managing conservation areas. At approval, the Project Appraisal Document noted that the success of protecting the NNT-NPA would depend on "the effective use of financial resources, strengthening government capacity" and "long-term political will" (World Bank 2005c). Funding from project resources was made available, but the WMPA was unsuccessful in adequately enhancing its capacity, managing its operations, and protecting the NNT-NPA watershed's biodiversity. A technical adviser to the WMPA found a near absence of "any expertise in biodiversity conservation" (Robichaud 2018), and independent monitors (the Lenders' Technical Adviser and the E&S Panel of Experts) found that the organization was "totally ineffective" in protecting the watershed. In addition, the WMPA was also beset with weak leadership—an audit found governance and financial mismanagement of the organization. Furthermore, the ongoing \$1.4 million of annual funding from the project may be insufficient to support even a well-functioning WMPA adequately. The International Union for Conservation of Nature recommends that about \$5 per ha is necessary to adequately fund conservation management in protected areas

in Asia (including ranger patrols), which translates to a budget of at least \$2 million annually to oversee the NNT-NPA watershed. Ultimately, the WMPA fell considerably short of its envisaged objectives, despite the many efforts made through the project. In fact, in 2014, funding from the project to the agency was suspended because it progressively became incapable of carrying out its mandate. Funding resumed only in 2016 when the WMPA prepared a five-year strategy for the organization.²¹

Photo 2.3. A Villager Accessing the NNT-NPA Watershed by Boat



Source: George Henry Stirrett.

Note: NNT-NPA = Nakai-Nam Theun National Protected Area.

2.13 The highly unrealistic targets set at design made it impossible to achieve outcomes established for the biodiversity offset. It is worth noting that even if the WMPA's capacity was sufficient and the institution was well managed, the initial design of the NT2 HPP biodiversity offset still may have prevented a successful outcome. The target in the NT2 HPP results framework was to ensure that management of the watershed would result in "no further degradation of habitats or in declines of threatened species" in the NNT-NPA watershed. This proved a highly unrealistic goal because illegal logging and poaching in the area predated the NT2 HPP, and the project was not in a position to enforce an end to such unlawful activities abruptly. Although it is difficult to determine conclusively why such stringent requirements were established during project preparation, it may have been the World Bank's desire to implement high environmental standards without fully appreciating the unrealistic commitments they were imposing for implementation.²² Furthermore, adequate baseline surveys were not carried out to determine the abundance, distribution, and diversity of flora and fauna. This made it impossible to quantify accurately the extent to which the project target was being met (or not). Nevertheless, during project implementation, conservation specialists repeatedly reported loss of habitat and species caused by illegal logging and poaching, especially across the Vietnamese border, though quantitative information was not available. Forest Carbon (2018) estimated the forest area lost (excluding the reservoir area) to be increasing from 409 ha per year in 2009–12 to 499 ha per year in 2012–17. Villagers occupying the plateau also contributed to habitat loss through uncontrolled

agricultural and forestry practices, which the evaluation team corroborated through interviews and observation. Although some observers suggested that the damage to the biodiversity offset would have been even worse if unabated by the NT2 HPP's efforts, such a counterfactual was not monitored, nor does it meet the standard established by the World Bank for the project's outcome. Notwithstanding the considerable support provided by the NT2 HPP for protecting the NNT-NPA, ultimately it was inadequate in meeting the requirements for a "well-designed, well-funded, and well-managed" biodiversity offset.²³

2.14 Although it would be difficult to restore the biodiversity in the NNT-NPA to what was originally envisaged, the government has an opportunity to remedy the lack of past success, and the World Bank can help realize a significant environmental commitment made to compensate for the NT2 HPP's environmental footprint. Some important biodiversity losses, such as large wildlife, sustained within the NNT-NPA are likely irrecoverable. Despite the unsuccessful attempt by the project to manage the NNT-NPA biodiversity offset, there is some cause for "cautious optimism," as noted by the independent E&S Panel of Experts, and an opportunity to learn from experience. The current government has made a strong commitment to sustainable management of its natural resources. In 2015, the government issued Government Decree 300/2015 banning illegal logging and poaching. Similar regulations were enacted in the past, but there is evidence of greater enforcement this time. Although the data the evaluation team obtained from the Wildlife Conservation Association is insufficient to establish a trend, it indicates that there have been arrests and convictions for local and foreign violators under the decree, including some high-level officials. The government has also assembled a committee of technical experts,²⁴ comprising several experienced international and domestic nongovernmental organizations, to support the WMPA. In addition, the government, on the committee's advice, appointed a new director in 2019 to revive the WMPA's five-year strategy for the NNT-NPA and engage qualified staff.²⁵ The International Union for Conservation of Nature is assisting the recruitment effort because the NNT-NPA has recently been upgraded from National Protected Area status to become the first national park in Lao PDR,²⁶ converting the WMPA to a national park office. Such designations can garner greater attention, scrutiny, and support, which can lead to improved conservation if reforms are sustained and effective. Although the World Bank's direct support to the WMPA through the NT2 HPP has ceased (the WMPA continues to receive funding from NTPC as per the Concession Agreement),²⁷ and it was relatively ineffective in achieving the intended results, there is continued assistance through a separate project focused specifically on conservation. It is directly supporting the NNT-NPA by augmenting the ongoing funding provided by NTPC as a part of its commitment under the NT2 HPP. These collective measures are promising and indicate some learning from experience, but they are preliminary, and the results of

these activities have not yet fully materialized. As such, the ongoing challenges in protecting the NNT-NPA watershed continue to pose a significant risk to the NT2 HPP's results.

Social Development Aspects

The physical aspects of resettlement were largely successful, though livelihood restoration—despite achieving most targets—faced significant challenges and was implemented inadequately. As a result, risks remain to the sustainability of the project's achievements. The project company and development partners' ongoing support to sustain livelihoods will be a key mitigant.

2.15 Although the physical aspects of the resettlement were largely successful, the timing of its implementation was not synchronized well with the hydropower facilities' construction schedule. The physical relocation included a comparatively modest 6,300 people from approximately 1,300 houses in 17 villages,²⁸ mostly in the Nakai Plateau where land had been acquired to construct the project.²⁹ NTPC had primary responsibility for relocating and compensating project-affected people. Much of the groundwork was undertaken during project preparation; the necessary policies were issued by the government,³⁰ and the institutional setup established, before the NT2 HPP approval in 2005. However, the physical relocation of project-affected people was not coordinated well with the power facilities' construction schedule and did not fully comply with the Concession Agreement between NTPC and the government or with Bank Group E&S safeguard policies. Despite the Concession Agreement requiring that housing and infrastructure be in place before resettling families, the first wave of 600 families were moved to temporary housing in 2006, two years earlier than originally planned. The resettled families had to build the houses themselves using NTPC-supplied materials on uncleared plots (which were also not ready for planting crops). The physical relocation of the second resettlement wave was completed by 2008. Ultimately, some resettled families had to wait for up to a year before they were provided with permanent housing.³¹ Furthermore, NTPC acquired some project lands (for transmission lines, roads, and the downstream channel) before completing Resettlement Action Plans without full compensation for project-affected people, contrary to the requirements of Bank Group policy.³² Despite IFIs previously raising concerns about the resettlement schedule,³³ it appears to have been dictated primarily by the construction timeline and plans to fill the reservoir rather than complying with the requirement for preparing satisfactory physical environments before moving people. Although individual families were aware of the location of their house or farm plots, other significant parameters that would enable villagers to take ownership and invest in managing their new environment were not determined fully until 2012 or later.³⁴

Photo 2.4. A Typical Resettled Dwelling in the Nakai Plateau



Source: Migara Jayawardena.

2.16 Several overarching constraints hampered the efforts to restore project-affected people's livelihoods. In keeping with good practice, the NT2 HPP was designed to double the incomes of those affected in the Nakai Plateau and restore incomes to preproject levels for those living downstream and within the NNT-NPA watershed. The former objective was ambitious because it extended beyond the minimum requirements of Bank Group policy (OP 4.12) requiring project-affected people to be at least as well off after the project as they were before it.³⁵ Although ample evidence from experience shows that resettlement programs should be customized through a continuing consultation process, the effort in the NT2 HPP appears to have used a top-down, prescriptive approach, with minimal customization of solutions based on input from stakeholders that would indicate learning from the feedback or experiences. Even though the project design called for adaptive management of the livelihoods program, there is little indication that the quality of the programs improved throughout most of the project period based on either the increased quality of technical inputs from advisers or on learning from experience.³⁶ A key constraint that emerged was the highly prescriptive, livelihood-related outputs (that preestablished program designs) formalized in the Concession Agreement. These requirements rigidly dictated the approach to livelihoods support, rather than relying on consultative inputs to shape their design flexibly to meet the needs and skills of the targeted families and achieve livelihoods outcomes. The downstream livelihoods program was more explicitly input-driven, capped at a funding target of \$16 million,³⁷ rather than explicitly aiming to restore incomes to at least the preproject levels. NTPC informed the evaluation team that it considered adhering to the requirements specified in the Concession Agreement to be an important and legally binding obligation, confirming the inflexibility the agreement

imposed on the livelihood programs' implementation. Another overarching constraint that the resettlement program faced was an ambiguous criterion for its closure. Although the income targets were defined clearly, the program closure was conditioned on the sustainability of livelihood restoration. However, what constituted a basis for sustainability was not clear in an otherwise extensively detailed Concession Agreement, which led to different interpretations among stakeholders about when the resettlement program could be closed.³⁸ Several project-associated people also noted voluminous documentation that many rotating project staff found impractical to easily understand and use as a guide to implementing the social development program.

2.17 Many livelihood options (pillars) identified for support experienced considerable difficulties because they were implemented inadequately. The resettlement program needed to help the resettlers adjust from a lifestyle supported primarily by subsistence swidden (slash-and-burn) agriculture to a new one in which they faced constraints on available land area and accessibility.³⁹ To facilitate this shift, restore livelihoods, and achieve the income targets in the Nakai Plateau, the project included financial and technical assistance to support five livelihood pillars: agriculture, fishing, animal husbandry, forestry, and off-farm income. Lessons learned from two demonstration farms and a pilot village established during preparation led to an extended project implementation period.⁴⁰ This was to allow sufficient transitional time for resettlers to adapt to their new environment. However, other important lessons were not heeded in implementing the livelihood pillars. Rice cultivation, which was a high priority within the agriculture pillar, had limited success because of the shortage of suitable land in the resettlement area. In particular, only a limited number (47 percent) of the small irrigation systems developed under the project to make the land more arable were usable, and only 36 percent were actually used (per Lenders' Technical Adviser notes from a 2017 visit). A village forestry association established to manage 17,000 ha of forests on behalf of the resettlers was repeatedly found to be ineffective early in project implementation,⁴¹ yet it was not abolished, and a new approach was not undertaken until after a World Bank Safeguards Compliance Review of project performance in 2016. Livestock initially suffered at least one year of widespread starvation because the larger animals that had previously roamed freely (such as buffalo) were within smaller confines. Resettlers were compensated for their losses, and the situation has stabilized because households have diversified their livestock holdings. The fisheries livelihood pillar (an important income earner and key source of protein) improved after an initial decline. Although fish catches in the reservoir have increased, there are concerns about its sustainability because of the lack of an active reservoir management program, the propagation of invasive species, and overfishing. There is little evidence that the project implemented adaptive management techniques effectively in the livelihood restoration program, despite a consultation process throughout and regular advice from

independent monitors. The overarching constraints highlighted previously certainly compounded the challenges the project faced in effectively implementing the livelihood pillars. Appendix C provides specific details of the livelihood restoration program.

Photo 2.5. A Villager at Work



Source: Migara Jayawardena.

2.18 The resettlement implementation period (RIP) needed to be extended to address shortcomings, although the outcome of these efforts cannot be fully verified. The independent E&S Panel of Experts decided in 2015 that the shortcomings of the livelihood restoration program warranted its extension by an additional two years. They believed that “a substantial proportion of the Resettlement Objectives and Provisions has not been fully achieved as yet” (Mcdowell, Scudder, and Talbot 2015).⁴² The E&S Panel of Experts’ perspective was further validated through a World Bank Safeguards Compliance Review undertaken in 2016 (World Bank 2017c), which found that a decade into implementation, the project was only partially compliant with the World Bank Group’s Resettlement and Indigenous Peoples policies. The IFIs insisted that NTPC and the government rectify the shortcomings. To facilitate these efforts, the World Bank helped establish a joint working group that included decision makers from key stakeholders,⁴³ which several participants interviewed credited with resolving disagreements and facilitating actions. The joint working group helped develop a Comprehensive Action Plan to reach RIP closure and sustain its impacts, including actions to continue after the RIP (a medium-term development program). Moreover, interviews with stakeholders and project documentation confirmed that the plan, which rolled out a decade after the project commenced, represented a qualitative shift in the approach to managing resettlement. It used a bottom-up approach and more inclusive consultations to better inform community development efforts and reflect local priorities, including incorporating village planning to resolve issues about land use and

community resource management.⁴⁴ The Implementation Completion and Results Report indicated that “11 actions were proposed to bring all safeguard policies into compliance, which was subsequently achieved by project closure in December 2017” (World Bank 2018). However, the required closing report for the Resettlement Action Plan that would consolidate the various intermediate reports and surveys, indicating how the program was implemented and results achieved, was not produced. Therefore, the veracity of the conclusions regarding the overall program is difficult to confirm.⁴⁵

Photo 2.6. A Community Discussion in a Village in the Nakai Plateau



Source: Migara Jayawardena.

2.19 Despite the many challenges, the project’s ambitious income targets were eventually achieved for nearly all of the affected people. At project closing, Living Standards Measurement Surveys and other surveys indicated that resettlers in the Nakai Plateau doubled their incomes compared with preproject levels. Other indications of improved quality of life are increased savings in nearly all households (baseline increase of 21 percent), land titles for new property (none of the resettled villagers had land titles preproject), increased access to infrastructure (1,330 houses and 270 km of roads constructed), new and upgraded health facilities (two new health centers and upgrades to a district hospital), and the construction of schools (17 primary and 16 nursery schools). Health outcomes improved: childhood mortality has dropped from 120 per 1,000 births to 50, stunted growth of children is down from 43 percent to 34 percent, and 90 percent of children under five are immunized. Primary enrollment in schools in the Nakai Plateau surpassed the national rural average, with enrollment by resettled families increasing from 31 percent to 91 percent. NTPC closed the downstream program in 2012/13, and the government started to provide further funding in 2016. Surveys taken between 2009 and 2014 indicate that there was an increase in consumption and dietary diversity compensating for the impact on fishing—a key aim of the initiative. However, as many as half of the 100,000–115,000 affected people may have been unable to restore their livelihoods to preproject levels, an issue raised by the World Bank’s Safeguards Compliance Review to be addressed before the project closed.

The evaluation team did not find any documentation indicating that the issue was resolved (World Bank 2017c, 2019c).⁴⁶ Limited monitoring and data were available to verify results for the enclave villages in the NNT-NPA watershed, though a 2018 study found that 90 percent of those surveyed said their lives had improved over the previous decade (ADB 2019, World Bank 2018). Women’s focus groups revealed that this was primarily because of access to health services (for maternal and prenatal care and child vaccinations), education, and animal vaccinations. However, the surveys were not provided to the evaluation team to verify.

Table 2.1. Nakai Resettlers’ Mean Household Income by Source

Income Sources	Survey Years (percent of income)			
	2006	2011	2013	2017
Fishing	14	31	33	29
Agriculture and cropping	31	15	25	28
Employment (salaries, wages, and pensions)	23	7	10	15
Livestock	16	4	6	13
Other income (bank interest, dividends, and remittances)	0	3	2	9
Forests income	9	38	22	5
Business (small household enterprises)	7	1	3	1

Source: Nakai Socio-Economic Surveys, NTPC.

2.20 The resettlement and livelihood restoration program was closed, although risks to sustaining the results remain. At the end of the two-year extension, the IFIs agreed to RIP closure as the World Bank wound down its formal involvement in the project (though MIGA and IDA guarantee exposure continue). The E&S Panel of Experts agreed that the income targets were met, and concurred with the decision to close the RIP. However, they also noted that the income levels were not maintained “for a reasonable period of time,” but presumed that the medium-term development plan would continue to be implemented (including monitoring) after the World Bank project closed (Mcdowell, Scudder, and Talbot 2015). Their final review in 2018 also found that some remedial measures for continued support of the downstream program were not fully functional.⁴⁷ The WMPA, which supported the enclave villages in the NNT-NPA watershed, was also changing in the reorganization. Taken together, it is reasonable, therefore, to assess some degree of risk with sustaining into the future the livelihoods impacts achieved by the project.

Management of Revenues

The revenues from the NT2 HPP were transparently accounted for in the government budget, within which priority expenditures of an equivalent value were funded. However,

the additionality of the NT2 HPP revenues in the national budget and the performance of the funded activities cannot be conclusively determined. Therefore, the decreasing trend in poverty in Lao PDR is likely due to the government's commitment to implementing its overall development strategy rather than any effort to earmark project revenues.

2.21 The revenue generated by the NT2 HPP is adequately accounted for and transferred to the government budget, as arranged under the NT2 HPP. There are two broad aspects to NT2 HPP revenue generation: revenues received by NTPC (through the sale of electricity) and revenues received by the government through multiple avenues (water user charges, corporate taxes levied on NTPC, and dividend payments earned through the government's equity of NTPC through the Lao Holding State Enterprise). The PDO refers to the latter. The government did not establish, as agreed, the NT2 Revenue Account, which was designed to account for and manage the budget revenues accrued from the project. Interviews with some World Bank staff indicated that the government was reluctant to make such a budgetary distinction specifically for the project, even at the time of appraisal, suggesting that this approach to ensure accountability of funds may have been unrealistic. However, the World Bank team, working closely with the government, developed a functional equivalent by 2015, to tag and identify revenues accruing from the NT2 HPP within the national budget (though this was years into project implementation). As a result, it was possible to confirm that net revenue of about \$25 million accrued to the government budget from the NT2 HPP annually. It mostly met the targeted amount of \$30 million, less the government debt payments,⁴⁸ during the initial years of project operations.⁴⁹ Moreover, the World Bank public finance specialist cross-checked the budget revenues with NTPC financial statements and confirmed that the figures were nearly identical.⁵⁰ Nevertheless, dividend income to the government has not all been transferred since 2013/14 and has instead been held back with Lao Holding State Enterprise.⁵¹ Although investments made through Lao Holding State Enterprise are also in the public interest and could be for priority areas in energy, it is a less transparent approach that deviates from what was agreed. This is a concern because overall government revenues are soon expected to increase substantially to as much as \$110 million annually, primarily as a result of dividend income (and corporate taxes) as NTPC's profits increase when debt servicing is completed.

Table 2.2. Revenues Generated for the Government from the NT2 HPP (\$, millions)

Year	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2017
Royalties (water user charges)	5.4	13.2	13.6	12.0	14.4	12.5	15.8
Dividends	-	-	18.4 ^a	18.7	6.1	4.3	1.6
Profit (corporate) tax	-	-	-	8.0	2.5	5.5	5.5
Net revenues received by Ministry of Finance	5.4	13.2	32.0	38.7	23.0	22.4	22.9

Source: Data from the World Bank obtained through the State Audit Organization and Ministry of Finance, Lao PDR.

Note: 2010/11 data are from after the commercial operation date; 2015/16 data include +3 months to align with calendar year ending in 2016.

a. Included a special one-time dividend.

2.22 The NT2 HPP revenues are being allocated transparently for public expenditure programs, although the approach was not replicated and remains unique to the project. In addition to accountability, the NT2 HPP had provisions for enhancing the transparency of the revenues accrued to the government. The revenue statements were shared with the Bank Group but were not separately disclosed. The State Audit Organization, which benefited from Bank Group technical assistance to strengthen its institutional capacity, audited the revenue statements. A sample of projects and programs funded from NT2 HPP revenues was published. The IFIs may have hoped that some of the governance measures would be applied in other future undertakings beyond NT2 HPP revenues, but the evaluation team did not find similar accountability and transparency initiatives replicated within the government budget.

2.23 There is evidence that the revenues from the NT2 HPP contributed to the government's poverty alleviation programs, although its additionality cannot be verified. Information provided by the government and World Bank staff based on audit reports indicates that funds equivalent to the revenues received from the NT2 HPP were allocated to a broad set of priority expenditure programs for poverty reduction and environmental conservation and management activities. However, most of these funds were allocated retroactively because the functional equivalent system to tag and identify NT2 revenues in the budget was not agreed to until 2015, nearly five years after the commissioning of the power plant. Furthermore, the Implementation Completion and Results Report and discussions with World Bank staff confirmed that because of a lack of baseline data, it is difficult to verify that NT2 HPP revenues were "additional resources" in the government budget and that they "will not substitute for financing from other sources," as claimed in the Project Appraisal Document (World Bank 2005c). Furthermore, the fungibility of funds within the public budget makes it challenging to attribute NT2 HPP revenues directly to specific expenditure allocations. Moreover, according to the public financial management specialists interviewed, the proposed performance audits of expenditures in priority programs (in addition to financial monitoring) were unrealistic because the undertaking exceeded the government's

capacity. Nevertheless, funding equivalent to NT2 HPP revenues within the national budget was used for investments in priority programs, even though its direct effectiveness cannot be conclusively determined.

Table 2.3. Estimated Allocation of Revenues (at the end of 2017)

Area of Allocation	Revenue	
	(\$, millions) ^a	(percent)
Education	65.81	35.3
Health	62.14	33.3
Public works and transport	15.67	8.4
Energy, mining, and agriculture	24.32	13.1
Natural resources and environment	1.31	0.7
Poverty-reduction fund	9.91	5.3
Projects implemented by provinces	7.05	3.9
Total	186.22	100

Sources: State Audit Organization Audit Reports 2009/10–2015/16, Ministry of Finance data FY15/16 and FY17.

Note: The total allocation slightly exceeds the total revenues of \$180 million received.

a. Nominal.

2.24 The critical driver alleviating poverty in Lao PDR appears to be the government’s commitment to implementing its development strategy rather than the earmarking of project funds. The government’s overall efforts to reduce poverty appear to deliver results. The Project Appraisal Document indicated that at the time of appraisal, the government had already begun to make progress in shifting budget resources in line with its development and poverty-reduction objectives. Before that, in 2002/3, the poverty rate was 33.5 percent and was on a downward trend. By 2007/8, the poverty headcount had decreased to 27.6 percent, and it declined further to 23.2 percent when measured in the Consumption and Expenditure Survey 2012/13 (World Bank 2017b). Interviews with government officials and Bank Group staff indicate that the decline in poverty likely continued, though the results from a more recent survey are not yet available. To be clear, this is not to suggest that this decline in poverty is solely or directly due to the NT2 HPP. Instead, it can be inferred that the more than \$180 million in government revenues generated from the NT2 HPP (less than 1 percent of total government revenues) contributed to implementing some part of the government’s successful efforts to reduce poverty. Thus, the primary driver of results appears to be the government’s commitment to implementing a succession of poverty-eradicating programs (for example, the 2003 National Growth and Poverty Alleviation Strategy and the sixth National Socioeconomic Development Program for 2006–10) rather than any specific efforts at earmarking NT2 HPP revenues within the budget.

Transformational Aspects of the NT2 HPP

The NT2 HPP was catalytic, helping kick-start a substantial scale-up of private sector-led hydropower development in Lao PDR that is driving export-led economic growth and contributing to reducing poverty in the country. However, there are threats to the sustained expansion of the sector caused by shortcomings in planning and inadequate adherence to E&S good practices.

2.25 Evidence is strong that the NT2 HPP played a catalytic role in helping scale up hydropower development in Lao PDR, where the industry is now a mainstay. At NT2 HPP approval in 2005, the country's industry had little private participation and was nascent. There were just two large-scale hydropower projects exporting electricity from a total capacity of less than 350 MW. After the NT2 HPP's financial closure, five additional projects totaling 1,000 MW of capacity secured private financing averaging about \$300 million over the next five years.⁵² After the successful commissioning of the NT2 HPP in 2010, market confidence in the sector strengthened further. Hydropower investments accelerated over the next five years, and 13 hydropower projects achieved financial closure with average investments of nearly \$650 million.⁵³ The total estimated capacity of these additional projects was more than 4,500 MW, creating a substantial hydropower market in the country geared toward exporting electricity to neighboring countries. Several financiers indicated to the evaluation team that they had funded subsequent hydropower investments with greater confidence in Lao PDR because they found the government to be a more credible partner after the experience it had gained from the NT2 HPP.

2.26 The expansion of hydropower is fueling export-led economic growth in Lao PDR, as envisaged in the country's development plans. According to the Lao Statistical Bureau, GDP growth in the country has averaged 7.2 percent per year since 2010 (the 13th fastest growth in the world [World Bank 2017d]), surpassing the 7 percent the government estimated at appraisal as being necessary to achieve its poverty-reduction target. The government estimates that the hydropower sector is boosting economic growth by 1.3 percentage points annually, making up the bulk of the incremental 1.5 percent GDP growth rate target anticipated from the hydropower and mining sectors. According to World Bank (2019a), the "contribution of the power sector to GDP growth rose dramatically," as electricity exports increased from 13 percent of merchandise exports in 2010 to 25 percent in 2019.⁵⁴ The share of the sector in GDP at factor cost rose from approximately 7 percent to almost 13 percent during the same period. Furthermore, it is estimated that each percentage increase in GDP contributed to a 0.4 percent reduction in poverty in the country (World Bank 2017b).⁵⁵ As a result, it can be inferred that the substantial increase in hydropower exports since the NT2 HPP is contributing to the decrease in poverty in Lao PDR.

2.27 Many of the NT2 HPP's power development and financing features served as a model replicated in structuring other hydropower investments in the country. The project also helped demonstrate the use of guarantees as an instrument for supporting the private development of hydropower, particularly the PPP approach. Lao Holding State Enterprise has expanded to play a similar role in several other power projects (two independent hydropower producers and one lignite power producer).⁵⁶ The evaluation team learned from the Thai power company that the World Bank used its global experience in helping them develop the initial PPA for the project, which continues to be a model replicated in all subsequent cross-border purchase agreements. The NT2 HPP was also the first World Bank guarantee in support of private hydropower development. Although there has been limited use of the financial instrument to develop hydropower, guarantees have been applied in the Bujagali project in Uganda (2007) and the Nachtigal project in Cameroon (2019) since the NT2 HPP's financing success. Additionally, the NT2 HPP was one of the first instances of MIGA's guarantees supporting a cross-border transaction and extending its cover for breach of contract risks—the latter now being more common (including developing a framework for underwriting joint Bank-MIGA projects). In Lao PDR, however, the Bank Group did not issue additional guarantees because the private sector had sufficient confidence after the NT2 HPP that the government would honor its commitments in the hydropower sector. Private insurance primarily covered subsequent investment risks, which increased from \$200 million annually before the NT2 HPP to \$1.3 billion annually during the postproject hydropower scale-up.

2.28 The government did not implement a robust planning process for hydropower to match the ambition of the substantial scale-up in developing the resource. It also fell short of capitalizing on the growing scale of the sector and market orientation to achieve more efficient sector outcomes. Together, these factors represent a missed opportunity to optimize the expansion catalyzed by the NT2 HPP, placing the sustained development of the sector at risk. Although the investment interest in the hydropower sector after the NT2 HPP was welcome, the World Bank noted in 2010 that the strategic approach to river basin planning and cross-border trade within the Greater Mekong subregion was more opportunistic than systematic (World Bank 2009b). The World Bank and other partners began providing simultaneous sector-level technical assistance (Hydropower and Mining Technical Assistance Project) to strengthen planning capacity (among other aspects), but the impact a decade later has yet to be fully realized, including in the domestic power market.⁵⁷ Studies have indicated that greater integration of the Greater Mekong subregion power market could benefit countries by avoiding additional generation investments, deferring national transmission upgrades, and avoiding higher generation costs (Ostojic et al. 2020). However, Lao PDR has not diversified its cross-border electricity trade in line with its vision to become the “battery of Asia,” and many

of its exports continue to supply the increasingly saturated Thai market.⁵⁸ There are also concerns from some quarters about the cascading hydrological impacts of overdevelopment in river basins (when resource use is not optimized or not adequately managed during operations), including from NTPC regarding potential effects on NT2 HPP operations.⁵⁹ Hydropower expansion in the country has led to about 15 international developers entering the market, but according to the World Bank Private Participation in Infrastructure database 10 proposals were unsolicited, and many were investor-driven rather than systematically planned initiatives. Many of the concessions were also awarded through direct negotiations or licensing programs instead of relying on approaches that are more competitive than the increased investor interest would allow. Lao PDR also did not use the size of its hydropower sector to shift to a system-to-system portfolio approach to power trade with other countries, as the World Bank recommended (World Bank 2015). Such reforms could exert more market-driven efficiencies for lower-cost electricity that would place the country in a more advantageous position in trade negotiations to secure better cross-border deals. Although the cost of export electricity can be considered least-cost so far, based on uninterrupted offtake in Thailand, future developments may need to be more competitive to supply lower-cost markets such as in Vietnam (World Bank 2015). The recent amendment to the Law on Electricity in 2017, which the World Bank helped prepare, is expected to “invert the investor-driven paradigm by pursuing systemwide planning” (World Bank 2020b). Success in this regard will be vital (with nearly 6,000 MW of hydropower projects either being prepared or under construction) if Lao PDR is to sustain its sector expansion.

2.29 The current E&S policies in Lao PDR are modeled after the NT2 HPP, but the government has applied them inconsistently in subsequent projects, mainly as guidelines for developers to follow rather than requirements that are monitored and scrutinized for compliance. The Ministry of Energy and Mines confirmed that the 2006 National Policy on Environmental and Social Stability in the Hydropower Sector and the 2015 National Policy on Sustainable Hydropower Development were designed based on the NT2 HPP experience. They also indicated that these policies serve as guidelines rather than requirements, perhaps because of a government and private sector perception that the NT2 HPP’s ambitions were too “gold plated” to be a replicable model for other similar investments (World Bank 2012). Additionally, the scale-up in hydropower investments had the unintended consequence of further stretching the government’s limited capacity to monitor and enforce E&S compliance, despite World Bank support to bolster it.⁶⁰ Although not within the purview of the NT2 HPP, the inconsistent adherence to E&S safeguards was displayed starkly in 2018 when a saddle dam collapsed in a major hydropower project because of substandard design and construction.⁶¹ This led the government to halt dam construction in the country, which

was resumed only after the government (with the support of the World Bank and other partners) had initiated a sectorwide review of safety for all large hydropower projects. The NT2 HPP included an independent Dam Safety Review Panel, but it is not clear whether such safeguards are applied consistently in other hydropower projects. Although the NT2 HPP's social development objectives were more ambitious than minimum safeguard requirements and not commonly replicated, there is some evidence that livelihood restoration is being applied in other developments in a more adaptive manner through less prescriptive approaches. However, the ambitious design of E&S aspects, which outmatched the capacity of the NT2 HPP implementing agencies, may have made the E&S approach more of a unique experience than a commonly replicable model.

2.30 The skills and expertise developed from the NT2 HPP experience have resulted in a group of skilled specialists in Lao PDR who have flourished in the growing hydropower sector that followed. According to the World Bank (2018a), the NT2 HPP has "helped nurture a cadre of senior managers, public servants, and sector specialists with experience [working on] large, complex project preparation and execution [in hydropower]." Estimates suggest that several thousand local workers (6,000 at its peak [Porter and Shivakumar 2011]) received formal and on-the-job training covering a range of technical and management skills through their participation in the NT2 HPP, though such information was not formally tracked. Several people involved with the NT2 HPP informed the evaluation team that they had encountered many former NT2 HPP workers in other hydropower projects, a reflection of the increased demand for their skills in the country's growing hydropower market. The workers, in turn, underpinned domestic sector capacity to support the industry's development.

Design and Preparation

The NT2 HPP was designed to achieve broader development objectives following the recommendations of the World Commission on Dams, although its ambition was not always commensurate with the capacity of the project's implementing agencies. As documented previously, many of the NT2 HPP's design features helped mobilize financing and successfully develop the power operation to generate revenues for the government's strategic development priorities. However, the project's E&S arrangements posed challenges that the operation struggled to overcome.

2.31 The NT2 HPP's design incorporated many key principles recommended by the World Commission on Dams for achieving broader development goals from hydropower development rather than narrowly focusing on only energy-related benefits. The NT2 HPP was an early attempt to incorporate much of the World Commission on Dams' guidance for hydropower development, which was issued during project preparation and adopted by the Bank Group in 2009 (as "Directions in

Hydropower” [World Bank 2009a]). The NT2 HPP enshrined several of these principles (box 2.1) directly in its PDO. The PPP approach backed by guarantees helped mobilize financing to a large investment in a small market. The investment was planned strategically to exploit the country’s abundance of hydropower potential by tapping into the larger, more established power market in Thailand. However, the government’s subsequent planning efforts were inadequate to fully address the strategic challenges of the scale-up that followed, and concerns have arisen about potential overdevelopment (including in the domestic market) and inadequate water resource management. The project design had many features to promote good practices in E&S aspects, though it faced several challenges during implementation. However, it helped ensure that communities in the project area benefited from improved livelihoods and various health, education, and other infrastructure services, including electrification. In a broader context, the NT2 HPP (and more specifically, the scale-up in hydropower that followed) helped the government successfully fund its economic growth and poverty alleviation strategies. The NT2 HPP also led to partnerships among IFIs and 27 overall financiers and engaged numerous nongovernmental stakeholders throughout. A recent review of closed Bank Group hydropower projects (2000–17) found a correlation between investments striving to integrate principles from “Directions in Hydropower” and greater success in achieving development goals (World Bank 2009a, 2020a). However, the NT2 HPP experience shows how attempting to incorporate multiple objectives and expansive ambitions into a single project can stretch implementing agencies’ capabilities and potentially place outcomes at risk.

Box 2.1. Key Principles of “Directions in Hydropower: Scaling Up for Development”

- Increase financing: address financing barriers and constraints to realizing projects
- Promote good practice: on environmental management, social inclusion, and governance
- Strengthen planning: to help realize the strategic value of hydropower
- Leverage regional development: to benefit local communities affected by dams
- Build partnerships: to strengthen financing options and dialogue on sustainability.

Source: World Bank 2009a.

2.32 The highly ambitious project design exceeded institutional capabilities in some critical aspects of environmental protection and social development. The ambition to incorporate many of the World Commission on Dams recommendations is understandable, but Bank Group guidelines (World Bank 2018 Policy on investment project financing) stipulate the need to balance the “appropriateness of design to the...capacity” of implementing agencies. However, the Bank Group appears to have underestimated the systemic weaknesses of the institutions handling wildlife

conservation in Lao PDR, including the nascent WMPA, which had little track record of successful performance. At appraisal, the WMPA's capacity was assessed to be a modest risk, presumably because the project was directly providing funding and technical assistance to strengthen the organization. However, the Bank Group overestimated the WMPA's ability to incrementally strengthen its capacity at the same time as protecting the NNT-NPA watershed by clamping down on ongoing illegal logging and poaching. By 2017, after more than a decade of support, the Bank Group assessed watershed management to be a "critical risk" and the WMPA as a "serious concern for long-term sustainability" of the NNT-NPA. Unlike with the WMPA, the Bank Group identified that the government's capacity was inadequate to manage the project's social development aspects. It prompted the transfer of primary responsibility of the livelihood restoration program to NTPC, though the evaluation team did not find any record of the Bank Group assessing the project company's capacity to carry out this mandate. As noted previously, NTPC faced difficulties coordinating and implementing many of the livelihood restoration initiatives envisaged in project design. Multiple stakeholders interviewed agreed that NTPC was not sufficiently experienced to carry out livelihood restoration effectively, suggesting that the World Bank overestimated NTPC's capabilities regarding such an ambitious social development undertaking. These examples do not suggest that the NT2 HPP should not have been ambitious in its objectives but instead indicate that the extent to which the project's ambitions exceeded implementing capabilities in some important instances made the approaches and goals unrealistic.

Implementation and Supervision

The NT2 HPP successfully implemented the power generation infrastructure and overcame many of the challenges faced related to the management of revenues within the government budget. However, the project was challenged throughout to achieve results related to key E&S aspects. Effective corrective actions were only put in place some years into project implementation, despite timely feedback from the extensive monitoring system. The World Bank took a leading role in coordinating the supervision of NT2 HPP implementation but could have been more proactive in resolving some of the critical challenges the project faced.

2.33 The World Bank played a leading role during the preparation and implementation of the NT2 HPP, helping to effectively coordinate activities and develop consensus between the government and the IFIs. The World Bank's contribution to project design and coordination among the government, project sponsors, and IFIs and other financiers through extensive and high-level engagement is well-documented. This leadership role continued through project implementation, in which the World Bank coordinated oversight activities through specialists based in country and regional

offices. IFI partners interviewed agreed that the World Bank was effective in coordinating oversight activities and sharing information with stakeholders. MIGA staff interviewed said that they relied on the World Bank to carry out most of the project-level supervision of implementation while they focused primarily on matters related to the guarantee that MIGA extended to the project. The World Bank also oversaw three complementary parallel engagements to support public financial management,⁶² the biodiversity offset,⁶³ and later, the overall power sector in Lao PDR (Hydropower and Mining Technical Assistance Project), and ADB supported work on forestry. The ongoing work on public financial management, for example, helped develop the functional equivalent as a substitute when the special account was not established, and the NT2 HPP engagement was a platform for dialogue with the government when the overall public financial management support program was nearly suspended. The parallel ongoing activities are even more critical now for seeing through some unfinished work that will determine the sustainability of the NT2 HPP's outcomes over the longer term. In fact, it was the World Bank's initiative to carry out the Safeguards Compliance Review soon after the resettlement program closing was extended that resulted in reviving some of the E&S activities that were failing. The World Bank played an active role by facilitating the flurry of activities that preceded project closing, which placed the NT2 HPP in a better position for longer-term success.

2.34 Extensive monitoring of investment activities provided timely information about project progress, but it was not always used effectively to manage activities in the context of the project's results framework. The NT2 HPP design included an extensive monitoring program with input from project implementing agencies (NTPC, the government, and the International Advisory Group), several independent groups (the E&S Panel of Experts, the Dam Safety Review Panel, and the Independent Monitoring Agency), and the IFIs and other financiers (including the lenders' technical adviser). As noted previously, there was regular oversight of project activities (including a yearly joint IFI team visit led by a senior World Bank official) and ample (if not overwhelming) information flow for making informed decisions. The safety of the dam, for example, was confirmed independently, which cleared the way to proceed with commencing operations. The Bank Group also actively oversaw the construction of the power facilities, including the redesign of the downstream channel that had far-reaching cost, timing, and E&S implications. However, despite repeated concerns conveyed by independent monitors regarding some key E&S activities, effective action took time to materialize. For example, key funds to the WMPA were suspended only in 2014, after the project had been under implementation for nearly a decade, after which some meaningful improvements in its operations took place. Repeated calls for a more effective consultative approach with better adaptive management of livelihood restoration activities were instituted effectively only after the Safeguards Compliance

Review in 2016. Unrealistic (NNT-NPA watershed) or unclear (sustainability of livelihood restoration) indicators in the NT2 HPP results framework and project agreements also impeded effective project monitoring and blurred the goals toward which the project was being managed.⁶⁴ Such impediments required proactive clarification or even formal restructuring to reach stakeholder consensus or realign objectives and reorient activities so the project is better placed to achieve its goals.⁶⁵ Taken together, it can be concluded that delayed action in effectively responding to extensive monitoring feedback to resolve some key issues the project faced is likely to have undermined its performance.

2.35 A joint working group of stakeholders with decision-making authority was established during implementation, which was instrumental in helping resolve several key multiparty issues before project closing. When the RIP was extended by two years, the World Bank helped establish a multistakeholder joint working group that included the different levels of government, NTPC, and the IFIs. The group helped address outstanding concerns, especially those related to livelihood restoration, initially by developing a Comprehensive Action Plan to reach RIP closure and then sustain the impacts (including actions to continue after the RIP) through a follow-on development plan (medium-term development plan). The joint working group served as a platform for coordination and cooperation among stakeholders, identifying and developing consensus around needed actions, assigning responsibility, and facilitating implementation. Several stakeholders who were interviewed credited the World Bank (and the team leader by name) for its role in forming the group and actively participating in it to resolve outstanding issues. The steps facilitated by the joint working group ultimately convinced the E&S Panel of Experts to agree to closing the RIP at the end of the two-year extension, and that there was a basis for sustainability if the agreed follow-on support were to continue. Given the working group's success in developing consensus and addressing disputes among key stakeholders, the project may have benefited from such a platform if it had been established earlier as a regular design feature of NT2 HPP implementation.

2.36 **The Bank Group provided extensive support to project supervision, but concerns arose about the consistency of its own capacity to oversee and guide implementation of this complex project.** The evaluation team found potential capacity shortcomings and inadequate project management on the part of the World Bank in some key areas. This is not to suggest that the Bank Group did not attempt to manage the project actively and regularly. Interviews and project results suggest the World Bank could have been more proactive and used its influence more opportunistically to guide project implementation better. For example, the special account for revenues should have been established before the power plant was commissioned, rather than resolving

the issue several years into operations, when there would presumably be less leverage. Despite constant shortcomings with the WMPA managing the NNT-NPA watershed, key payments were not suspended until 2014, well into project implementation. Monitors repeatedly flagged the issues surrounding the poor technical implementation of the livelihood pillars, including the ineffective consultation process. However, resolution of some issues began to show progress only after the resettlement program extension and the establishment of the joint working group—more than a decade into project implementation. The World Bank NT2 HPP team supporting the project had many specialists, but discussions with staff and external stakeholders showed that there might have been lapses in expertise in some key areas and a lack of continuity over the lengthy implementation period. A social development specialist said that they intended to rely on the expertise that NTPC procured to implement the livelihood pillars, rather than having similarly qualified staff within the World Bank teams. This is not a prudent approach because the World Bank's role is to assess project performance independently and guide the operation, which was much needed in this instance. For example, the evaluation team found little evidence of the World Bank successfully intervening when the forestry pillar lacked community involvement, when food security concerns were not addressed adequately,⁶⁶ or when downstream incomes were not fully restored.⁶⁷ Staff and external stakeholders noted that a specialist with expertise in conservation joined the World Bank team well into implementation in 2012. After that, funding for the WMPA was leveraged, and reforms pushed by the World Bank to better protect the NNT-NPA began to show some progress. More timely support with more sufficient and appropriate expertise would have enabled the World Bank to play a more constructive role in helping the client address some key shortcomings, especially in E&S implementation.

Box 2.2. How Transformational was the NT2 HPP?

The Nam Theun 2 Hydropower Project (NT2 HPP) was designed to influence further reforms and development beyond the direct project outcomes. The Independent Evaluation Group, through one of its evaluations, developed a useful set of criteria that serve as a guide for identifying transformational interventions. This box summarizes the transformational impact across this matrix based on the evidence and conclusions from the NT2 HPP evaluation.

- **Relevance:** *To what extent and in what ways did the NT2 HPP address a major developmental challenge?* The NT2 HPP was a key part of a government effort to exploit the country's hydropower resources to increase economic growth to the levels necessary to support its long-term growth and poverty eradication strategy. Preproject analyses determined that growth needed to be boosted by 1.5 percent to 7 percent overall on a sustained basis to achieve this goal. The catalytic role the NT2 HPP played led to a scale-up in hydropower in Lao People's Democratic Republic (Lao PDR), contributing approximately 1.3 percent to economic growth, which has hovered above 7 percent. There is evidence that overall poverty in the country is also in decline. In addition,

extensive analysis was also carried out during project preparation to confirm the absorptive capacity of electricity in Thailand, which has become the primary market for trading hydropower produced in Lao PDR. The NT2 HPP also has global implications, since it is helping mitigate climate change by avoiding emissions of 1.7 million tons of carbon dioxide on a life cycle basis.

- **Depth of Change:** *To what extent and in what ways did the NT2 HPP cause or support fundamental change in a system or market; thereby addressing the root causes required to support a change in trajectory.* The NT2 HPP fundamentally changed the nature of developing hydropower in Lao PDR by mobilizing the private sector for development and financing, which has been replicated repeatedly (including through the NT2 HPP public-private partnership structure). The project also trained a cadre of experienced professionals in the country, who have provided a qualified labor pool for investors to access in successive investments. However, the NT2 HPP has been challenged to serve as a model for environmental and social (E&S) good practice nationally as it has struggled to achieve results even within its own project. Although many of the national E&S policies were modeled after the NT2 HPP, they have not been implemented or enforced consistently in practice by the government, which has led to questions about the sector's sustainability. The government also did not seize the opportunity to widely replicate the revenue management initiatives that arose from the NT2 HPP, although they were mostly successful at the project level.
- **Scale of Change:** *To what extent and in what ways did the NT2 HPP cause large-scale impact at the national level?* At the time of approval, the NT2 HPP capacity of 1,000 megawatts exceeded the total installed in the entire country. However, more than 4,000 megawatts of capacity have developed since the NT2 HPP achieved financial closure, with more investments under construction. More than \$1.4 billion in private investments were mobilized immediately after the NT2 HPP was approved, and this increased by a further \$10 billion after the NT2 HPP began producing electricity successfully. The number of NT2 HPP-trained professionals is estimated to be in the thousands, with one estimate of 6,000 at its peak.
- **Sustainability:** *To what extent and in what ways has the impact of the NT2 HPP been economically, financially, and environmentally sustainable in the long term?* Economically and financially, the hydropower sector continues to generate revenue and contribute to economic growth. However, there is increasing evidence that there may be saturation in the electricity market in Thailand, and that Lao PDR will need to diversify its power exports to other countries and enhance its competitiveness to maintain the expansionary trajectory. There are also concerns regarding cascading hydrological impacts from possible overdevelopment of the sector, which could stymie further expansion without adequate river-basin and power-system planning. E&S sustainability is similarly concerning, given the challenges that the NT2 HPP and other projects have faced. Although there is some evidence of learning from experience, improving its E&S and hydropower planning remains critical if Lao PDR is to sustain its transformation with the continued exploiting of its hydrological resources.

Source: World Bank 2016.

3. Lessons from the NT2 HPP

3.1 The NT2 HPP provides many lessons that can inform the design and implementation of future hydropower developments, given its scale, complexity, and significance. The following summary reflects major lessons that emerged as guidance for strategic development interventions and the design and implementation of future investment in the sector.

Strategic Lessons for Development Interventions

3.2 **A project design to capture more comprehensive development outcomes from hydropower, as recommended in “Directions in Hydropower” (World Bank 2009a), needs to balance its ambitions with the corresponding implementation capacity, particularly as it relates to experience with environmental protection and social development that may exceed the capabilities of many hydropower developers.** The ambitious, multiple subobjectives of the NT2 HPP to capture the broader development impacts of exploiting hydropower resources are understandable. However, these went beyond the capabilities of implementing agencies, especially regarding E&S aspects. Even the project’s built-in technical assistance was unable to provide adequate reinforcements. This is not to dissuade project designs from being ambitious. However, it is important to design projects commensurate with the capabilities of implementing agencies and assess optional institutional alternatives, take other measures to mitigate risks, or adjust ambitions accordingly where capacity is limited.

3.3 **Strategically catalytic interventions, such as the NT2 HPP, can lead to transformational impacts when there is a commitment and capacity for implementing follow-on actions to replicate and mainstream its features.** In the case of the NT2 HPP, some of its features were replicated whereas others were not. Mobilization of the private sector and the PPP approach served as a model for scaling up hydropower—a key strategic element of the government’s development plan. By contrast, there was less adherence by the government to enforcing stringent E&S standards nationally as the sector expanded, potentially because of the NT2 HPP’s own challenges in this area, a perception that it was unrealistically ambitious, and the government’s own capacity limitations. The government also did not replicate the project’s specific revenue management measures. Lao PDR could have expanded the sector more strategically with better river basin planning, by capturing more market-driven efficiencies, and by diversifying its export markets. Development partners continue to provide support in these areas, but the broader adoption of good practices depends more on the government’s commitment to specific follow-on reforms and may be beyond a single project’s influence.

3.4 Bank Group participation, including the use of guarantees, can be instrumental in mitigating risks and enhancing the private sector’s confidence to mobilize in nascent markets with unexploited potential and scalable investment opportunities. Despite its substantial potential, investors were concerned with the embryonic market and the absence of a track record in developing large and complex hydropower projects with private participation. The transition toward a more market-oriented economy was also at an early stage, making the private sector timid. The Bank Group’s participation gave investors confidence to participate in the NT2 HPP, and the guarantees tempered the policy and political risks of dealing with a government that lacked sector experience. Once the NT2 HPP was commissioned successfully, there was greater market confidence that the government was a credible partner that would honor its obligations. A rapid expansion of the sector followed.

3.5 A government’s adherence to its commitment to implementing a sound development strategy may be a more significant driver for achieving broader poverty alleviation outcomes than earmarking revenues for specific expenditures that are fungible within a general budget. It was confirmed that the government received the revenues anticipated from the NT2 HPP. However, there is no evidence that the government proactively earmarked the NT2 HPP revenues (or those from other hydropower exports) for preagreed priority areas or that the funds were additional. However, the government (on its own) allocated more than an equivalent amount within its budgets toward these priorities. The government’s commitment to its development priorities resulted in sustained economic growth and a reduction in poverty. Although the NT2 HPP contributed to this achievement, it is unlikely that this was due to the earmarking of project revenues within the government budget.

3.6 Hydropower can have sizable global environmental benefits in terms of combating climate change, though such consideration should also account for the negative impacts that can arise from greenhouse gas emissions from storage reservoirs. The NT2 HPP helps avoid a considerable volume of CO₂ emissions by displacing the use of natural gas for producing electricity in Thailand. However, the storage reservoir for the project also had higher-than-anticipated greenhouse gas emissions caused by excessive biomass decay, which offset nearly one-quarter of the emissions avoided by the project. Nevertheless, the net impact of the avoided emissions increased the project’s net global benefits by more 70 percent compared with just the benefits accrued to Lao PDR from the trade and use of the electricity produced from the NT2 HPP.

Operational Lessons for Project Design and Implementation

3.7 Unrealistic and poorly crafted results indicators can lead to projects pursuing unachievable goals and can lead to misdirected efforts and unsuccessful outcomes if not rectified expeditiously. The NT2 HPP included several indicators in its monitoring framework that established unrealistic targets (such as preventing any degradation of the NNT-NPA watershed) or unclear standards (in defining the basis for sustainability of livelihoods). Thus, the project was unable to define a clear goal in protecting the NNT-NPA watershed and had difficulty reaching consensus among relevant parties for closing the resettlement program.

3.8 It is important to distinguish clearly up front where a project is expected to meet stretch targets and where safeguard compliance is the measurable standard if an investment has ambitions for some E&S aspects that extend beyond minimum safeguard requirements. The NT2 HPP established an ambitious goal to double the incomes of resettlers in the Nakai Plateau while maintaining incomes at preproject levels for those affected downstream and in enclave villages—the latter being a safeguard policy requirement. The evaluation found that there was some ambiguity at times among World Bank staff and clients concerning the interpretation of the separate standards applied to the different groups. The misunderstanding may have contributed to incomes not being maintained fully in the case of some downstream inhabitants or to a lack of adequate monitoring for the same in the enclave villages.

3.9 Prescriptive specifications in project agreements may be suitable for areas in which there are clearly defined industry norms and standards (power plant design), but they can be difficult to implement where outcomes require more flexible, adaptive approaches to management (livelihood restoration). The extensively detailed Concession Agreement in the NT2 HPP was useful in terms of specifying the standards and timing to which the dam, power plant, and associated infrastructure were constructed. However, similar specificity had disadvantages for social development activities, which are more contextual and need to be adapted throughout implementation. Stricter adherence to prescriptive outputs led to livelihood solutions that were not adjusted sufficiently to reflect feedback from project-affected people.

3.10 Complex projects with implementation responsibilities spread among different stakeholders can benefit from a preagreed, multiparty coordination and resolution mechanism, even if investments are designed well and most parameters are agreed to in advance. Complex projects often include multiple stakeholders to implement and oversee different interventions, as with the NT2 HPP, but they typically need to work interdependently and in coordination toward achieving common project outcomes. In such cases, a platform for dialogue and dispute resolution can be useful for

coordinating stakeholders and facilitating action. A stark example in the NT2 HPP was the different interpretations among stakeholders of the definition of sustainable livelihoods, which led to the extension of the resettlement program. The multistakeholder joint working group that was established was widely credited with bringing together the government, NTPC, and IFIs to help resolve pending critical issues. Some suggested that the project would have benefited from such a platform if it had been established much earlier in the project implementation period.

3.11 Independent expert monitoring can complement project implementation capacity and instill stakeholder confidence in complex, multithematic interventions, if findings and recommendations are synthesized for practical application and the process does not overwhelm project teams. The NT2 HPP had a multitude of independent expert monitors that reflect the project's complexity. Although these monitoring groups provided valuable and timely feedback, it was not always heeded. Many of the E&S shortcomings were repeatedly identified by various monitoring groups throughout the project, with significant action only taking place toward project closing. There is evidence in the NT2 HPP that some of the input was voluminous and overwhelming, which appears to have contributed to some major initiatives not appropriately and expeditiously incorporating feedback to improve implementation. Conversely, input from groups such as the Dam Safety Review Panel was integrated appropriately.

3.12 Complex, multithematic interventions may be challenging to manage under a single project because it can be difficult to supply the wide range of expertise needed. The NT2 HPP's multiple and diverse objectives were challenging to manage under a single project, given the diverse expertise that was needed. The construction of hydropower facilities, managing conservation in a biodiversity offset, an ambitious social development program, and public financial management were all interrelated yet distinct activities that required different skills and knowledge. In fact, the array of targeted support for some aspects, such as biodiversity conservation and revenue management, was augmented simultaneously through separate IFI initiatives. However, the NT2 HPP had varied success trying to mobilize a diverse set of expertise within the project in a well-coordinated way to achieve results across multiple subsector themes. The experience highlights the need for careful consideration of project designs to determine whether multiple objectives are supported better under a single intervention or through multiple, strategically coordinated initiatives.

Notes

¹ The Greater Mekong subregion includes Cambodia, the Lao People's Democratic Republic (Lao PDR), Myanmar, Thailand, Vietnam, and the Yunnan Province of China.

² Numerous documents, including the Project Appraisal Document (PAD [World Bank 2005c]) and Porter and Shivakumar (2011), refer to the NT2 HPP repeatedly as a model example for developing hydropower.

³ The other equity holders included the Italian-Thai Development Public Company Limited and the Electricity Generating Public Company Limited, both of Thailand.

⁴ The Mekong River Commission initially conceived the idea to develop hydropower in the Nam Theun River to supply electricity to the domestic market in Lao PDR.

⁵ There were instances during the preparation period when sponsors considered withdrawing from the project for various reasons. Documents indicate and interviews confirmed that the World Bank management and team leaders, along with the government, took various confidence-building measures to secure an experienced lead sponsor. They also helped maintain interest through the Asian financial crisis that dramatically affected the region's economies, including through high-level discussions with the governments of France (where *Électricité de France International* is based) and Thailand (owner of the Electricity Generating Authority of Thailand, the primary offtaker of NT2 HPP electricity).

⁶ The NT2 HPP Project Concept was approved in 1997, formally including the project in the institution's project-financing pipeline and initiating the internal project-preparation cycle.

⁷ Porter and Shivakumar (2011) further confirmed that in the 1990s, "developers initially sought financing from commercial banks. However, because of the risks associated with dam construction and uncertainties about the political commitment and governance capacities of the government, few were willing to consider the requests without some type of guarantee from an international financial institution."

⁸ According to the International Hydropower Association, EDF Group (parent company of *Électricité de France [EDF]*) has installed hydropower capacity of 20 gigawatts in France (400 megawatts [MW] in Corsica and the French overseas departments) and another 1,443 MW in Europe, in addition to the NT2 HPP in Lao PDR.

⁹ The payments from the Lao PDR electricity company (*Électricité du Laos*), however, are delayed by as much as one year, but the financial impact on Nam Theun 2 Power Company (NTPC) is small because production for the domestic market accounts for only about 5 percent of total sales.

¹⁰ According to documents and interviews with stakeholders, some difficulties faced during the clearance of biomass included variable terrain and the presence of unexploded bombs, lack of interest from locals beyond the removal of valuable timber, an unfavorable cost-benefit analysis, and the absence of assigned responsibilities.

¹¹ Zhou (2011) uses stochastic models to estimate the emissions during the operation phase, factoring in the original flooded biomass decomposition, and predicts a value of 80–90 grams of carbon dioxide (CO₂) equivalent per kilowatt-hour of greenhouse gas emissions, which is higher

than a previously estimated value of approximately 10 grams of CO₂ equivalent per kilowatt-hour.

¹² The definite source of the introduction of invasive species is not clear, though interviews with local communities indicate that some may have been introduced by migrant workers on the project and others possibly through unauthorized fishers from other regions and countries.

¹³ Several technical specialists and fishers informed the evaluation team that retraining in fishing techniques more suitable for deep water fishing is essential to operate in the inundated areas.

¹⁴ The evaluation team was informed that there has only been sporadic monitoring and patrolling of the reservoir since stopping the exercise in 2012, partly because of a lack of budget.

¹⁵ There are reports of the deliberate introduction of the invasive species of fish that appeared within the first year. Field notes recorded that a villager in Sop Hia was catching mostly tilapia and common carp (both considered by the International Union for Conservation of Nature to be in the top 100 invasive species globally) and in large numbers (Savannakhet Provincial Agriculture and Forest Office; Shoemaker and Robichaud [2018]). NTPC acknowledged the potential for other invasive species, including the Siamese glassfish, that will influence the future evolution of the fish population in the NT2 HPP reservoir (Cottet et al. 2015).

¹⁶ In 2015, the E&S Panel of Experts concluded that reservoir fisheries were not sustainable, given illegal fishing in the protected (spawning) areas. A two-year, short-to-medium plan under the Northern Plateau Livestock and Agriculture and Fisheries Project, established in 2017, is considered to have partially reduced illegal fishing by setting up permanent checkpoints and increased fisheries-focused patrols. However, during the evaluation team's field visit, villagers and townspeople revealed that although observation posts are present, they witnessed corruption at the more remote regions, and that poaching is ongoing and abetted by traders raiding protected areas at the northern end of the reservoir. With the danger of increasing competition, it is feared that commercial fishers will attempt to maximize their catch and, where possible, switch to areas not protected or less well protected. NTPC (2018) indicates fishing at sustainable levels, but the situation could reverse if reservoir patrolling remains a low priority, there continues to be inadequate licensing and boat registration by fisheries associations and marginal commitment by the District Agriculture and Forestry Office, and the Fisheries Management Plan is not revised accordingly. The evaluation team interviewed fisheries experts who called for all parties to remain vigilant and adjust fisheries management to assure the sustainability of reservoir fisheries and, thereby, provide livelihood opportunities to local people for a prolonged period, rather than the fisheries being overexploited and exhausted, or taken over by outsiders.

¹⁷ Based on World Bank (2017a) guidance of \$37 per ton of CO₂ at 2017 prices, adjusted to 2019 prices. The environmental cost of CO₂ is escalated into the future at 2.25 percent annually. The net present value is discounted at an economic opportunity cost of 10 percent.

¹⁸ Consisting of 62 percent natural forest habitat and 38 percent non-forest habitat or disturbed areas, according to the NT2 HPP environmental assessment and management plan.

¹⁹ The areas impacted by the NT2 HPP infrastructure are characterized as lower mixed deciduous, dry dipterocarp, mixed broadleaf, and coniferous habitats and associated species, which is

different from what is found in the NNT-NPA. An exception was the loss of wetland habitat, which was deemed significant and NTPC was tasked with protecting 859 kilometers of riverine habitat in compensation.

²⁰ In including the area as a part of the NNT-NPA, areas could be designated under different degrees of protection (priority biodiversity zones, totally protected zones, and village use and access areas) to accommodate resettled populations' use of the area.

²¹ The five-year strategy by the WMPA detailed patrolling, law enforcement, conservation priorities, capacity building, and coordination of research. It was followed by the Prime Minister's decree 122 of 2017, mandating qualified staff.

²² One World Bank task team leader said that the expectation was "not to prevent any loss of biodiversity," contradicting the wording of the indicator in the PAD. Several World Bank staff said that the unrealistic objective led them to move beyond the results indicator and manage this aspect of the project to the extent they deemed feasible. One manager overseeing the project said that they "decided not to restructure the project," which was the only feasible way to adjust the indicator to be commensurate with what could be realistically achieved. A methodological anomaly for evaluating project results (by linking them to the disbursement of World Bank funds) may also have created a disincentive to restructuring the project to better align the results indicator for the biodiversity offset.

²³ Criteria as stated by the Chair of the World Bank Inspection Panel at a discussion on Challenges of Implementing Biodiversity Offsets in Development, May 20, 2020.

²⁵ The resumption of the NT2 HPP funding for the WMPA in 2016 was based on the preparation of a five-year strategy for the agency detailing patrolling, law enforcement, conservation priorities, capacity building, and coordination of research.

²⁶ Raising the management standards from IUCN Category VI (protected area with sustainable use of natural resources) to IUCN Category II (protect large-scale ecological processes for biodiversity conservation, research, and recreation).

²⁸ This is a modest number of relocated people compared with the project's scale relative to other hydropower investments in the region. The NT2 HPP physically relocated 6 people per MW. Similar numbers for the Trung Son project in Vietnam and the Xiaolangdi project in China were 41 people per MW and 109 people per MW, respectively.

²⁹ This includes land acquired for the reservoir area to be flooded and the dam, the dam site, the powerhouse, and a 27 kilometer canal to the Xe Bang Fai (XBF) River. A small number of people in the downstream area were also relocated because of the changes in the flow regime caused by the NT2 HPP.

³⁰ The Decree on Resettlement and Compensation (June 17, 2003), the National Policy on Resettlement and Compensation (April 25, 2003), and the Technical Guidelines for Resettlement

and Compensation (April 15, 2003), which mirrored the operational policies of the World Bank and Asian Development Bank (ADB).

³¹ All of the independent observers—the E&S Panel of Experts, the International Advisory Group, and the Lenders’ Technical Adviser (LTA)—and the project cited a shortage of wood for construction. Considering that the number of houses and estimates of need would have been easy to assess, the fact that it took second priority to other construction needs is another indication of the secondary status of project-affected people to the primary task of dam construction.

Based on information provided by NTPC, each permanent house has a toilet, bathroom, electricity, a rainwater collection tank, and grain storage. The houses followed a basic design, slightly modified individually to suit family size and preferences. Each family was allocated 0.66 hectares (ha) of land for crops, of which 0.16 ha was expected to be irrigated. Residents have exclusive fishing rights to the new reservoir, and a share in the over 17,000 ha of forests surrounding the villages.

³² As noted in the Resettlement Action Plan (RAP) 1–5 Completion Reports, RAPs were completed and final compensation paid between 2009 and 2011.

³³ Joint IFI aide-mémoire, February 20–24, 2006, shows the priority of meeting the impoundment schedule, although it cautions to “avoid rushing the resettlement process at the end when the impoundment date is getting close.” The aide-mémoire also states that previous IFI “missions have encouraged NTPC and the government to improve synchronization between resettlement site infrastructure development, livelihood program development, and project construction,” but thought the situation had improved. The E&S Panel of Experts and the International Advisory Group raised similar concerns.

³⁴ Other significant parameters remained, such as defining village boundaries and land availability for individual and common use, and were decided later through a process of participatory land use planning that continued but was not fully realized even by closing. One area of concern was the drawdown areas available for agriculture when the reservoir receded. It took years to determine the areas and allocate access to families—a clear indication of giving minimal attention to the expressed needs of resettlers and the weakness of local institutions that were created ad hoc at the time of resettlement.

³⁵ The project’s objective was reasonable because merely restoring preresettlement income levels would have rendered resettlers unable to meet the higher living costs faced in their new environment. For example, electricity and other services required cash income.

³⁶ ADB’s Theun Hinboun project, which immediately preceded the NT2 HPP downstream on the same river, provided lessons that included (i) building more ownership of the village-level (livelihood restoration) projects, (ii) taking steps to make the savings and credit programs more sustainable, and (iii) establishing participatory benefit monitoring and evaluation (ADB 2002). Key lessons learned from the World Bank’s District Upland Development and Conservation Project, which immediately preceded the NT2 HPP and was located within the same watershed, include the following: (i) conservation is intimately linked with the welfare of the communities, and interventions must address both; and (ii) in (the watershed’s) diverse socioeconomic and natural environments, interventions must be based on a clear understanding of the situation in the field. This could be achieved either by a slow pace of project activities (learning by doing,

with the option to adjust planning as activities move forward) or by gaining up-front understanding through studies (World Bank 2004).

³⁷ This was later increased by an additional \$2.3 million and extended by a year to cover the hinterland villages in the XBF River catchment before program responsibility was handed over to the government.

³⁸ The LTA formulated recommendations to clarify and assess sustainability, but there is no indication that they were considered during the project.

³⁹ When relocated, project-affected people were allocated 600 square meters for a house plot and a separate family plot of 0.66 ha for farming in the area surrounding the village. Besides being smaller, the resettled lands had poor-quality soils. The resettlers' access to other areas for farming and agriculture, including the NNT-NPA watershed, was restricted to protect those areas. International Advisory Group Report 7, May 2007, provides a detailed description of the high expectations and challenges faced by resettlers and the resulting anxieties.

⁴⁰ The NT2 HPP was implemented from 2005 (approval) through 2017 (World Bank project closing), with nearly a nine-year duration post-commissioning, primarily to provide sufficient time for implementing the livelihoods components.

⁴¹ LTA Report 30 indicated in 2013 that the village forestry association was an "ineffective experiment unable to provide long-term benefits to resettlers," and in a 2015 presentation, it stated that resettlers had "no sense of ownership." The association was turned into a corporation in 2011, which made it subject to corporation taxes, resulting in the end of dividend payments after several years. It was also noted to not adequately facilitate community involvement and participation, as was intended.

⁴² In 2014, reports from the E&S Panel of Experts and LTA identified issues that needed to be addressed before resettlement implementation period closure (see especially LTA, Resettlement Implementation Period, Closure Assessment, November 2015).

⁴³ These included NTPC and relevant government levels and was essentially the first time that all NT2 HPP parties had participated in a common decision-making forum. Unfortunately, the LTA was neither included nor consulted in the preparation of the Comprehensive Action Plan. The LTA had reviewed the early document, however, and said that it focused too much on processes rather than outcomes. The preparation of the plan was still ongoing when the LTA reviewed it nine months into the two-year resettlement implementation period extension, and the document was not completed until early 2017, more than a year into the extension. There are no indications that progress was assessed at the time of closure.

⁴⁴ The issue of community ownership of resources has plagued the resettlement program from the beginning. Resettlers arrived with information about their own plots, but village boundaries and land use plans were not developed for at least two years. This constrained people from knowing which forest areas, unallocated areas, and drawdown areas were available to use. Consequently, neither village leaders nor residents could use the resources or manage them for individual or village use. Project documents note that the practice of allocating entitlements piecemeal contributed to a dependency and lack of empowerment among resettlers. References are common in both E&S Panel of Experts and LTA documents.

⁴⁵ Bank Group policy requires a Resettlement Action Plan Completion Report for each resettlement initiative (as was done for other aspects for the NT2 HPP). World Bank management informed the evaluation team that they considered the final panel report to serve this function. However, the panel is an independent monitoring agency (similar to the World Bank's role in supervision due diligence), and the agency responsibility for completing the Completion Report is the implementing agency (NTPC). The Bank Group and other supervising and monitoring agencies should finally review and validate this Completion Report, which would indicate how the livelihood program was implemented and fully capture the results from various documents and surveys, to confirm the NT2 HPP resettlement program's final status. In this regard, the failure to produce the report does not comply with the requirements for implementation of the resettlement policy.

⁴⁶ An NTPC assessment, however, erroneously concluded that livelihood restoration was not required because the loss of fishery livelihoods was not the result of land acquisition or restricted access to natural resources. World Bank policy (OP 4.12) covers both the direct and indirect impacts of an investment, and the NTPC assessment is also contrary to the project's results framework, which called for "maintaining incomes at preproject levels."

⁴⁷ The final review (2018) recommended reviving the Village Income Restoration Fund, which by then had been suspended in many villages since 2015. An Adaptive Management Committee was established as part of the Comprehensive Action Plan, which continues to monitor the downstream areas, but the review in 2018 indicated that it was mostly dormant.

⁴⁸ The Project Appraisal Document (World Bank 2005c) states that the government's revenue target (\$30 million in initial years of operations) is before deducting the repayment of any debt it incurs in financing its equity contribution. The government and the IFIs were not able to provide any specific ex post information in this regard.

⁴⁹ The overall nominal revenues from the NT2 HPP to the government are estimated at \$1.8 billion over the concession period. During the initial years, up until 2020, the yearly estimate is \$30 million (less repayments to ADB and European Investment Bank for loans that constituted the 25 percent government equity in NTPC), increasing to about \$110 million afterward, when the major debt serving by NTPC is completed.

⁵⁰ Payments made by NTPC to the government through water resource charges, corporate taxes, and dividends to Lao Holding State Enterprise, based on audited financial statements.

⁵¹ Lao Holding State Enterprise, which was initially established solely as a vehicle for government participation in the NT2 HPP, had begun to make similar investments in other projects.

⁵² Private Participation in Infrastructure (PPI) database by the Public-Private Infrastructure Advisory Facility, World Bank.

⁵³ PPI database by the Public-Private Infrastructure Advisory Facility, World Bank.

⁵⁴ International Monetary Fund, Direction of Trade Statistics database; Thailand Ministry of Commerce.

⁵⁵ Sum of net value added in various economic activities without taxes and subsidies.

⁵⁶ The public-private partnership structure enables the government to support these investments through Lao Holding State Enterprise, providing greater assurances to the private partners because it serves as a platform for coordination with the government, which also has a stake in the enterprise. The government's shares in the project company also present an additional avenue for generating more revenues through dividend income.

⁵⁷ The domestic market for small-scale hydropower has also expanded rapidly without adequate planning, creating a financial burden for its power company (Électricité du Laos). These run-of-the-river schemes may have been overdeveloped because they create a surplus during the wet season and a shortfall during the dry season (when the power company needs to supplement by importing more costly electricity from Thailand). This exacerbates the power company's already precarious financial situation and undermines its ability to serve its electricity consumers in Lao PDR.

⁵⁸ Lao PDR has signed Memorandums of Understanding with several Greater Mekong subregion countries, but many of these prospects have yet to be developed (except exports to Thailand).

⁵⁹ NTPC informed the evaluation team that a developer has obtained approval from the government to carry out a feasibility study upstream of the NT2 HPP, which if the project were to be realized, could affect its water resources. Although the approval was only for a study, and NTPC has recourse based on its Concession Agreement, it highlights the transaction-by-transaction nature of river basin planning rather than a systematic approach to the development of the country's hydro resources.

⁶⁰ According to the World Bank Implementation Completion and Results Report for the NT2 HPP, project efforts helped catalyze the establishment of the government's Environmental Protection Unit and Resettlement Committee. World Bank support through the Hydropower and Mining Technical Assistance Project also aimed to "increase the incidence of compliance" with the National Policy on Environmental and Social Sustainability of the Hydropower Sector.

⁶¹ The Xe-Pian Xe-Namnoy HPP was a build-operate-transfer joint investment venture formed in March 2012 by SK Engineering and Construction, Korea Western Power, Ratchaburi Electricity Generating Holding, and Lao Holding State Enterprise.

⁶² Initially, the Financial Management Capacity Building Credit and technical assistance on expenditure management.

⁶³ Initially, the Lao Environment and Social Project and subsequently its follow-on, the Second Lao Environment and Social Project.

⁶⁴ Interviews with staff noted that an anomaly in the World Bank project monitoring systems may have also contributed to the management challenges. Because the NT2 HPP had disbursed its IDA grant for environmental and social support by 2012, the system was no longer generating (or requiring input for) Implementation Status Reports. Regular supervision of the NT2 HPP continued, but staff indicated that it may have led to a disconnect with all of the indicators in the results framework for the project.

⁶⁵ World Bank management indicated that they "made a decision not to restructure the project," and that even if it were done, it would not affect project performance based on World Bank

methodology because the grant funds were already disbursed. The methodology for evaluating restructured projects is linked to its disbursements.

⁶⁶ The NT2 HPP Social Development Plan states, “The introduction of rice as an integral part of the livelihood model followed continuous questions and concerns about food security and cultivation of rice, the staple crop for all ethnic groups. It was not enough to produce vegetables and obtain income from forestry to purchase rice, but the psychological factor of food security, of producing at least enough rice to feel at ease during the resettlement move.” However, these concerns were downplayed, as the program started with initiatives acknowledged by observers and resettlers to be inadequate (offering little return for efforts), according to Living Standards Measurement Surveys and LTA reports.

⁶⁷ An NTPC assessment erroneously concluded that livelihood restoration was not required because the loss of fisheries livelihoods was not the result of land acquisition or restricted access to natural resources. World Bank policy (OP 4.12) covers both the direct and indirect impacts of an investment, and the statement by NTPC is contrary to the project’s result indicators that aim for the “maintenance of pre-project levels of income.” The evaluation team was unable to find any evidence that the World Bank successfully intervened and helped change the outcome.

Bibliography

- Asian Development Bank (ADB). 2002. "Project Performance Audit Report on the Theun-Hinboun Hydroelectric Power Project in the Lao People's Democratic Republic." Project Performance Audit LAO 27325, Asian Development Bank, Manila.
- Asian Development Bank (ADB). 2003. "Technical Assistance to the Lao People's Democratic Republic for Preparing the GMS: Nam Theun 2 Hydropower Development Project." Asian Development Bank, Manila.
- Asian Development Bank (ADB). 2005. "Report and Recommendation of the President: Nam Theun 2 Hydropower Project." Asian Development Bank, Manila.
- Asian Development Bank (ADB). 2019. "Completion Report—Lao People's Democratic Republic: Greater Mekong Subregion: Nam Theun 2 Hydroelectric Project." Asian Development Bank, Manila.
- Baird, Ian G., Bruce P. Shoemaker, and Kanokwan Manorom. 2015. "The People and Their River, the World Bank and Its Dam: Revisiting the Xe Bang Fai River in Laos." *Development and Change* 46 (5): 1080–1105.
- Baird, Ian G., and Noah Quastel. 2015. "Rescaling and Reordering Nature-Society Relations: The Nam Theun 2 Hydropower Dam and Laos-Thailand Electricity Networks." *Annals of the Association of American Geographers* 105 (6): 1221–39.
- Bucknall, Julia, Vivien Foster, Rikard Liden, Kimberly Nicole Lyon, and William Rex. 2014. "Supporting Hydropower: An Overview of the World Bank Group's Engagement." Live Wire Brief 2014/36, World Bank, Washington, DC.
- Chamberlain, James R., Charles T. Alton, and Latsamay Silavong. 1998. *Socioeconomic and Cultural Survey, Nam Theun 2 Project Area, Lao People's Democratic Republic*. Care International: Vientiane, Lao People's Democratic Republic.
- Chan, Barney. 2016. "Current Status of Forest Concessions on Southeast Asia." Forestry Policy and Institutions Working Paper 33, Food and Agricultural Organization, Rome.
- Cruz Del-Rosario, Teresita. 2011. "Opening Laos: The Nam Theun 2 Hydropower Project." Lee Kuan Yew School of Public Policy Research Paper LKYSPP11-05, National University of Singapore, Singapore.
- Cottet, Maud, Stéphane Descloux, Pierre Guédant, Philippe Cerdan, and Régis Vigouroux. 2015. "Fish Population Dynamic in the Newly Impounded Nam Theun 2 Reservoir (Lao PDR)." *Hydroécologie Appliquée* 19 (September): 321–55.

- Coudrat, Camille Noémie Zoé, Chanthalaphone Nanthavong, Sengphachanh Sayavong, A. Johnson, Jim B. Johnston, and W. G. Robichaud. 2014. "Non-Panthera Cats in Nakai-Nam Theun National Protected Area, Lao PDR." *Cat News Special Issue* 8: 45–52.
- Davies, Nick, and Oliver Holmes. 2016. "Revealed: How Senior Laos Officials Cut Deals with Animal Traffickers." *The Guardian*, September 27, 2016.
<https://www.theguardian.com/environment/2016/sep/27/revealed-how-senior-laos-officials-cut-deals-with-animal-traffickers>.
- Deshmukh, Chandrashekhar. 2013. "Greenhouse Gas Emissions (CH₄, CO₂ and N₂O) from a Newly Flooded Hydroelectric Reservoir in Subtropical South Asia: The Case of Nam Theun 2 Reservoir, Lao PDR." Université Paul Sabatier, Toulouse.
- Deshmukh, Chandrashekhar, Frédéric Guérin, Axay Vongkhamsao, Sylvie Pighini, Phetdala Oudone, Saysoulinthone Sopraseuth, Arnaud Godon, et al. 2018. "Carbon Dioxide Emissions from the Flat Bottom and Shallow Nam Theun 2 Reservoir: Drawdown Area as a Neglected Pathway to the Atmosphere." *Biogeosciences* 15 (March): 1775–94.
- Forest Carbon. 2018. "Mapping Forest Cover Change 2012–17, Nakai Nam Theun National Protected Area, Lao PDR: A Summary Report to the World Bank." Forest Carbon, Jakarta.
- Guérin, F., C. Deshmukh, D. Labat, S. Pighini, A. Vongkhamsao, P. Guédant, W. Rode, A. Godon, V. Chanudet, S. Descloux, and D. Serça. 2016. "Effect of Sporadic Destratification, Seasonal Overturn, and Artificial Mixing on CH₄ Emissions from a Subtropical Hydroelectric Reservoir." *Biogeosciences* 13: 3647–63.
- Independent Monitoring Agency (IMA) Reports. 2007–2010, 2012. "Downstream Livelihood Restoration Program."
- Independent Monitoring Agency (IMA) Reports. 2007–12. "Nakai Resettlement Implementation."
- Independent Monitoring Agency (IMA) Reports. 2007–12. "Project Lands Compensation and Livelihood Restoration Programs."
- International Advisory Group Reports. 2004–08, 2020, 2011. World Bank, Washington, DC.
- Kottelat, Maurice. 2016. "The Fishes of the Nam Theun and Xe Bangfai Drainages, Laos." *Hydroécologie Appliquée* 19 (4): 271–320.
- Lao PDR. 1998. *Nam Theun 2—Study of Alternatives*. Vientiane, Lao PDR.
- Lender's Technical Adviser Reports. 2007–16. "Nam Theun 2 Power Company."
- Liden, Rikard, and Kimberly Lyon. 2014. "The Hydropower Sustainability Assessment Protocol for Use by World Bank Clients: Lessons Learned and Recommendations." World Bank, Washington, DC.

- Mcdowell, David K., Thayer Scudder, and Lee M. Talbot. 2015. "Lao People's Democratic Republic Nam Theun 2 Multipurpose Project: Twenty Fourth Report of the International and Social Panel of Experts (English)." Panel of Experts Report No. 24, World Bank, Washington, DC.
- NTPC (Nam Theun 2 Power Company) (NTPC). 2005a. "Environmental Assessment and Management Plan: Nam Theun 2 Hydroelectric Project." Nam Theun 2 Power Company, Vientiane, Lao PDR.
- NTPC (Nam Theun 2 Power Company). 2005b. "Nam Theun 2: Social Development Plan, Volumes 1–4, Addenda, and Supplementary Information." Nam Theun 2 Power Company, Vientiane, Lao PDR.
- NTPC (Nam Theun 2 Power Company). 2006–07, 2010–17. "Environment and Social Progress Report." Environment and Social Unit, Nam Theun 2 Power Company, Vientiane, Lao PDR.
- NTPC (Nam Theun 2 Power Company). 2008. "Project Lands Socioeconomic Survey." Nam Theun 2 Power Company, Vientiane, Lao PDR.
- NTPC (Nam Theun 2 Power Company). 2009, 2012, 2014. "Downstream Program Socioeconomic Survey." Nam Theun 2 Power Company, Vientiane, Lao PDR.
- NTPC (Nam Theun 2 Power Company). 2010–16. "Audited Financial Statements." Nam Theun 2 Power Company, Vientiane, Lao PDR.
- NTPC (Nam Theun 2 Power Company). 2011, 2013, 2017. "Living Standards Measurement Survey." Nam Theun 2 Power Company, Vientiane, Lao PDR.
- NTPC (Nam Theun 2 Power Company). 2012. "Nam Theun 2, Mekong Forum on Water, Food, and Energy." Nam Theun 2 Power Company, Vientiane, Lao PDR.
- NTPC (Nam Theun 2 Power Company). 2012–14. "Quarterly Socioeconomic Monitoring Report." Nam Theun 2 Power Company, Vientiane, Lao PDR.
- NTPC (Nam Theun 2 Power Company). 2013. "Nakai Resettlers' Reality: From the Past to the Future." Nam Theun 2 Power Company, Vientiane, Lao PDR.
- NTPC (Nam Theun 2 Power Company). 2014. "Nam Theun 2: Presentation at The Nature Conservancy Workshop." Nam Theun 2 Power Company, Vientiane, Lao PDR.
- NTPC (Nam Theun 2 Power Company). 2014–15. "Village Income Target Survey, 2014–15." Nam Theun 2 Power Company, Vientiane, Lao PDR.
- NTPC (Nam Theun 2 Power Company). 2017. "Compliance Review of the Concession Agreement Specifically for Ethnic Groups–Related Obligations." Nam Theun 2 Power Company, Vientiane, Lao PDR.

- NTPC (Nam Theun 2 Power Company). 2018a. "Nam Theun 2: Downstream Program Assessment, Final Draft." Nam Theun 2 Power Company, Vientiane, Lao PDR.
- NTPC (Nam Theun 2 Power Company). 2018b. "Eighth (and Final) Report on the Fisheries Status of the Nakai Reservoir." Nam Theun 2 Power Company, Vientiane, Lao PDR.
- Ostojic, D. R., S. R. Thorncraft, J. J. Hedgecock, L. Sedogo, and P. Wang. 2020. "Power Market Development in the Greater Mekong Sub-Region." Presentation prepared for CIGRE 2020.
- Panel of Experts Reports 1–28. 1997–2018. Nam Theun 2 Multipurpose Project International Environmental and Social Panel of Experts, World Bank, Washington, DC.
- Porter, Ian C., and Jayasankar Shivakumar, eds. 2011. *Doing a Dam Better: The Lao People's Democratic Republic and the Story of Nam Theun 2*. Washington, DC: World Bank.
- Robichaud, William G., Anthony R. E. Sinclair, Naa Odarkor-Lanquaye, and Brian Klinkenberg. 2009. "Stable Forest Cover under Increasing Populations of Swidden Cultivators in Central Laos: the Roles of Intrinsic Culture and Extrinsic Wildlife Trade." *Ecology and Society* 14 (1): 1–27.
- Robichaud, William. 2013. "Nakai-Nam Theun Protected Area." In *Evidenced Based Conservation: Lessons from the Lower Mekong*, edited by Terry C. H. Sunderland, Jeffrey Sayer, and Minh-Ha Hoang. Bogor, Indonesia: CIFOR.
- Robichaud, William G. 2018. "Elusive Conservation in the Nam Theun 2 Catchment." In *Dead in the Water: Global Lessons from the World Bank's Model Hydropower Project in Laos*, edited by Bruce Shoemaker and William Robichaud. Madison: University of Wisconsin Press.
- Salignat, Olivier, Stéphane Descloux, and Vincent Chanudet. 2011. "To Clear or Not to Clear Vegetation Prior to Impoundment? Feed-Back Experience on the Nam Theun II Reservoir (Lao PDR)." HYDRO 2011 Conference, Prague, Czech Republic.
- Shoemaker, Bruce Perry, Ian G. Baird, and Monsiri Baird. 2001. *The People and Their River: A Survey of River-Based Livelihoods in the Xe Bang Fai River in Central Lao PDR*. Ottawa: Canada Fund for Local Initiatives.
- Shoemaker, Bruce, Ian G. Baird, and Kanokwan Manrom. 2014. "Nam Theun 2: The World Bank's Narrative of Success Falls Apart." *World Rivers Review* 29 (4): 10–11.
- Shoemaker, Bruce, and William Robichaud, eds. 2018. *Dead in the Water: Global Lessons From the World Bank's Model Hydropower Project in Laos*. Madison: University of Wisconsin Press.
- Streicher, Ulrike. 2016. "The Wildlife Rescue Programme of the Nam Theun 2 Hydropower Project (Lao PDR)." *Hydroécologie Appliquée* 19 (November): 407–28.
- Timmins, R. J., and T. D. Evans. 1996. "Wildlife and Habitat Survey of the Nakai-Nam Theun National Biodiversity Conservation Area." The Wildlife Conservation Society, New York.

- United States Agency for International Development (USAID). 2017. "Post-Approval Field Review Report: Nam Theun 2 Hydropower Project." USAID, Washington, DC.
- Watershed. 2004. "Forum: Speaking of Nam Theun 2...Past, Present, and Future?" *Watershed: People's Forum on Ecology* 10 (1): 9–17.
- Watershed Management and Protection Authority (WMPA). 2004. "Social and Environmental Management Framework and Operational Plan (SEMFOF-1)." WMPA, Vientiane, Lao PDR.
- World Bank. 2004. Lao People's Democratic Republic—District Upland Development and Conservation Project." Implementation Completion and Results Report, World Bank, Washington, DC.
- World Bank. 2004b. "Realizing the Development Potential of Lao PDR." Country Economic Memorandum 30188, World Bank, Washington, DC.
- World Bank. 2005a. "IDA Guarantee Paves Renewed Interest in Private Hydropower—the Nam Theun 2 Project." Project Finance and Guarantees (June 2005), World Bank, Washington, DC.
- World Bank. 2005b. "Lao People's Democratic Republic—Nam Theun 2 Hydropower Project." Development Grant Agreement H155-LA, World Bank, Washington, DC.
- World Bank. 2005c. "Lao People's Democratic Republic—Nam Theun 2 Hydropower Project." Project Appraisal Document 31764-LA, World Bank, Washington, DC.
- World Bank. 2009a. "Directions in Hydropower: Scaling Up for Development." Water Working Notes 21 (June), World Bank, Washington, DC.
- World Bank. 2009b. "Lao People's Democratic Republic—Technical Assistance for Capacity Building in the Hydropower and Mining Sectors Project." Project Appraisal Document 50918-LA, World Bank, Washington, DC.
- World Bank. 2012. *Lao People's Democratic Republic—Country Assistance Strategy Completion Report, FY2005–11*. Washington, DC: World Bank.
- World Bank. 2014. *Live Wire—Supporting Hydropower: An Overview of the World Bank Group's Engagement*. Washington, DC: World Bank.
- World Bank. 2015. Lao PDR: Power Sector Policy Note, World Bank, Washington, DC.
- World Bank. 2016. *Supporting Transformational Change for Poverty Reduction and Shared Prosperity: Lessons from World Bank Group Experience*. Independent Evaluation Group. Washington, DC: World Bank.
<http://ieg.worldbank.org/sites/default/files/Data/reports/WBGSupportTransformationalEngagements.pdf>.

- World Bank. 2017a. "Shadow Price of Carbon in Economic Analysis." Guidance Note (November 12), World Bank, Washington, DC.
- World Bank. 2017b. *Lao PDR Systematic Country Diagnostic: Priorities for Ending Poverty and Boosting Shared Prosperity*. Systematic Country Diagnostic. Washington, DC: World Bank.
- World Bank. 2017c. "Lao PDR—World Bank Safeguards Policy Compliance Review, Nam Theun 2 Hydropower Project (Final Draft)." World Bank, Washington, DC.
- World Bank. 2017d. "Lao—First Poverty Reduction Support Credit and Grant Project." Program Document 31747, World Bank, Washington, DC.
- World Bank 2018. "Lao PDR—Nam Theun 2 Hydroelectric Project and NT2 Social and Environment Project" and "Lao PDR—Nam Theun 2 Hydropower Project." Implementation Completion and Results Report ICR00004317, World Bank, Washington, DC.
- World Bank. 2019a. "Country Economic Memorandum (Draft) for Lao PDR." World Bank, Washington, DC.
- World Bank. 2019b. "Lao PDR—Nam Theun 2 Hydropower Project." Implementation Completion Results Report Review ICRR0021573, Independent Evaluation Group, World Bank, Washington, DC.
- World Bank. 2019c. "Lao PDR—World Bank Safeguards Policy Compliance Review, Nam Theun 2 Hydropower Project, update 2019." World Bank, Washington, DC.
- World Bank and Asian Development Bank (ADB). 2012. "Nam Theun 2 Board Update: Project Progress during 2012." World Bank, Washington, DC.
- World Bank, Asian Development Bank (ADB), and Agence Française de Développement (AFD). Multiple Years. Joint IFI aide-mémoire, Nam Theun 2 Hydropower Project.
- World Bank. 2020a. *Evaluation of the World Bank Group's Support for Electricity Supply from Renewable Energy Resources, 2000–2017*. Independent Evaluation Group, World Bank, Washington, DC.
<https://ieg.worldbankgroup.org/sites/default/files/Data/Evaluation/files/renewableenergy.pdf>.
- World Bank. 2020b. "Lao PDR—Technical Assistance for Capacity Development in Hydropower and Mining Sector." Implementation and Status Results Report ISR40860, World Bank, Washington, DC.
- Zhou, Jiaoni. 2011. "Life Cycle Assessment of Greenhouse Gas Emissions from Nam Theun 2 Hydroelectric Project in Central Laos." Master of Environmental Management Degree Masters Project, Duke University, Durham, NC.

Appendix A. Project Ratings

Indicator	ICR	ICR Review	PPAR
Outcome	Satisfactory	Satisfactory	Satisfactory
Bank performance	Satisfactory	Satisfactory	Moderately satisfactory
Quality of monitoring and evaluation	Substantial	Substantial	Substantial

Note: The Implementation Completion and Results Report (ICR) is a self-evaluation by the responsible Global Practice. The ICR Review is an intermediate Independent Evaluation Group product that seeks to independently validate the findings of the ICR. PPAR = Project Performance Assessment Report.

1. Relevance of Objectives and Design

Objectives

The project development objective (PDO), according to the legal agreement, was to assist the recipient to implement priority poverty-reduction and environmental programs by generating revenues through environmentally and socially sustainable exploitation of the resources potentially generated from the Nam Theun 2 Hydroelectric Power (NT2 HPP) facility.

Relevance of the Objectives

At the time of appraisal, the NT2 HPP was consistent with the “the government’s strategy for promoting growth through private sector development, regional integration, and the sustainable development of Lao PDR’s [Lao People’s Democratic Republic] natural resources.” The NT2 HPP is designed to promote export-led growth through regional integration, with 93 percent of the capacity dedicated to supplying electricity to neighboring Thailand and the remainder confirmed as a least-cost solution for supplying the domestic market. The public-private partnership approach prioritizes a consortium led by a reputable private operator, with the project design directly addressing the sustainable exploitation of Lao PDR’s hydro resources. The World Bank Country Assistance Strategy under which the project was appraised had a specific objective dedicated to supporting the NT2 project as an “area-based, sustainable natural resource development project that can contribute to growth and capacity development and that has been designed with thorough consideration for environmental and social aspects.”

In the 2017 World Bank Systematic Country Diagnostic for Lao PDR (World Bank 2017b), the first of three priority development pathways is the “sustainable and efficient management of natural resources” and it is noted that “promoting the strategic use of natural resources and protecting the environment” should remain a “top priority” for the government and an integral component of the Country Partnership Framework.

Accordingly, two of the three World Bank priorities in this framework for Lao PDR are to support “inclusive growth and protection of the environment.” Furthermore, poverty alleviation and natural resource management remain central to the country’s Eighth National Socioeconomic Development Plan. More specific to the NT2 HPP, a key objective of the Country Partnership Framework is “investing in infrastructure for growth and inclusion” to “sustain investment in poverty reduction using the resources generated by the further development of the country’s hydropower potential.” Therefore, it can be concluded that the objective of this major project was and remains a high development priority for the government of Lao PDR and the World Bank.

The comprehensive and ambitious PDO is consistent with the recommendations from the World Commission on Dams’ 2000 report (which the World Bank formally adopted through World Bank [2009a]), which calls for designing hydropower projects to provide more comprehensive development benefits rather than addressing only energy-related goals. The project had a lead sponsor that was qualified and had a proven track record of developing hydropower, though it proved to be less adept at delivering on social objectives. Similarly, the Watershed Management and Protection Authority (WMPA), which was a nascent organization in a country with a weak track record of biodiversity protection, was also mismatched for protecting the Nakai-Nam Theun National Protected Area (NNT-NPA). The extended and well-resourced preparation period of nearly a decade and a thorough assessment of demand for electricity in Thailand (a key risk to project success) was mitigated well. As such, not all aspects of project design were matched well with the capacity of some implementing entities.

The overall relevance of the project is **substantial**.

2. Efficacy

The PDO can be broken down into four distinct subobjectives: (i) generation of revenues from the sale of electricity produced by exploiting the hydropower resources obtained through the NT2 power plant constructed with project funds, (ii) doing so in an environmentally sustainable manner, (iii) doing so in a socially sustainable manner, and (iv) implementation of priority poverty-reduction and environmental programs from revenue generated from the NT2 HPP facility.

Objective 1: Exploitation of Hydro Resources to Generate Electricity and Related Revenues from the NT2 Hydroelectric Power Facility

The NT2 HPP power plant achieved its targeted list rating of 1,070 megawatts and has had an average annual output from 2011–18 of 5,912 gigawatt-hours (GWh), exceeding its contracted export volume of 5,354 GWh annually to Thailand and 200 GWh each year for consumption in Lao PDR. There is reason to believe that the NT2 HPP facility’s

performance will continue because its list capacity is consistent with the envisioned design and broadly met or exceeded its operational targets to date. Additionally, reservoir volume loss because of silting was only 0.02 million cubic meters by 2017 versus a limit of no more than 2 million cubic meters.

From a national development viewpoint, an important benefit of the NT2 HPP is the revenue it generates for the government from three primary sources: water resource user charges, taxes, and dividends from the government's 25 percent equity share of Nam Theun 2 Power Company (NTPC) through the Lao Holding State Enterprise.¹ At appraisal, it was estimated that the average annual nominal revenue to the government would be \$30 million until 2020 (covering the period until closing of the World Bank project in 2017), to increase substantially to approximately \$110 million average annually (nominally) afterward until the end of the concession period in 2034. During the operational period from 2010–17, total net revenues from the NT2 HPP to the government were \$180 million (which is \$25 million annually when adjusted for the commissioning year [2010] when the power plant operated for only part of the year), thus achieving most of the annual target of \$30 million estimated in the Project Appraisal Document (PAD) for these initial years up to 2020.²

The achievement of PDO 1 is rated **substantial**, considering that the NT2 HPP fully achieved the power plant's list capacity and the electricity generated, and it continues to earn revenues for the government broadly in line with what was envisaged.

Objective 2: Exploitation of Resources for the Nam Theun 2 Hydroelectric Power Facility in an Environmentally Sustainable Manner

The physical works associated with the NT2 HPP were extensive—ranging from road construction to dam construction, impoundment of the reservoir and changes in river flows, and establishment of resettlement villages—with an equally wide range of environmental impacts and potential for environmental damage, including loss of flora and fauna, water quality, waste management, and abandoned construction sites.

During project construction, an independent panel reviewed and confirmed that NTPC complied with World Bank policy requirements for dam safety.³ All 348 construction sites used for the project were also decommissioned and eventually restored in line with requirements, per the Head Construction Contract Environmental Management Plan.

NTPC slow-filled the reservoir, resulting in a low impact on wildlife in the plateau. It enabled the rescue of 268 individual animals (from 49 species) that were trapped (World Bank 2018). One study found the program to be a “great success” (Streicher 2016). NTPC carried out a wildlife program in the plateau focusing on species such as elephants,

turtles, and muntjacs, but the stabilization of species on the plateau post-translocation cannot be fully determined because of limited monitoring and availability of data.

At the time of impoundment in 2008, NTPC had cleared less than 1,900 hectares (ha) of the 3,000 ha area. Ultimately, because not all of the biomass was removed,⁴ it exacerbated the anticipated initial decline in water quality after impoundment, increasing the carbon dioxide (CO₂) and methane emissions from the reservoir.⁵ This affected fish stocks and water quality. The latter stabilized after three years, and NTPC's efforts to restock the reservoir and the introduction of several invasive species eventually led to fish catches exceeding the 2009 estimate of 21 kilograms per ha to as much as 27 kilograms per ha (NTPC 2018b), though the nature of fishing changed.^{6,7}

The excess biomass decay has also had a lasting effect on the reservoir emissions. Nevertheless, the NT2 HPP has a net positive impact on global greenhouse gas emissions because it displaces the use of natural gas in Thailand's power system. The net present value of the NT2 HPP's global benefits, on a life cycle basis, is nearly \$400 million, at a 10 percent global economic (social) discount rate.

The fish stocks stabilized downstream on the Nam Theun and the Xe Bang Fai (XBF) Rivers after an initial decline caused by changes in the flow regime, though a conclusion cannot be drawn without more comprehensive monitoring concerning its current status (Kottelat 2016). The flow changes to the rivers have also been amplified by increased storms resulting potentially from climate change, and NTPC is monitoring water levels and adjusting operations accordingly to minimize the potential for flooding considering the inundation of downstream villages. NTPC and others concurred that climate change-related impacts were not assessed fully at the time of project design. The Implementation Completion and Results Report also confirmed that the project complied with all riparian release measures, including international waterways (OP 7.50).

Inexperience, weak management, and lack of capacity were major shortcomings that contributed to the WMPA's poor performance in protecting the NNT-NPA watershed. The lack of capacity was exacerbated further because the WMPA was imposed with an unrealistic goal. The WMPA was to ensure "no further degradation of habitats or declines in populations of threatened species in the overall watershed" when illegal logging and poaching predated the project and continued throughout. Furthermore, a lack of baseline surveys and inadequate monitoring made it impossible to accurately ascertain the degree to which the NNT-NPA was protected. Taken together, the NT2 HPP objective of protecting the biodiversity of the NNT-NPA watershed was not achieved as planned. The government is making a renewed push to address issues with

the World Bank's support through a separate project. However, any progress in these efforts will produce outcomes in the future only.

Appendix C discusses the NT2 HPP's environmental aspects in further detail.

On balance, despite several key achievements, the failure to protect the biodiversity offset results in a rating for PDO 2 of **modest**.

Objective 3: Exploitation of Resources for the Nam Theun 2 Hydroelectric Power Facility in a Socially Sustainable Manner

The NT2 HPP ultimately physically moved 6,289 people (more than the 6,000 anticipated at appraisal) from 1,310 houses in 17 villages into 1,330 houses in 16 new villages. However, the implementation was not well coordinated with the power facilities' construction schedule and was not fully compliant with the project's Concession Agreement and the World Bank Group's environmental and social safeguard policies.

The NT2 HPP design also included a livelihood restoration program. The project set an ambitious goal to improve living standards by doubling the income of all resettled people in the Nakai Plateau after nine years of project implementation—an objective that went beyond Bank Group policy requirements (OP 4.12 on Involuntary Resettlement). The resettled households achieved at a minimum the rural poverty level of income, which was approximately double the preproject incomes (estimated at \$820 per capita per year, which in local currency equals 192,200 Lao kip per month when adjusted for inflation). This target was surpassed with actual median incomes of 220,000 Lao kip per capita per month. Although the income targets were broadly met, the NT2 HPP's livelihood restoration program was plagued with difficulties that challenged those responsible and imposed burdens on project-affected people. Many livelihood pillars were implemented poorly and found limited success. In 2015, the Environmental and Social (E&S) Panel of Experts extended the closing date of the resettlement implementation period (RIP) by two years, stating that “a substantial proportion of the Resettlement Objectives and Provisions has not been fully achieved as yet” (Mcdowell, Scudder, and Talbot 2015).⁸ The panel ultimately confirmed that the project achieved a “basis for sustainability,” as required in the Concession Agreement, and that they had “confidence that the project is on the road to overall sustainability.” However, a medium-term development plan was developed as a complement to the Comprehensive Action Plan, which was to be implemented after World Bank project closure. The plan's success remains unclear.

Other indications of improved quality of life are noted as increased savings (from 21 percent to nearly all households), land titles for new property (none had them

previously), increased access to infrastructure (1,330 houses and 270 kilometers of roads), and improved health. With support from two new health centers and upgrades to a district hospital, childhood mortality has dropped from 120 per 1,000 to 50, stunted growth of children is down from 43 percent to 34 percent, and 90 percent of children under five are immunized. Additionally, the construction of 17 primary and 16 nursery schools contributed to primary enrollment surpassing the national rural average (enrollment increased from 31 percent to 91 percent in resettled villages).

There was also an effort to improve quality of life for the enclave communities within the NNT-NPA watershed as they faced potential reduction in access imposed by the project's conservation efforts. There was limited monitoring and data available to verify results, but a 2018 study found that 90 percent of those surveyed had improved lives (including access to education and health services).

Approximately 100,000–115,000 people live in areas downstream of the NT2 HPP dam and powerhouse, and they are vulnerable to changes in river flows that can result in loss of land, changes in income from fisheries, protein intake, and water quality. The NT2 HPP project was designed to compensate the downstream project-affected people for lost property and develop alternative livelihoods to address potential protein deficiencies and lost income caused by the loss of fisheries. For the expected increased flooding of agricultural land in the lower XBF River, the project aimed to raise riverbanks to protect paddy fields, complemented by development assistance through some of the same alternative livelihood models proposed for fisheries losses. The World Bank team informed the Independent Evaluation Group that nine options were offered based on consultations and feasibility studies. They included integrated rice-fish farming, fishpond culture, integrated livestock-fish farming, livestock rearing, and alternate livestock production as compensation. The program was ended in 2012 (before responsibility was handed over to the government) after it reached its budget target of \$16 million and an extension of \$2.3 million for one additional year to cover hinterland villages in the XBF River catchment. Most of the activities concluded at that point because government funding was not forthcoming.⁹ After closure, NTPC showed data from three surveys between 2009 and 2014 that indicated a significant increase in household consumption and dietary diversity but a decrease in incomes over the same time, estimating that as many as 10,000 households may have been unable to restore their livelihoods to the preproject level (NTPC 2018a, v). The Safeguards Compliance Review in 2015 (based on a desk study and field investigation, June–September 2016) cited this uncertainty as an issue to be addressed, but there is no documentation to suggest that it was resolved (World Bank 2017c; 2019c). Nonetheless, the final review concluded that even if income restoration was not achieved fully, the programs

appeared to offset the loss of fish protein in household diets—an important indicator for this activity.

Appendix C discusses the NT2 HPP's social aspects in further detail.

On balance, because most results were achieved despite the implementation challenges, PDO 3 is rated **substantial**.

Objective 4: Assist the Recipient with Implementation of Priority Poverty-Reduction and Environmental Programs from Revenue Generated from Nam Theun 2 Hydroelectric Power Facility

The aim of this objective is to (i) ensure that the expected revenues are accounted for and (100 percent) transferred from NTPC to the government budget, (ii) use the revenues in eligible poverty-reduction and environmental activities while ensuring that the activities funded from NT2 HPP revenues are additional, and (iii) transparently report the generation and application of NT2 HPP revenues. From 2010–17, total net revenues from NT2 HPP to the government were estimated at \$180 million, or an annual average of about \$25 million by World Bank project close. The government did not establish the NT2 Revenue Account designed for accounting for and managing revenues accrued from the project. However, the World Bank team worked closely with the government (though years into project implementation) to develop a functional equivalent by 2015. For the revenues accrued previously (2009/10–2014/15), they were consolidated manually, verified by the State Audit Organization, published, and posted, though with a delay of two to three years. The World Bank team indicated that the public financial management specialist validated these figures further by cross-checking them with NTPC's financial accounts. As a result, it was possible to confirm that the revenues accrued to the government budget from the NT2 HPP.

The revenue statements from the NT2 HPP, which were shared with the World Bank and audited by the State Audit Organization, were not disclosed separately. However, a sample of the projects and programs funded from NT2 HPP revenues were published (a first for Lao PDR).

There is evidence that the revenues from the NT2 HPP contributed to the government's poverty alleviation programs, although its additionality cannot be verified. Information provided by the government and World Bank staff based on audit reports indicates that funds equivalent to the revenues from the NT2 HPP were part of the budgetary expenditures during the same period. However, most of these funds were allocated retroactively because the functional equivalent to tag and identify NT2 HPP revenues in the budget was not agreed to until 2015, nearly five years after commissioning. Furthermore, the ICR and discussions with World Bank staff confirmed that it is difficult

to verify that NT2 HPP revenues were “additional resources” and the claim in the PAD that it “will not substitute for financing from other sources.” There was no adequate baseline data. Nevertheless, funding equivalent to the NT2 HPP revenues from the national budget was used for the priority programs envisioned in the PAD, and the government’s efforts to reduce poverty appear to deliver results. The NT2 HPP revenues would have contributed to this outcome, given that an equivalent amount was allocated appropriately within a fungible budget.

Overall, the achievement of PDO 4 is rated **substantial**.

3. Efficiency

The evaluation team carried out an analysis to confirm that the NT2 HPP remains economically justified from local (Lao PDR) and global perspectives. The financial information related to the project/NTPC was also assessed to confirm the financial sustainability of the NT2 HPP.

The analysis estimated that the NT2 HPP’s net economic benefit for Lao PDR was an economic net present value of \$550 million at a 10 percent discount rate, which corresponds to an economic internal rate of return (EIRR) of 15.3 percent. This is consistent with the appraisal stage analysis that estimated an economic net present value of \$523 million and an EIRR of 16.3 percent. A sensitivity analysis was carried out for possible reduction in output by as much as 20 percent in the future, and the project’s economic returns remained robust. This is primarily because the NT2 HPP has already recouped the initial economic resources used for its substantial investment costs. Therefore, the project can stand considerable variation in future performance and continue to remain economically viable.

The NT2 HPP displaces fossil-based electricity produced from the combined-cycle gas turbine power plant in Thailand. As a result, there are local environmental benefits in Thailand from the avoided nitrogen oxide and global environmental benefits from avoided CO₂ that contribute to the mitigation of climate change.

The present value of the total local externalities because of the NT2 HPP, discounted at 10 percent, that is accrued to Thailand is \$128 million. This amounts to a total local (regional) net economic benefit, including local externalities, of \$678 million.

Based on the analysis carried out, the total net present value for the NT2 HPP is estimated at \$1,070 million with an EIRR of 19 percent, taking into account local (Lao PDR) net benefits, regional externality (to Thailand) from avoiding local pollution, and the global net externalities from avoiding greenhouse gases that adversely affect climate change.

NTPC has been achieving stable financial results because the NT2 HPP has continued to produce electricity, on average, above what was projected annually, with the Electricity Generating Authority of Thailand purchasing and making payments without issue. NTPC informed the evaluation team that the payments from Électricité du Laos, which make up a small portion of the NT2 HPP's revenues, are delayed, on average, by about one year. Based on NTPC's audited financial statements, the revenues from the sales to the Electricity Generating Authority of Thailand and Électricité du Laos were between \$260 million and \$270 million for the 2011–16 period, which exceeded the projected level at appraisal (\$230 million to \$260 million) for the same period. Gross profit margin and operating profit margin were also stable during the 2010–16 period, with averages of 72 percent and 65 percent, respectively. Historical debt-service coverage ratios had been stable between $\times 1.3$ and $\times 1.4$ level from 2011–16, and cash flows to service debt are expected to be sufficient because the loans from the Thai lenders and the US dollar lenders are expected to be fully repaid by 2020 and 2022, respectively. Based on the results of the financial model prepared by the World Bank at project completion, which included the actual results up to 2016, the financial internal rate of return is calculated as 11.0 percent, and the financial net present value is \$119.0 million. This is compared with the projected financial internal rate of return of 11.7 percent and financial net present value of \$235 million identified in the PAD. Taken together, the review of NTPC's financial statements provides reasonable assurances that the project is financially sustainable.

Overall, the efficiency of the NT2 HPP is rated **substantial**.

4. Outcome

The NT2 project remains highly relevant as a flagship hydropower operation in Lao PDR and helps avoid local (in Thailand) and global pollution by displacing electricity that would have been produced from natural gas. The project design, though comprehensive in its coverage, at times overestimated the capacity to implement a diverse set of multithematic activities successfully. The power infrastructure, including the dam, was constructed as envisaged, and its operations are exceeding expectations, and the revenue generated for the government as a result broadly meets envisaged goals. Government revenues from the NT2 are being allocated fully to poverty alleviation and environmental management activities, per the objectives. In addition to the social benefits arising from the use of the government revenues, the project—despite its challenges in implementing the livelihood restoration program—broadly met its obligations for resettling and helping improve incomes of most project-affected people in the NT2 reservoir, watershed, and downstream areas. The environmental aspects related to the construction of the hydropower facilities were generally handled well, though there were areas of concern, many of which were overcome by project closing.

An issue of particular concern that was not addressed fully at project closing is the unsuccessful effort to protect the biodiversity in the NNT-NPA watershed. Despite these shortcomings and in light of the total results that the project achieved, the efficacy is **substantial**. The NT2 HPP was constructed with only minor delays and very modest cost overruns, but it has substantial global benefits, including carbon offsets. Thus, the project's efficiency is **substantial**.

Therefore, on balance, based on the Bank Group harmonized evaluation criteria, the overall development outcome of the NT2 HPP is **satisfactory**.

5. Risk to Development Outcome

The project achieved a satisfactory outcome, but potential risks remain to sustaining these results, especially since operations are expected to continue into the future. Some key risks are as follows:

- *Protecting remaining biodiversity:* It is unlikely that the impact of past shortcomings related to the protection of the NNT-NPA watershed can be reversed, but there is still an opportunity to conserve what remains within the protection area. The government's renewed commitment to protecting its natural resources and biodiversity (including enforcement of violators), the establishment of a committee of technical experts to advise the WMPA, management restructuring, the continued availability of funding from NTPC, and the ongoing Second Lao Environment and Social Project funded by the World Bank all provide a unique opportunity to correct some past failures. Otherwise, the biodiversity offset will remain unsuccessful and pose continuing reputational risk for the Bank Group.
- *Sustainability of livelihood restoration:* The successful implementation of the medium-term development plan that followed RIP closure is connected integrally to the Comprehensive Action Plan that resurrected the performance of livelihood restoration efforts. Many of the livelihood pillars continued to have limited success, and the fisheries pillar (the most successful) faces several threats, as noted previously. Therefore, the gains made by the NT2 HPP's closing date could potentially be reversed without follow-through on the plan.
- *Allocation of additional government revenues:* The revenues the NT2 HPP has generated for the government up to now of about \$180 million are only a modest part of the overall expected revenues of \$1.95 billion over the concession period. A marked uptick in revenues to the government is expected to reach about \$110 million per year, as the debt servicing of the NT2 HPP is completed between 2020 (the Thai baht debt) and 2022 (the US dollar debt). Thus, most of the NT2

HPP's revenues to the government are yet to materialize. Therefore, it will be important to ensure that the revenues continue to be accounted for transparently and that the government is prepared to use the funds effectively in additional interventions for poverty alleviation and environmental management. Although the increase in revenue is modest compared with the present size of the government budget, several government officials and even World Bank staff were unaware of this expected revenue increase when interviewed by the evaluation team. The continued effective use of NT2 HPP revenues for their intended purposes will be a key barometer of long-term project success.

6. Bank Performance

Quality at Entry

The NT2 HPP project went through an extensive preparation period because of its scale and complexity, the ecological sensitivities in the area that needed to be considered, and the potential for negative social impacts if they were not addressed adequately. During this extended preparation period, lessons were drawn from other hydropower projects. The latest approaches to sustainable hydropower development were taken into account, including key recommendations from the World Commission on Dams and others (Extractive Industries Review, Worldwide Fund for Nature Study); extensive consultations were held with stakeholders in developing solutions (including pilot and demonstration villages for resettlement); the channeling of government revenues from the NT2 HPP toward poverty alleviation and environmental protection was agreed; and a public-private partnership arrangement for realizing the project was structured. Taken together, the design of the NT2 HPP was comprehensive and ambitious.

However, the project's ambition exceeded the capacity of the implementing agencies in protecting the NNT-NPA watershed and in implementation of the livelihood restoration program. These oversights were not assessed adequately at appraisal. The capacity of the WMPA to carry out its responsibilities (rated modest in the PAD) was underestimated, even though it was recognized that there was a substantial likelihood that conservation goals articulated under the project could be "compromised" by cross-border wildlife trade and commercial activities, such as illegal logging (World Bank 2005c). In addition, the evaluation team was unable to identify a capacity assessment of NTPC to carry out the livelihood restoration component, and it appears that the company had limited expertise in this field. The magnitude of some of these risks appears to have been underestimated at project design.

Thus, the overall quality at entry for the NT2 HPP is **satisfactory**.

Quality of Supervision

The NT2 HPP project was supervised regularly throughout its duration with support from the field office in Lao PDR and specialists from Bank Group headquarters in Washington, DC. To coordinate as many as 27 lenders, the World Bank took the lead in designing a broad framework for implementation support, since it was agreed contractually that at least the international financial institution lenders would participate in joint support oversight visits to Lao PDR. These missions were fielded annually and led by a World Bank director to ensure high-level corporate oversight. Given the project's significance, an International Advisory Group was established to advise the World Bank president on project implementation. The project benefited from oversight from several independent groups that were established, including a Dam Safety Review Panel, independent monitoring agencies, an E&S Panel of Experts, and a Lenders' Technical Adviser group. This was in addition to the primary oversight by NTPC and the government. The extensive supervision activities extended through the duration of project implementation (12 years) and were funded partly through an agreed payment from the project sponsor (NTPC).

The ample (if not overwhelming) information flow provided a basis for making informed decisions. This is reflected in the dam safety and the overall construction completion. However, regarding aspects such as livelihood restoration and the protection of the NNT-NPA watershed, effective action took time to materialize. It was only in 2014 that key funding to the constantly underperforming WMPA was suspended after the project was under implementation for nearly a decade. Repeated calls for a more consultative approach with better adaptive management of livelihood restoration activities were instituted effectively only after the Safeguards Compliance Review in 2016. During this review, the discovery that the project did not comply with several key safeguard policies came after a decade of implementation. Effective project management was also constrained by unrealistic or unclear indicators in the NT2 HPP results framework and the Concession Agreement.¹⁰ These impediments required proactive clarification or even formal restructuring to clarify or realign objectives and reorient activities, so the project is placed better to achieve its goals. The late action for resolving some of these issues the project faced likely undermined performance.^{11,12}

Therefore, the overall quality of supervision the NT2 HPP is **moderately satisfactory**.

On balance, the overall Bank performance is **moderately satisfactory**.

7. Quality of Monitoring and Evaluation

Design

Given the complexity and scale of the investment, together with its high external visibility, the monitoring and evaluation (M&E) design for the NT2 HPP consisted of a multilayer framework covering a comprehensive set of indicators supported by various data sources. As noted in the Bank Performance section of this appendix, the monitoring mechanisms used for the project included independent monitors, World Bank oversight (implementation support), and information and data from various projects and government reports. Given the extended 12-year project implementation period, the NT2 HPP key performance indicators included an initial set of indicators for 2009, when the power plant was expected to be commissioned, and then a final set of (ultimate) indicators that reflected the expected outcomes at project close. This was an appropriate approach because the successful development of the dam and power plant (including E&S safeguards compliance) was fundamental to all final project outcomes, and was measurable with the 2009 indicators (equivalent to intermediate outcome indicators). However, project implementation would continue for approximately eight years after commissioning. During this time, measures would be implemented to restore livelihoods and improve other social conditions for project-affected people, sustainable environmental management, and channeling of revenues to help finance poverty alleviation and environmental management activities. The outcomes that correspond directly to the overall development objective of the NT2 NPP were to be measured through the closing (ultimate) indicators to ensure sustainability.

The overall project results framework was sufficient to monitor progress. However, some indicators were unrealistic (NNT-NPA biodiversity) or unclear (revenue generated was measured by the power plant's installed capacity and not a specific revenue target).

Implementation

During the initial implementation period (2005–10), when the dam, power plant, and associated infrastructure were being constructed, monitoring of technical specifications and safeguard compliance were fully implemented. The ICR notes that the data collected were timely, enabling the team to monitor progress and take action when necessary. A public expenditure review was also carried out in 2010, providing insights into the public financial management system's readiness as revenue generation commenced. Furthermore, an Independent Evaluation Group assessment of the Country Assistance Strategy from FY05–11 specifically focused on NT2 HPP progress at the time.

After the power plant's commercial operation date, including the resettlement of project-affected people (2011–14), several oversight mechanisms were concluded, including

submitting Implementation Status Reports reflecting an anomaly due to the World Bank funds being fully disbursed at the time. However, other monitoring and reporting mechanisms such as risk reporting, supervision aide-mémoire, updates to the World Bank Board of Executive Directors, and NTPC reports continued to be produced. Nevertheless, World Bank staff suggested that the absence of Implementation Status Reports until they were resurrected in 2014 may have created a disconnect between supervision activities and the specifics of the results framework. During this period, the project team identified that although royalties were allocated to eligible activities, dividends and taxes were not being adequately accounted for, which led to the agreement on a functional equivalent for revenue accounting. However, little progress was made to rectify the monitoring shortcomings (baseline surveys on wildlife and unrealistic indicators) related to the protection of the NNT-NPA watershed offset. The Comprehensive Safeguard Review that was initiated after the E&S Panel of Experts' RIP closing date extension resulted in a flurry of actions to address several issues of noncompliance that were reported. The subsequent establishment of the multistakeholder joint working group also became a monitoring mechanism that was on the critical path of project closure by the World Bank.

Use

The extensive M&E setup that the NT2 HPP project used was also used by the various groups and institutions that were given the responsibility of monitoring and assessing various aspects of project implementation. On some aspects of environment and social development, the E&S Panel of Experts and the Lenders' Technical Adviser group raised repeated concerns related to the NNT-NPA watershed and various livelihood pillars. However, some of this input did not appear to be heeded and addressed in the project until nearly a decade into implementation, with only a couple of years before close. Furthermore, interviews with client and Bank Group staff indicated that the voluminous preparation and monitoring data was at times overwhelming, suggesting that perhaps not all available information was used effectively during implementation.

The overall M&E quality for the NT2 HPP is rated **substantial**.

Notes

¹ The net revenue that is available would be subject to any government repayments of funds used to secure its equity in Nam Theun 2 Power Company (NTPC; repayment of European Investment Bank and Asian Development Bank debt).

² The Project Appraisal Document clarifies that the target of \$30 million should be reduced to reflect the government's repayments to the Asian Development Bank and the European Investment Bank for loans that constituted the 25 percent equity in NTPC.

³ The independent Dam Safety Review Panel concluded its work in 2016 and said that the NT2 HPP is safe in design and operation, and that operation and maintenance programs are impressive. Expert review of dam safety will continue, with Lenders' Technical Adviser reports and an Electricité de France assessment of infrastructure safety and inspection of hydro safety every two years. The next review is scheduled for 2020.

⁴ According to documents and interviews, some difficulties faced with biomass clearance included variable terrain and the presence of unexploded bombs, lack of interest from locals beyond the removal of valuable timber, an unfavorable cost-benefit analysis, and the absence of assigned responsibilities. Interviews with stakeholders indicated that some of these challenges might have been underappreciated at the time of appraisal.

⁵ Zhou (2011) uses stochastic models to estimate the emissions during the operation phase, factoring in the original flooded biomass decomposition, and predicts a value of 80–90 grams of carbon dioxide (CO₂) equivalent per kilowatt-hour of greenhouse gas emissions, which is higher than a previously estimated value of c. 10 grams of CO₂ equivalent per kWh.

⁶ The definite source of the introduction of invasive species is not clear, though interviews with local communities indicate that migrant workers on the project may have introduced some of it, and also possibly through unauthorized fishers from other regions and countries.

⁷ Several technical specialists and fishers informed the evaluation team that retraining in fishing techniques more suitable for deep water fishing is essential to operate in the inundated areas.

⁸ In 2014, the E&S Panel of Experts and LTA reports identified issues that needed to be addressed before resettlement implementation period closure (see especially the LTA Resettlement Implementation Period—Closure Assessment, November 2015).

⁹ According to NTPC (2018a, viii), it handed the program to the government at the end of 2012, but “since 2014 the DSP has not been actively implemented by the government, and many of the village funds are now inactive.” The handover was part of the Concession Agreement and not subject to agreement by the E&S Panel of Experts.

¹⁰ Interviews with staff noted that an anomaly in the World Bank project monitoring systems might have also contributed to the management challenges. Because the NT2 HPP had disbursed its International Development Association grant for environmental and social support by 2012, the system was no longer generating (or requiring input for) Implementation Status Reports. Regular supervision of the NT2 HPP continued, but staff indicated that it may have led to a disconnect with all of the indicators in the results framework for the project.

¹¹ World Bank management indicated that they “made a decision not to restructure the project,” and that even if it were done, it would not affect project performance based on World Bank methodology because the grant funds were already disbursed. The methodology for evaluating restructured projects is linked to its disbursements.

¹² Based on stakeholder interviews, there is evidence that the extension of the livelihood restoration program promoted by the E&S Panel of Experts' assessment led to frantic attempts to rectify the situation before the project closing date. The effort focused on completing many output-oriented activities without producing a final Resettlement Action Plan closure report to assess outcomes, as World Bank policy required. Instead, the evaluation team was informed that

because the panel concurred with the decision to close the livelihoods program, this constituted final judgement on achieving the objectives, despite their qualified concurrence (cautious optimism). However, a review of the panel report and the update of the Safeguards Compliance Review indicate that not all of the requirements for compliance were met. Rather, many of the panel's requirements were "achieved in planning," and others were not even assessed for the final report.

Appendix B. Methods and Evidence

This evaluation is a Project Performance Assessment Report. It is based largely on interviews with more than 200 project stakeholders (including in the Lao People's Democratic Republic [Lao PDR] and Thailand during a field visit carried out from September 19 to October 5, 2019, and in other global locations via videoconference and in person), and a review of project documents and additional data provided by stakeholders, including the various independent monitoring reports, financial documents for the project company and other investors, World Bank compliance reports, and joint international financial institution aide-mémoire issued after yearly missions carried out during implementation to supervise the Nam Theun 2 Hydropower Project (NT2 HPP).

Documents Reviewed

The NT2 HPP has been documented extensively. The evaluation team relied on this significant volume of project-related documents and related literature for evidence of project performance. This included World Bank Group project documents, reports from independent monitoring groups (including the Environmental and Social [E&S] Panel of Experts, the Lenders' Technical Advisers, and the International Advisory Group), project and financial documents from Nam Theun 2 Power Company (NTPC), including monitoring information and surveys, documentation from other stakeholders, and additional literature related to the project. The team also relied on the World Bank's self-evaluation (Implementation Completion Review Report) and its validation by the Independent Evaluation Group.

Stakeholders Interviewed

The field visit to Lao PDR included meeting in Vientiane with government officials and members of state-owned enterprises, the project company, civil society organizations, and other development partners; and in the project area in the Khammouane and Bolikhamxay provinces with regional and local officials, various local communities of project-affected people, and those operating and managing the NT2 HPP.

The field visit to Thailand included meetings with a focus group of Thai financiers of the NT2 HPP, the Electricity Generating Authority of Thailand (the primary offtaker of electricity produced by the NT2 HPP), and country office staff from the World Bank and Asian Development Bank.

Participants in other meetings conducted in person and by videoconferencing included members of the E&S Panel of Experts, Lenders' Technical Advisers, focus groups of US

dollar financiers who received assurances through the International Development Association and Multilateral Investment Guarantee Agency guarantees, and Bank Group and other international financial institutions staff. The Bank Group staff interviewed included past NT2 HPP task team leaders and management who designed and oversaw the NT2 HPP's implementation, Multilateral Investment Guarantee Agency personnel supporting the underwriting of its guarantee, the World Bank team who carried out the Comprehensive Safeguards Compliance Review in 2016, and staff who worked on the project, including those supporting the technical and hydropower aspects, environmental and social facets, and public financial management. A complete list of all people interviewed follows in this appendix.

The evaluation findings have high confidence, based on the extensive documents reviewed and the large number of stakeholders interviewed. There was a high degree of consistency within the documents and among stakeholders on most findings.

List of Persons Met

Ministry of Finance, Government of Lao PDR	
	Mme. Thippakone Chanthavongsa, vice minister
Department of Fiscal Policy and Law	Thongchanh Soulinphoumy, deputy director general
Budget Department	Somphaphone Mangnomek, technical staff
Department of Fiscal Policy and Law	Somphonee Changdaboud, technical staff
Department of Fiscal Policy and Law	Choummaly Khammouny, division director
Treasury Department	Nouseuy Phomsichanh, deputy director
Ministry of Energy and Mines, Government of Lao PDR	
Department of Energy Business	Bounthiem Saysongkham, deputy director general
Division of Project Monitoring	Khamphanh Sihavong, director
Division of Project Monitoring	Paphavanh Singharath, deputy director
Division of Cooperation	Sonexay Sengmany, technical staff
Division of Community Development	Pheuiphet Sadaoheung, director
Division of Cooperation	Chanthaphone Panyathong, deputy director
Department of Energy Management	
Division of Project Construction Management	Phouxay Viengvixay, director
Department of Energy Policy and Planning	
Division of Power System Planning	Santisouk Phimmachanh, director
Division of Power Generation Planning	Lithanoulok Lasphho, director
Ministry of Planning and Investment, Government of Lao PDR	
Department of International Cooperation	Saymonekham, DDG/DIC
Department of Investment Planning	Phonexay, DDG/DIP
	Pany Vorachith/DoP
	Phengkhit
	Phulatsami
Department of International Cooperation	Sisangvone/DIC
Former MPI vice minister	Bounthavy Sisouphanthong

Ministry of Natural Resources and Environment, Government of Lao PDR	
	H. E. Mr. Sommath Pholsena, minister
Department of Natural Resources and Environment Inspection	Aloun Xayavong, director
Department of Water Resources Management	Inthavy Akkharath, director general
Department of Environmental Quality Control	Chithanom Ounsida, deputy director general
Ministry of Agriculture and Forests, Government of Lao PDR	
	H. E. Mr. Thongphat Vongmany, vice minister
Department of Forestry	Sousath Sayakoummane, director general
Department of Forestry, Protected Area Management Division	Savanh Chanthakoummane, director
Électricité du Laos	
Électricité du Laos	Komonchanh, deputy managing director
Électricité du Laos	Khamphieu, assistant managing director
Technical Department	Boungnong Bouttavong, deputy manager
Loss Reduction and Demand Side Management Office	Phaivanh, deputy director
Lao Holding State Enterprise (LHSE), Government of Lao PDR	
LHSE	Mayphet Phonphila, deputy director general
Business Planning Division	Keodouangphachanh, manager
Project Division	Noumay Souvannaphoum, deputy manager
Planning Division	Sovi Phommonichan, manager
Contract Administration Division	Keovolavanh Nanthavong, deputy manager
LHSE	Anousone Thonmanivong, technical staff
LHSE	Manolob Sadettanh, technical staff
Former CEO LHSE	Somboun Manolom
Nam Theun 2 Power Company (NTPC)	
Vientiane Office	Didry Olivier, chief executive officer
	Vatsana Pravongue, deputy manager
NT2 dam site, Dam Waterway Section	Khamvanh Vilayvanh, foreman
NT2 dam site, Civil Works Section	Khamphanh Thammavong, deputy head
NTPC Power House	Florent Perrot, COO
NTPC Power House	Akachat Saisuwan, deputy plant director
NTPC Power House	Axay Vongkamxao, environment manager
NTPC Power House	Soulavet Pinkham, operation department
Nakai-Nam Theun National Protected Area (NNT-NPA) Watershed Management and Protection Authority (WMPA)	
	Savanh Chanthakoummane, director
Committee of Technical Experts	Chantavy Vongkhamheng, secretary
	Thong Et Phayvanh, former head of WMPA
	Stephen Duffy, former chief technical adviser
Electricity Generating Authority of Thailand	
Power Purchase Agreement Division	Nitus Voraphonpiput, director

Power Purchase Agreement Division	Padej Sermpanich, assistant director
Thai Commercial Lenders	
Kasikorn Bank	Theinchai Oranrigsupak, first vice president
	Dusit Danviroonhavanit, assistant vice president
	Phaninthip Pinthong, business analyst
	Thanakorn Katiwidcha, business analyst
Krungsri/MUFG	Patawee Kanareugsa, vice president
Corporate Banking Group	Teerapon Apisophonsiri, senior relationship manager
Thanachart Bank	Theera Kankirawatana, senior vice president
	Phatrajavin Vardhabibat, vice president
SCB	Jirat Mungnimit, senior analyst, credit product origination
	Pimpun Ninpanit, analyst, credit product origination
US Dollar Financiers	
Inter-Credit Agent	Patsy Lim
Société Générale	Aurelien Schwob
Société Générale	Rob Ford
MUFG Bank	Kelvin Chew
MUFG Bank	Tan Chuan Yong
ING Bank N. V., Singapore	Julie Sim
ING Bank N. V., France	Bertrand Renault
SMBC	Aseem Modwal
Bolikhamxay Province Governor Office	
	Dr. Kongkeo Xaysongkham, governor
	Phansamone Phongvichith, cabinet secretary
Provincial Office (PO) Energy and Mines	Khamsing Saiphonvong
PO Health	Fongsaly Louangmixay
PO Education and Sports	Khamkhak Layvanh
PO Agriculture and Forests	Phatthachone Keophouthawong
PO Natural Resources and Environment	Khomdy Thiplamphanh
Khammouane Province Governor Office	
	H. E. Mr. Oday Soudaphone, governor
Nakai District Governor Office	
	Somphong Vanphaythong, governor
	Thonekeo Chanthavong, vice governor
Provincial Agriculture and Forestry Office	
	Bounchanh Saypanya, director
Resettlement Management Unit, Nakai District	
	Keo-oula Souliyadeth, head of RMU
	Chanthapanya, technical staff
	Omeka, technical staff
	Laty, head of administration unit
	Vanthalipha, technical staff
	Ekkaluck, representative, Lao National Construction Front

Agriculture Learning Center	
	Phout Xayavong, deputy head
	Phonephet Yanbounsouan, technical staff
Organic Agriculture Learning Center, Nongbouakham Village	
	Phaylakhone Louangsen, head
Resettlement Villages In Nakai Plateau (Nakai District)	
Sopon village, Nakai District	
Sopon village Lao Women Union	Lee Souvannalath, head
Village Administrative Office	Heuang Phonevilaykeo, deputy head
Sopon Primary School, year 4	Ving Xongchanhdeng, student
Secondary School	Seuth Laoma, student
Villager/Sopon village	Pao
Nakai District Education and Sport Office	Bountay Sengmany, official
Other villages	
Malay village	Champa Chombounhome, teacher (dengue awareness)
Malay village	Phong, villager
Bouama village	Aeng, farmer, private organic farm
Sop Hia village	Kham Khamphouban, member, weaving group
Nakai Tay village, Nakai District	
	Vandy Xoysomvang, head, Village Development Fund
	Khanh Xoysomvang, member, Village Development Fund
	Boun Thongsavanh, villager
Nam Nian village, Nakai District	
	Non Khinmano, chief of village
	Phomma Phetsouphanh, deputy chief of village
Affected Villages in NNT-NPA (Watershed, Nakai District)	
Nahao village, Nakai District	
	Seng, head of village
	Bounhien, clan leader
	Leuth, second deputy head of village
	Xiengdee, clan leader
Navang village, Nakai District	
Navang and Fang Daeng villages	Khale Nouansavong, village head
Navang village	Phong Khounpasong, chairman of village, elder
Navang village	Peng Khounpasong, vice head of Navang village
Navang village	Done Inthavong, first deputy head of Navang village
Navang village	Phonesavanh Nouansavong, third deputy head of Navang village
Fang Daeng village	Vong Keoudai, head of Fang Daeng village
Fang Daeng village	Phonexay Soulikhan, security of Fang Daeng village
WMPA	Sengphachan Xaiyavong, technical staff of WMPA, legal enforcement
Mak Feuang village, Nakai District	
Mak Feuang village	Phouang Chanthavong, first deputy head of village
Mak Feuang village	Khaen Singphay, first deputy head of village, party secretary
Mak Feuang village	Soun Chaichomchaleun, second deputy of village, party secretary
Mak Feuang village	Bounsouang Singphay, head of village

Affected Villages on the Downstream Xe Ban Fai River (Gnommalat and Mahaxay Districts)	
Nongping village, Gnommalat District	
Nongping village	Khamsing Sysamouth, head of Nongping village
District Agriculture and Forestry Office	Phomma Chandhavong, deputy director
District Agriculture and Forestry Office	Avone Syarksone, deputy head of agronomy
District Agriculture and Forestry Office	Thavone Soukhaseum, senior government affairs officer
District Agriculture and Forestry Office	Phoudala Nuankhamphan, communications officer
Nakiao village, Mahaxay District	
Nakiao village	Khaima Maymany, head of Nakiao village
Nakiao village	Thongdan Sysombath, second deputy head of village
Nakiao village	Bounkhong Sengvonthong, village elder
Phova village, Mahaxay District	
Phova village	Keonouane, deputy village chief
Phova village	Phanmaha, deputy village chief
Phova village	Diphone Thammavongsa, deputy village chief
Phova village	Seun, head village women union
Phova village	Keolanout Souvanna, chairperson, village party committee
Phova village	Douangsivanh, head of village development trust funds
Environmental and Social Panel of Experts	
	Lee M. Talbot
	Elizabeth Mann
	David K. McDowell
Independent Monitoring Authority	
	William Duckworth
Lenders' Technical Advisers	
	Tony Zola
	Stephen Sparkes
Wildlife Conservation Association	
Members of the Committee of Technical Experts	Chanthavy Vongkhamheng, director
	Boundai Meuongmala, technical staff
	Anoulack Sinouvong, technical staff
Wildlife Conservation Society	
Vientiane office	Santi Xaypanya, director
	Manoly Sisavanh, deputy director
Project Anoulak	
	Camille N. Z. Coudrat, founder and director
Agrisud International	
	Claire Kieffer, project coordinator, Lao PDR
Asian Development Bank	
Resident mission Bangkok	Pradeep J. Tharakan, principal energy specialist
Resident mission Singapore	Genevieve O'Farrell, environment specialist
SERD	Maria Aloha Samoza

Resident mission Vientiane	Januar Hakim, principal portfolio management specialist
Former team leader for NT2 HPP	Woochong Um, director general and chief compliance officer; former team leader for NT2 HPP
World Bank	
World Bank office in Myanmar	Gevorg Sargsyn, acting country director and operations manager
World Bank office in Vientiane	Nicola Pontara, country manager
	Chandana Kularatne, senior economist
World Bank office in Bangkok	Birgit Hansl, country manager for Thailand
	John Roome, regional director, sustainable development
	Anna Bjerde, vice president
	Julia Fraser, program manager, Energy Global Practice
Former task team leaders of NT2 HPP	Jamil Sopher
	Illangovan Patchamuthu, country director for Pakistan
	Mohinder Gulati
	William Rex, lead water resource management specialist
	Ingo Wiederhofer, lead social development specialist
	Daryl Fields
	Pankaj Gupta, adviser
	Vilija Kostelnickiene, senior operations officer
In Vientiane and Washington, DC	Jie Tang, practice manager for Energy Global Practice
In Vientiane	Takafumi Kadono, senior energy specialist
	Bipul Singh, senior energy economist
	Robert Taliercio, regional director
	Adrian Fozzard, practice manager
	Nicola Smithers, practice manager
	James A. Brumby, senior adviser
	Shabih Mohib, program leader
	Leah April, senior public sector specialist
In Vientiane	Fanny Weiner, senior public sector management specialist
In Vientiane	Viengkeo Phetnavongxay, senior environmental specialist
	George Henry Stirrett, environmental specialist
	Glenn Morgan
	Jean-Michel Pavy
	Martin Henry Lenihan, senior social development specialist
	Satoshi Ishihara, senior social development specialist
	Chaohua Zhang, lead social development specialist
In Vientiane	Sybounheung Phandanouvong, senior social development specialist
World Bank Comprehensive Safeguards Review Team	Peter Leonard, regional safeguards adviser
	Juan Quintero
	Sofia De Abreu Ferreira, senior counsel
	Warren Paul Mayes, senior social development specialist
	Wolfhart Pohl, lead environmental specialist
	Aradhna Mathur

	Svend E. Jensby, senior social development specialist
	Xiaoxin Shi, counsel
	Manush Hristov, senior counsel
Multilateral Investment Guarantee Agency	
	Elena Palei, sector manager, infrastructure
	Marcus Williams, sector manager
	Kate Wallace, senior environmental and social development specialist
	Chinwe Nonyerem Binitie, senior counsel
	Sandro Diez-Amigo, senior evaluation officer
	Cherian Samuel, lead evaluation officer
	Vlajko Senic
European Investment Bank	
European Investment Bank headquarters	Katarzyna Swirgon
Agence Française de Développement (AFD)	
Vientiane office	Matthieu Bommier, country director
AFD-NDPC Nam Theun Plateau Livestock Agriculture and Forestry Project (NP-LAF)	
	Frederic Bazin, project manager

Appendix C. Fiduciary, Environmental, and Social Aspects

Financial Management

Financial management was rated satisfactory or better throughout project based on the reviews carried out by the financial management specialist of the World Bank. The reviews included project accounting and reporting arrangements, organization and staffing, internal control procedures, planning and budgeting, counterpart funding, funds flow, and disbursement and external audits. According to the ICR, project financial audits were provided in a timely manner with unqualified (clean) opinions on the project financial statements, which were published within the State Audit Organization audits (instead of publishing them separately). The Independent Evaluation Group was able to verify that the World Bank received audited financial statements from Nam Theun 2 Power Company (NTPC) and Lao Holding State Enterprise in a timely manner.

In addition to the fiduciary responsibilities, overall financial management of the budget process and the expenditure of revenues to the government from the Nam Theun 2 Hydropower Project (NT2 HPP) were integral to achieving the project's development objectives. Although a specific designated account for NT2 HPP was not set up by Ministry of Finance, the accountability for the revenue generated from NT2 HPP was satisfactorily addressed by the agreement to a functional equivalent in 2015. The World Bank team informed the Independent Evaluation Group that before this agreement, the revenues from NT2 HPP to the government were calculated manually as a result. A cross-check by the World Bank confirmed that the revenues from NT2 HPP as reported by the government were a near match with the payments made to the government by NTPC and Lao Holding State Enterprise, according to their audited financial statements. The financial statements for funded programs and projects until 2014 experienced delays of two to three years, although the government met more than 80 percent of its audit requirements by project close, whereas the audits for the FY15/16 program disbursement and full audit for FY17 are pending.

Procurement

A detailed review of procurement by an independent firm and a World Bank specialist during project preparation had confirmed that NTPC's procurement process was consistent with World Bank procurement guidelines for guarantee operations, which require that goods and works have been procured with due attention to economy and efficiency, that they are of satisfactory quality, that they are delivered in a timely

fashion, and that they are priced to not adversely affect the economic and financial viability of the project. The major physical infrastructure construction was completed with only a modest 4.5 month delay beyond the estimated 54 months at a cost of \$737 million, which was only 2 percent higher than the originally estimated cost of \$722 million. The bulk of the International Development Association grant, which was managed by NTPC in coordination with the World Bank offices in Thailand (regional) and the Lao People's Democratic Republic (Lao PDR), was also procured within 20 months by 2008, after which the grant was fully disbursed. Procurement was rated as satisfactory throughout the project, and the Implementation Completion and Results Report indicates that the grant was efficiently managed by NTPC and the World Bank.

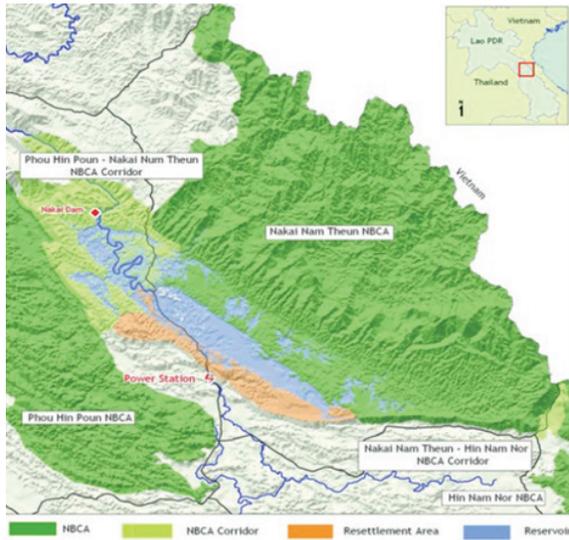
Environmental and Social Development

The NT2 HPP triggered all Bank Group environmental and social safeguard policies in effect at the time of appraisal. In addition, the project was also striving to achieve positive environmental and social impacts beyond the minimum requirements for safeguards. The environmental and social sustainability was one of the key goals of the project that was prominent and directly included in the project development objective. Given the critical importance of achieving the sustainability goals, the evaluation team included three specialists who specifically assessed in detail the environmental and social aspects of NT2 HPP. A project at the scale of NT2 that is complex and located in an ecologically sensitive area inhabited by local populations requires extensive care and a wide range of environmental and social actions to meet industry and international standards and to comply with Bank Group safeguard policies. A summary of key environmental and social aspects is provided in the next two sections of this appendix.

Environmental Aspects

Background. The NT2 dam, reservoir, downstream flows, and its entire watershed form part of the Annamites, a mountain range extending east of the Mekong River from Central Lao PDR and Vietnam to southern Vietnam and Cambodia. The range contains some of the world's greatest biodiversity, with thousands of plant and animal species sharing their habitats with human communities present for generations (Timmins and Evans 1996; Chamberlain, Alton, and Silavong 1996). Major mammal discoveries, new species of amphibians and reptiles, and the presence of the remaining old growth tree species, such as the Chinese swamp cypress (*Glyptostrobus pensilis*) and rosewood (*Dalbergia oliveri*) continue to attest to its high-species richness, endemism, and value (Robichaud 2013). The project involved basin transfer of water from the Nam Theun River to the Xe Bang Fai River.

Photo C.1. Nakai Plateau and Partial Nakai-Nam Theun National Protected Area



Source: NTPC.

Note: NNT-NPA = Nakai-Nam Theun National Protected Area; NBCA = National Biodiversity Conservation Area.

The main environmental preparation documentation included an Environmental and Social Impact Assessment, an environmental assessment management plan (EAMP), and a Cumulative and Strategic Environmental Assessment completed by Asian Development Bank (ADB) or the World Bank before or by 2005 and a Social and Environmental Management Framework and Operational Plan (SEMFOP) for the Nakai-Nam Theun National Protected Area (NNT-NPA). The policies and detailed requirements of the relevant government of Lao PDR laws and policies were incorporated in a Concession Agreement between the government and Nam Theun 2 Power Company (NTPC) that became effective in November 2005.

Environmental Management, Health, and Safety Management. NTPC has a quality, health, safety and environment (QHSE) policy that commits to manage its operational risks related to its hydropower generation in terms of health and safety, hydro safety, and environment for its staff and contractors and for the neighboring communities. NTPC has developed and implementing a comprehensive hydro-safety and QHSE management system. NTPC's QHSE management system has been also assessed and is certified by SGS as meeting the requirements of ISO 9001:2015 (quality), ISO 14001:2015 (environment), and OHSAS 18001:2007 (health and safety).

The environmental activities during construction were designated in the Environmental Management Plan of the Head Construction Contract. During the early stages of project construction, reports indicate inadequate attention was paid to environmental issues and occupational health and safety by the Head Construction Contract, including effective disposal of solid waste, control of groundwater contamination, satisfactory

landfill capacity along with assurance of financial and institutional sustainability at the of the district level to bring the project in compliance with the CA.¹ In 2007, as construction intensified, the Lenders' Technical Advisers reported that the improvements in environmental management significantly slowed in some areas and that several expected improvements did not materialize. The Environmental and Social Panel of Experts (POE) also noted that "environmental consciousness, thoroughness and adherence to planning, which has been notably absent from much of their environmental and restoration work thus far."

By 2009, conditions improved such that noncompliances identified were ultimately resolved. The POE in 2010 found it "reassuring" that the dam site is "clean, all temporary buildings have been removed, revegetation is occurring naturally on the slopes around the dam itself and the water systems appear to have been closed down and buried." They also noted that the "NTPC's environmental monitoring system appears to be more effective than in the past in getting key work done by the head contractor and that is a welcome development." There is a sound action plan in draft, which envisages that 90 percent of the disturbed areas will be rehabilitated as forest and the balance as grazing areas. In the end, all 348 construction sites were decommissioned and restored (for example, regrading land back to its natural slope, and revegetation) before being returned for its original or other future purpose.

Based on site visit observations, NTPC appears to be managing the powerhouse above standards. The labeling was adequate and the key warning and emergency labels included both English and local languages (although this was not the case at the dam site). All staff use necessary personal protective equipment² when needed. NTPC keeps records of occupational health and safety (OHS) statistics and indicated that there were four fatalities³ during the construction, and none after the commercial operation date. NTPC also keeps an inventory of waste generated during operations and has well-designed hazardous⁴ and nonhazardous temporary storage facility, which follows industry practice. Oil and lubricants are properly stored in the plant, all necessary EHS precautions are taken into account in the design of the storage facility. There are two underground fuel storage tanks and six above ground storage tanks with adequate secondary containments to prevent potential spills and leakages. According to the NTPC OHS statistics, there were less than 10 loss time accidents after commissioning. NTPC had 978 days without an accident until August 2019. NTPC also implements near-miss reporting procedures in its operations.

Dam Safety. The safety of dam construction and maintenance is of vital importance in developing hydropower, and NT2 HPP needed to comply with Operational Policy (OP) 4.37 on Safety of Dams. Prior to construction, a Dam Safety Review Panel was appointed to independently advise on technical construction, operations and dam safety issues and

ensure that corrective measures were undertaken. The panel formally commented and made recommendations on infrastructure designs, and the operations and maintenance plan. Per the Concession Agreement, the panel was required to review and report until six years after the commercial operation date. The panel issued its final review in 2016.

The assessment is based on information reviewed and site visit observation by the evaluation team. NTPC established Emergency Contingency Plans at impoundment based on the United States Federal Emergency Management Agency standards for the Nakai Dam, reservoir and saddle dams, and the regulating dam and downstream spills. Dam safety is managed by the NTPC Global Safety/Hydro-Safety Department in coordination with the NTPC Risk Management Committee. Monitoring requires weekly and monthly reports on dam movement, leakage, and groundwater pressure. During the wet season, reports increase in frequency to biweekly, or more if there are high inflows. Infrastructure is tested routinely, with annual spillway testing. NTPC maintains an extensive network of automatic hydromet stations and forecasts flows using three computer models.

Issues reported during the project included leakage at Nakai Dam, and the sufficiency of infrastructure to address maximum floods. On the latter, in 2011 exceptionally high inflows of 1,300 m³/s were recorded on Nam Kathang—estimated to be a 1-in-5000-year flood. In response, NTPC increased the 1-in-10,000-year flood scenario from 1,500 m³/s to 2,062 m³/s and expanded the spillway on the regulating dam. During the same year discharges exceeded 6,500 m³/s, the highest ever recorded and estimated in previous hydrological analysis to be a 1-in-100-year flood. Nakai Dam is able to pass floods up to 16,000 m³/s. The NTPC operates a system aimed at avoiding biological and social impacts downstream. Although district authorities are informed with each increase, there have been incidents of downstream populations not being adequately warned of the increases. In response, NTPC compensated villagers located at the Theun-Hinboun reservoir for damages that arose.

The Dam Safety Panel concluded its work in 2016 stating that the NT2 HPP safety, operation, and maintenance programs are impressive. The 2016 Safeguards Compliance Review undertaken by the World Bank's Operations Policy and Country Services also indicated compliance with OP 4.37. Expert review of dam safety will continue, with LTA reports, every two years.

Removal of Biomass. The Social Development Plan (SDP) identified that there was substantial biomass in the impoundment area noting that “water quality after inundation will depend largely on removal of vegetation ... and that it is vital to minimize from the beginning” the risks of poor water quality having “negative consequences for fish production and the livelihood for reservoir fishers” (NTPC 2005b).

Thus, the SDP explicitly stated that to assure good water quality after impoundment, “biomass must be removed as much as possible.” Under the SDP, 3,000 hectares of biomass removal had been agreed although the Water Resources and Environment Agency—now MONRE had requested 4,500 ha. The requirement in the Concession Agreement was to maximize removal of biomass in high biomass areas of the Nakai Reservoir.

In 2008, as impoundment began, 1,500 ha of the 3,000 ha of biomass had not been cleared according to the POE. The risk was foreseeable as salvage logging fell behind and there was a call for remedial measures to address inadequate synchronization of construction and environmental and social schedules. The slow mobilization of capacity and expertise by the NTPC and the government and inadequate application of diligence procedures by NTPC were cited as reasons in Independent Monitoring Agency reports. The evaluation team’s on-site discussions revealed that there was little consensus about approaches biomass removal. Consequently, the POE called for clearance of “strategic areas of biomass.” Eventually, actions taken were guided by an NTPC study stating that partial removal would benefit water quality and social activities (NTPC 2005a). It was noted by a former member of LTA that priority was given to the removal of only the “most valuable vegetation” as there were difficulties of clearance: unexploded bombs; no interest by locals beyond removal of valuable timber; an unfavorable cost/benefit analysis; and, the absence of assigned responsibilities. Ultimately, 1,872 ha were cleared, mainly for navigation and fisheries purposes. Combining this removal with areas previously cleared for agriculture, the NTPC estimated that 60 percent of the permanently flooded area was finally cleared. In retrospect, Environmental and Social Experts from EDF have commented that the initial approach to systematic clearance of vegetation in inundated areas may not be as vital since the cost-benefit paradigm was unfavorable in the case of NT2 HPP (Cottet and others 2016),⁵ argue that without additional data on water quality in the reservoir, one can only speculate about the extent of anoxic conditions where biomass removal was not undertaken. The same authors also observe that although the reservoir remains suitable for fisheries it is likely that it could have been far more productive had recommendations of the SDP and the POE been adopted.

A study quantified total CO₂ emissions from the Nam Theun 2 reservoir less than a year after flooding in 2009 and just a few months after the maximum impoundment level was first reached at the end of 2013. It showed that soils from the drawdown area proved to be a significant contributor to the total CO₂ emissions ranging from 40 to 75 percent of total annual gross emissions. Total emissions in 2010 and 2011 were about an order of magnitude higher than preimpoundment emissions. Stochastic models predicting GHG emissions in the operation phase of the project underestimated the volume because of

biomass decomposition. The operation phase dominates the GHG emissions and, factoring in the flooded biomass decomposition, a global warming potential value of 80–90 grams of CO₂ equivalent per kWh is attained—higher than the previous estimates by the World Bank of 38 grams of CO₂ equivalent per kWh.⁶

Translocation of Animals. The plans for reservoir preparation by the NTPC included preimpoundment surveys and postimpoundment translocation programs for animal populations likely to be affected by inundation. Plans for the translocation of animals concentrated on reptiles and mammals, including the large-antlered muntjac (*Muntiacus vuquangensis*), a newly discovered endemic species, and Asian elephant populations. NTPC implemented a Wildlife Program on the Nakai Plateau through partnerships with Wildlife Conservation Society Lao PDR and Conservation International. This included the translocation of animals (such as muntjac and turtles trapped on islands), and their placement in suitable habitats and the movement of elephants. Activities included wildlife rescue and release into the NNT-NPA during the reservoir inundation period; turtle conservation; wetlands conservation; invasive species management; and monitoring of key species. Antipoaching patrols and rescue teams were also established for the reservoir and surrounding areas, and an education program was undertaken to discourage exploitation of wildlife. The “careful and deliberate implementation” of the program combined with the slow filling of the reservoir resulted in the low impact on wildlife, which was cited by one source as “an outstanding success” (Streicher 2016). However, post-translocation data are limited to fully assess stabilization or improvement in the Nakai Plateau, which was a key project outcome indicator (World Bank 2018a). NTPC’s Asian elephant program begun 2005 continues to date with monitoring of elephant movements and the maintenance of mineral licks. Transects and DNA counts have indicated a population level of over 140 individuals. However, it has been observed that human-elephant conflicts are higher in the rainy season when elephants are attracted to ripening crops and have continued to be a serious issue. In 2016, NTPC contracted the wildlife authority to prepare a plan to sedate and relocate a group of three elephants.

Water levels and water quality. As the project involved transfer of water from the Nam Theun to the XBF Rivers, preparation documents assessed potential impacts on the riparian ecology of the downstream areas resulting from reservoir releases. A program was prepared to mitigate and compensate for marked variations in water flow and velocity in the XBF River and anticipated decreased flow in Nam Theun. Although impacts on the NT River were assessed to be temporary, the XBF River above its confluence with the downstream channel was expected to experience backwash during flooding periods and reduced fishing opportunities because of increased turbidity and velocity. Other changes to water chemistry, potable water supplies, and increased

riverbank erosion were flagged in the environmental assessments of the World Bank, stipulating mitigation measures in line with industry practice. The environmental assessments and other studies also examined potential impacts on river-based livelihoods, such as how flood regimes along the river and its tributaries were critical to fish productivity and vegetable and rice agriculture as well ecological stability (Shoemaker, Baird, and Baird 2001).

Table C.1. Before-and-After Flows on NT2 HPP-Affected Rivers

River/Stations	Data series	Preproject Flows			Postproject Flows
		Mean annual discharge (m ³ /s)	Mean driest month (m ³ /s)	Mean wettest month (m ³ /s)	
Nam Theun at dam site	1950–2002	238	31.9 (Apr.)	734.7 (Aug.)	2 m ³ /s minimum except when spilling
Nam Kathang at regulating dam	1994–2002	10.2	0.3 (Apr.)	38.5 (Sept.)	Same as preproject flows
Xi Bang Fai at Mahaxai	1989–2002	265.4	12.7 (Apr.)	921.2 (Aug.)	Add 330 m ³ /s, except during outages and when XBF is in flood
Mekong after confluence of Xi Bang Fai	1922–1992	6,960	1,552 (Apr.)	21,453 (Aug.)	Slight reduction in wet season flows and increase in dry season flows

Source: Main Features of the Nam Theun 2 hydroelectric project (Lao PDR) and the associated environmental monitoring programs – Scientific figure on ResearchGate. [accessed 12 Mar, 2020]

In line with expectations of the project’s limnologists, physical and biological evolution of the reservoir was rapid with a marked reduction of the thermocline and anaerobic conditions being attained three years after inundation,⁷ the water quality of downstream flows returning to near previous conditions. In the *NT River*, NTPC and other agencies report incidences of spilling from Nakai Dam resulting in temporary flooding of villages at the tail of the Theun-Hinboun reservoir—for which NTPC compensated villagers. To avoid and mitigate such flooding in the future, NTPC has established a Protocol of Notice under which it notifies the Theun-Hinboun Power Company in advance of a spilling, so they can lower reservoir levels in advance. Modeling predicted that seasonal flooding in the *XBF* floodplain would involve 3,820 ha of land being covered under more than 1 m depth of water as a result of the discharge of 330 m³/s, for an average duration of 3.6 days per year. To avoid such seasonal flooding, power generation from NT2 HPP is reduced or halted when flows in the XBF approach flood level.⁸ This procedure was applied in 2011 and in 2018, when generation for Thailand was halted for 24 days.⁹

A report from the POE in 2012, further confirmed by international financial institutions (IFIs; World Bank and ADB 2012) and others (such as Shoemaker, Baird, and Manorom 2014), note that changes in the volume and water quality from NT2 HPP had significantly impacted the welfare of local communities.¹⁰ Interviews conducted by the evaluation team with local villagers revealed the extent of flooding episodes since the impoundment of the NT2 reservoir,^{11, 12} which they report have increased in intensity and duration, leading to adverse impacts on their livelihood. Contributing factors include the frequency of more intense storms in the reservoir's catchment and backup of the XBF River (as a consequence of water released to the discharge channel) and the Mekong River. Compensation was offered to livestock lost and food provided to villagers who were affected since some of the paddy fields were damaged. NTPC is continuing a monitoring program on the XBF River to assess the erosion/sedimentation effects of increased flows and to determine whether or not long-term river channel morphology changes are due to NT2¹³. The downstream flow into the Nam Kathang is managed to be identical to inflows as the NT2 HPP regulating pond, located downstream of the powerhouse, enables the regulation of the varying flows resulting from the planned and unplanned outages at NT2 HPP.¹⁴ According to studies conducted by NTPC and project preparation documents, the flows in the section of the Mekong River were expected to be minimal compared with overall flows.¹⁵ However, there is some concern that the progressive construction of dams coupled with extreme weather can begin to test the resilience of the Mekong ecosystem.¹⁶

NTPC and others concurred that climate change-related impacts were underappreciated at the time of project design. A 2017 World Bank study "Lao PDR is vulnerable to natural disasters and ill-prepared to deal with climate change."¹⁷ indicated that however, given the anticipated elevated flow rate and volume changes resulting from more intense and frequent storm episodes, there is a need for further investigations of this matter. Such findings can help adjust downstream flow regime practices to avoid or mitigate further adverse impacts, especially on villages at the junction of the channel with the XBF River.

NTPC has complied with its commitment in the EAMP/Concession Agreement and implemented a water quality monitoring and assessment program for the NT (downstream of the Nakai Dam in the downstream channel), and XBF (downstream of the channel) watershed, which continues to this day. The project has established a number of monitoring stations covering the affected streams, channels and the reservoir area¹⁸. In the NT watershed, NTPC set up 10 water quality monitoring stations in the upstream and downstream rivers and nine stations in the reservoir. In the XBF watershed, water quality is monitored at six stations in Nam Kathang and Nam Gnom streams, six stations in downstream and tailrace channels, and four stations in the XBF

River. In addition, there are also nine automatic sampling stations at various locations below the NT2 dam and downstream channels. NTPC also monitors hydrobiology at 11 stations in the NT watershed and six stations in the XBF watershed.

As a result of the NT2 HPP, the NT River transformed from a riverine system to a lacustrine system by the creation of the NT reservoir. During this transformation, physico-chemical parameters in both NT and XBF watershed have also been changed. The oxygen levels in the bottom layer rapidly decreased due to decomposition of organic matter (uncleared biomass, as previously discussed) and accumulated soils in the bottom layers. The long-term monitoring results indicate that the water quality in NT2 reservoir has improved over the years. In general, the NT2 reservoir has low to intermediate productivity due to the low to medium level nutrient content (oligo-mesotrophic). In addition, high level of Dissolved Oxygen (DO) (> 5 mg/L) is observed at surface almost all stations in the reservoir.¹⁹ Thus, the reservoir is likely to support aquatic species that require well oxygenated waters (more information in the next section on fisheries).

Water released to NT and XBF Rivers are mixed and well oxygenated.²⁰ Thus, the DO remains above the guideline (>5 mg/L) for NT, Nam Kathang, and XBF Rivers throughout the whole year. However, the diversion of the Nam Theun River into the XBF watershed via the reservoir has impacted the XBF River in terms of temperature, conductivity, turbidity and Total Suspended Solids (TSS). Particularly during wet seasons, turbidity and TSS exceed the guideline in Nam Theun downstream, Nam Kathang, and XBF River. Biological Oxygen Demand and chemical oxygen demand slightly exceed the guideline in few months in Nam Theun downstream of Nakai Dam, Nam Kathang upstream, Nam Kathang Downstream of Regulating Dam and XBF River. However, such exceedances are related to increased rainfall and possibly to mining activities in the Nam Phao. In contrast, biological indicators confirmed good water quality at upstream tributaries, downstream of the Nakai Dam and downstream of the powerhouse.

Fisheries and aquatic biota.²¹ The environmental assessments and other studies also examined potential impacts on river-based livelihoods, such as how flood regimes along the river and its tributaries were critical to fish productivity as well ecological stability (Shoemaker, Baird, and Baird 2001). Fish surveys of the NT and XBF basins were conducted at 42 sites in 1996, at 25 sites in 2002, and 16 sites in 2003 (Kottelat 2016). Diversity was higher in the Xe Bang Fai than the Nam Theun, which had relatively low diversity compared with the Mekong River. Programs planned for fish biodiversity included: riparian release downstream of the Nakai Dam and management of low flow events in the downstream channel to avoid stranding biota. Monitoring arrangements

were established to measure the impacts of the new flow regime and take corrective actions to avoid adverse impacts.

In keeping with other tropical reservoirs, a boom in fish biomass in Nakai Reservoir occurred during the initial years of inundation followed by a decline after nutrients were diluted and washed out, as previously discussed. The water quality has stabilized since, and NTPC's efforts to restock the reservoir eventually led to an increase in fish.

However, the E&S POE raised concerns about illegal fishing in protected (spawning) areas placing at risk the sustainability of fishing in the reservoir. In response, a two-year plan was established, including a new approach to fisheries management—the setting up of permanent checkpoints and increased fisheries focused patrols, which was an important development considered to have partially reduced illegal fishing. However, local villagers told the evaluation team that they witnessed continuing illegal fishing (albeit less) especially in remote and less protected areas. There are also concerns with the introduction and propagation of invasive species in the reservoir.²² Despite these challenges, the 2018 Fisheries Status on the Nakai Reservoir reports that fish catches nevertheless exceeded the 2009 estimate of 21 kg/ha to as much as 27 kg/ha, although the results are indicative given the nature of data collection.^{23, 24} A Fish Catch Monitoring Surveys undertaken since 2008, suggest that the potential maximum fish production may not exceed 30–34 kg/hectare for subsistence and commercial purposes. Team learned that there has been variable monitoring and patrolling of the reservoir since stopping the exercise in 2012 and it is understood that the reservoir is now without such management, in part because of a lack of budget. Therefore, despite the achievements by the NT2 HPP to stabilize fisheries in the reservoir after impoundment, there are sustainability concerns in the absence of an active reservoir management program, propagation of invasive species and overfishing

Invasive species appeared within the first year in the reservoir and field notes recorded that tilapia and common carp were caught in large numbers²⁵. These fish are considered by the International Union for Conservation of Nature to be the top 100 worst invasive species in the world. They are believed to be introduced deliberately; however, experts pointed out that there are sufficiently established fish species and there is no need to introduce new species. NTPC also acknowledged the potential for other invasives, including the Siamese glassfish (*Parambassis siamensis*), to greatly influence the future evolution of the fish population in the NT2 Reservoir."²⁶

Downstream flows for the NT and XBF Rivers are now colder, faster and higher through the year, and have reduced some fish habitats and fish movements of both rivers and their tributaries (Kottelat 2016). Other factors affecting fisheries gleaned during the evaluation team's field visit include overfishing by communities or placement of permanent nets at the confluence of tributaries, the presence of check dams without any

consideration for fish movement and the need for passages. It has been documented that the historically diverse fish species on the XBF experienced that were already in decline, further reduced in variety and abundance after the commercial operation date (Kottelat 2016). The E&S POE reported a 35 percent decline of fisheries in 2010 and 25 percent in 2011. On the NT River, studies have shown that the significant reduction in the average flow rate (daily and seasonal variability) will induce changes to fish habitats and fish migration among other things (Kottelat 2016). Villagers living near the XBF stated in interviews that the ecology of the river has changed for all seasons such that they have lost use of aquatic vegetation and fish as part of their protein diet. According to the same villagers, fish cages have been severely damaged by flooding and turtles and egrets are less plentiful—in effect providing barometers of changing conditions. Though past fishing techniques are not suitable for high flow environment, there appears to be no current limit on net size and all caught fish and invertebrates are taken with consequences to the sustainability of the resource base. According to these villagers, some fish migration has almost disappeared with many remaining in the Mekong River and no longer entering the XBF in significant numbers. Despite these challenges, and the cessation of fish catch monitoring, there are indications based on previous data that fish stocks are stabilized on the NT and XBF Rivers since the initial decline due to changes in the flow regime. However, according to some experts “no conclusion” can be made from the previous sampling without more comprehensive monitoring (Kottelat 2016).

NNT-NPA watershed and biodiversity. The NT2 HPP was expected to have an environmental footprint estimated at 130,589 ha of total loss or modification of land area, consisting of 62 percent natural forest habitat and 38 percent of nonforest habitat or disturbed areas, according to the EAMP. To compensate, the project design included a biodiversity offset in a 338,718 ha area of the Nakai-Nam Theun National Protected Area (NNT-NPA) and adjacent corridors. The NNT-NPA was recognized as one of the most significant conservation areas remaining in Southeast Asia with a complex of habitats rare,²⁷ endemic and highly threatened species, which were threatened due to a history of illegal logging and poaching.²⁸ Given these losses and threats to the watershed (anticipated to be exacerbated by project access roads), the Bank Group’s Natural Habitats Safeguard Policy (OP 4.04) was triggered and the NT2 project was expanded (as a compensatory measure) to include the biodiversity offset program.²⁹ Although the EAMP noted that the protected land area exceeded the project’s environmental footprint, it did not recognize that the area lost or degraded due to the project and what was designated for conservation within the NNT-NPA had different biodiversity characteristics and value.^{30, 31} Moreover, the EAMP was inadequate, as it defined the area of influence too narrowly, where there would be significant impacts and conservation needs, ignoring the southern watershed and the plateau. This is an area of intense cultivation and potentially significant environmental impacts by resettlements

along the reservoir's southern shoreline that contains remnants of valuable forestry and an escarpment of karst limestone housing significant biodiversity.³² Had the EAMP included the southern watershed and the plateau, it would have helped protect the entire watershed, created further connectivity, improved movement of animal populations with other nearby protected areas,³³ and facilitated effective land use planning in the resettlement areas.

The NNT-NPA was one of the first areas designated for biodiversity protection in Lao PDR. At appraisal, the country did not have a track record of managing conservation areas and the Watershed Management and Protection Authority (WMPA) was also a nascent organization³⁴ that was given the responsibility of protecting the watershed. The WMPA was responsible for coordinating and managing all activities in the NNT-NPA, including implementation of the biodiversity offset, as per the SEMFOP I (initially) and follow-on SEMFOPs II and III. At the time of Bank Group approval of NT2 HPP, it was noted that the success of the NNT-NPA protection would depend on "the effective use of financial resources, strengthening government capacity" and "long-term political will," although only the availability of financial resources through NT2 HPP was cited as a key mitigation measure built into the project. Even though the NT2 HPP would serve as a funding source for the WMPA, including a transfer of about \$1.4 million to cover WMPA's ongoing operational costs, it was likely insufficient. The International Union for Conservation of Nature recommends \$5/ha to adequately fund conservation management in protected areas, including ranger patrols, which translates to a budget of at least \$2 million annually to oversee the NNT-NPA. Finally, the design of NT2 HPP placed an unrealistically ambitious target for the WMPA to achieve by ensuring "no further degradation of habitats or in declines of threatened species" in the NNT-NPA watershed; when illegal logging and poaching was ongoing and predated the project.

The WMPA was unsuccessful in adequately protecting the biodiversity of the NNT-NPA, although funding for supporting its operations was made available from NT2 HPP resources. The POE at the beginning of the project in 2005 stressed the need for the WMPA to develop a master plan for access tracks; revisit the budget, including the amounts projected for patrolling and livelihood assistance to villagers; and, speed-up the technical assistance to fill key WMPA management functions prioritizing the acquisition of a conservation/wildlife ecologist. Around the same time, the IMA expressed concern about WMPA's strategy for conservation, management, and capacity and also stipulated the need for additional staffing. When staff positions were filled, there was considerable consensus among those interviewed that the appointees did not possess the appropriate qualifications or understand the approach to wildlife conservation (science and management). The WMPA Board overseeing the institution also faced similar challenges as members possessed little understanding or ownership of

wildlife conservation. The LTA and the POE repeatedly found the WMPA to be “totally ineffective” in protecting the watershed’s biodiversity. An audit in 2011–12 found governance and financial mismanagement issues within the WMPA and that the institution was progressively becoming incapable of carrying out its mandate.³⁵ A technical adviser to the WMPA from 2006/09 found a near absence of “any expertise in biodiversity conservation”³⁶. Technical advisers from several countries and Lao PDR served from 2005/14, but their influence was deemed limited being unable to offer “much input on key drivers of organizational success such a staff recruitment”³⁷. Mismanagement of the WMPA led its funding from the NT2 HPP being suspended in 2014, which resumed in 2016 only after the preparation of a five-year strategy by the institution detailing patrolling, law enforcement, conservation priorities, capacity building, and coordination of research (and followed by Prime Minister decree 122 of 2017 mandating qualified staff).

Despite its shortcomings, the staff of WMPA made efforts to establish plans, develop management protocols, conduct poaching patrols, and train villagers. However, monitoring the status and trends of biodiversity in the watershed lacked integrity. A wildlife monitoring program based on camera trap and transect walk methods was established and conducted from 2006/07 to 2010/11. It recorded the presence of large carnivores during a period overlapping with the construction of NT2 reservoir, its flooding in 2008, and the commercial operation date in 2010. However, according to wildlife experts the use of data from the first study poses difficulties over amalgamation with the 2018/19, although reports of poaching were recorded in 2013 and 2016. The evaluation team was informed by villagers and biodiversity specialists that there were continuing instances of poaching in the NNT-NPA across the border with Vietnam and through rivers entering the Nakai Reservoir along its northeastern shore (McDowell, Scudder, and Talbot 2013, 1–15; Davies and Holmes 2016; Watershed 2004). However, given the absence of any baseline studies from the beginning of the project indicating species diversity, distribution, and abundance, the POE and the IFIs found “the lack of time-based wildlife data makes an objective analysis of wildlife status and trends impossible.”

The habitat in the NNT-NPA has been affected by illegal logging, especially across the Vietnamese border³⁸. Villagers occupying the plateau also contributed to habitat loss due to uncontrolled agricultural and forestry practices. Rates of forest cover loss increased during the project’s implementation: excluding the reservoir area, the area lost is estimated at 409 ha/year in 2009–2012, increasing to 499 ha/year in 2012–2017³⁹. As late as 2015, high incidences of illegal logging were widespread with economic losses to Lao PDR estimated at \$50 million (Chan 2016). The government issued a decree (#300) in 2015, for which, unlike in previous instances, there is some initial evidence of

enforcement by the authorities. Forest loss is now considered low in percentage terms with present forest cover approximately 88 percent in the NNT-NPA.⁴⁰ The evaluation team learned from interviews of an emerging threat to the biodiversity of the watershed. Some living in enclave villages face impaired livelihoods due to restrictions placed on them for hunting, fishing, and farming. Some of these villagers are tempted to encroach beyond permitted areas to restricted ones. In addition, the evaluation team also observed that dense, impenetrable thickets of the giant sensitive tree, (*Mimosa pigra*) have invaded the banks of slow flowing portions of the rivers entering the reservoir. The plant has been listed as one of the world's 100 worst invasive species and was brought into the project area on the wheels of heavy equipment to the power station site via the Nakai road. NTPC has established a program to identify and control invasive species focusing on five species, including *Mimosa pigra*.

Despite the unsuccessful attempt by the project to manage the NNT-NPA biodiversity offset, there is cause for some cautious optimism, as noted by the POE. The current government has made a strong commitment to sustainable management of its natural resources. In 2015, the government issued a decree (#300) banning illegal logging and poaching. Although similar regulations have been enacted in the past, there is evidence of greater enforcement in this instance. Although the data⁴¹ obtained by the evaluation team is insufficient to establish a trend, it does indicate that there are indeed arrests and convictions for local and foreign violators under the decree, including some high-level officials. The government has also assembled a committee of technical experts comprising several experienced international and domestic nongovernmental organizations to support the WMPA.⁴² In addition, the government, on the committee's advice, in 2019, appointed a new director to revive the five-year strategy (SEMFOPI III) for the NNT-NPA and engage qualified staff. The recruitment effort is being assisted by the International Union for Conservation of Nature since the NNT-NPA was designated (upgraded) as the first national park in Lao PDR,⁴³ converting the WMPA to a national park office. Finally, the World Bank's support to the WMPA through the NT2 HPP has ceased, although there is continued assistance through a separate project focused specifically on conservation. It is directly supporting the NNT-NPA by augmenting the funding from NTPC.⁴⁴ Although it will be difficult to restore the biodiversity in the NNT-NPA to what was originally committed in the NT2 HPP, there is an opportunity for the government to remedy the lack of past success, and for the World Bank to help realize a significant environmental commitment made to compensate for the NT2 HPP's environmental footprint.

Compensatory forestry. A 2003 ADB study determined that 28,700 ha of forest would be lost due to inundation establishing the NT2 reservoir. To offset this loss, an area of approximately 38,900 ha of degraded forests within the Nakai-Nam Theun National

Protected Area (NNT-NPA) qualified for rehabilitation, including approximately 28,700 ha for natural regeneration. The study also identified 5,000 ha in the Nakai resettlement area and other areas outside the NT2 HPP domain as an alternative if all of the area in the NNT-NPA could not be detected. The NNT-NPA WMPA together with the government, with assistance from NTPC, was responsible for rehabilitating and reforesting the forest area. The EAMP and SEMFOP I stated: “the Project will undertake activities to rehabilitate and/or reforest degraded forest areas currently having less than 20 percent crown cover” and observed that “there are 41,737 ha of un-stocked forest within the NNT-NPA” to meet the compensatory forest requirements.

In 2004, even before the NT2 HPP was approved by the IFIs, there were indications that, although there were 38,900 ha available in the NNT-NPA, it would be difficult to “track and isolate” compensatory forestry activities under the wider WMPA program. In 2008, WMPA undertook GIS analysis to overlay areas of previously identified un-stocked forest and concluded there were limited opportunities for compensatory forestry in NNT-NPA. It was also considered too early to begin reforestation in Nakai resettlement area, as the priority was to organize the resettled hamlets at their new locations. Many attempts to design an adequate compensatory forestry program to be funded by ADB failed until 2017 when an agreement was reached between the government and the ADB, the IFI funding the project. The scope included other reforestation programs since suitable sites were not available in the project area. The implementation of community forestry activities in the resettlement area is discussed in the social section covering livelihoods.

Social Development Aspects

Background. As previously noted, the NT2 HPP triggered all ten Bank Group safeguard policies, and considerable time and effort was spent developing mechanisms to comply with the Involuntary Resettlement (OP 4.12) and Indigenous Peoples (OP 4.10)⁴⁵ policies. The main social documentation for the project comprised (i) the comprehensive Social Development Plan (SDP)⁴⁶ and (ii) the SEMFOP-1,⁴⁷ for the watershed area. The respective obligations of the project were specified in the unusually detailed Concession Agreement signed between NTPC and the government in 2002 and amended in 2005 and 2007. The SDP and SEMFOP identified four sets of affected people, for which Resettlement Plans and Ethnic Minority Plans⁴⁸ were prepared: 1) an estimated 6,200 people on the Nakai Plateau who would be resettled to make way for the reservoir; 2) residents of 31 enclave villages (about 5,800 people) in the protected watershed, who would be encouraged to limit their ecological footprint in the protected zone; 3) residents located downstream of the powerhouse who would lose land for the construction of the dam, powerhouse, employee village and the 27 km canal leading to the Xe Bang Fai; and 4) people living along the Nam Theun and XBF Rivers whose water

regimes would be changed by the project. Each of the affected consisted of several ethnic groups, both longtime residents and newer settlers, many of whom were identified as being subject to OD 4.20 on indigenous peoples, especially on the plateau and in the watershed. Those subject to the resettlement policy, OP 4.12, were located on the plateau and the project lands around the powerhouse and down to the confluence with the XBF River. An estimated 1,300 households (about 6,200 individuals) were expected to be resettled on the plateau and 90 households in the downstream area.⁴⁹ In addition to the main safeguards documents, in 2007 six brief site-specific Resettlement Action Plans were prepared for the project lands, transmission lines, roads, the spillway and the downstream channel connecting to the XBF River, further articulating the SDP. The six Resettlement Action Plans ultimately covered 2,846 project-affected households, including 134 whose homes were replaced.⁵⁰ However, much of the land for the construction-related activities had already been acquired before the site-specific plans were even prepared,⁵¹ without completing compensation having been completed, as required by the OP and CA.⁵²

Resettlement and Compensation

Nakai Plateau resettlement. Some of the groundwork for resettlement was undertaken, starting several years before appraisal, to inform resettlement planning. In addition to conducting local consultations, an anthropological study, and preliminary population mapping—all of which are standard in the preparation of safeguard documents-- two additional activities were initiated to establish an empirical basis for developing the SDP: (i) two demonstration farms were established in 1996, on plots thought to be representative of local conditions; and (ii) a pilot village was established in 2002.

One demonstration farm resettled three families (high, medium and low income) where they were supported in transitioning from their familiar traditional, extensive subsistence agriculture to more intensive farming practices. The objective was to assess the responsiveness and adoption patterns of the families, and relative promise offered by different crops and livestock management approaches to attain productive, sustainable results from plots that were smaller and had poorer soils than they had in the original villages. The second demonstration farm focused on developing a nursery for fruit and other trees to be made available to resettlers and to explore the viability of additional income generating options. A key ingredient in the program was the introduction of irrigation, which was supposed to enable farmers to switch from swidden to more intensive, sedentary agriculture. Two key lessons were learned from the demonstration: (i) it took a long time (3 years) for families to familiarize the traditional farmers with new, more sophisticated farming and water management practices, despite receiving a far higher level of support than would be available during project implementation, and (ii) confirmed that it would be possible for a local family to

manage successfully a home plot of about 0.75 ha (vegetable, fruit and forage), if given constant support and supervision. Some lessons from the demonstration farms were articulated in the SDP,⁵³ although the agricultural settlement design and livelihood programs eventually put in place lacked essential elements of the lessons.⁵⁴

The pilot village moved in settlers (four different clans, comprising 29 families) in 2002. The objective of the pilot village was to gain experience in consulting on family needs, to implement a resettlement program and provide a live demonstration for other resettlers of the reality of new settlements. The pilot village included houses with electricity and an irrigation system with water supply and other supplementary activities. Each family was allocated 600 m² for a house plot and a separate family plot of 0.66 ha in the area surrounding the village⁵⁵—the need for proximity between the dwellings and the farming plots was a key lesson that emerged.⁵⁶ Other lessons learned in the pilot included the need for equity in allocating home and agriculture plots, with due consideration for the disadvantaged; the difficulty of establishing functioning irrigation systems; the need to adjust farming approaches and contents to individual households, and the need to allocate significant time for the planning process to engage everyone.⁵⁷ Although these lessons were clarified in the SDP and the need to customize solutions was recognized, it was only loosely adhered to during implementation with more of a “one size fits all” approach.⁵⁸

Early consultations made it clear that the residents of the Nakai Plateau who were to be resettled wanted to remain on the plateau, rather than move to a new area. The limited amount of available land on the plateau and poor quality of the soil posed a major challenge to develop a resettlement plan that would be viable for the resident population. The estimated 6,200 people on the plateau were primarily engaged in extensive, subsistence swidden agriculture, especially upland rice, animal husbandry, and river fishing, with some opportunities for cash income from selling nontimber forest products, animals, and timber.⁵⁹ The plan, to move people to the southern side of the reservoir, would enable most of the villages and hamlets to stay within their traditional boundaries, but the area was significantly constrained in size and the quality of the soil. Thus, resettlers were to be granted a housing plot and agricultural plot of considerably smaller than the 3 ha/household plot that was recommended in the CIRAD appraisal of the resettlement zone in 2005.⁶⁰ Resettlers were expected to change from a relatively simple, yet diversified production system to a much more sophisticated one based on intensive, integrated cropping, fishing, and animal husbandry system based on irrigation, cut-and-carry forage, and community-based forestry development. Moreover, the family plot was not adjusted to family size. The Resettlement Action Plan predicted that the transition would take time, with the expectation that some ethnic groups would adjust more rapidly than others and that specific measures to assist them “have been

incorporated into the project design.”⁶¹ This is a standard provision of OD 4.20 with the Project Appraisal Document (PAD) claiming that the Ethnic Minority Development Plan (EMDP) contained in the SDP identifies “mechanisms for dealing with specific issues pertaining to the ethnic minorities during project implementation.”⁶² However, the EMDP is much more descriptive than proscriptive, providing little practical guidance or insights, which may explain why it was generally not adhered to in practice.⁶³

The resettlement program aimed to create new settlements with improved housing and sanitation, water, (some) irrigation, electricity, roads, schools, and health facilities that were unavailable to the people in their former location, along with livelihood programs that aimed to give them opportunities to increase their incomes and standard of living. The Concession Agreement required NTPC to ensure that housing and infrastructure be in place before families were resettled.⁶⁴ The original plan was for resettlement to be undertaken between the 2008 and 2009 wet season⁶⁵. However, despite incomplete planning and site preparation, the first wave of resettlement occurred in 2006, moving 600 families from the lowest elevations, whose homes were threatened by flooding by the coffer dam. Despite well-articulated plans and the emphasis in the DSP on site preparation, consultation, and participation, the families were moved into temporary housing (which they were provided with materials to construct), ultimately waiting as long as a year for permanent housing and facilities to be made available. Shortages of suitable wood for permanent housing plagued the resettlement program through different stages, as indicated by various parties. The second resettlement wave started the following year and physical relocation was completed by 2008. The schedule was dictated by the construction schedule and plans to fill the reservoir, rather than meeting the Concession Agreement requirement that a satisfactory physical environment be prepared before people were moved.⁶⁶ Individual families knew the location of their house plots and farm plots before the move, and the location of public facilities were mapped out. Other significant parameters regarding village boundaries, land availability for individual and common use, remained to be decided through a process of participatory land use planning. This process was not completed until 2012, by which time it was clear that the delay had significantly affected the ability of villagers to take ownership of their new environment and invest in management of their natural resources.⁶⁷ The programs and ultimate practices were also not sufficiently modified to tend to the characteristics or needs of individual minority groups.⁶⁸ Although it was assessed as having been “conducted in a fair and equitable manner,”⁶⁹ it also paid “inadequate attention to ethnicity in implementation and M&E, as noted by the POE.”⁷⁰

Physical resettlement was ultimately successful,⁷¹ and the promised infrastructure was eventually successfully put in place, albeit delayed and not synchronized with resettlement.⁷² Irrigation has remained problematical, however.⁷³ A total of 6,289 people

in 1,310 households were moved from 17 villages into 1,330 houses in 16 new villages. Each house has a toilet, bathroom, electricity, a rainwater collection tank, and grain storage. The houses followed a basic design, slightly modified individually to suit family size and preferences. Each family was allocated 0.66 ha of land for crops, of which 0.16 was expected to be irrigated. Residents have exclusive fishing rights to the new reservoir, and a share in the over 17,000 ha of forests surrounding the villages⁷⁴. 270 km of main and access roads were constructed. Thirty-two nurseries and schools, two health centers and community facilities in each village were constructed and operational, and a regional hospital was rehabilitated. A total of 176 community-based organizations were created, managing different community resources.⁷⁵

Downstream. The project involves transfer of water from the NT and XBF Rivers, and, as such, affects the downstream areas. The NT impacts were considered to be temporary and affect few people, as downstream villages were not located on the river. In the XBF, however, villages above the confluence of the downstream channel with the XBF were expected to experience backwash during flooding periods. The PAD anticipated that villages downstream of the channel would experience a number of impacts: dry season riverside gardens would be lost; fishing opportunities would be lost due to increased turbidity and velocity and changes in water chemistry; drinking water sources would be compromised; the duration of seasonal floods would increase, and dry season river crossings would be lost. Also, riverbank erosion was expected to increase and the operation of river pumps for irrigation would be threatened. Addressing such issues would be standard in Bank Group safeguard policies.⁷⁶

The downstream program was developed (in 2008) and implemented by NTPC. Ongoing activities were then handed over to the government when the downstream program closed in 2012.⁷⁷ It had three main approaches. First, owners of riverside gardens would be offered alternate plots, if available, or compensated directly. Second, villages along the river were given standpipes and irrigation pumps along the river were replaced or stabilized. Third, to offset the loss of fishing and protein, different livelihood programs were implemented, ranging from improved rice seeds and animal breeds, and small animal distribution to aquaculture, cash crops, mechanization. Finally, a Village Income Restoration Fund was established in each of the target villages to offer loans for residents to invest in new livelihood activities.

The NNT-NPA Watershed. Although the SEMFOP is a comprehensive document, the social component is rather limited. It aims to maintain livelihoods of residents of the 31 enclave villages by improving productivity of the land they currently use by developing new paddy, constructing small-scale irrigation systems, improving swidden fallows, improving soil management, promoting agroforestry and integrating grazing and forestry. Implicit in this is the expectation that residents will confine their activities to

current areas, rather than expand, for which a Resettlement Process Framework was included in the first SEMFOP. The project undertook public health initiatives in the area, as well as some livelihood activities, but social documentation has been sparse for this component in terms of both descriptions of activities and assessment of outcomes. There was also very little livelihood monitoring that was undertaken in the NNT-NPA watershed. However, the ADB NT2 Completion Report (2019) says that the Living Standards Measurement Survey undertaken in late 2017 (cited in the World Bank's Implementation Status and Results Report of June 2017) indicated that 90 percent of interviewees said "life has gotten better" over the past 10 years, mentioning improved access to education and health services as the main factors. The review team did not have access to the report, however, or any others that might have been issued during or after implementation.

Livelihood Restoration in the Nakai Plateau

The livelihood restoration program in NT2 HPP was ambitious in that the Concession Agreement required that the income of affected persons reach a "sustainable" target of the prevailing poverty line by year 5 and double it by the end of the resettlement period. This explicit target is unusual and even exceeds World Bank safeguard standards, strictly speaking. With this goal in mind and consistent with resettlement good practice, the project developed livelihood programs to enable resettlers to improve their incomes and standard of living. The SDP articulates the objective of the livelihood program: *To ensure that the people are able to derive a reliable income in order to achieve and sustain the expected standard of living by engaging in activities that are within their capacity, taking into account the availability of the resources on the Nakai Plateau and the type of enterprises that they are already engaged in.*⁷⁸ The Concession Agreement stipulated that the indicator of success for the project was to "improve and ensure sustainable livelihoods for the Resettlers" and to achieve the target incomes⁷⁹.

Sustained livelihood improvement was seen as a major challenge from the beginning, and has remained so to this day. In effect, the task was essentially to help villagers who have a largely subsistence, diversified forest, river, and swidden agriculture economy adopt technologies and practices that enable them to move to a more intense, market-driven economy in a few years. The added challenge was to have this transformation occur within a much constrained physical environment with poor soils, small land allocations, and restrictions on previous swidden practices.⁸⁰ To achieve this, according to the SDP,⁸¹ the resettlers were to be given access to technical advice and resources, as well as institutional support to encourage both collective action and individual initiatives. The program has five livelihood pillars: fishing, agriculture, animal husbandry, forestry, and off-farm income. The first four mirrored the range of activities the resettlers already engaged in, and the fifth imagined new opportunities in

entrepreneurship, marketing, and providing services. Based on experience from the preproject pilot and demonstration farms, the NT2 HPP⁸² design took into account the need for time for resettlers to adjust to the new opportunities and households would pursue different livelihood strategies. Consequently, the PAD clearly articulated the need for the livelihood programs to evolve over time through a participatory process that provides “flexibility and respects the experience, choices, and preferences of affected people. Villagers will work together with project staff and specialists in designing household and village livelihood activities to ensure ownership and smooth implementation.” The PAD also promises that the Resettlement Action Plan “provides (in addition to the livelihood programs), land, housing, infrastructure, and social services, and includes measures to assist ethnic minorities and other vulnerable households in culturally appropriate ways” (World Bank 2005c, 51).⁸³ The livelihood restoration program assumed that resettlers would continue to have diversified income sources, as none of the pillars alone was expected to generate enough income to feed and sustain a family. Although the livelihood programs were theoretically initiated at financial close, various elements were expected to come into play at different times.

Overall, the livelihoods restoration program on the Nakai Plateau, despite limitations and failings of different livelihood pillars, achieved income targets by 2013. Living Standards Measurement Surveys (LSMSs) for 2011 and 2013 showed a consistent pattern of rising incomes with only 3 percent of households having incomes below the target levels. NTPC and the government proposed the closure of the resettlement implementation period (RIP) on this basis in 2015. However, the E&S POE pointed out a large part of the income in 2013 came from illegal logging and thus was not sustainable according to the Concession Agreement.⁸⁴ Thus the E&S POE called for another two years of project support and the continuation of the RIP. A Safeguards Compliance Review by the World Bank’s Operations Policy and Country Services in 2016 identified numerous issues with the livelihoods restoration program. Subsequently, a Comprehensive Action Plan (CAP) was prepared under the joint working group, which was established specifically to address remaining environmental and social issues related to the NT2 HPP so that the RIP could be closed. By the end of 2017, the POE agreed to RIP closure. This triggered the start of funding from NTPC of the NT2 Development Fund, which would support the government’s medium-term development program that was prepared in conjunction with the CAP.

Agriculture pillar. The agriculture pillar was critical to the villagers, as one of their highest priorities was food security, meaning rice.⁸⁵ However, the program design fell short of meeting this objective. Rather, the initial design was for each house to have a small piece of irrigated paddy land, and rely on other marketable crops to purchase household needs.⁸⁶ The program focused on improving soil quality, developing

irrigation, and promoting cash crops, vegetables and fruits, on household and family plots. Some of the villages, particularly in the southern section of the settlement area, were able to raise paddy and gain access to additional area for farming, but space was limited; irrigation design and implementation were perpetually problematical; and market access was slow to develop. There is no documentation to indicate that a sustainable, affordable way to improve soil quality was ever developed or promulgated in the resettlement area. Over time, different crops were promoted, including cassava, and then agroforestry, with varied amounts of success. Meanwhile, rice consumption decreased from an average 23 kg/person/month in 2006–2007 to 14.5 kg/person/month in 2017.⁸⁷ By the time of the last LSMS survey in 2017, 75 percent of the household plots were in production during the wet season, compared with 65 percent in 2011. About 50 percent of the households used the plots to cultivate paddy or upland rice in the dry season in 2017, an increase from the 9 percent in 2011, and 14 percent in 2013.⁸⁸ By 2017, 22 percent of the household plots included agroforestry. Of the 228 small irrigation systems developed under the project, 47 percent were usable in 2017 and only 36 percent were actually used.⁸⁹ Nonetheless, agriculture comprised 28 percent of average household income in 2017, only a modest proportional drop from 31 percent in 2006 and an increase from the 15 percent in 2011.⁹⁰

The agriculture pillar could have made a much more significant and dependable contribution to the restoration of livelihoods, as it appeared to have a substantive empirical base from the demonstration farms. However, this was not the case for several reasons. First, the demonstration, like many pilots, enjoyed a level of technical support⁹¹ that was not carried into implementation. Field staff were limited and inexperienced from the beginning and, even by 2010, the LTA noted the junior district staff are not adequate for extension or water management support.⁹² Second, it is not clear that the agriculture advisers and field staff have ever developed satisfactory recommendations to use the poor soils and improve soil quality throughout most of the resettlement site. As of late 2007, the IFIs stated that “it is yet to be demonstrated that resettlers can sustain agricultural livelihoods on the poor soils involved,”⁹³ and no subsequent IFI aide-mémoire offers any assurances that this had been demonstrated. IFI support seems also to have been weak as demonstrated in the dearth of ideas in the aide-mémoire and the fact that only one IFI aide-mémoire (June 2008) had an addendum addressing agricultural issues. Third, irrigation was promised on a small portion of each holding, but only addressed later in the resettlement process⁹⁴. At that time, much of the original irrigation planned was deemed unfeasible by NTPC and alternatives were explored, especially gully dams. But by 2017, only 44 percent of the 228 systems in place were operational.⁹⁵ Moreover, by then the issue of financing ongoing operation and maintenance costs, an NTPC obligation in the Concession Agreement, was uncertain. Fourth, the SDP and PAD emphasize the need to tailor household and village programs

to the needs and preferences of villagers, but there is little indication that this was the operational policy of NTPC or the government in the resettlement zone. In 2016, however, the idea of greater customization of solutions was put forward and became enshrined in the CAP prepared to reach RIP closure.⁹⁶ As the plan management focuses on actions, rather than outcomes, there is no data regarding actual implementation of the “tailoring” idea and the extent to which there were real results. Finally, although the original design of the agricultural pillar expected resettlers to grow trees as well as crops, it was not until late in the implementation process that resettlers were successfully encouraged to grow both trees and crops in their plots, to practice agroforestry. Associated with this approach, the NTPC started distributing barbed wire to farmers to protect their farm plots from wandering animals. This simple addition appeared to be a needed action to get resettlers to think more positively about their plots and how to use them. By 2017, the LTA reported positively on the adoption of agroforestry in 2015, indicating the first real breakthrough in the pillar.⁹⁷

Livestock pillar. Previously, resettlers kept livestock, which roamed freely. A few families had large herds of buffalo, and many had a head or more, as well as smaller animals.⁹⁸ The families had no access to veterinary care, so the animals were subject to various illnesses and holdings fluctuated⁹⁹. During project preparation, the large animals were characterized as being “savings banks” to be used for unexpected cash needs,¹⁰⁰ and total animal holdings were seen as exceeding the carrying capacity of the resettled lands. Therefore, the main thrust of the livestock program was to make smaller animals available to families without animals and to provide vaccination and support to other animals, promote herd reduction, with the ultimate objective to get families to keep animals from roaming and to cut-and-carry forage grasses to feed them, utilizing the manure as fertilizer. The transition resulted in at least one year of widespread animal starvation, and the project compensated families for the lost animals.¹⁰¹ Over time, many of the buffalo have been replaced by cattle and barbed wire was eventually distributed to protect crops from the animals that continued to wander around. By 2017, 91 percent of the resettler households had livestock, compared with 87 percent in 2006 and 71 percent during the lowest point. Holdings are diversified, with more pigs, goats and ducks, providing households resilience to external shocks.¹⁰² Mean income from livestock in 2017 reached 13 percent, compared with 23 percent in 2006 and 4 percent in 2011.¹⁰³ The threat of animal overpopulation remains, but appears to be on the horizon, rather than imminent.¹⁰⁴

Fisheries pillar. With the advent of the reservoir, it was expected that more people would derive income and protein from fishing, and this has been realized, to some degree. The fishing program has a number of elements, dealing with reservoir management, water quality monitoring, protecting spawning areas, protecting the

reservoir from outsiders, and promoting and managing marketing. Although overall management is an ongoing issue, particularly regarding village participation and both individual and collective responsibility, the situation appears to be stabilized for the moment despite some risks to sustainability (discussed in the environment section of this annex). As expected, there was a huge influx of fish after the dam closed and the reservoir was filled, followed by a drop to a stable level. The fish population has since stabilized, although species have changed. In the 2006 LSMS, fishing accounted for 14 percent of income, compared with 38 percent in 2008 and 35 percent in 2009. It then decreased to 28 percent overall in 2017, although vulnerable households derived 36 percent of their income from fishing in 2017¹⁰⁵. The LTA and E&S POE have both suggested that the fisheries pillar has been the most successful. The latest LTA report indicates increased local patrolling and enforcement of restrictions, especially in the protected zones although there are some concerns about the long-term sustainability due to a lack of an active reservoir management program, propagation of invasive species, and illegal fishing in spawning areas.

Forestry pillar. The forestry pillar of the livelihood program has been the most problematical. The original idea as stated in the SDP was that the over 17,000 hectares of forests in the area would be managed on behalf of the resettlers as a commercial venture, for which each household, as a shareholder, would receive an annual dividend, estimated to be approximately USD100.¹⁰⁶ The pillar was supposed to provide about a third of family incomes from both timber and nontimber forest products.¹⁰⁷ The Nakai Plateau Village Forestry Association (VFA) was created in 2005. It had a role in providing lumber for resettler houses, and paid a dividend to households in 2008 and 2009. After a couple of years, the dividends dried up and efforts have been under way to promote individual and community agroforestry, both on individual plots and community areas, respectively. The failure of this component, which was expected to contribute annually to household incomes, has yet to be overcome. Forest income includes income from hunting, collecting timber, NTFP and VFA dividends. Forestry income has ranged from 9 percent in 2006, which largely meant hunting, to 5 percent in 2017. The highest levels of forest income reported in the LSMS were in 2011 (38 percent) and 2013 (22 percent), which both reflects a more systematic focus on the issue in those surveys, and the widespread practice at the time of illegal harvesting of rosewood for export, which has since ceased.¹⁰⁸

The forestry pillar was framed in the SDP in the following terms: the forestry is owned by the resettlers, but an entity will be set up to manage the resource until resettlers can manage it themselves.¹⁰⁹ However, it turned out that even by 2007, the allocated area was poorly managed and getting worse, according to the May 2007 International Advisory Group Report 7, page 7. Then the VFA was turned into a corporation, which

made it subject to corporation taxes, calling an end to dividends. Problems with the VFA were continuously mentioned by all monitoring groups, including the LTA referring to the organization an “ineffective experiment unable to provide long-term benefits to resettlers.”¹¹⁰ It was not until a decade into implementation when the World Bank undertook the Safeguards Compliance Review in 2016 that the VFA was stopped and attention started to focus on developing an alternative management model that is driven by community members and responsible to them.¹¹¹ One task of the CAP is for each village to prepare a community-driven forest management. As of late 2018, however, the plans were not available and there is no record of any under implementation.

Off-Farm Livelihood Pillar. The off-farm livelihood pillar has been a minor one, spread widely but involving very few people. It has included vocational training from handicrafts, motorcycle maintenance and hospitality to business planning and development, processing fish and agricultural products, and market awareness. According to LSMS surveys, wage employment has gone from 23 percent in 2006 to 30 percent of family income in 2008, and to 15 percent in 2017.¹¹² Meanwhile, business and other income accounted for 10 percent of income in 2017. To support this pillar, Village Development Funds were created in each village to issue loans to residents to enable them to start businesses or invest in their ongoing activities. Increased attention has been paid to this pillar over time; however, it is not clear to what extent the income results obtained in the surveys are attributable to project programs. So far, this pillar has relatively little visible outcome.

Downstream. The program started in 2008 and ended in 2012 after it reached its budget target of \$16 million and an extension of one year for over \$ 2 million to cover hinterland villages in the XBF catchment. Responsibility was then handed over to the government. Most of the activities concluded at that point as government funding was not forthcoming.¹¹³ After closure, NTPC showed data from three surveys between 2009 and 2014 that indicated a significant increase in household consumption and dietary diversity, but decrease in incomes over the same time, estimating that as many as 10,000 households may have been unable to restore their livelihoods to the preproject level¹¹⁴. The Safeguards Compliance Review in 2015 cited this uncertainty as an issue to be addressed, but there is no documentation to suggest that it was resolved¹¹⁵. NTPC produced a Downstream Program Assessment in 2018 that concluded that even if income restoration was not fully achieved, the programs appeared to offset the loss of fish protein in household diets—an important indicator for this activity. The assessment (2018) recommended reviving the Village Income Restoration Fund, which by then has been suspended in many villages since 2015¹¹⁶ An Adaptive Management Committee was established as part of the CAP, which continues to monitor the downstream areas, but the Downstream Program Assessment in 2018 indicated that the fund was dormant

and, as such, the assessment concluded that the program was not in compliance with OP 4.01. Based on questionable logic, however, the assessment concluded that because the loss of fishery livelihoods was not the result of land acquisition or restricted access to natural resources, livelihood restoration was not required, as the activity was not subject to OP 4.12 and thus the program was compliant¹¹⁷. This is a mistaken interpretation of the OP since it covers both direct and indirect impacts of an investment. Moreover, maintaining incomes of downstream project-affected people at preproject levels was an explicit indicator in the NT2 HPP results framework. The assessment also noted that since 2013, when the downstream program was handed over to the government, no funding had been transferred from the Province to districts to continue the work begun by NTPC.¹¹⁸

NNT-NPA watershed. There has been little livelihood monitoring in the watershed or documentation of the extent to which programs outlined in the SEMFOP were undertaken. An ADB Completion Report cites a 2018 survey in which 90 percent of interviews said that life was better in the past 10 years, most of which attributed the improvements to WMPA works.¹¹⁹ Women's focus groups revealed that the principal improvements were access to education, health services for maternal and prenatal care, and child vaccination. Animal vaccinations were also valued. In 2017, the WMPA was restructured and a Consortium of Technical Experts was engaged to implement a revised SEMFOP III (which includes neither a Resettlement Process Framework nor EMDP), focusing on livelihoods development and rural development. A World Bank project, Second Lao Environment and Social Project (LENS II), has subsequently become effective to focus on watershed issues and the enclave communities¹²⁰. Consequently, there is little consistent monitoring data to determine sustainable social progress in the watershed.

Notes

¹ The construction of a new high-density, polyethylene-lined landfill has been delayed from the original target of end of 2018 because the need to find a suitable plot, obtain the land certificate, and permits for tree cutting. Construction has now begun, and completion is expected before the end of 2019.

² Including hard hat, safety boots, hearing protection, coverall, and eye protection

³ Two of these fatalities involved construction workers and other two were from local communities who were drowned in streams during swim attempts.

⁴ Almost all hazardous waste is stored in drums at this landfill with a liner located about 20 km from the power plant since the current infrastructure in the country is not adequate to handle hazardous waste.

⁵ Olivier Salignat et al cite the following reasons: (i) only a small fraction of the rapidly degradable biomass is located in the aerial (leafy) vegetation, (ii) cutting the vegetation alone

does not address the question of disposal of their biomass and burning generates significant adverse impacts, (iii) exportation of the biomass is not practically feasible, (iv) clearance of large areas is technically very challenging and poses significant environmental and social impacts, and (v) residues from logging may impact powerhouse operations.

⁶ Zhou, J. 2011. Life Cycle Assessment of Greenhouse Gas Emissions from Nam Theun 2: Hydroelectric Project in Central Laos. Master of Environmental Management degree Duke University, USA.

⁷ Products of anaerobic decomposition include hydrogen sulfide that corrodes dam turbines and is noxious to aquatic organisms.

⁸ When flood levels are at or above 15.5 m at the gauge at Mahaxai—a village slightly downstream of the confluence of the downstream channel and XBF

⁹ There is also additional measures implemented by NTPC to address downstream social impacts of the NT2 HPP.

¹⁰ Adversely impacted fisheries and aquatic ecosystems, rice production, and riverbank gardens.

¹² The last at a height of some 4 to 5 meters exceeding previous heights of a little over 1 meter, a maximum level observed by flow release.

¹³ The program consists of 27 photo-monitoring points, a further 647 non-indicator photo-monitoring sites (annual recording), and 40+ river cross-sections (every five years, last completed in 2013 and 2018). An NTPC report from 2017 documents the results of photo-monitoring, indicating no significant levels of erosion. However, some downstream communities have identified areas of riverbank erosion after the receding of the 2018 flood. Whilst such erosion resulting during the flood of 2018 is unlikely to be attributable to NT2, it is impossible to determine whether or not long-term river channel morphology changes are due to NT2 without scientific sedimentological analysis of TSS data and cross-section data.

¹⁴The regulating pond was originally intended to mitigate impacts of daily peaking generations to provide a constant flow downstream, but such regulation is no longer necessary since Electricity Generation Authority of Thailand does not operation NT2 HPP as a peaking plant.

¹⁵ Flows were predicted to be reduced by an average of 302 m³/s between the confluences with the Nam Kading and the Nam Hinboun, due to both NT2 and Theun-Hinboun; water levels were predicted to fall by 220 m³/s between the confluences with Nam Hinboun and XBF—an average 3 percent reduction in Mekong flows; and a small reduction in flows in the wet season (lowering flood levels 18 centimeters) and a small increase in the dry season was predicted below the XBF confluence.

¹⁶ Statement by Director of the Stimson Center's Southeast Asia Program.

¹⁷ World Bank Group Systematic Country Diagnostic (SCD 2017)

¹⁸ NTPC Environmental and Social Progress Report, 2014, 2015, 2016, and 2017

¹⁹ NTPC Environmental and Social Progress Report, 2014–2017

²⁰ NTPC Environmental and Social Progress Report, 2014, 2015, 2016, and 2017

²¹ Fish and protein intake were also a results indicator for the social development aspect of the NT2 HPP. The environment section only reviews the fisheries impact while the protein and livelihood impact of fisheries is discussed in the social section.

²² There are reports of the deliberate introduction of invasive species of fish that appeared within the first year. Field notes recorded that a villagers in Sop Hia was catching mostly tilapia and common carp (both considered by IUCN to be in top 100 invasive species, globally) and in large numbers (Savannakhet Provincial Agriculture and Forrest Office). NTPC acknowledged the potential for other invasives, including the Siamese glassfish that will influence the future evolution of the fish population in the NT2 reservoir (Cottet, et al. Op. cit).

²³ 8th (and final) report on the Fisheries Status of the Nakai Reservoir (2018)

²⁴ As published data are based exclusively on marketing or landing site data, such figures are at best only indicative for the actual catches.

²⁵ University Of Wisconsin Press 2018. Broken Pillars In: Dead in the Water. Global Lessons from the World Bank's Model Hydropower Project in Laos.

²⁶ Canonico, G. C. et al. 2005. The Effects of Introduced Tilapias on Native Biodiversity. Aquatic Conservation: Marine and Freshwater Ecosystems 15 (5).

²⁷ World Bank Group Project Appraisal Document 2005.

²⁸ Communications with members of the IMA and the E&S Panel of Experts (POE) indicated in early POE reports and ADB Environments in Transition: Cambodia, Lao PDR, Thailand, Vietnam, 2001.

²⁹ The World Bank's OP 4.01 does not support projects that, in the institution's opinion, involve the significant conversion or degradation of critical natural habitats. Wherever feasible, World Bank-financed projects are sited on lands already converted (excluding any lands that in the World Bank's opinion were converted in anticipation of the project). The World Bank does not support projects involving the significant conversion of natural habitats unless there are no feasible alternatives for the project and its siting, and comprehensive analysis demonstrates that overall benefits from the project.

Biodiversity offsets are measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development and persisting after appropriate avoidance, minimization, and restoration measures have been taken." The goal of many biodiversity offsets is to achieve No Net Loss and preferably a Net Gain of biodiversity on the ground (or in the water), in comparison to the baseline situation before the original project is implemented.

³⁰ The area impacted by the NT2 HPP infrastructure are characterized as lower mixed deciduous, dry dipterocarp, mixed broadleaf and coniferous habitats and associated species, which was different from what is found in the NNT-NPA.

³¹ In addition, NTPC was tasked with protecting a separate 859 km of riverine habitat in compensation for the loss of wetland habitat.

³² In including the area as a part of the NNT-NPA, areas could be designated under different degrees of protection (Priority Biodiversity Zones, Totally Protected Zones and village use/access areas) to accommodate the use of the area by resettled populations.

³³ Phou Hin Poun and Phou Nam Hin Poun corridors

³⁴ Established as Prime Ministerial Decree 25 in 2001, amended in 2005 (PM Decree 39) and in 2010 (PM Decree 471).

³⁵ (POE Report # 21A, Mar 2013) and Lauginie 2014. Organizational Review of the Watershed Management and Protection Authority (WMPA) and later, the World Bank's Implementation Status and Results Report (Implementation Status and Results Report, July 2016) noted that the WMPA was unable to execute all designated managerial functions in a technically sound, transparent and professional manner.

³⁶ Robichaud, W. 2018. Elusive Conservation in the Nam Theun 2 Catchment. In *Dead in the Water: Global Lessons from the World Bank's Model Hydropower Project in Laos*. University of Wisconsin Press.

³⁷ Ibid.

³⁸ Based on POE reports and communications with specialists.

³⁹ Forest Carbon. 2018. Mapping Forest Cover Change 2012–2017, Nakai Nam Theun National Protected Area, Lao PDR. A Summary Report to the World Bank. Jakarta.

⁴⁰ Forest Carbon. 2018. Mapping Forest Cover Change 2012–2017, Nakai Nam Theun National Protected Area, Lao PDR. A Summary Report to the World Bank. Jakarta.

⁴¹ Data provided by the Laos Wildlife Conservation Association.

⁴² Wildlife Conservation Organization based in Lao PDR; Project Anoulak, covering wildlife research and protection; Agrisud International on livelihood; and, Creative Literacy Laos, to assist community education and conservation awareness.

⁴³ Raising the management standards from IUCN Category VI (protected area with sustainable use of natural resources) to IUCN Category II (protect large-scale ecological processes for biodiversity conservation, research, and recreation).

⁴⁴ The NT2 HPP is now closed by the World Bank. However, the World Bank Second Lao Environment and Social Project (LENS II), which is presently under implementation, is providing \$3 million over 5 years to augment NTPC funds, which will continue until the end of the NTPC concession period. The objective is to help upgrade the NNT-NPA to a National Park, and the WMPA into a National Park Office.

⁴⁵ Legally, the project is subject to Operational Directive 4.20 (OD 4.20), which was the operational policy in place at the time of Appraisal. The Safeguards Compliance Review, which evaluated for compliance with 4.20 also noted that there is minimal differences between OD 4.20 and OP 4.10 (p. 49). Consequently, this analysis evaluated for compliance using OP 4.12 as the reference.

⁴⁶ Volume 1—Introduction and Cross Cutting Issues; Volume 2—Nakai Plateau – EMDP and RAP; Volume 3—Downstream Areas – EMDP, Resettlement and Livelihood Restoration; and volume 4—Project Lands Resettlement (Acquisition and Compensation) Plan.

⁴⁷ This was subsequently followed by two additional volumes, both of which appear to have eliminated the EMDP and Resettlement Process Framework.

⁴⁸ The name given in the project to what are otherwise referred to as Indigenous Peoples Development Plans in the Operational Directive.

⁴⁹ NT2 Project Appraisal Document (PAD), March 2005, p. 51, p. 53, respectively.

⁵⁰ Compiled from the 5 downstream RAP Completion Reports, issued by NTPC

⁵¹ As opposed to the reservoir-related activities.

⁵² Noted in Joint IFI Aide-memoire, Feb.20–24, 2006, pp. 15–16, IFI Aide-memoire, Nov 10–21, 2007, pp. 15–17. The RAPs were closed and final compensation paid between 2009 and 2011 (RAP 1–5 Completion Reports).

⁵³ NT2 Social Development Plan, Volume 2, appendix I, Demonstration Farms.

⁵⁴ For example, the cropping area was located away from the homestead, irrigation was delayed and chronically problematical due to design and other problems, and the technical support was deficient, with few and poorly qualified extension workers. These issues are repeatedly chronicled in the reports of the International Advisory Group, LTA, and the Panel of Experts, and in supervision reports.

⁵⁵ During consultations for the final design of the pilot village, participants decided they wanted to be placed clan by clan, and to have houses clustered, rather than spread out.

⁵⁶ The recommendation that emerged from the demonstration farm was to have the farm plot nearby, which was understood to save labor and time, compared with having a distant farm plot. A common reason cited in the Living Standards Measurement Survey (LSMS) for not using the farm plot was the shortage of labor.

⁵⁷ NT2 Social Development Plan, Volume 2, appendix J, Pilot Village Experience. The NT2 PAD also highlighted the need to adjust to circumstances and the experience and preferences of the people, p. 56.

⁵⁸ An interview with an expert intimately involved in the early preparations and later in the LTA group. In LTA, Panel of Experts, and International Advisory Group reports, there are numerous references to the need to tailor programs for different groups. One section of the Comprehensive Action Plan, issued by the joint working group in 2017, explicitly calls for “tailoring” of programs, especially for ethnic minorities and vulnerable. Progress was communicated through the NTS “Environment and Social Progress Reports.” The reports of 2005 and 2006 were disclosed publicly, as required, but later reports were not disclosed until after the Safeguard Compliance Report was issued. The 2016 and 2017 reports indicated progress on ethnic sensitivity training for local officials and action on efforts to be more inclusive in local institutions, and language training to enable more effective participation by minorities 2016, pp. 92–105; and 2017, pp. 96–119.

⁵⁹ NT2 SDP Volume 2, chapter 25, Livelihood Integration and Income Scenarios, p. 1. NT2 PAD, p. 51; Annex 12, p. A152.

⁶⁰ Patrick Julien, Michel Raunet and Somchanh Syphanravong, “Morphopedological and agronomic appraisal in the resettlement zone for the farmers of Nakai Plateau (Laos), Nam Theun DAM – NTPC Project, June 2005, pp. 17, 19. The study was conducted to assess the resettlement sites in detail after the decisions were already made, thus the results do not support the optimistic expectations stated in the PAD and other documents.

⁶¹ PAD, p. A153. Other than ongoing financial support for vulnerable families, the promised programs to tailor inputs for particular groups has never appeared, however. Nonetheless, the LTA and POE, as well as the International Advisory Group, continually raised the issue. It was a clear objective of the Comprehensive Action Plan (2017). It is not clear from reports if the point was just ignored or if neither NTPC nor field staff had the expertise and skills to develop and implement tailored programs.

⁶² PAD, p. A170. The review team has not seen any examples of the implementation of these mechanisms, in project documents or comments or reviews by the Panel of Experts, the International Advisory Group, LTA, or IMA. Until the World Bank’s Safeguard Compliance Review, there are virtually no references to the IP policy or its implementation in documentations prepared after appraisal. In 2015, the Panel of Experts Report 24, p. 52, stated: To date, except for the Ethnic Minority Development Plan in the 2005 Social Development Plan and with the partial exception of the Ahoe, virtually no “Ethnic Minority Development Plans have been developed, let alone implemented, nor appropriate the government and NRO staff training undertaken.

⁶³ “Finding 5: The project may have not provided the NT2 ethnic minorities with all the protections and opportunities afforded in the Concession Agreement and under the World Bank safeguard policy on indigenous peoples” (USAID 2017, 6). The report recommends much more comprehensive and constructive steps to address the question than does the World Bank’s Safeguard Compliance Review 2017, which indicated that the EDMP “lacked detailed implementation plans,” and had “frugal implementation” (50).

⁶⁴ “Relocation of Resettlers shall not be commence until after the Resettler housing and essential community infrastructure and services are complete (including, without limitation, the village access road, allocated farm plots, schools, housing and clinics and availability of water for Resettler households and as far as possible, water for gardening,” Schedule 4.1 Part 1, clause 7.1 of the Concession Agreement.

⁶⁵ NTPC Quarterly Socio-Economic Survey, QSEM 8&9, Second and Third Quarter 2014, p. 4.

⁶⁶ Ibid p. 14. The AM clearly shows the priority of meeting the impoundment schedule, although it cautions to “avoid rushing the resettlement process at the end when the impoundment date is getting close.” The AM says that previous “missions have encouraged NTPC and the government to improve synchronization between resettlement site infrastructure development, livelihood program development, and project construction.” And sees improvement.

⁶⁷ Joint IFI Aide-memoire, October 7–15, 2012, p. 11. It is worth noting that the village planning was undertaken again as part of the Comprehensive Action Plan, from 2016 to 2018, as the results

from the first round were understood to be unsatisfactory and inadequately participatory. See CAP.

⁶⁸ POE Report 24, 2015, p 52.

⁶⁹ World Bank Safeguards Compliance Review, 2017, p. 46.

⁷⁰ *Ibid*, p. 54.

⁷¹ This means that people moved and stayed, the only exception being one extended household of Ahoé who moved back to their former settlement.

⁷² Noted in the Joint IFI Management Review Mission, Aide-Memoire, February 20–24, 2006, p. 3, citing similar conclusions of the Panel of Experts and the International Advisory Group.

⁷³ The last LTA report, 2018, claims that more systems are working than previously, but O&M issues are unresolved and there are no plans to meet the full Concession Agreement obligations. Other elements, such as ice houses, fish landing sites took several years to be developed. As late as 2017 the Comprehensive Action Plan was dealing with drainage for village facilities that had previously been lacking, although cited by the POE, NTPC Environmental and Social Progress Report, January–December 2017, p. 9. Pages 5–10 give an idea of efforts to reach resettlement implementation period closure.

⁷⁴ The meaning of this ownership share is yet to be determined (individual or household?). The government established Village Forestry Association (VFA) in 2005 that was supposed to manage the forests commercially on behalf of the villagers. They initially received dividends for a couple of years and then no more. The VFA is basically defunct and discussions were still under way in 2018 regarding how to engage communities in managing the forestry land, and on the community level to decide on local priorities, use allocations and limitations.

⁷⁵ These figures are largely drawn from a presentation by Pierre Guédant and Vatsana Pravongue of NTPC, “Nam Theun 2 Hydropower in Lao PDR: Lessons Learned from a Unique Resettlement Project,” AIA Special Symposium, Manila Philippines, 20–22 February 2017.

⁷⁶ It was considered innovative in that a program to mitigate and compensate for downstream impacts was part of the initial preparation, developed proactively to respond to anticipated impacts in water flow and velocity, in the XBF and decreased flow in the Nam Theun rivers. The World Bank’s Implementation Completion and Results Report (2018) included the following: “As noted by the POE, the downstream program went beyond the scope of World Bank Safeguards policies and was recognized as innovative at the time.” It is not clear how this is consistent with World Bank Group Safeguards, as the objective of safeguards, at a minimum, is to mitigate or compensate third parties for adverse impacts. Since people living downstream were expected to be effected negatively, a program to address them is fully within the realm of safeguards.

⁷⁷ Nam Theun 2 Downstream Program Assessment, final Draft, April 2018, p viii.

⁷⁸ NT2 SDP, Social Development Plan, Volume 2, chapter 25, p. 7.

⁷⁹ Concession Agreement Schedule 4, part 1 para 1.2 p. 2 for income outcomes; Concession Agreement Schedule 4 part 1, para 2.2, p. 4 for Resettlement Implementation Period.

⁸⁰ The International Advisory Group Report 7, May 2007, provides one of the clearest statements of the challenges of resettlers and their anxieties already evident, in addition to their high expectations.

⁸¹ NT2 Social Development Plan, Addenda and Supplementary Information, January 2005, Addendum to chapter 25, Livelihood Integration and Income Scenarios— Transition to Stability; and the list of entitlements, chapter 25, p. 12–13.

⁸² SDP and PAD.

⁸³ The latter references to ethnic minorities echo a basic requirement of OD 4.20. There is little evidence to indicate that these measures were ever taken seriously until the Comprehensive Action Plan, the results of which are not documented.

⁸⁴ POE Report 24, October 2015, p. 4.

⁸⁵ SDP Volume 1, p. 3 lists the principal changes introduced in the SDP based on feedback from the 1997–1998 consultations.

⁸⁶ Early and later IFI Aide Memoires questioned the appropriateness of the agriculture pillar for the people and the soil resources. 2006, p. 13; 2008, p. 11.

⁸⁷ Nakai Scio-Economic Survey Round Eight (LSMS), March 2017, Summary of Results, David Fredericks, Nam Theun 2 Power Company, Ltd. p.2.

⁸⁸ Nakai LSMS 8, 47–49

⁸⁹ Notes from lenders' technical adviser group, generated during 2017 mission.

⁹⁰ Nakai LSMS 8, p. 55.

⁹¹ Technical assistance, hand-holding, and close farmer-technical collaboration

⁹² LTA Report No 22, June-August 2010, p. 32.

⁹³ Joint IFI Aide-memoire, November 10–21, 2007, p. 13.

⁹⁴ The plan was for irrigation to be installed by year 3 of moving, but the process of deciding feasibility, designing systems and implementing them took years. Eventually, before the process was complete, the discussions began about maintenance responsibilities. Overall, this appears either not to be a priority of NTPC or both NTPC and local officials lacked adequate skill to implement it. Aide Memoires do not suggest that the World Bank Group offered any expertise of significance.

⁹⁵ LTA, Report No 38, February to November, 2017.

⁹⁶ Comprehensive Action Plan for Resettlement Implementation Period Closure and Beyond, Version 25, January 2017, p 46 for agriculture/livestock and p. 82 regarding ethnic minorities.

⁹⁷ LTA, Report No 35, p. 37. It is surprising that barbed wire was “discovered” as a need so late in the resettlement, as it was well-known from the beginning that the traditional practice is to let large animals roam. The practice continues, as observed in the town of Nakai. It would seem like an obvious conclusion that the project would help resettlers protect their crop fields from the cattle, but apparently it did not dawn on advisers until they started to advocate agro-forestry.

Even then, the LTA advised that distribution should be used as an “incentive” to adopt agro-forestry, rather than a common and widespread need of all farmers.

⁹⁸ LSMS No 8, March 2017, p. 68–74.

⁹⁹ See SDP, Volume 2, chapter 21 Agriculture and Livestock Development.

¹⁰⁰ NT2 SDP, Volume 2, chapter 13, Nakai Plateau EMDP Baseline Data. Confirmed in LSMS, round 8, March 2017.

¹⁰¹ ADB, NT2 Completion Report, p. 66 para. 61; compensation was paid for 555 buffaloes.

¹⁰² LSMS No. 8, March 2017, pp. 70–75. Large holdings are concentrated, however, as 19 percent of households own buffalo, half of which are owned by 4 percent of households; and 29 percent of households own cattle and 4 percent own 36 percent of the total, p. 73.

¹⁰³ *Ibid*, p. 55.

¹⁰⁴ LTA Report 38, November 2017 p. 4–5, cites that the current number exceeds theoretical carrying capacity, but is not particularly alarmed.

¹⁰⁵ LSMS No. 8, March 2017 pp. pp. 59–62.

¹⁰⁶ NT2 SDP, chapter 23: Forestry Development for Nakai Resettlers, p. 7.

¹⁰⁷ POE, Report 24, 2015, p. 22 lists reasons for the failure from maladministration to fees and taxation and inadequate support from NTPC and government agencies, among others.

¹⁰⁸ LSMS No 8, March 2017, pp. 77–79. Due to both decreased supply and increased enforcement.

¹⁰⁹ SDP, chapter 23, p. 6–7.

¹¹⁰ LTA Report 30, October 2012-March 2013, p. vii and 38.

¹¹¹ Interview with the Compliance Review Team, which confirmed the author’s impression that the VFA is no more than an institutional mechanism to fleece resettlers of their resources.

¹¹² The project itself generated considerable employment both in the villages and on construction sites, both of which decreased after 2010.

¹¹³ According to the NTPC Downstream Program Assessment, April 2018, The NTPC handed the program to the government at the end of 2012, but “since 2014 the DSP has not been actively implemented by the government and many of the village funds are now inactive,” p. viii. The handover was part of the Concession Agreement, and not subject to agreement by the POE.

¹¹⁴ NTPC Nam Theun 2 Downstream Program Assessment, Final Draft, April 2018, p. v.

¹¹⁵ World Bank Safeguards Policy Compliance Review, Nam Theun 2 Hydropower Project, Final Draft, November 2017, based on a desk study and field investigation between June and September, 2016, and annotated addendum, 2019.

¹¹⁶ NTPC, Downstream Program Assessment, p. 33.

¹¹⁷ *Ibid*, p. 37.

¹¹⁸ *Ibid*, Annex 2 p. 17.

¹¹⁹ ADB, Completion Report, Nam Theun 2 Hydroelectric Project, July 2019, p. 77; the survey itself was not made available to the team.

¹²⁰ *Ibid*, p. 77.

Appendix D. Economic and Financial Analyses

The evaluation team carried out economic and financial analyses to confirm that the NT2 HPP remains economically justified and that it is financially sustainable. The analyses (and models) relied on data and assumptions from assessments carried out by the World Bank and Asian Development Bank in its postcompletion evaluations; supplemented by additional information gathered from project documents and a review of related literature.

Economic Analysis of NT2 HPP

The economic model and the associated analysis is carried out from several perspectives: (i) the economy of Lao PDR as it pertains to the net benefits generated from producing electricity for exports and domestic use, (ii) regional benefits beyond Lao PDR due to local externalities, and c) net global benefits due to the avoidance of global greenhouse gas (GHG) emissions.

Net Economic Benefits to Lao PDR

Analysis of alternatives. The Hydropower Office of the Lao PDR Ministry of Industry and Handicraft undertook an analysis of alternatives in 1998 (Lao PDR 1998). It compared 20 potential hydropower projects using a dual methodology: a) a quantitative comparison of candidate projects based on a monetary standard was first performed, taking into account all costs, benefits, and impacts that could be reasonably reduced to monetary values, and b) a parallel qualitative ranking since many costs and benefits were difficult to quantify. Thirty-six different scenarios were developed by which the government's commitment on target power exports to Thailand could be met. NT2 HPP was found to be the most attractive power export scenarios in all cases.

As part of due diligence for the NT2 HPP, the World Bank and the prospective power off-taker, Electricity Generating Authority of Thailand (EGAT), undertook an evaluation of the economic expansion planning of the Thai power system in which the project was modeled as a candidate competing for a place in the expansion plan along with a range of fossil-based alternatives (World Bank 2004). The base-case analysis concluded that the NT2 HPP should be included in the least-cost generation expansion plan from 2010. Both studies confirmed that NT2 HPP was the preferred candidate project among alternatives.¹

Methodological approach. The evaluation team developed a Cost-Benefit Analyses model to compare economic benefits with economic costs of NT2 HPP by calculating the economic internal rates of return (EIRR) and economic net present values (ENPVs). The border price (Free on Board (FOB) export price) was selected because most costs and

benefits are tradable and there would be no need for their adjustment, which invariably introduces error into the shadow pricing exercise. It also obviates the need to estimate a blended shadow exchange rate factor as was done at appraisal and completion. The economic life of the project was evaluated for 25 years, essentially the life of the electro-mechanical equipment and the Concession Agreement between the Nam Theun 2 Power Company (NTPC) and the government. Nontradable benefits and costs were adjusted by a standard conversion factor valued at 88 percent for Lao PDR and 98 percent for Thailand.² An economic cost of capital (EOCK) of 10 percent was used to discount net economic flows. The project, which has an estimated economic life until at least 2050 will be transferred to the government at the end of the concession period in 2035. Therefore, an in-use value of the existing depreciated assets was used³ as an economic benefit at the end of the concession period in 2035.

Valuation of energy benefits from NT2 HPP. Revenues from primary and secondary electricity sales (5,354 GWh) to Thailand are incremental economic benefits to Lao PDR. However, it was noted at appraisal that the project will result in an annual reduction in electricity production of 275 GWh from the existing Theun-Hinboun hydropower, which shares the catchment area with NT2 HPP. Therefore, the evaluation reduced the amount of primary energy exported to Thailand to account for the reduction of output from Theun-Hinboun hydropower, as was also done at appraisal and completion. The evaluation also assumed that the reduction in Theun-Hinboun hydropower output would result in generation operating and maintenance cost savings and factored these savings into the EIRR and ENPV calculation as an economic benefit.

The electricity contribution of NT2 HPP (200–300 GWh) as a percentage of domestic consumption in Lao PDR is small and falling, reduced from 16 percent in 2011 (the first full year of production) to 9.5 percent in 2018. Therefore, at appraisal and completion, benefits from electricity sales to Lao PDR were defined as nonincremental because it was argued that they replace imports from Thailand. The evaluation team concurs that all energy sold to Lao PDR should be deemed nonincremental.

Primary and secondary energy sales to Thailand are tradable and their economic benefits are valued in terms of revenue. Lao PDR engages in electricity trade with Thailand and imports electricity from China and Viet Nam. Therefore, electricity is a tradable commodity and domestic electricity consumption from Nam Theun 2 is therefore valued in terms of resource cost savings, that is, the cost of importing electricity from Thailand.

In addition, it is worth noting that the charges levied by the government for the use of water (royalties) can also reflect a further economic benefit of the exploitation of Lao

PDR' hydro resources. However, for the purpose of this analysis, this potential additional benefit was not used; and may undervalue the total benefits.

Economic costs of NT2 HPP. The economic capital cost of NT2 HPP was derived from the actual financial cost of the project. Only financing costs, such as interest during construction, were removed to estimate the economic (shadow) values. The evaluation proceeded on the basis of no taxes or duties in capital costs, as noted at appraisal and closing, although there was no evidence to validate this assumption. Therefore, the EIRR calculation may be underestimated. The economic capital cost of NT2 HPP also included the transmission line from the project to the Lao-Thai border for power evacuation. The cost of operation and maintenance of NT2 HPP was based on historical data of 0.525 cents per kWh generated.

The economic cost of land that the project occupied was not included in the capital cost at appraisal or completion and thus underestimated the capital cost. At appraisal, it was estimated that the project would require up to 6,480 ha of land for project infrastructure, including transmission lines. Relocation of communities of the Nakai Plateau of about 1,100 households that were to be affected by the creation of the reservoir entailed the loss of rice fields, fields for other crops and vegetables, forest land, and fishing grounds. It was estimated that these households earned \$449 in 1998 (about \$550 in 2019 prices) and that 250 hectares would be removed from agriculture production. This evaluation assumed that the foregone annual income of 1,100 relocated households represents lost output of the land acquired by the project. Based on this foregone income, the evaluation estimated that the economic cost of the land used for the project had a value of about \$5 million.

Similarly, the actual capital cost includes \$78.6 million in environmental and social mitigation costs, which may not accurately account for the economic cost of resettlement since it is unknown how much of this amount represents actual resource costs or transfer payments. The government also budgets for environmental and social mitigation costs related to the project, but it is not known how much of it represents an actual resource cost or transfer payment. Nevertheless, the EIRR calculation retained the \$78.6 million in environmental and social mitigation costs as a part of the overall capital costs.

Results of analysis. The net economic benefits for Lao PDR from the NT2 HPP was an economic net present value (ENPV) of \$550 million at a 10 percent discount rate, which corresponds to an economic internal rate of return (EIRR) of 15.3 percent (please see table C.1 for summary of results). This is consistent with the appraisal stage analysis that estimated an ENPV of \$523 million and an EIRR of 16.3 percent. A sensitivity analysis was carried out on the possible reduction in output from NT2 HPP from 2019 onward. A

10 percent reduction in the electricity produced from NT2 HPP from 2019 onward would decrease the ENPV to \$492 million and an EIRR of 14.9 percent, indicating that the project would still be economically justified. The project is more sensitive to reduction in electricity produced, which could occur due to low water levels (as was the case for 2015 and 2016 during implementation), which can be exacerbated by climate change—something that was underappreciated at the time of appraisal. A 20 percent reduction in the output of electricity in NT2 HPP would reduce the ENPV to \$433 million at an EIRR of 14.6 percent. The project’s robustness to changes in operations is primarily because, after nearly a decade since commissioning, NT2 HPP has already recouped the initial economic resources used for its substantial investment costs. The Economic PV of the investment and operational costs until 2018 is \$991 million, which is eclipsed by the \$1,032 million in benefits for the same period, for an ENPV of \$41 million (@10 percent discount rate). Therefore, the project can stand considerable variation in future performance and continue to remain economically viable.

Given the ex post nature of the analysis for major investments and robustness of the project’s economic returns, further sensitivity around variables that may still shift in the future were not considered. It is worth noting that the project construction was completed in 2010, in 58.5 months (4.5 months longer than the time frame estimated at appraisal) at a cost overrun on physical investments of only two percent (well within the contingency allocation of \$200 million). This is significantly less than the average 14 months of time overruns and over 30 percent cost overruns (beyond the allocated contingencies) experienced by a sample of World Bank financed hydropower projects evaluated recently by the Independent Evaluation Group especially given the large-scale and complex nature of the NT2 HPP. Finally, the extensive analysis that was carried out at appraisal regarding the offtake potential and absorptive capacity for electricity produced by NT2 HPP has borne true, and therefore, was not further assessed. NT2 continued to be a least-cost solution for EGAT with a levelized cost of 2.7 US cents/kWh while the average generation cost in Thailand is 5.7 US cents/kWh (World Bank 2014). Therefore, offtake is not expected to be disrupted as EGAT has continued to purchase electricity from NT2 HPP without interruption; while Lao PDR has significantly expanded its hydropower exports to Thailand since NT2 HPP with the development of over 4,000 megawatts of hydropower. Taken together, there is relatively little risk to the economic return, and sufficient robustness in outcome to absorb such risks, if they were to materialize in the future.

Valuation of Local and Global Environmental Externalities

The NT2 HPP displaces fossil-based electricity produced from combined-cycle gas turbines (CCGT) in Thailand. As a result, there are local environmental benefits in

Thailand from the avoided nitrogen oxide (NO_x) and global environmental benefits from avoided carbon dioxide (CO₂) that contribute to the mitigation of climate change.

Local environmental externalities. Generating electricity from natural gas (CCGT, in the case of Thailand) produced local pollution in the form of emissions from NO_x. Thus, purchasing electricity from NT2 HPP, Thailand avoids an equivalent production of domestic power from CCGT, whereby, the NO_x emissions that would have otherwise occurred is avoided. Furthermore, it is assumed that the marginal unit of electricity that is domestically consumed in Lao PDR is imported from EGAT in Thailand. Therefore, the domestic supply of electricity from NT2 HPP through Électricité du Laos also displaces an equivalent amount of electricity production from CCGT in Thailand avoiding additional emissions of NO_x. Thus, all avoided local pollution due to NT2 HPP will be in Thailand.

NO_x gases react to form smog and acid rain as well contributing to the formation of particulate matter and ground level ozone, both of which are associated with adverse health effects⁴. The economic impact of the emission of NO_x (or the benefit from avoided emissions) is estimated at a base value of 0.24 US cents/kWh⁵ electricity produced from natural gas adjusted for an escalation factor based on population and gross domestic product growth over time. The PV of the total local externalities due to NT2 discounted at 10 percent that is accrued to Thailand is \$128 million. This reflect a total local (that is, regional) net economic benefit from NT2 HPP, including local externalities of \$678 million.

There is one important countervailing factor that may lead to an overestimate in the net regional environmental benefit. The unsuccessful protection of the biodiversity offset has an environmental cost to Lao PDR. Data limitation prevents an accurate calculation of the economic impact of the biodiversity loss of the reservoir inundation and the inability of the project to offset it by controlling illegal logging and poaching, but it merits qualitative consideration when interpreting the overall benefits of the NT2 HPP.

Global environmental externalities. A CCGT power plant also produces greenhouse gases (GHGs) in the form of carbon dioxide (CO₂), which negatively contribute to the global climate change. CCGT power plant is estimated by the World Bank to produce 380 grams of CO₂ per kWh adjusting for efficiency and heat-rate, which is more conservative than the 469 grams of CO₂ per kWh suggested by the UN's Inter-Governmental Panel on Climate Change. The price of carbon provided by the World Bank's guidance note (World Bank 2017a) estimated \$37 per ton of CO₂ in 2017 prices, adjusted to 2019 prices⁶. The environmental cost of carbon dioxide is escalated into the future at 2.25 percent annually.

According to Guérin et al. (2016) and Zhou (2011), dams and their associated reservoirs are not GHG neutral and contribute to methane emissions from energy and material inputs in the construction and decommissioning of these projects, as well as the anaerobic decomposition of flooded biomass. The World Bank estimated ex ante the cost of GHG emissions associated with NT2 HPP at a rate of 38 grams of CO₂ equivalent per kWh. However, the higher-than-expected biomass decomposition likely increased the CO₂ emissions from the NT2 reservoir due to the shortcoming in clearing before inundation, as noted in the environmental assessment of this report. Therefore, an estimate factoring in the original flooded biomass decomposition indicates a potentially higher emission factor of 80–90 grams of CO₂ equivalent per kWh (Zhou 2011), of which the higher end of the range was used in the analysis.

The PV of the global environmental benefits is estimated at \$513 million and the PV of costs associated with a methane emissions from the reservoir is estimated at \$122 million. The net *global* economic benefit from the avoidance of CO₂ due to NT2 HPP is \$392 million. An equivalent estimate for expected reduction in GHG emissions was not considered at appraisal.

Based on the analysis carried out, the *total* NPV for the NT2 HPP taking into account local (Lao PDR) net benefits, regional externality (to Thailand) from avoiding local pollution, and the global net externalities from avoiding GHGs that adversely affect climate change, is estimated at \$1,070 million with an EIRR of 19 percent.

Table D.1. The Economic Impact of the Nam Theun 2 Hydropower Project

	Economic Costs to Lao PDR		Sales (exports)		Resource Cost Savings		Net Economic Benefits		Net Local Environmental Benefits		Global Environmental Benefits		TOTAL ECONOMIC BENEFITS (+ regional + global externality)
	Economic Costs to Lao PDR		Sales (exports)		Resource Cost Savings		Net Economic Benefits		Net Local Environmental Benefits		Global Environmental Benefits		
	Economic Costs to Lao PDR		Sales (exports)		Resource Cost Savings		Net Economic Benefits		Net Local Environmental Benefits		Global Environmental Benefits		
	Capital	O&M	Thailand	Lao	Theun-PDR	Hinboun	(to Lao PDR)	to Lao PDR	to Thailand	Regional Economic Benefits (+ local externality to Thailand)	Environmental Benefit	Environmental Cost	
2004	99.26	0.00	0.00	0.00	0.00	0.00	(99.26)	0.00	0.00	(99.26)	0.00	0.00	(99.26)
2005	169.98	0.00	0.00	0.00	0.00	0.00	(169.98)	0.00	0.00	(169.98)	0.00	0.00	(169.98)
2006	203.49	0.00	0.00	0.00	0.00	0.00	(203.49)	0.00	0.00	(203.49)	0.00	0.00	(203.49)
2007	320.54	0.00	0.00	0.00	0.00	0.00	(320.54)	0.00	0.00	(320.54)	0.00	0.00	(320.54)
2008	227.04	0.00	0.00	0.00	0.00	0.00	(227.04)	0.00	0.00	(227.04)	0.00	0.00	(227.04)
2009	155.69	0.00	0.00	0.00	0.00	0.00	(155.69)	0.00	0.00	(155.69)	0.00	0.00	(155.69)
2010	4,740	39.27	0.00	246.74	18.15	1.44	227.06	0.00	13.76	240.82	68.33	16.18	292.96
2011	5,807	5.06	278.24	26.05	1.44	300.67	0.00	17.44	318.11	83.71	19.83	382.00	
2012	5,689	6.34	275.16	19.36	1.44	289.63	0.00	17.68	307.31	82.01	19.42	369.89	
2013	5,816	7.05	286.20	23.73	1.44	304.33	0.00	18.70	323.03	83.84	19.86	387.01	
2014	5,977	12.68	284.06	17.88	1.44	290.70	0.00	19.89	310.59	86.16	20.41	376.34	
2015	5,656	16.68	248.66	15.17	1.44	248.60	0.00	19.48	268.08	81.53	19.31	330.30	
2016	6,699	46.14	288.24	18.63	1.44	262.17	0.00	23.87	286.04	96.56	22.87	359.74	
2017	6,056	36.32	243.44	16.34	1.44	224.91	0.00	22.33	247.24	87.30	20.68	313.86	

2018	5,985		37.86	250.17	15.72	1.44	229.48	0.00	22.84	252.32	88.60	20.99	319.94	
2019	5,865		36.32	243.88	18.77	1.44	227.78	0.00	23.16	250.93	89.11	21.11	318.94	
2020	5,865		36.27	243.88	18.77	1.44	227.82	0.00	23.96	251.79	91.40	21.65	321.54	
2021	5,865		39.31	243.88	18.77	1.44	224.78	0.00	24.80	249.57	93.68	22.19	321.07	
2022	5,865		30.40	243.88	18.77	1.44	233.69	0.00	25.66	259.35	95.97	22.73	332.59	
2023	5,865		30.02	243.88	18.77	1.44	234.07	0.00	26.55	260.62	98.25	23.27	335.60	
2024	5,865		31.58	243.88	18.77	1.44	232.51	0.00	27.48	259.99	100.54	23.81	336.71	
2025	5,865		30.95	243.88	18.77	1.44	233.15	0.00	28.43	261.58	102.82	24.35	340.05	
2026	5,865		30.95	243.88	18.77	1.44	233.15	0.00	29.42	262.57	105.11	24.89	342.78	
2027	5,865		30.95	243.88	18.77	1.44	233.15	0.00	30.45	263.59	107.39	25.43	345.55	
2028	5,865		30.95	243.88	18.77	1.44	233.15	0.00	31.50	264.65	109.68	25.98	348.35	
2029	5,865		30.95	243.88	18.77	1.44	233.15	0.00	32.60	265.75	111.96	26.52	351.19	
2030	5,865		30.95	243.88	18.77	1.44	233.15	0.00	33.73	266.88	114.25	27.06	354.07	
2031	5,865		30.95	243.88	18.77	1.44	233.15	0.00	34.91	268.05	116.53	27.60	356.99	
2032	5,865		30.95	243.88	18.77	1.44	233.15	0.00	36.12	269.27	118.82	28.14	359.94	
2033	5,865		30.95	243.88	18.77	1.44	233.15	0.00	37.38	270.53	121.10	28.68	362.94	
2034	5,865		30.95	243.88	18.77	1.44	233.15	0.00	38.68	271.83	125.67	29.76	367.73	
2035	5,865	-405.09*	30.95	243.88	18.77	1.44	638.23	0.00	40.03	678.26	127.96	30.31	775.91	
							ENPV	550.07		ENPV	677.98		ENPV	1,069.50
							EIRR	15.29%		EIRR	16.26%		EIRR	19.04%

Note: *Estimated in-use value of NT2 HPP at end of concession period.

Financial Analysis of NT2 HPP

Financial performance: The NTPC has been achieving stable financial results as the NT2 HPP has continued to produce electricity on average above what was projected annually with EGAT purchasing and making payments without issue. NTPC informed the evaluation team that the payments from Électricité du Laos, which make up a small portion of the revenues from NT2 HPP, are delayed on average about one year. Based on NTPC's audited financial statements, the revenues from the sales to EGAT and Électricité du Laos were between \$260 million to \$270 million for the 2011–2016 period, which exceeded the projected level at appraisal (\$230 million to \$260 million) for the same period. Gross profit margin and operating profit margin were also stable during the 2010–2016 period, with average of 72 percent and 65 percent, respectively. Based on the track record in the past, with the strong energy demand and competitive power generation costs of the NT2 HPP, the project is expected to produce electricity in a satisfactory manner in the future. Historical debt-service coverage ratios (DSCR) had been stable between $\times 1.3$ and $\times 1.4$ level from 2011–2016 and cash flows to service debt is expected to be sufficient as the loans from the Thai lenders and the US dollar lenders are expected to be fully repaid by 2020 and 2022, respectively. The DSCR projected ex ante was about $\times 1.48$. The solvency of NTPC was confirmed during interviews by the evaluation team with NTPC and a focus group of financiers where they saw little risk in NTPC servicing its debts. The \$ financiers also confirmed that they did not face any circumstances where they contemplated calling the guarantees they received for the NT2 HPP. See table C.2 for a summary of key financial information.

Table D.2. Key Financial Figures for NTPC (2010–16)

Actual Financial Results	2010	2011	2012	2013	2014	2015	2016
Revenue	231	272	269	279	267	262	266
Gross profit	171	197	192	203	189	183	186
Operating profit	153	176	171	181	175	164	174
Profit before income tax	93	88	90	109	115	111	129
Profit for the year	89	88	90	109	115	108	126
Repayments on borrowings	16	56	64	73	79	81	89
Interest paid	66	68	65	60	51	44	37
Debt service	81	125	128	133	130	125	126
Gross profit margin (<i>percent</i>)	74	72	71	73	71	70	70
Operating profit margin (<i>percent</i>)	66	65	63	65	66	63	65

Financial Returns and Net Present Value: Given the broadly robust financial performance to date and the near-completion of debt servicing, a separate model was not developed by the evaluation team to assess the financial viability of the project.

Instead, the evaluation relied on the audited financial statements for NTPC and financial modeling carried out by the World Bank to assess the financial performance and future outlook for the NT2 HPP. In accordance with the financial model prepared at project completion, which included the actual results up to 2016, the financial internal rate of return (FIRR) is calculated as 11.0 percent, and the financial net present value (FNPV) is \$119.0 million. This is compared with the projected FIRR of 11.7 percent and FNPV of \$235 million, identified in the Project Appraisal Document. The Implementation Completion and Results Report explains that the differences between the expected and actual FIRRs and FNPVs are due mainly to the 4.5 month construction delay and net additional costs of \$47 million incurred for managing environmental and social issues, as well as general overhead and administration.

Notes

¹ The evaluation team did not validate the government's or the World Bank's alternative analyses, since the NT2 HPP is already in operation.

² The standard conversion factor for Lao PDR was based on the ratio of the shadow exchange rate (free market rate) in 2019 to the official exchange rate. The standard conversion factor for Thailand was the same as used at completion based on trade data for 2012–2016.

³ For simplicity, the economic in-use value was calculated applying a straight-line depreciation as a proxy for the use of the assets over the project's concession period.

⁴ <http://www.icopal-noxite.co.uk/nox-problem/nox-pollution.aspx>

⁵ World Bank Technical Note

⁶ World Bank Guidance Note on Shadow Price of Carbon in Economic Analysis, 2017.

Appendix E. Borrower Comment



Lao People's Democratic Republic
Peace Independence Democracy Unity Prosperity

Ministry of Energy and Mines
Department of Energy Business

No: 2153 /DEB-MEM-PMD
Date: 03 NOV 2020

Attention:

Mr. Christopher Nelson
Manager of Infrastructure and Sustainable Development Micro Unit Independent Evaluation
Group, the World Bank.

Subject: Comments to draft Project Performance Assessment Report on Nam Theun2 Hydropower
Project.

Dear Christopher Nelson,

Reference is made to letter dated 29 September 2020, requesting the Department of Energy Business (DEB) provide the comments on draft Project Performance Assessment Report on Nam Theun 2 Hydropower Project. Overall, we agree with the context of the report is well summarized and covered all project components and obligation of relevant GOL agencies under the Nam Theun 2 Hydropower Project Concession Agreement that links to IDA Guarantee B-0080-LA, IDA Grant H155-LA, and MIGA Guarantee 5139 mainly were compliant. For some non-compliances have given the reasons and solutions for the next step.

Nevertheless, DEB as CA implementing agency would like to provide some comments in relation to Ministry of Energy and Mines, in particular page 23, paragraph 2.29 start from ending of the 12th to 16th line **“the inconsistent adherence to environmental and social safe guards was starkly displayed in 2018 when a saddle dam collapsed in a major hydropower project due to sub-standard design/construction. It killed 49 people and promoted the GOL to halt all dam construction in the country”**. This may replace by other words, it seems not related to Nam Theun 2 Project. We are aware after the saddle dam collapsed, the World Bank has continuously performed as a great GOL counterpart to persuade the international organizations to assist and support MEM to initiate a sector-wide review of safety with all large hydropower projects. The World Bank's performance on this should be shifted to the document related to Dam Safety Works.

Thank you for opportunity to comment on the draft report.

Yours sincerely,



Somphit KEOVICHITH
Director General

Project Monitoring Division | Department of Energy Business | Ministry of Energy and Mines
Email: energy@deb.gov.la | Web: www.poweringprogress.org | Tel: 856 21 452539-40

425