



## Evaluation Study

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# Energy Sector in the Greater Mekong Subregion

Operations Evaluation Department

**Asian Development Bank**

## ABBREVIATIONS

ADB	– Asian Development Bank
ADF	– Asian Development Fund
ADTA	– advisory technical assistance
ASEAN	– Association of Southeast Asian Nations
CAPE	– country assistance program evaluation
CPS	– country partnership strategy
CSP	– country strategy and program
DMC	– developing member country
EdL	– Electricité du Laos
EGAT	– Electricity Generating Authority of Thailand
EGP	– Experts Group on Power
EIRR	– economic internal rate of return
EPF	– Electricity Power Forum
ESS	– energy sector strategy
FG	– Focal Group
FIRR	– financial internal rate of return
GDP	– gross domestic product
GMS	– Greater Mekong Subregion
GMS-SF	– GMS Strategic Framework
GZAR	– Guangxi Zhuang Autonomous Region
IGA	– Intergovernmental Agreement
Lao PDR	– Lao People’s Democratic Republic
MOU	– memorandum of agreement
MRC	– Mekong River Commission
NT2	– Nam Theun 2
OCR	– ordinary capital resources
OED	– Operations Evaluation Department
OEM	– Operations Evaluation Mission
PIP	– public investment program
PoA	– plan of action
PPA	– power purchase agreement
PPAR	– project performance audit report
PPP	– public–private partnership
PPTA	– project preparatory technical assistance
PRC	– People’s Republic of China
PWG	– Planning Working Group
RCAPE	– regional cooperation assistance program evaluation
RCIS	– Regional Cooperation and Integration Strategy
RCOBP	– regional cooperation and operations business plan
RCSP	– regional country strategy and program
RETA	– regional technical assistance
RIMPPI	– Regional Indicative Master Plan on Power Interconnection
RPTCC	– Regional Power Trade Coordination Committee
RPTOA	– Regional Power Trade Operating Agreement
SAPE	– sector assistance program evaluation
SIDA	– Swedish International Development Cooperation Agency
SIEPAC	– Sistema de Interconexion Electrica para America Central (Central American Electrical Interconnection System)

TA	–	technical assistance
THPC	–	Theun–Hinboun Power Company
WAPP	–	West Africa Power Pool

### WEIGHTS AND MEASURES

GWh	gigawatt-hour	–	1,000,000 kilowatt-hours
km	kilometer	–	unit of distance
kV	kilovolt	–	1,000 volts
kWh	kilowatt-hour	–	1,000 watt-hours
MVA	megavolt-ampere	–	1,000,000 volt-amperes
MW	megawatt	–	1,000,000 watts
MWh	megawatt-hour	–	1,000,000 watt-hours
tWh	terawatt-hour	–	1,000,000,000 kilowatt hour
V	volt	–	unit of voltage
VA	volt-ampere	–	unit of reactive power
W	watt	–	unit of active power

### NOTE

In this report, “\$” refers to US dollars.

### Key Words

adb, asian development bank, cambodia, development effectiveness, energy sector, greater mekong subregion, gms, guangxi, guangxi zhuang autonomous region, hydropower, infrastructure, lao pdr, lao people’s democratic republic, myanmar, people’s republic of china, performance evaluation, power sector, prc, regional power trading, thailand, viet nam, yunnan, yunnan province

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The guidelines formally adopted by the Operations Evaluation Department (OED) on avoiding conflict of interest in its independent evaluation were observed in the preparation of this report. Ramesh B. Adhikari, formerly Director of OED Division 2, was involved in the review of the report from the peer review stage up until the editorial stage. In terms of consultant input, Outhai Oudavong and Magdalena Casuga assisted as consultants in the preparation of the energy sector study, while Dan Millison peer reviewed an early draft of the report and provided advice on energy and environment-related issues. To the knowledge of the management of OED, there were no conflicts of interest of the persons preparing, reviewing, or approving this report.

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## EXECUTIVE SUMMARY

This sector assistance program evaluation (SAPE) presents the findings, lessons, and recommendations of an independent assessment of the Asian Development Bank's (ADB) assistance to the energy sector in the Greater Mekong Subregion (GMS), comprising Cambodia, Lao People's Democratic Republic (Lao PDR), Myanmar, Thailand, Viet Nam, and Guangxi Zhuang Autonomous Region and Yunnan Province in the People's Republic of China. The SAPE evaluates the performance of ADB assistance during 1992–2007, but accords relatively more emphasis to activities and developments since 1999. While the evaluation attempts to cover all the GMS countries, the difficulties in obtaining energy sector data and related information have limited the coverage of Myanmar and, in some cases, Guangxi Zhuang Autonomous Region and Yunnan Province. In terms of energy sector content, the SAPE focuses mainly on the hydropower and power transmission subsectors, which are the subsectors related to ADB lending operations. In the project-level analysis, the SAPE focuses mainly on completed operations, with only limited coverage of ongoing operations.

### Sector Context

The GMS countries have diverse energy resources that are unevenly distributed among the member countries. Although the subregion is well endowed with hydropower and fossil fuel resources, most of the exploitable resources are locally concentrated. Hydropower resources in Lao PDR, Myanmar, and Yunnan Province are abundant and are expected to exceed their own demands for the foreseeable future. Most of the fossil fuel resources are in Yunnan Province and to a lesser extent in Viet Nam. Myanmar has gas fields, mainly offshore. Thailand also has limited domestic gas and oil reserves, but the country is expected to rely on imports for its future energy needs. Cambodia also relies on imported energy.

The total exploitable hydropower potential in the GMS is particularly large, with Myanmar and Yunnan Province having by far the greatest potential. Between 1990 and 2006, electricity production has increased at an average annual rate of 8.2%, but the quality of power transmission infrastructure is very uneven. The People's Republic of China, Thailand, and Viet Nam have well-developed power grid systems, with both 230 kilovolt (kV) and 500 kV integrated backbone grids. By contrast, Cambodia, Lao PDR, and Myanmar have 66 kV, 115 kV, 132 kV, and 230 kV transmission systems of limited extent, quality, and reliability. Electricity consumption in the GMS from 1990 to 2006 grew slightly faster (9.8% per annum) than the growth rate of electricity production. Average per capita consumption of electricity was 934 kilowatt-hours (kWh) in 2006, with Thailand posting the highest consumption of 2,105 kWh, and Cambodia the lowest at 55 kWh.

Thailand and Cambodia are net importers of electricity, while the Lao PDR is a net exporter. Power trade in the GMS originated in 1971 when Lao PDR and Thailand entered into a power purchase agreement for export of power from the Nam Ngum hydropower plant in Lao PDR to northeast Thailand. ADB supported this early effort with technical assistance (TA) for Nam Ngum project development. In 1984, ADB financed the Xeset hydropower plant, which also exports electricity from Lao PDR to Thailand. From 1990 onward, bilateral power trade intensified as memoranda of understanding were signed between various governments in the subregion. Regional power interconnections in the GMS are mainly via medium voltage transmission lines. The first high voltage cross-border transmission line within the GMS will be the line from Nam Theun 2 (NT2) hydroelectric power plant in Lao PDR to Thailand. Work on additional high voltage transmission lines between Cambodia, Lao PDR, and Viet Nam and

several other cross-border initiatives are ongoing. Interconnecting disparate power systems is one of the challenges faced by the GMS.

The GMS energy sector faces several important development challenges. One of these is the uneven access to modern energy services between GMS economies and also between urban and rural areas. A large share of the population in the GMS is still “energy poor” in that they depend on traditional sources of energy. Another challenge concerns the GMS’ dependence on imported energy. In the medium term, given rapid demand growth, the GMS is likely to remain heavily dependent on imported fossil fuels. Other challenges include (i) the need to enhance the institutional and policy frameworks of member countries to ensure that environmental and social costs in energy systems remain reasonable, (ii) the need to improve energy productivity, and (iii) the need to align institutions and policy regimes to deal effectively with the energy challenges facing the region.

### **GMS Energy Program**

During the first 10 years of the GMS program, it did not have an explicit and integrated development strategy. In 2002, the GMS Strategic Framework (GMS-SF) was the first attempt by the GMS countries to formulate and adopt in broad terms a subregional development-planning framework that defined the vision, goals, and strategic thrusts of GMS cooperation for 2002–2012. It envisages a GMS that is more integrated, prosperous, and equitable through (i) an enabling policy environment and effective infrastructure linkages that will facilitate cross-border trade, investment, energy, and other forms of economic cooperation; and (ii) the development of human resources and skills competencies. The GMS-SF identifies five strategic thrusts to be pursued to realize the vision and goals of subregional cooperation and specifies 11 flagship programs, including regional power interconnection and trading.

Development of a regional energy sector strategy (ESS) has been under way since early 2006. The overall rationale for the ESS is to investigate cross-border energy supply options to realize larger markets and economies of scale, to provide diversification and energy security, and to better incorporate environmental considerations into energy sector planning. The ESS is intended to develop a regional strategy for 2006–2020 to expand cooperation among GMS countries to meet rising energy needs. An expert’s panel to guide the ESS was formed, and a draft of the ESS was prepared and presented in a regional workshop in June 2008. A road map based on the draft ESS suggesting actions up until 2012 was presented to the GMS governments for consideration in late November 2008.

The institutional setup of the GMS energy program has evolved over the past 15 years. The Energy Power Forum, set up initially in 1995, has evolved into two separate institutional structures: the Energy Sector Forum and the Regional Power Trade Coordination Committee (RPTCC). The latter consists of two subgroups—the Focal Group and the Planning Working Group—and is developing the framework for regional trade in power. The three main achievements that have been realized under the GMS energy program related to regional power trade and interconnection are (i) an Intergovernmental Agreement (IGA) on Regional Power Trade in the GMS, which provides the overall framework for cooperation and development of power trade in the subregion; (ii) a Regional Power Trade Operating Agreement (RPTOA), which sets out the operating rules and guidelines supporting the creation of a regional power market; and (iii) a Regional Indicative Master Plan on Power Interconnection (RIMPPI), which carries out technical analyses of regional power systems, seeking to identify the level of regional energy demand and the physical power interconnections that are seen as necessary for meeting that demand.

## ADB's Energy Strategy and Program

Following the adoption of the GMS-SF in 2002, the GMS Regional Cooperation Strategy and Program (RCSP) was prepared, which sets out ADB's strategy and program for the subregion. The overarching goal of the RCSP is to reduce poverty in the GMS through the "3C" program vision of enhanced connectivity, increased competitiveness, and greater sense of community. The document discusses the role of transport, telecommunication, and power systems infrastructure in achieving physical integration. It suggests that greater physical connectivity will lead to better access to markets and thus competitiveness, and it seeks to promote competitiveness through the provision of software for facilitation of trade and investment and movement across borders.

The energy sector is the second largest sector in the GMS after the transport sector. The total energy investment costs under the GMS program have amounted to \$1.7 billion, 17% of the total GMS project costs of \$10.3 billion. To date, ADB has provided about \$185.4 million additional and concessionary assistance for the GMS energy sector, of which 95% or \$176.3 million has been as loans, while \$9.1 million has been in the form of TA. ADB lending to the sector has consisted of four loans: three to the Lao PDR and one to Cambodia. Three of the loans financed the construction of hydropower stations in the Lao PDR aimed at exporting power to Thailand: the Nam Leuk Hydropower Project (surplus energy), the Theun–Hinboun Hydropower Project, and the NT2 Hydroelectric Project. In addition, another loan, the GMS Transmission Project, financed the construction of power transmission infrastructure in Cambodia linking Phnom Penh with the border of Viet Nam. The GMS energy sector has received 16 TA grants amounting to \$9.1 million, of which nine have been for project preparation. Advisory TA has focused mainly on assisting the subregional Energy Power Forum, preparing a RIMPPI, formulating the RPTOA, developing a GMS ESS, and addressing issues related to environmentally sustainable development of electricity infrastructure in the GMS.

### Top–Down Assessment

The top–down assessment consists of four criteria (strategic assessment, institutional assessment, value addition, and ADB performance). Overall, the top–down assessment of the GMS energy sector is rated "successful," with some areas needing improvement.

**Strategic Assessment.** This assesses the extent to which the GMS ESS has been aligned with the needs and priorities of GMS countries and with ADB's priorities. Feedback from government officials indicates that ADB assistance for GMS energy projects has been fully in line with their national development plans. The GMS energy projects were all priority projects within the individual government public investment programs. The GMS energy program is also fully in line with ADB's sector and thematic priorities, including those for energy and private sector development. Moreover, energy development in the regional context remains high on ADB's development agenda, with regional and subregional economic cooperation programs (cross-border infrastructure and related software) forming the first pillar of ADB's Regional Cooperation and Integration Strategy.

In terms of program positioning, subregional energy investments have been focused mainly on capacity expansion of electricity generation through hydropower development, with one project addressing regional transmission interconnection. Capacity-building efforts have focused on institutional strengthening, preparing a RIMPPI, formulating the RPTOA, developing a GMS ESS, and addressing issues related to environmentally sustainable development of

electricity infrastructure in the GMS. Both the investment and capacity-building efforts correctly targeted several of the main development challenges in the sector. The sequencing of energy sector activities with initial activities, concentrating on putting in place power trading agreements (IGA and RPTOA) followed by formulation of an indicative regional master plan (RIMPPI) and more recently addressing issues related to environmental impacts of construction of hydropower and transmission projects, is considered appropriate.

Coordination in the energy sector has been good. There have been regular consultations and coordination mechanisms in place among ADB, other development partners, and governments. In particular, ADB and the World Bank have been closely collaborating, both as coparticipants in the RPTCC, as well as in the preparation, financing, and implementation of the NT2 Hydroelectric Project in the Lao PDR. In addition, ADB has closely interacted with the Japanese, French, and Swedish government aid agencies, which all participate in RPTCC meetings. Overall, the strategic assessment of the GMS energy sector is rated “substantial.”

**Institutional Assessment.** The institutional assessment consists of three criteria: (i) ownership, (ii) structural assessment, and (iii) resource mobilization. In terms of the first criterion, the GMS countries have generally demonstrated a high level of ownership of GMS programs and activities, and there is recent evidence suggesting that this support has been increasing and that GMS member countries are now taking a more active role in program direction and in initiating activities. In the context of the energy sector program, this is best demonstrated by the active and sustained participation of the government representatives in the various GMS working groups and forums, including the RPTCC.

The structural assessment focused on the review of various institutional and management structures of the GMS energy program, including the GMS government decision-making structures and the role of non-ADB supporting bodies. Institutional structures, as well as the decision-making process on program and sectoral priorities at the RPTCC level and corresponding endorsements from higher levels, are deemed effective. An issue relating to decision making is the nature and degree of intersectoral communication and information sharing within the program. Reports have stated that there has been little interaction between different sectors and their working groups; however, the GMS Secretariat has been attempting to address this problem through initiatives such as the GMS newsletter and cross-representation on sectoral working groups. Another issue relates to the coordination between the RPTCC and its two subgroups, the Focal Group and the Planning Working Group. There appears to be excessive repetition between the meetings of the two subgroups and the RPTCC, which usually meets twice a year.

In terms of resource mobilization, the energy sector has benefited from ADB’s proactive initiative in catalyzing large sums of capital from the private sector through the use of the public–private partnership modality for two hydropower projects in the Lao PDR. Taking into account ADB’s limits on concessional funding, it could be increasingly difficult to fund regional energy projects particularly in Lao PDR and Cambodia. Where feasible, ADB provides ordinary capital resources funding and, at the same time, mobilizes private and other development partner cofinancing. Overall, the institutional assessment of the GMS energy sector is rated “substantial.”

**Value Addition.** The GMS program has brought about regional collective actions needed for greater connectivity and integration of energy plans, programs, and strategies among the GMS countries. The GMS program has served as a platform, resulting in mutual benefits that would otherwise not be available solely through national initiatives or projects.

Broadly, these include creation of external/extraboundary spillover effects or positive externalities through provision of public goods and services with transboundary implications, lowering of coordination or transaction costs, and capture of economies of scale. Another apparent benefit has been the demonstration effect of the GMS program, both within and outside the subregion. Overall, the value addition of the GMS energy sector is rated “substantial.”

**ADB Performance.** ADB performance was assessed following five criteria: (i) adviser and honest broker support, (ii) institutional support by the GMS Secretariat, (iii) coordination with other development partners, (iv) capacity building, and (v) portfolio management. ADB performed best with regard to coordination with other development partners and capacity building. In terms of aid coordination, ADB and the World Bank have worked closely on the GMS energy program since its inception, and by all accounts this has been a good partnership. The World Bank has regularly attended RPTCC meetings since its inception in 2004. ADB has been relatively less proactive in coordinating with other development partners in the energy sector such as the Mekong River Commission (MRC) due mainly to a lack of capacity on the part of MRC to implement its hydropower strategy and program, and the Association of Southeast Asian Nations. There is, however, good scope for future collaboration to improve, particularly with MRC, after the appointment of a new chief executive officer in March 2008 following a gap of 7 months. In terms of capacity building, several initiatives have been carried out that addressed the GMS countries’ needs, among which were efforts aimed at assisting the subregional Electricity Power Forum, preparing a RIMPPI, and formulating the RPTOA. In terms of institutional support by the GMS Secretariat, although GMS governments generally valued the support highly, several GMS national coordinators indicated that they would appreciate receiving assistance from the GMS Secretariat to enhance the capacity of their respective GMS national coordinating committees to liaise with the various sector working groups, sector forums, and other stakeholders. In terms of portfolio management, ADB’s performance has been mixed, with the two completed projects and one of the ongoing projects performing well but the other ongoing project encountering implementation difficulties. Overall, ADB’s performance in the GMS energy sector is rated “substantial.”

### **Bottom–Up Assessment**

The bottom–up assessment consists of five criteria: relevance, effectiveness, efficiency, sustainability, and impact. GMS energy operations comprising four loans and 16 TA grants were evaluated. Overall, the bottom–up assessment of the GMS energy sector is rated “successful.”

**Relevance.** Relevance assesses the appropriateness of ADB’s energy sector operation in the GMS in terms of its consistency and alignment with the GMS countries’ development strategies and ADB priorities, country assistance and regional cooperation programs, and appropriateness of project design to achieve intended benefits. Opportunities identified for regional cooperation included agreements and complementary investments for equitable exploitation of common hydropower potential, petroleum resources, and intercountry transmission of energy supplies. ADB’s program in general and the two hydropower projects in the Lao PDR, in particular, supported ADB’s Energy Policy at the time of project formulation and they continue to be consistent with current policy, which has regional cooperation as a continuing objective. These projects are also important in the subregion’s pursuit of ways to meet its increasing demand for energy brought about by rapid growth and the countries’ need for revenues such as through power export. Overall, the GMS energy program is rated “highly relevant.”

**Effectiveness.** The effectiveness of ADB assistance to GMS energy is assessed in terms of achievement of outcomes and outputs of the regional energy program, particularly for the two completed loan projects and 11 completed TA operations. The two completed projects, namely, the Theun–Hinboun (1994–1998) and the Nam Leuk (1996–2002) hydropower projects, achieved most if not all of their planned outputs/outcomes. Both projects aimed to export surplus power from Lao PDR to Thailand and support optimal development of the Lao PDR’s power subsector. Since the start of its commercial operations until the present, the Theun–Hinboun plant has functioned without major problems and has been able to meet the targeted levels of electricity exports to Thailand. Similarly, during its first 3 years of operation, the Nam Leuk plant exceeded its expected average long-term generation capacity of 215 gigawatt-hours per year and was able to meet targeted levels of electricity exports to Thailand. Achievements of the Nam Leuk Project were reportedly less for the other objectives of strengthening the management and protection of the Phou Khao Khouay National Park and improving the capabilities of the executing agency. The completed TA operations were also successful in accomplishing planned objectives, which in general prepared the groundwork and ensured capacity building for the programs and projects that followed. Overall, the GMS energy program is rated “effective.”

**Efficiency.** Efficiency of ADB’s energy operations for the GMS refers to the extent to which ADB resources have been delivered on time and optimally utilized. The economic internal rates of return (EIRRs) were reestimated for the two completed hydropower projects in the Lao PDR: the results for Theun–Hinboun (210 megawatt [MW]) confirm the economic benefits generated by the project (EIRR of about 22%), but the reestimated EIRR for Nam Leuk (60 MW) at about 10%, is lower than the appraisal estimate of 14% and project performance audit report estimate of 12%. The reason for the lower EIRR for Nam Leuk is the slightly lower generation and the higher transmission losses than had been expected at project appraisal. In terms of process efficiency, the Theun–Hinboun Project was completed within schedule, while the Nam Leuk Project experienced some delays in civil works that extended project completion by an additional 6 months. Execution of the two projects was satisfactory, and their designs are assessed as optimal. Meanwhile, the ongoing NT2 Hydroelectric Project (1,070 MW), approved in April 2005, is the largest hydropower project in the Lao PDR. Expected physical completion is November 2009. To date, about 50% of the civil works required has been completed and construction delays have been reported, but so far drawdowns have been made on schedule and no reported cost overruns have been made. At appraisal, the financial internal rate of return (FIRR) was estimated at 12% while EIRR was estimated at 16%. The sensitivity analysis shows that the estimates are robust. Based on the EIRR and implementation delays, the Nam Leuk Project is assessed as less efficient and Theun–Hinboun Project is assessed as efficient. Given the relative importance of the projects in the sector, overall, the GMS energy sector is rated “efficient.”

**Sustainability.** Sustainability refers to the likelihood of keeping up for a long time achieved sector outcomes and outputs in view of the perceived financial, environmental, political, and institutional risks. In terms of financial sustainability, the recalculated FIRR for the Theun–Hinboun Project is 22%, which is well above the weighted average cost of capital (4.8%). Theun–Hinboun is considered physically sustainable, provided preventive maintenance is continued. The reestimated FIRR for the Nam Leuk Project is around 4%, which is sufficient to cover the cost of capital but not sufficient to cover taxes payable by Electricité du Laos. Given this and the slightly lower than anticipated generation and higher transmission losses, it raises concerns about the project’s sustainability. The willingness-to-pay estimate implies that there is considerable consumer surplus in the Lao PDR, which could be tapped through tariff increases and could improve the financial viability of the project. Addressing problems that lead to high transmission losses would also increase the likelihood of the project’s sustainability. Meanwhile,

the ongoing NT2 Hydroelectric Project is facing issues related to the implementation of the agreed upon social and environmental mitigation measures although its design included lessons from previous safeguard issues. The main risks are less than expected revenues from customers and inadequate water flows and/or flooding, which may result in the loss of electricity output and revenues. The measures in place to mitigate these risks are considered adequate. As noted in the effectiveness section, the completed TA operations were successful in accomplishing planned objectives that prepared the groundwork and ensured capacity building for the programs and projects that followed. Despite the less likely sustainability of the Nam Leuk Project, which is less than one third the capacity of the size of Theun–Hinboun and because of the generally good institutional capacity in the executing agencies, the sustainability of outcomes and outputs of both completed and ongoing energy TA operations is deemed likely. Overall, the GMS energy operation is rated “likely sustainable.”

**Impact.** Impact refers to the contribution of ADB assistance to long-term changes in development conditions in the energy sector, contribution to socioeconomic development, as well as environmental and social impacts. In general, while power trading in the GMS has so far been limited, significant positive impacts have already been created, mainly benefiting the trading countries—Lao PDR and Thailand—in terms of revenues, access to electricity, employment, and improved infrastructure. The economic benefits of the bilateral power trade between Lao PDR and Thailand have been more evident on the part of the Lao PDR, although its exports of electricity to Thailand suffered a major slump during the Asian financial crisis. In a complementary manner, the power trade between Lao PDR and Thailand has provided Thailand access to clean and low-cost energy sources needed to support its growing economy. The two completed ADB-financed hydropower plants, Theun–Hinboun and Nam Leuk, which were built primarily for export of electricity to Thailand, have also benefited rural communities in both countries through increased electrification. The projects have also had positive impacts on employment and infrastructure development. In terms of environmental and social impact, part of the revenues from both power plants are made available for the governments’ social programs, and respective executing agencies have provided funds for mitigation of the environmental and social impacts. Notably, 1% of the electricity export revenue from the Nam Leuk Project goes to the protection of the Phou Kao Khouay National Park and its resources. Nonetheless, the project performance audit report for Theun–Hinboun reported negative environmental and social impacts, which were exacerbated by the lack of a resettlement plan and by a weak environmental mitigation program. Overall, the GMS energy operation is likely to have “substantial” impact.

## **Overall Assessment**

Overall, the SAPE assesses ADB’s assistance to the GMS energy sector as “successful.” The top–down assessment of the energy sector strategy is rated “successful” and the bottom–up assessment of the energy program is also rated “successful,” but with some areas in each assessment needing improvement.

## **Conclusions, Key Issues, Lessons Identified, and Recommendations**

The following are the main conclusions:

- (i) The GMS program has grown over the years to become a major regional cooperation initiative of ADB, as well as of the GMS countries. Energy sector initiatives have been an important element of the GMS program. The bottom–up assessment rates the relevance of the energy program most highly, with effectiveness, sustainability, and impact also rated well. The efficiency of ADB’s

- assistance is confirmed by the reassessment, despite the EIRR of one of the completed projects being slightly lower at the postcompletion stage.
- (ii) The GMS energy program has resulted in significant economic benefits to the participating countries. The strong increase in the Lao PDR's electricity generation and exports to Thailand over the past 10 years has led to an extension of the domestic market in the former, contributed to the growth in gross domestic product, generated substantial foreign exchange earnings, and also strongly benefited rural and remote border communities. In a complementary manner, the power trade has provided Thailand with access to cleaner and lower cost energy and has also benefited its rural communities with electricity.
  - (iii) An important apparent benefit of the GMS energy program has been the demonstration effect, both within the subregion and internationally, of implementing successful regional projects. Although it is difficult to gauge the exact breadth and extent of the demonstration effect, there is clear evidence that investor confidence in undertaking power export projects in the region has risen strongly in recent years. This is evidenced by the large number of private sector hydropower projects under construction or being planned in the Lao PDR.

A key issue facing the GMS power subsector is the long lead time that is required to achieve multilateral power trading. Although the countries in the region have negotiated a large number of bilateral, project-specific power purchase agreements, there is still relatively little progress in negotiating multilateral power purchase agreements allowing for power trading among more than two countries. The RPTOA envisages in its latter phases the achievement of such multilateral trading, but a number of legal and technical issues are currently hindering progress and need to be resolved. Based on similar experience in other regions, multicountry power pool trading could require an additional 10 years to be put in place.

The following are the main lessons identified:

- (i) Although progress was at times slower than anticipated, the GMS program has been successful in promoting and enhancing cooperation on cross-border power trade and interconnections among its member countries. The key to this progress was the setting up of effective institutional arrangements with strong government ownership (e.g., the Electric Power Forum, RPTCC) and the establishment of an appropriate policy framework for power trading in the GMS via multiparty agreements (e.g., IGA, RPTOA).
- (ii) Notwithstanding generally effective institutional arrangements in the GMS energy sector, both the GMS energy program's internal coordination, as well as interprogram coordination with other sectors, could still be improved. Within the GMS energy program, coordination between the RPTCC and its two subgroups, the Focal Group and the Planning Working Group, appears to be suboptimal. A more streamlined structure, with working group meetings lasting only 2 days when not followed by the RPTCC meeting, should be considered. In terms of interprogram coordination, reports in the past have indicated that there is little interaction between sectors and their working groups. The GMS Secretariat has been addressing this problem through initiatives such as the GMS newsletter, cross-representation on sectoral working groups, and more recently the introduction of the "economic corridors" approach, whereby various sectoral working groups will be represented in a proposed Economic Corridors Forum.
- (iii) The GMS is still comprised of predominantly agricultural economies, with almost 70% of its population dependent on local resources. The region's high economic growth is putting increasing stress on important natural land and water systems in

the region. Evidence from the one ongoing and two completed ADB hydropower projects indicate that there have been difficulties in implementing social and environmental mitigation measures. There is a need to enhance the institutional and policy frameworks of member countries to ensure that environmental and social costs in energy systems remain reasonable.

- (iv) ADB has coordinated well with the World Bank and bilateral aid agencies in the energy sector. ADB's coordination with the other major regional agency, MRC, has been less active, due mainly to a lack of capacity on the part of MRC to implement its hydropower strategy and program. Following the appointment of MRC's Chief Executive Officer in March 2008, ADB and MRC have resumed coordinating closely on water-related energy sector issues.

The following are the key recommendations for future operation:

Key Recommendations	Responsibility	Proposed Target Date
(i) <b>Promote Other Energy Investments besides Power Trading.</b> More attention should be given to supporting other energy investments besides power trading, consistent with ADB's initiatives for energy efficiency and climate change (para. 127).	SERD	Next RCSP
(ii) <b>Expand Cofinancing.</b> ADB should be more strategic in providing assistance by leveraging its concessional resources to mobilize financing from the private sector and other development partners (para. 128).	SERD	Next RCSP
(iii) <b>Pay Attention to Safeguard Implementation.</b> More creativity and flexibility are needed in addressing safeguard implementation on high-impact energy projects (para. 129).	SERD	2009

ADB = Asian Development Bank, RCSP = regional cooperation strategy and program, SERD = Southeast Asia Department.

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# GREATER MEKONG SUBREGION ENERGY PROJECTS



## I. INTRODUCTION

### A. Objective and Scope

1. The objective of this sector assistance program evaluation (SAPE) is to provide an independent assessment of the Asian Development Bank's (ADB) assistance to the energy sector in the Greater Mekong Subregion (GMS), comprising Cambodia; Lao People's Democratic Republic (Lao PDR), Myanmar, Thailand, Viet Nam, and Guangxi Zhuang Autonomous Region (GZAR) and Yunnan Province in the People's Republic of China (PRC). The SAPE evaluates the performance of ADB assistance during 1992–2007,<sup>1</sup> identifies issues and lessons, and makes recommendations for improving current and future operations. The SAPE findings feed into the broader GMS regional cooperation assistance program evaluation (RCAPE) being carried out by the Operations Evaluation Department (OED).

2. There are some geographic- and sector-specific limitations to the scope of the SAPE. Although Myanmar is one of the GMS countries, the SAPE does not fully cover it due to lack of access to relevant energy sector data and absence of any direct ADB assistance. Similarly, even though the PRC occupies an important position in the GMS program, only one province (Yunnan Province) and one autonomous region (GZAR)<sup>2</sup> actually participate in the GMS program. The SAPE has attempted to include analysis of Yunnan Province and GZAR energy sector developments whenever possible, although this has been constrained in some cases by the difficulty in obtaining province/region-level energy data. In terms of energy sector content, the SAPE focuses mainly on the hydropower and power transmission subsectors, which are the subsectors related to ADB lending operations. In the project-level analysis, the SAPE focuses mainly on completed operations, with only limited coverage of ongoing operations.

### B. Evaluation Framework and Methodology

3. An evaluation framework was adopted for the GMS RCAPE that applies equally to all the five subregional sector studies that feed into it.<sup>3</sup> This framework draws on the guidelines<sup>4</sup> for preparing country assistance program evaluation (CAPE) reports and follows a top–down/bottom–up approach. The top–down assessment comprises four separate assessments: (i) strategy assessment, (ii) institutional assessment, (iii) assessment of value addition of the GMS program to the energy sector, and (iv) assessment of ADB's performance. The bottom–up assessment comprises the standard evaluation criteria used to evaluate individual operations: relevance, effectiveness, efficiency, sustainability, and impact. For more information on the evaluation framework, refer to the RCAPE evaluation approach paper.<sup>5</sup>

4. In terms of methodology, the evaluation draws upon a review of documents and other relevant studies, a review of the performance of the GMS energy portfolio, and discussions between ADB staff and officials of government agencies concerned with the energy sector. Two operations evaluation missions (OEMs) were undertaken on 2–12 March 2008 and 21 April–

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<sup>1</sup> Although the SAPE covers 1992–2007, relatively more emphasis has been placed on activities and developments since 1999, corresponding to the date of Operations Evaluation Department's (OED) previous GMS impact evaluation (footnote 6).

<sup>2</sup> GZAR joined the GMS program in 2005.

<sup>3</sup> The other four sector studies are (i) transport and trade facilitation, (ii) tourism, (iii) capacity development, and (iv) regional public goods and agriculture. Regional public goods include the environment and natural resources, health sector, and social sector.

<sup>4</sup> ADB. 2006. *Guidelines for the Preparation of Country Assistance program Evaluation Reports*. Manila.

<sup>5</sup> Signed memo dated 13 February 2008 from Mala Hettige to R. Keith Leonard, Operations Evaluation Department.

10 May 2008, and the evaluation incorporates the results of the OEMs' interviews in Bangkok, Hanoi, Phnom Penh, and Vientiane and field inspections of the Theun–Hinboun hydropower plant in Khammouane Province, Lao PDR, which was partly financed through an ADB loan.

### **C. Findings of Earlier Evaluations of the GMS Program**

5. In 1999, an impact evaluation study of the GMS program<sup>6</sup> was undertaken in order to draw lessons from the first 7 years of its implementation. The study found that overall progress had been satisfactory, but raised concerns about the lack of focus of the GMS program and about limitations on the availability of ADB resources for regional cooperation. With regard to the energy sector, the study found that the GMS energy programs had played a critical catalytic role in the sector through support of the subregional working group on energy, provision of support for the private sector Mekong Energy Forum, and direct funding of technical assistance (TA). The study also found that the activity-based approach of the GMS contrasted favorably with the rule-based approach of other international organizations such as the World Energy Council.

6. In 2007, a midterm review of the GMS Strategic Framework (GMS-SF)<sup>7</sup> was undertaken in order to draw lessons from the first 5 years of its implementation. That review concluded that the GMS program had "... made very good progress in the 'hardware' aspects of cooperation involving the first strategic thrusts of the GMS-SF, but less so in the 'software' components of cooperation involving the four other thrusts of the GMS-SF, especially in the measures necessary to enhance competitiveness and in activities addressing social and environmental issues in the GMS..." With regard to the energy sector, the review found that considerable progress had been made in terms of (i) putting the GMS on the global energy map, (ii) establishing a policy and institutional framework for power trade, (iii) initiating construction of infrastructure for grid interconnection, and (iv) promoting private sector participation in power projects. The cited activities reportedly have been providing a strong foundation for power trade and interconnection in the GMS, as well as subregional power development in general. The review recommended the following: (i) formulation of a road map for developing a regional energy market to systematically manage the process and address complex technical policy and institutional issues, and (ii) implementation of measures to effectively address the social and environmental impact of hydropower projects.

### **D. Organization of the Report**

7. Section II of the SAPE describes the conditions of the energy sector in terms of available capacity, demand for energy services, existing constraints and challenges, and the way the GMS countries have responded to the challenges. Section III assesses ADB's performance in the energy sector in terms of strategic and institutional focus (top-down assessment). Section IV assesses the performance of ADB's program (bottom-up assessment). Section V summarizes the SAPE's overall energy sector performance ratings. The last section identifies conclusions, key issues, lessons identified, and recommendations and options for improving ADB's partnership with the GMS in the energy sector.

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<sup>6</sup> ADB. 1999. *Impact Evaluation Study of the Asian Development Bank's Program of Subregional Economic Cooperation in the Greater Mekong Subregion*. Manila.

<sup>7</sup> ADB. 2007. *Midterm Review of the Greater Mekong Subregion Strategic Framework (2002–2012)*. Manila.

## II. SECTOR CONTEXT

### A. Background

8. The GMS countries have diverse energy resources that are unevenly distributed among them. Yunnan Province of the PRC has coal resources that can generate 125,000 megawatts (MW) of electricity over a 30-year period.<sup>8</sup> The Mekong River basin has a catchment area of over 795,000 square kilometers with an estimated potential of 285 terawatt-hours, with exploitable capacity mostly in the Lao PDR, Myanmar, and southern PRC. The economies of the countries that make up the GMS also differ in structure, size, and level of development. Thailand dominates the GMS in terms of both gross domestic product (GDP) and energy consumption. Thailand is the fastest growing economy with the highest electricity use in kilowatt-hours (kWh) hours per year among the GMS countries. With GDP growing at an average of over 5% annually and the industry sector growing at a faster rate than its GDP, Thailand will continue to explore various options for energy supply, including electricity imports from Lao PDR and PRC. Viet Nam's economic growth has averaged 8% per annum in the past decade, with resulting electricity demand growth of 15% per annum.

9. The GMS is well endowed with hydropower and fossil fuel resources, but most of the exploitable resources are locally concentrated. Hydropower resources in Lao PDR, Myanmar, and Yunnan Province are abundant and are expected to exceed the countries' own demands for the foreseeable future (exceeding provincial demand in the case of Yunnan Province). Myanmar has proven natural gas reserves of 17 trillion cubic feet, mostly in offshore fields. Thailand has the largest proven gas reserves and the second largest proven crude oil reserves in the GMS, but the country is expected to rely on imports for a significant portion of its future hydrocarbon needs. Cambodia relies on imported energy for power and transport. The Lao PDR has a net hydropower surplus, but imports 100% of its transport fuel. Viet Nam has substantial coal reserves and the largest proven crude oil reserves. Thailand imports electric power from the Lao PDR and plans to import power from Yunnan Province in the future. Viet Nam imports power from Yunnan Province and GZAR, and plans to import power from Cambodia and Lao PDR in the near future.

10. In the GMS, the total exploitable hydropower potential is about 248,000 MW, with Myanmar and Yunnan Province having by far the greatest potential (Table 1). Myanmar's huge hydropower potential of 100,000 MW, however, is generally located far from other GMS countries. The potential of rivers near the border with Thailand is much lower, being only about 10,000 MW. As of 2007, the installed capacity from hydropower generation was only 21,035 MW, with Yunnan Province, Viet Nam, and Thailand having the largest capacity.<sup>9</sup>

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<sup>8</sup> World Bank. 1999. *Power Trade Strategy*. Washington, DC (Report No. 19067-EAP).

<sup>9</sup> World Bank. 2007. *World Bank Strategy in the Greater Mekong Sub Region for Supporting Development of Power Trade*. Washington DC (draft).

**Table 1: Total Exploitable Hydropower Potential and Installed Capacity in the GMS**  
(megawatt)

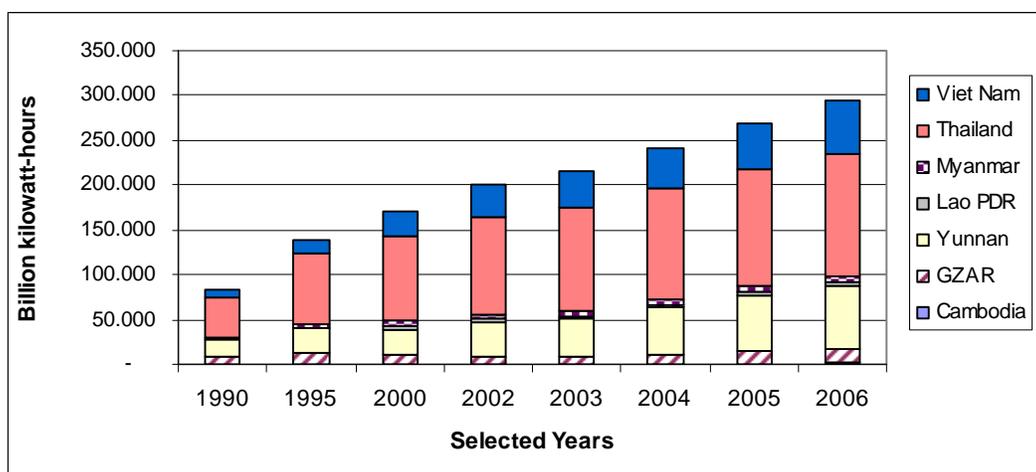
Item	Cambodia	PRC				Myanmar	Thailand	Viet Nam	Total
		Yunnan Province	GZAR	Lao PDR					
Potential	15,000	90,000	na	18,000	100,000	10,000	15,000	248,000	
Installed	13	11,980	na	663	802	3,422	4,155	21,035	

GMS = Greater Mekong Subregion, GZAR = Guangxi Zhuang Autonomous Region, Lao PDR = Lao People's Democratic Republic, na = not available, PRC = People's Republic of China.

Sources: World Bank. 2007. *World Bank Strategy in the Greater Mekong Subregion for Supporting Development of Power Trade*. Washington, DC (August). Draft; Viet Nam Electricity. 2007. *Viet Nam Electricity Corporate Profile 2006–2007*. Hanoi; Department of Electricity, Ministry of Energy and Mines. 2006. *Electricity Statistics of Lao PDR: 2005*. Vientiane; Electricité du Cambodge. 2007. *Statistical Handbook: 1995–2005*. Phnom Penh; and Xiaojiang Yu. *Regional Cooperation and Energy Development in the Greater Mekong Subregion*. Oxford (Energy Policy 31 [2003] 1221–1234).

11. Between 1990 and 2006, electricity production in the GMS increased at an average annual rate of 8.2% (Figure 1 and Table A1.3). During this period, growth was fastest in Viet Nam (12.6%), followed by Cambodia (11.1%), and Lao PDR (9.5%). This overall strong growth does mask some important trends. For example, from 1995 to 2000, electricity production expanded at a much slower rate (only by 4.1%) in the wake of the economic slowdown caused by the Asian financial crisis. Between 2000 and 2006, electricity production increased at a high rate of 9.5% per annum in the GMS. This is roughly twice the rate of growth of electricity production in the Association of Southeast Asian Nations (ASEAN) region, and three times that of the world.

**Figure 1: Electricity Production in the GMS, 1990–2006**

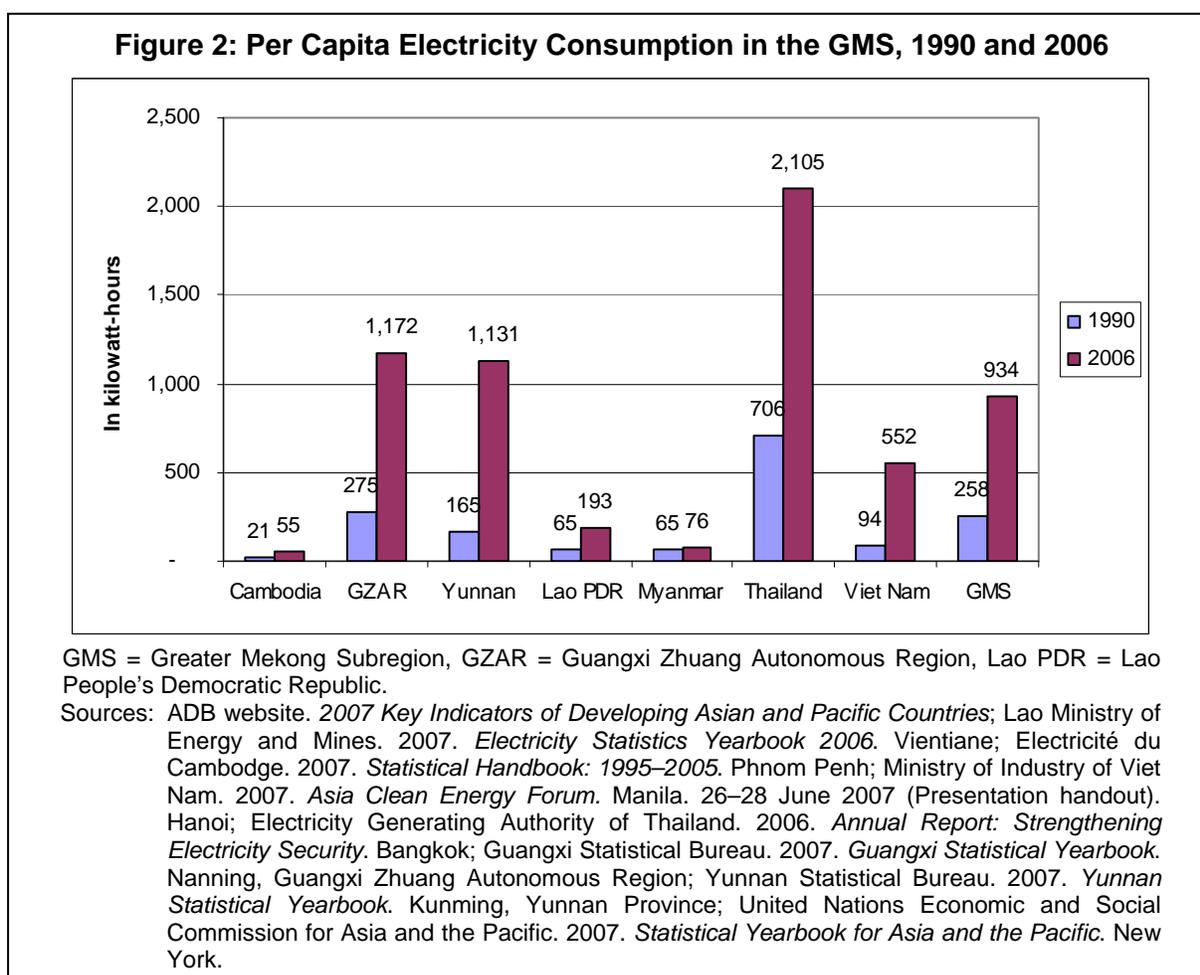


GMS = Greater Mekong Subregion, GZAR = Guangxi Zhuang Autonomous Region, Lao PDR = Lao People's Democratic Republic.

Sources: ADB website. 2007 *Key Indicators of Developing Asian and Pacific Countries*; Lao Ministry of Energy and Mines. 2007. *Electricity Statistics Year Book 2006*. Vientiane; Electricité du Cambodge. 2007. *Statistical Handbook: 1995–2005*. Phnom Penh; Ministry of Industry of Viet Nam. 2007. *Asia Clean Energy Forum*. Manila. 26–28 June 2007 (Presentation handout). Hanoi; Electricity Generating Authority of Thailand. 2006. *Annual Report: Strengthening Electricity Security*. Bangkok; Guangxi Statistical Bureau. 2007. *Guangxi Statistical Yearbook*. Nanning, Guangxi Zhuang Autonomous Region; Yunnan Statistical Bureau. 2007. *Yunnan Statistical Yearbook*. Kunming, Yunnan Province; United Nations Economic and Social Commission for Asia and the Pacific. 2007. *Statistical Yearbook for Asia and the Pacific*. New York.

12. The quality of power transmission infrastructure in the GMS is very uneven. PRC, Thailand, and Viet Nam have well-developed power grid systems, with both 230 kilovolt (kV) and 500 kV integrated backbone grids. Cambodia, Lao PDR, and Myanmar have 66 kV, 115 kV, 132 kV, and 230 kV transmission systems of limited extent, quality, and reliability. The variable quality of power transmission infrastructure hinders the regional power trade.

13. Electricity consumption in the GMS during the same period grew (9.8% per annum) slightly faster than the growth rate of electricity production. Average per capita consumption of electricity in the GMS was 934 kWh in 2006, with Thailand posting the highest consumption of 2,105 kWh, and Cambodia, the lowest at 55 kWh. Between 1990 and 2006, per capita electricity consumption in the GMS almost tripled, owing mainly to significant increases in per capita electric consumption in Yunnan Province, Viet Nam, and GZAR. In Cambodia, Lao PDR, and Thailand, electricity consumption per capita tripled (Figure 2).



14. Overall, the GMS is a net importer of energy. In 2005, nearly 25% of the total primary energy consumption of the region was imported. Thailand is the largest importer of energy, having to import nearly 60% of its energy in the form of electricity, natural gas, and oil products at a cost of approximately \$5 billion annually. Cambodia, Lao PDR, and Viet Nam import 100% of their transport and other petroleum-based fuels. GZAR and Yunnan Province also have to import refined products from other areas of the PRC. Myanmar and Viet Nam are net exporters

of energy at present, but, given the rapid demand growth, the region is likely to remain heavily dependent on imported fossil fuels in the medium term. Power trade in the GMS originated in 1971 when Lao PDR and Thailand entered into a power purchase agreement (PPA) for export of power from the Nam Ngum hydropower plant in Lao PDR to northeast Thailand. ADB supported this early effort with TA for the Nam Ngum project development. In 1984, ADB financed the Xeset hydropower plant, which also exports electricity from Lao PDR to Thailand. From 1990 onward, bilateral power trade intensified as memoranda of understanding (MOU) were signed between various governments in the subregion.<sup>10</sup> Existing electricity trade flows in the GMS are mainly from Lao PDR to Thailand and Viet Nam, with smaller amounts traded from Lao PDR to Cambodia.

15. Regional power interconnections in the GMS are mainly via 110 kV and 230 kV transmission lines, such as those between the Nam Ngum and Xeset hydropower plants in Lao PDR and Thailand. The first 500 kV cross-border transmission line within the GMS will be the line from Nam Theun 2 (NT2) hydroelectric power plant in Lao PDR to Thailand. Work on several 500 kV transmission lines between Cambodia, Lao PDR, and Viet Nam and several other cross-border initiatives are ongoing. Interconnecting disparate power systems is one of the challenges faced by the GMS.

## **B. Development Challenges**

16. As noted above, energy sector growth has contributed to the recent fast-paced economic development in the GMS, and the growth prospects for further energy sector development look quite attractive in the short and medium term. To realize this potential, a GMS regional energy sector strategy (ESS) was formulated during 2006–2008.<sup>11</sup> The ESS sets out a number of important emerging challenges in the sector that will need to be addressed.

17. The ESS highlights as one of the main challenges the uneven access to modern energy services between GMS economies and also within urban and rural areas. Electrification rates are 95% in PRC, Thailand, and Viet Nam; 54% in Myanmar; 45% in Lao PDR; and only 18% in Cambodia. A large share of the population in the GMS is still “energy poor” in that they depend on traditional sources of energy; poor households often spend a large share of their income on fuel wood or charcoal.<sup>12</sup> Despite proven benefits, enhancing access to modern energy in rural areas has so far remained a major challenge, particularly for poor consumers with no current access to grid-supplied power or other reliable energy services.

18. GMS dependence on imported energy poses a potential challenge to sustaining economic growth. In the medium term, given rapid demand growth, the GMS is likely to remain heavily dependent on imported coal, crude oil, natural gas, and refined petroleum products. Limited fossil fuel production prospects, weak electricity demand management, slow development of alternative energy sources, and volatile global oil prices make the region insecure and vulnerable to price and supply shocks. ADB is well positioned to provide TA and

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<sup>10</sup> World Bank, Transport, Energy and Mining Sector Unit, East Asia and Pacific Region. 2007. *World Bank Strategy in the Greater Mekong Subregion for Supporting the Development of Power Trade*. Washington, DC (August). Draft.

<sup>11</sup> ADB. 2008. *Building a Sustainable Energy Future: The Greater Mekong Subregion*. Manila.

<sup>12</sup> Energy poverty has been defined as the absence of sufficient choice in accessing adequate, affordable, reliable, high quality, safe, and environmentally benign energy services to support economic and human development (Cleveland, Cutler [Lead Author]; Peter Saundry [Topic Editor]. 2008. "Energy Transitions Past and Future." In: *Encyclopedia of Earth*. Eds. Cutler J. Cleveland [Washington, DC: Environmental Information Coalition, National Council for Science and the Environment]). Available: <http://www.eoearth.org>.

financial assistance to improve overall energy efficiency and expand local renewable energy capacity (which would ultimately contribute to tradable power surpluses).

19. Other important challenges mentioned in the ESS include:
- (i) **Environmental and social issues.** The GMS comprises predominantly agricultural economies with almost 70% of its population dependent on local resources. The high economic growth has put increasing stress on important natural land and water systems in the region. There is currently a need to enhance the institutional and policy frameworks of member countries to ensure that environmental and social costs in energy systems remain reasonable.
  - (ii) **Improving energy efficiency.** The GMS has reported modest improvements in overall energy efficiency, largely due to the shift from noncommercial to commercial energy sources. A number of barriers emanating from policy regimes, lack of information about energy efficiency practices, weak policy and institutions, and lack of human capacity hinder the region from realizing its potential for improving energy efficiency.
  - (iii) **Aligning institutions and policy regimes.** The overall quality of energy supplies remains low and unpredictable in large parts of the GMS. Current financial incentives, lack of competitive pressures on energy suppliers, and weak policy regimes will need to change drastically to deal effectively with the energy challenges facing the region. More robust policy framework and stronger institutional capacity are needed to mobilize additional private sector investment.

### C. Member Government Strategies and Plans

20. In general, energy sector strategies and plans have typically been within the purview of the respective GMS country's socioeconomic development plans, whereas power sector development plans have often been formulated separately. The strategies have typically given importance to (i) providing an adequate supply of energy at an affordable price, (ii) ensuring the reliability and security of electricity supply, and (iii) encouraging the efficient use of energy. Appendix 2 provides a summary of the national energy sector policies/strategies and plans of the GMS countries.

21. Cambodia's latest economic development plan 2006–2010 acknowledges the very low electrification rate in the country and targets 100% of villages to have access to electricity by 2020 and 70% of rural households to have access to quality electricity by 2030. Similarly, both the Lao PDR's strategic development plan for the energy and mining sectors and its power development strategy recognize the economic and social advantages of electrification and the low rate of domestic consumption, and its power development plan foresees rapid expansion of generation, transmission, and distribution. In terms of regional trading, these plans recognize the Lao PDR's great potential for being a major GMS power exporter and prioritize the honoring of power export commitments with Thailand and Viet Nam by promoting independent power producer generation development and promoting the development of a 500 kV transmission grid with neighboring GMS countries. The PRC's development strategy and plans focus mainly on developing internal resources. However, with the increasing importance of the ASEAN and the efforts within GMS, Yunnan Province and GZAR have accorded higher priorities to developing power trading with Lao PDR, Thailand, and Viet Nam. PRC petroleum companies are also sponsoring a feasibility study for a proposed gas pipeline from southwestern Myanmar to Yunnan Province. Thailand's 10th national plan prioritizes infrastructure development and energy efficiency improvements. Regional power trading forms an integral part of the Viet Nam government's power sector strategy, especially importing power from neighboring countries to

meet short-term power shortages (2007–2010) as well as for meeting long-term power needs once the hydropower potential of the country is fully exploited.

22. Over the past 15 years, the power market in the GMS has moved toward greater regional cooperation, with bilateral power trade becoming increasingly well established. The governments of Lao PDR and Thailand have a framework agreement for power trade between them, first signed in June 1993 and periodically modified to reflect market changes. The latest understanding, reached between the two governments in early 2008, specifies power sale arrangements of up to about 7,000 MW. An MOU for the sale of up to 5,000 MW of electricity from the Lao PDR and 2,000 MW from Cambodia to Viet Nam was signed in March 2008.

#### **D. GMS Regional Cooperation Strategies and Plans**

23. During the first 10 years of the GMS program, it did not have an explicit and integrated development strategy. In 2002, the GMS-SF was the first attempt by the GMS countries to formulate and adopt in broad terms, a subregional development-planning framework that defined the vision, goals, and strategic thrusts of GMS cooperation for 2002–2012. It envisages a GMS that is more integrated, prosperous, and equitable through (i) an enabling policy environment and effective infrastructure linkages that will facilitate cross-border trade, investment, energy, and other forms of economic cooperation; and (ii) the development of human resources and skills competencies. The GMS-SF identifies five strategic thrusts to be pursued to realize the vision and goals of subregional cooperation and specifies 11 flagship programs, including regional power interconnection and trading.

24. Development of the regional ESS has been under way since early 2006, when ADB approved a TA grant to assist in its formulation. The overall rationale for the ESS is to investigate cross-border energy supply options to realize larger markets and efficiencies of scale, to provide diversification and energy security, and to better incorporate environmental considerations into energy sector planning. The ESS is intended to develop a regional strategy for 2006–2020 to expand cooperation among GMS countries to meet rising energy needs and to (i) help articulate a clear a vision for GMS energy cooperation in the energy sector, (ii) develop a strategy to meet energy challenges until 2020, (iii) identify priority investment projects for the public and private sectors, and (iv) draw up an operating framework for enhancing regional energy security. An expert's panel to guide the ESS was formed, and a draft of the ESS was prepared and presented in a regional workshop in June 2008.<sup>13</sup> A road map based on the draft ESS suggesting actions up until 2012 was presented to the GMS governments for consideration in late November 2008.

25. The institutional setup of the GMS energy program has evolved over the past 15 years. Initially, an Electric Power Forum (EPF) was established in 1995 to identify and pursue opportunities for subregional cooperation in the field of electrical energy among the GMS countries. Subsequently, an Experts Group on Power (EGP) Interconnection and Trade was created in June 1998 to develop detailed work programs and recommend its findings to the EPF to promote the development of a regional transmission network and facilitate the expansion of cross-border power trade. Both the EPF and the EGP had their last meeting in December 2004. The EPF reconvened as the Energy Sector Forum and had its first meeting in December 2004. The Energy Sector Forum, which has a broader mandate in scope than the electric power focus of the previous forum, will be focusing more generally on energy (including

<sup>13</sup> ESS Experts Panel. 2008. *Building a Sustainable Energy Future: The Greater Mekong Subregion*. Draft report presented at the Final Regional Workshop, Bangkok, Thailand on 5–6 June.

oil, gas, coal, etc., as well as electricity). Since 2004, the EGP's tasks concerning the development of regional power trade have been taken over by the Regional Power Trade Coordination Committee (RPTCC) and its subgroups, the Focal Group (FG) and the Planning Working Group (PWG). The PWG in turn is expected to have two divisions: (i) the regional PWG, which will make plans for upgrading facilities to increase cross-border transmission capacity or improve reliability/security; and (ii) the operational PWG, which will undertake studies to improve reliability and security of regional network operation and will ensure that power market participants comply with the standards set. Given that no multicountry GMS power market operation is as yet taking place, only the regional planning work under the regional PWG is active at present. Appendix 3 provides a summary of the GMS institutional structure in the energy sector.

26. The RPTCC's mandate includes a number of tasks related to the establishment and implementation of regional trade arrangements. The RPTCC and its working groups are now addressing the infrastructural, technical, policy, regulatory, and other prerequisites that will lead to future multilateral PPAs. The RPTCC has carried out technical studies on performance standards and transmission regulation, and plans to do additional work on standard metering and grid codes, and to tackle other critical issues to support evolving power trading capabilities.

27. A number of important achievements have been realized under the GMS energy program related to regional power trade and interconnection. These include

- (i) the Policy Statement on Regional Power Trade in the GMS, signed in October 1999 (during the Sixth EPF meeting in Phnom Penh);
- (ii) the Intergovernmental Agreement (IGA) on Regional Power Trade in the GMS,<sup>14</sup> signed by the six GMS countries in 2002, which provides the overall framework for cooperation in and development of power trade in the subregion;
- (iii) the general design of a Regional Power Trade Operating Agreement (RPTOA), which sets out the operating rules and guidelines supporting the creation of a regional power market, introduced in 2005;<sup>15</sup> recognizing that the GMS generating capacity, transmission systems, and regulatory framework are not ready for multicountry trading and competitive operations, the study undertaken in 2005 for preparation of the RPTOA recommended a four stage approach; stages 1 and 2 focus on harmonizing power rules and constructing transmission lines; competitive buying and selling of electricity among two or more GMS countries will take place in stages 3 and 4 (see Box 1 for details of the four stages); as part of the stage 1 activities, two MOUs setting out the guidelines and a road map for the RPTOA were agreed among the GMS countries in 2005<sup>16</sup> and 2008,<sup>17</sup> respectively; stage 1 is expected to be fully realized by 2010; and
- (iv) associated with the RPTOA: the planning for construction of various cross-border power interconnection projects; these projects have been identified in the Regional Indicative Master Plan on Power Interconnection (RIMPPI),<sup>18</sup> a document that carries out technical analysis of regional power systems, seeking

<sup>14</sup> GMS. 2002. *Inter-Governmental Agreement on Regional Power Trade in the Greater Mekong Subregion*. Phnom Penh.

<sup>15</sup> RPTCC. 2005. *Draft Regional Power Trade Operating Agreement*. Vientiane. This draft was presented in the third RPTCC meeting held in Vientiane, Lao PDR on 7–8 April 2005.

<sup>16</sup> RPTCC. 2005. *Memorandum of Understanding on the Guidelines for the Implementation of the Regional Power Trade Operating Agreement – Stage 1*. Kunming.

<sup>17</sup> RPTCC. 2008. *Memorandum of Understanding on the Road Map for Implementing the Greater Mekong Subregion Cross-Border Power Trading*. Vientiane.

<sup>18</sup> Mercados EMI-Soluziona. 2008. *Long Run Indicative Master Plan for the GMS Region: Final Report Prepared for Asian Development Bank*. Manila.

to identify the level of regional energy demand and the physical power interconnections that are seen as necessary for meeting that demand; the RIMMPI makes recommendations on least-cost grid interconnection scenarios, and identifies activities to coordinate technical issues needed to link national transmission systems.

#### **Box 1: Four Stage Approach to Power Trading**

GMS power trading is envisioned to evolve in four stages, characterized as follows:

- (i) **Stage 1:** One-way power sales under a power purchase agreement from an independent power producer in one country to a power utility in a second country, using dedicated transmission lines established;
- (ii) **Stage 2:** Trading between two countries, initially using spare capacity in dedicated stage 1 transmission lines, and eventually using other third country transmission facilities;
- (iii) **Stage 3:** All countries interconnected with 230–500 kilovolt lines will introduce centralized operations with a regional system operator that would facilitate third-party participation in trading (entities other than generators/sellers and utilities/purchasers); and
- (iv) **Stage 4:** All countries accept legal and regulatory changes to enable a free and competitive electricity market, with independent third-party participation.

Source: Regional Power Trade Coordination Committee. 2005. *Draft Regional Power Trade Operating Agreement*. Vientiane.

28. In terms of GMS-wide plans, two reporting mechanisms have been introduced to help track project activities under each of the GMS sectors. The first, the GMS Plan of Action (PoA), was introduced as an initiative of the GMS ministers following the 2004 GMS Ministerial Conference and was recently updated for the Third GMS Summit in March 2008. The PoA defines program priority projects and the timeframes within which they will be implemented. The latest PoA<sup>19</sup> incorporates sectoral action plans for the second half of the GMS-SF implementation period (2008–2012). The second mechanism, the GMS development matrix, is a publicity and information tool designed to provide information on GMS projects, assist planning, and help mobilize investment resources for the GMS program. The matrix provides information on both sector- and flagship-based activities, project descriptions, type of activity (TA or loan), project costs, countries involved, stages of implementation, and whether projects are (or are to be) publicly or privately financed. The initiative for the matrix was first identified in the GMS-SF, and the projects selected for inclusion in the matrix were those identified by the sector working groups. The matrix is updated regularly and is available on the ADB GMS website.<sup>20</sup>

## **E. ADB Strategies and Program**

### **1. ADB Strategies**

29. Since 2001, ADB's operations have been guided by both its long-term and medium-term strategic frameworks, which are intended to help ADB respond to the challenges of poverty and to help achieve the Millennium Development Goals in the Asia and Pacific Region. The two long-

<sup>19</sup> ADB. 2008. *Greater Mekong Subregion: Vientiane Plan of Action 2008–2012*. Vientiane.

<sup>20</sup> Available: <http://www.adb.org/GMS/Projects/devmatrix.asp>

term frameworks were approved in 2001<sup>21</sup> and 2008<sup>22</sup> and medium-term frameworks were approved in 2001<sup>23</sup> and 2006.<sup>24</sup>

30. Similarly to the GMS countries (para. 23), ADB did not have an explicit and integrated regional development strategy for the GMS program during the first 10 years. Following the adoption of the GMS-SF in 2002, the GMS Regional Cooperation Strategy and Program (RCSP)<sup>25</sup> was prepared, which set out ADB's strategy and program for the subregion. The RCSP was to be implemented through the 11 flagship programs, and the GMS-SF was endorsed by the GMS leaders. The overarching goal of the RCSP is to reduce poverty in the subregion and this is envisaged as happening through the "3C" program vision of enhanced connectivity, increased competitiveness, and greater sense of community. The document discusses the role of transport, telecommunication, and power systems infrastructure in achieving physical integration. It suggests that greater physical connectivity will lead to better access to markets and thus competitiveness, and seeks to promote competitiveness through the provision of software for facilitation of trade and investment and movement of goods across borders.

## 2. ADB Program

31. ADB assistance to GMS countries is carried out through both national programs and the GMS cooperation program. While the GMS program is guided by the GMS-SF and the RCSP, country programs are guided by country partnership strategies (CPSs) (previously titled country strategy and program [CSP]). While CPS documents focus only on country-level operations, they do make explicit and extensive reference to the role of the regional program in country operations. Given that all lending and project implementation occur on a country basis, it is sometimes difficult to determine what a GMS project is and how such projects link to country-based projects. Under the GMS program, a project is determined to be regional if it has been discussed by the respective GMS working groups and/or included in the respective GMS sector strategy. This means that often a project will be based nationally but listed as a GMS project as it has regional dimensions. Such projects align with both CPSs (or CSPs if they are yet to be updated) as well as the GMS RCSP, and are usually mentioned in both documents. Projects in the GMS development matrix all have this feature.

32. Table 2 provides a summary of ADB's planned energy assistance to the region, as presented in the latest GMS regional cooperation operations business plan (RCOBP).<sup>26</sup> The map of this report indicates the location of these proposed projects. Six loan projects totaling \$231 million and five TA operations totaling \$5.4 million are included in the RCOBP's 2008–2011 regional energy pipeline. The Lao PDR will receive the lion's share of the lending assistance, reflecting its great potential for exporting power to neighboring countries. Viet Nam will also receive a loan for power interconnection.

<sup>21</sup> ADB 2001. *Moving the Poverty Reduction Agenda Forward in Asia and the Pacific: The Long-Term Strategic Framework of the Asian Development Bank (2001–2015)*. Manila.

<sup>22</sup> ADB. 2008. *Strategy 2020: The Long-Term Strategic Framework of the Asian Development Bank (2008–2020)*. Manila.

<sup>23</sup> ADB. 2001. *Medium-Term Strategy (2001–2005)*. Manila.

<sup>24</sup> ADB. 2006. *Medium-Term Strategy (2006–2008)*. Manila.

<sup>25</sup> ADB. 2004. *Greater Mekong Subregion Cooperation Strategy and Program 2004–2008*. Manila.

<sup>26</sup> ADB. 2008. *Greater Mekong Subregion: Regional Cooperation Operations Business Plan, 2009–2011*. Manila.

**Table 2: ADB's Planned Allocations for Regional Energy Activities**

Activity	Country	Pipeline (\$ million)	
		Loan	TA
<b>a. Loans</b>			
GMS Northern Power Transmission, Phase 1	Lao PDR	20	
GMS Nam Ngiep 1 Hydropower	Lao PDR	35	
GMS Nabong–Udon Thani Power Transmission and Interconnection	Lao PDR	74 <sup>a</sup>	
GMS Nam Ngum 3 Hydropower	Lao PDR	47	
Lao PDR–Viet Nam Power Interconnection (Ban Sok–Pleiku)	Lao PDR	25	
Lao PDR–Viet Nam Power Interconnection (Ban Sok–Pleiku)	Viet Nam	30	
<b>b. TA</b>			
GMS Preparing the Ban Sok–Pleiku Power Transmission	Regional <sup>b</sup>		1.0
GMS Nam Theun 2 Hydropower Development–Safeguards Monitoring	Lao PDR		0.4
Facilitating Sustainable Environment-Friendly Regional Power Trading in the GMS Phase 2	Regional <sup>c</sup>		2.0 <sup>d</sup>
Developing the Regional Transmission and Regulatory Authority	Regional <sup>e</sup>		1.0 <sup>f</sup>
Lao PDR GMS Northern Power Transmission II	Lao PDR		1.0
<b>Total</b>		<b>231</b>	<b>5.4</b>

ADB = Asian Development Bank, GMS = Greater Mekong Subregion, Lao PDR = Lao People's Democratic Republic, TA = technical assistance.

<sup>a</sup> Project cost have risen since completion of the project preparatory TA. It is now envisaged that the project would be financed via a multitranche financing facility in the amount of \$100 million.

<sup>b</sup> Covering Lao PDR and Viet Nam.

<sup>c</sup> Covering Cambodia, Lao PDR, and People's Republic of China.

<sup>d</sup> Financing is expected to be provided by the People's Republic of China (via the regional cooperation and poverty reduction fund) and Swedish governments.

<sup>e</sup> Covering all GMS countries.

<sup>f</sup> Financing is expected to be provided by the French government.

Source: ADB. 2008. *GMS: Regional Cooperation Operations Business Plan, 2009–2011*. Manila.

## F. ADB's Assistance to the GMS Program

33. The energy sector is the second largest sector in the GMS after the transport sector. As of December 2007, of the 36 investment projects assisted by ADB, 21 were in the transport sector and 4 were in the energy sector.<sup>27</sup> Energy project costs amounted to \$1.7 billion, 17% of the total GMS project cost of \$10.3 billion. ADB funded \$176.3 million or 10% of the project costs. Table 3 provides a summary of the energy portfolio of the GMS program.

**Table 3: Energy Projects in GMS Program**

Item	\$ Million	%
Total GMS project costs	10,336.160	100.0
Total GMS energy project costs	1,747.161	16.9
Total GMS infrastructure (transport and energy) ADB loans	3,481.3	100.0
Total GMS ADB energy loans	176.3	5.1
Of which: GMS loans in hydropower development	132.0	3.8
Of which: GMS loans in power transmission	44.3	1.3

ADB = Asian Development Bank, GMS = Greater Mekong Subregion.

Source: ADB projects databases.

<sup>27</sup> This includes only "regional energy projects" approved after 1992, as defined by ADB's GMS Unit. Not included are (i) national energy projects with regional dimensions approved prior to the commencement of the GMS program in 1992 (such as the various loans for the Lao PDR Xeset Hydropower Project approved in 1984, 1987, and 1990); (ii) certain national energy projects with regional dimensions approved after the commencement of the GMS program (such as the Cambodia Second Power Transmission and Distribution Project approved in 2006); and (iii) past private sector energy projects with regional dimensions (such as the Cambodia Power Transmission Lines Co., Ltd. Project approved in 2007).

34. Of the total GMS energy assistance, \$176.3 million or 95% was concessional (Asian Development Bank Fund [ADF]) loans, while roughly \$9.1 million was in the form of TA grants, which are additional to other concessionary loans and grants to those countries under their respective CPSs. ADB lending to the sector has consisted of four loans, three to Lao PDR and one to Cambodia. Three of the loans financed the construction of hydropower stations in the Lao PDR aimed at exporting power to Thailand: the Nam Leuk Project (surplus energy), the Theun–Hinboun Project, and the NT2 Project. In addition, another loan, the GMS Transmission Project, financed the construction of power transmission infrastructure in Cambodia linking Phnom Penh with the border of Viet Nam. One of the loans was funded from ADB’s ordinary capital resources (OCR) and three were funded through ADF. A notable feature of GMS lending assistance is the use of the public–private partnership (PPP) lending modality for Theun–Hinboun and NT2, the only cases to date of the use of this innovative financing modality for GMS projects.<sup>28</sup> The map shows the locations of the four approved GMS regional energy projects.

35. ADB has funded 16 regional energy TA operations at a total cost of \$9.1 million. Project preparatory technical assistance (PPTA) has been dominant, with the nine PPTA operations amounting to \$6.9 million, while the seven advisory technical assistance (ADTA) grants amounted to \$2.2 million.<sup>29</sup> The ADTA activities have focused mainly on assisting the subregional EPF, preparing a RIMPPI, formulating a RPTOA, developing a GMS ESS, and addressing issues related to environmentally sustainable development of electricity infrastructure in the GMS. The hydropower subsector has received the majority of the TA funding. Table 4 summarizes the energy sector lending and nonlending program since 1995, and Appendix 4 provides details of project implementation and lessons learned.

**Table 4: Number and Amount of ADB Loans and TAs to GMS Energy Sector**

Item	Cambodia	Lao PDR	GMS Energy	Total GMS
<b>a. Loans</b>				
Number of approved loans	1	3	4	36
Amount (\$ million)	44.3	132.0	176.3	3,576.3
% of total energy loans	25.1	74.9	100.0	
% of total GMS loans	1.2	3.7	4.9	100.0
<b>b. TA</b>				
No. of approved TA grants			16	165
% of total GMS TA grants			9.7	100.0
Amount (\$ million)			9.1	86.2
% of total GMS TA grants			10.6	100.0

ADB = Asian Development Bank, GMS = Greater Mekong Subregion, Lao PDR = Lao People’s Democratic Republic, TA = technical assistance.

Note: The amount of TA grants includes only portion financed from the TA Special Fund and Japan Special Fund does not include amount from other sources and government contribution.

Source: ADB projects databases.

36. The two completed hydropower projects selected for detailed evaluation by the SAPE and forming the basis of the bottom–up assessment (section IV) are the Theun–Hinboun Project and Nam Leuk projects.<sup>30</sup>

<sup>28</sup> While there have been only two PPP projects approved to date, ADB is preparing two similar projects in the Lao PDR, namely the Nam Ngum 3 Hydropower Project and the Nam Ngiep 1 Hydropower Project for financing in 2009.

<sup>29</sup> Includes one small-scale core TA, which supported the third and fourth subregional meetings of the EPF. This TA is not counted in the total ADTA figure, since the TA was fully financed by the Government of Norway.

<sup>30</sup> The NT2 Hydroelectric Project and the GMS Transmission Project are still ongoing.

37. ADB assistance for the energy sector of Cambodia, Lao PDR, Thailand, Viet Nam, and Yunnan Province of PRC has been a combination of GMS loans and non-GMS loans. Similarly, TA for the energy sector has been split into GMS and non-GMS. Table 5 shows the quantum of assistance for the two categories.

**Table 5: GMS and Non-GMS Energy Projects (Loans and TA), 1992–2007 (\$ million)**

Item	Non-GMS			GMS				Total Loan	Total TA	Grand Total
	Loan	PPTA	ADTA	Loan	PPTA	ADTA	Core TA			
Cambodia	66.80	0.60	2.64	44.30	0.91			111.10	4.15	115.25
PRC (Yunnan)	207.00	0.55	0.79					207.00	1.34	208.34
Lao PDR	95.50	4.14	4.33	132.00	4.41	0.14		227.50	13.02	240.52
Thailand	602.45		0.95					602.45	0.95	603.40
Viet Nam	559.98	8.10	10.91		1.25			559.98	20.26	580.23
RETA					3.46	9.82	0.08		13.36	13.36
<b>Total</b>	<b>1,531.73</b>	<b>13.39</b>	<b>19.62</b>	<b>176.30</b>	<b>10.03</b>	<b>9.96</b>	<b>0.08</b>	<b>1,708.03</b>	<b>53.08</b>	<b>1,761.10</b>

ADTA = advisory technical assistance, GMS = Greater Mekong Subregion, Lao PDR = Lao People's Democratic Republic, PPTA = project preparatory technical assistance, PRC = People's Republic of China, RETA = regional technical assistance, TA = technical assistance.

Note: "Loan" refers to Asian Development Bank (ADB) loans only. TA amount may include funding from TA Special Fund, Japan Special Fund, other sources, and government contribution.

Sources: GMS Secretariat and ADB information systems.

38. From 1992 until now, GMS energy project lending has accounted for only 10% of total ADB energy lending to the GMS countries. In TA, however, the proportion is significantly higher being 39% (counting cofinanced TA). Regional technical assistance (RETA) accounts for about 25% of the total TA value, although the benefits of these RETA are distributed among the GMS countries. Since 2003, there has been an increase in the activities classified under the GMS banner, with two loan projects and 11 TA operations so-designated.

## G. Strategies and Plans of Development Partners

39. Among the international organizations, the World Bank is the most active in regional energy/power development in the GMS countries, with the Mekong River Commission (MRC) and ASEAN also involved. Among the bilateral donors, the governments of Japan (through the Japan Bank for International Cooperation, the Japan International Cooperation Agency, and the Japan Special Fund); France (Agence Française de Développement); Norway (Norwegian Agency for Development Cooperation); and Sweden (Swedish International Development Cooperation Agency [SIDA]) have been active. SIDA offered to finance a seconded staff to ADB to work full-time on RPTCC activities. Appendix 5 summarizes the energy sector activities of the main development partners, and Box 2 compares GMS regional power sector activities with those of other major regions. Given the complexities involved, progress in the GMS is substantial, considering that regional power trading has evolved over a period of decades in other parts of the world.

### Box 2: Greater Mekong Subregion Energy Cooperation in the Global Context<sup>a</sup>

As described in Box 1, the Greater Mekong Subregion (GMS) power trading is envisioned to evolve in four stages. The GMS is considered to be at stage 1, and is expected to take several more years or more to mature to stages 3 and 4. Some other regional and subregional power trading programs with multilateral support with noteworthy progress are as follows:

**Latin America and Caribbean – Stage 3.** In 2006, the Inter-American Development Bank (IADB) approved a \$170 million loan for construction of the Sistema de Interconexion Electrica para America Central (SIEPAC) or Central American Electrical Interconnection System 230 kilovolt transmission line linking six countries (Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama). This line will increase power trading capacity from 30 megawatts to 300 megawatts. IADB also provided \$12.5 million in regional technical assistance to develop regional operational rules, create a regional regulatory framework, and establish a regional system operator. The power grids of Colombia and Mexico are expected to link to the SIEPAC system. The SIEPAC project is a result of the Plan Puebla Panama (established in 2001), and the Initiative for Integration of Regional Infrastructure supported by IADB (established in 2000), the Andean Development Corporation, and the Financial Fund for the development of the River Plate Basin.

**Eastern Europe – Stage 2/Stage 3.** In 2005, the World Bank approved an Adaptive Program Loan of up to \$1 billion to facilitate regional power integration of eight countries (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Former Yugoslav Republic of Macedonia, Romania, Serbia and Montenegro, and Turkey). These countries are part of the European Commission and Stability Pact-sponsored and World Bank-supported Energy Community of Southeast Europe. The Energy Community was created following the December 2003 Athens Memorandum of Understanding.

**Africa – Stage 1/Stage 2.** In 2005, the World Bank approved an Adaptive Program Loan of \$350 million to support the West Africa Power Pool (WAPP) Project. The WAPP Project is designed to integrate fragmented national electric power systems of the region to increase access to affordable, stable, and reliable electricity. The World Bank-supported Southern Africa Power Market Project has a similar approach as the WAPP Project, with Adaptive Program loans of up to \$440 million authorized beginning in 2004.

<sup>a</sup> For brevity, only electric power subsector activities are included in this box. The World Bank Group has also supported other regional energy projects, e.g., the Bolivia–Brazil Gas Pipeline, the Chad–Cameroon Petroleum Pipeline, the West African Gas Pipeline, and the Baku–Tbilisi–Ceyhan Oil Pipeline.

Sources: Available: <http://www.iadb.org/news/articledetail.cfm?language=EN&artid=3182>

<http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/EXTECAREGTOPENENERGY/0,,contentMDK:20417792~pagePK:34004173~piPK:34003707~theSitePK:511377,00.html>

<http://web.worldbank.org/external/projects/main?pagePK=64283627&piPK=73230&theSitePK=40941&menuPK=228424&Projectid=P075994>

<http://web.worldbank.org/external/projects/main?pagePK=64312881&piPK=64302848&theSitePK=40941&Projectid=P069258>

40. The World Bank has been very active in the GMS energy sector and has collaborated closely with ADB on GMS energy-related issues. In 1998, the World Bank issued a report entitled *Power Trade Strategy*, which helped the GMS countries and the development partners to better understand the issues involved in regional power trade. In collaboration with the GMS, the World Bank has played a significant role in the design of an action plan for moving forward and in the development of the IGA. The World Bank has also been an active participant in the RPTCC since its first meeting in July 2004. The World Bank and ADB have also worked closely together on the preparation and implementation, and are cofinanciers, of the NT2 Hydroelectric Project in the Lao PDR. The World Bank's involvement in the GMS energy sector is likely to increase following the formulation of a new World Bank strategy on *Supporting Development of Power Trade* (footnote 9). This strategy outlines four key principles and indicates that the World Bank will provide both policy/institutional as well as investment support to carry out the strategy. Less clear, however, is how this strategy aligns with the various GMS and ADB strategies in the energy sector.

41. MRC is the intergovernmental organization responsible for managing the Mekong River Basin and its resources. Since signing an MOU for cooperation in March 2000, ADB and MRC

have had relatively limited interaction with respect to energy-related areas. To date, collaboration has been in just two areas: (i) as comembers of a steering committee on RETA to prepare a regionally optimized, sustainable, and environmentally acceptable hydropower development plan for three rivers that are mainly in the Lao PDR;<sup>31</sup> and (ii) coordination of activities in the Nam Ngum River Basin of the Lao PDR. More active collaboration was hindered by MRC's not having been active in the hydropower sector, despite having formulated its own hydropower strategy in 2001. In early 2008, MRC reactivated its dormant hydropower program and assigned a dedicated staff to follow up on the program. As one of the leading brain trusts on subregional water resources, MRC is now well placed to contribute significantly to the hydropower development program. Optimum development of hydropower resources (i.e., without degradation of other water uses) requires detailed hydrological and water quality modeling and monitoring, which MRC should be able to provide. MRC may also be able to play an active role in addressing physical cross-border impacts caused by large hydropower plants (e.g., the Se San 3 plant in Viet Nam, which was expected to severely disrupt agriculture, affecting about 50,000 people downstream in the Lao PDR). Given these new developments, there is good scope for future collaboration between the GMS and MRC on issues related to hydropower development.

42. ASEAN is also present in the GMS energy sector through the ASEAN Energy Forum, which has been in existence longer than the RPTCC. To date, ASEAN's activities have been oriented more toward studies and meetings, with less emphasis on physical power interconnection activities. Cooperation had been limited to attendance at conferences/meetings, with ADB invited to ASEAN events and meetings and ASEAN participating in the last two RPTCC meetings. In 2006, cooperative arrangements between ASEAN and ADB were formalized through the signing of an institutional MOU which aims to "accelerate ASEAN regional cooperation and integration process in Asia" through the GMS, among other subregional programs. However, joint planning and involvement in joint activities continue to occur on a largely ad hoc basis, although there are indications that there may be more formal collaboration between the two bodies on infrastructure sectors in the future.

### III. STRATEGIC AND INSTITUTIONAL (TOP-DOWN) ASSESSMENT

43. The top-down assessment consists of four criteria (strategic assessment, institutional assessment, value addition, and ADB performance). Overall, the top-down assessment of the GMS energy sector is rated "successful" with some areas needing further improvement. Performance assessment summaries are in section V.

#### A. Strategic Assessment

##### 1. Alignment of Regional Sector Strategy with Country and ADB Priorities

44. This section assesses the extent to which the GMS ESS has been aligned with the needs and priorities of GMS countries (as discussed in paras. 20–22 and in Appendix 2) and with ADB's priorities.

45. This is rated "substantial." Feedback from government officials indicates that ADB assistance for GMS energy projects has been fully in line with the national development plans. The GMS energy projects were all priority projects within the individual government public

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<sup>31</sup> ADB. 1996. *Technical Assistance for the Se Kong–Se San and Nam Theun River Basins Hydropower Development Study*. Manila. MRC acted as the coordinating agency for the RETA and, along with ADB and the World Wildlife Fund, was a member of the project steering committee.

investment programs (PIPs). For example, in the Lao PDR, both the 1991–1995 PIP and the 1996–2000 PIP included the Nam Leuk Project, and the 2008 Strategic Development Plan for Energy and Mining Sectors, 2006–2020 included the NT2 Hydroelectric Project. Similarly, the Cambodia Second Socioeconomic Development Plan<sup>32</sup> (2001–2005) also mentioned the Regional Transmission Project as one of the first priorities in energy for regional development, since it would connect Phnom Penh to the Viet Nam electricity grid.

46. The GMS energy program has been fully in line with ADB’s sector and thematic priorities, including those for energy, private sector development, and regional cooperation and integration. The 1995 Energy Policy highlighted ADB’s potential role as a catalyst for regional cooperation and expressly recommended that ADB assist in promoting agreements and complementary investments for equitable exploitation of common hydropower potential and intercountry exchange of energy supplies. Subsequently, the ESS was reviewed in 2000 and evaluated by OED in 2007. A new ESS is currently under formulation, and it is clear that regional energy cooperation will be a key priority under this new strategy. The GMS energy program is thus assessed to be relevant both at the time of GMS program formulation as well as at present.

47. The GMS energy program is also fully in line with ADB’s private sector development strategy. A notable achievement in the GMS energy program has been the approval of two PPP projects, the Theun–Hinboun Project and the NT2 Hydroelectric Project. PPPs are one of the most effective means of filling resource gaps in the GMS program and reducing risks for private investors, since under such arrangements both the private and public sectors provide finance and share risks for projects. The use of the PPP modality has opened up new possibilities for private sector participation in GMS countries.

48. Energy development in the regional context remains high on ADB’s development agenda. Regional and subregional economic cooperation programs (cross-border infrastructure and related software) form the first pillar of ADB’s Regional Cooperation and Integration Strategy (RCIS).<sup>33</sup> The GMS program, the draft GMS ESS, and ADB’s RCSP are all in line with the RCIS. The RCIS emphasizes the role of physical connectivity caused by a combination of cross-border hard infrastructure and the related “software” comprising harmonization of regulations, procedures, and standards. The GMS program targets this appropriately, although the software side has been slow to develop.

49. As discussed in para. 27, the GMS energy program has reached two important agreements related to regional power trade and interconnection: the IGA and the RPTOA. These led to the development of the RIMPPI, initially drafted in 2002 with a second version prepared in 2007, which prioritizes the development of 11 power interconnections in the GMS. Most of the interconnections in the RIMPPI appear to be fully aligned with the needs of the individual countries and the region. However, some of the proposed multicountry interconnections will require resolution of various factors, such as tariffs and access to transmission line capacity in transit countries, synchronization of the different power systems in each of the GMS countries (in the case of conventional alternating current transmission lines), and commitment of sufficient generation capacity to justify high voltage direct current lines.

## **2. Positioning of the Sector Strategy and Program**

50. Positioning of the sector strategy and program is rated “high.” As indicated in para. 45, both the regional power trading strategy (as set out in the IGA and the RPTOA) and the new ESS

<sup>32</sup> Cambodia. *Second Socioeconomic Development Plan, 2001–2005*. Phnom Penh.

<sup>33</sup> ADB. 2006. *Regional Cooperation and Integration Strategy*. Manila.

are considered highly relevant to the priority development needs of the whole GMS, as well as to those of the individual countries. The current energy strategy and program ensure energy sector continuity for at least the medium term. This is bolstered by the energy sector being a priority area in both ADB's previous and latest long-term strategic framework (footnotes 21 and 22).

51. In terms of program positioning, regional energy investments have been focused mainly on capacity expansion of electricity generation through hydropower development, with one project addressing regional transmission interconnection. Power trading in the form of bilateral hydropower export projects poses substantially greater risks than projects intended for domestic supply only, and as such these types of intervention are appropriate for ADB. Bilateral power trading is a logical first step in progressing toward a multicountry trading system where ADB's "honest broker" interventions deliver even higher value. Capacity-building efforts have focused on assisting the subregional EPF, preparing a RIMPPI, formulating RPTOA, developing a GMS ESS, and addressing issues related to environmentally sustainable development of electricity infrastructure in the GMS. Both the investment and capacity-building efforts correctly targeted several of the main development challenges in the region (paras. 16–19).

52. The sequencing of GMS energy activities is considered appropriate. Originally, a two-pronged approach was adopted by the EPF right after it was established in 1995 to promote enhanced power cooperation in the GMS. The first prong involved providing the policy and institutional framework for promoting power trade opportunities, while the second prong involved a "building block" approach to developing the essential grid interconnection infrastructure to physically facilitate the cross-border dispatch of power. Progress under the first prong has been impressive, with activities concentrating on putting in place power trading agreements (IGA and RPTOA), setting up appropriate regional bodies (RPTCC), and formulating an indicative regional master plan (RIMPPI). Second prong activities have included preparation and financing of a number of regional energy projects using progressively more sophisticated financing structures. The synergy and sequencing of the activities within and between each of the two prongs also appear to have been effective.

### **3. Coordination and Complementarity**

53. This is also rated "substantial." There have been regular consultations and coordination mechanisms in place between ADB, other development partners (both multilateral and bilateral), and governments. As indicated in para. 40, ADB and the World Bank have been closely collaborating, both as coparticipants in the RPTCC as well as in the preparation, financing, and implementation of the NT2 Hydroelectric Project in the Lao PDR. More recently, the World Bank formulated a new strategy on supporting the development of power trading in the GMS, but it seems that this was done somewhat unilaterally, without very much prior consultation.<sup>34</sup> It is unclear how this new strategy aligns with the various prevailing GMS and ADB strategies in the energy sector. In terms of coordination with bilateral partners, ADB has closely interacted with the Japanese, French, and Swedish government aid agencies, which all participate in RPTCC meetings.

54. One development partner, MRC, has indicated that awareness about the GMS program has been somewhat lacking. Specifically, MRC indicated that they did not always receive timely invitations to GMS events and were not fully aware of the GMS energy sector activities being

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<sup>34</sup> World Bank resident mission staff informed the OEM that the strategy was prepared in Washington, DC and was mainly "headquarters driven." ADB resident mission staff interviewed by the OEM had not been consulted about it and were not aware of the strategy.

carried out. There appears to be some room for improvement in increasing awareness about the GMS program among aid agencies.

## **B. Institutional Assessment of the Sector**

### **1. Ownership**

55. This is rated “substantial.” Recent evidence suggests that there has been increasing government support for the GMS program and that GMS member countries are now taking a more active role in program direction and in initiating activities. Governments have increasingly supported the program, as there is a feeling that “ADB delivers,” there is confidence that results are being achieved, and the GMS program involves long-term planning and implementation. That the initiative for the first heads of government GMS Summit in 2002, 10 years after the start of the GMS program, came from one of the countries (Thailand) itself, rather than being proposed by ADB, appears to support this observation.

56. The GMS countries have generally demonstrated a high level of ownership of energy sector programs and activities. This is best demonstrated by the active and sustained participation of the government representatives in the EPF, EGP, and RPTCC. Nevertheless, there are some questions as to whether the plans for energy grid development are wholeheartedly supported by all member governments.<sup>35</sup> The degree of technical knowledge to evaluate and assess the costs and benefits of various GMS energy program components and whether they are worth participating in also varies between countries and may affect the degree to which the countries can participate in and benefit from the GMS energy program. Alternatively stated, the GMS program may carry perceived “overhead” costs; in this context, national-led projects will naturally have higher priority than regional projects except where the latter have demonstrably higher financial and economic benefits.

### **2. Structural Assessment**

57. This section discusses the different institutional structures guiding the management of the GMS energy program, looking in particular at the GMS governments’ decision-making structures and at the role of non-ADB supporting bodies. General principles for decision making and issues of communication and organizational coherence are also discussed. Overall, the assessment rates the GMS energy program’s institutional structures as “substantial.”

58. Decisions around GMS program planning and policy occur through a series of levels of GMS government representation, progressing from sector working groups and sector forums, to Senior Officials Meetings, to the ministerial level, and then finally (since 2002) to the heads of government level through the GMS summits. The general process for decision making sees working groups/forums developing detailed sector strategies, action plans, and projects, which then get passed on to Senior Officials Meetings for review and eventual endorsement to GMS ministerial meetings or summits. Projects or activities may be proposed or vetoed for country involvement by country representatives at any stage along the line. The composition and function of these institutional structures with respect to the energy sector have been discussed in para. 25 and are further elaborated in Appendix 3.

59. **Decision-Making Principles and Dynamics.** Since the GMS program’s inception, general principles for decision making have been adopted to ensure that program activities can

<sup>35</sup> Oxfam. 2007. *Unraveling the Greater Mekong Subregion Program: An Overview and Update on Key Structures, Program and Developments*. Manila. See page 12, last paragraph.

proceed without requiring full consensus from each GMS government. ADB explicitly states that the program is not a rules-based setup and that it specifically intends to operate in a flexible environment in order to enable things to go forward. The “two plus” principle allows two or more countries to cooperate on a regional initiative, even if other countries are not yet ready to participate. Decision making over program and sectoral priorities is largely made at the RPTCC level, with endorsement from higher levels.

60. **Interprogram Coordination.** An issue relating to decision making is the nature and degree of intersectoral communication and information sharing within the GMS program. Reports in the past have stated that there has been little interaction between different sectors and their working groups (footnote 6). The GMS Secretariat has been attempting to address this problem through initiatives such as the GMS newsletter and cross-representation on sectoral working groups (e.g., the staff of the GMS Environment Operations Center have attended meetings of the energy and transport working groups). In addition, the GMS Core Environment Program has undertaken strategic environmental assessments for several sectors, including the energy sector. Interprogram coordination is expected to be further enhanced by the adoption of the “economic corridor” approach, whereby various sectoral working groups will be represented in the proposed Economic Corridor Forum.

61. **RPTCC and Subgroup Coordination.** Another issue relates to the coordination between the RPTCC and its two subgroups, the FG and the PWG. Several government officials and development partners have indicated that there appears to be some repetition between the meetings of the two subgroups and RPTCC. The FG, which currently oversees the PWG, was created as a transitional body to serve as a technical “bridge” between the PWG and the RPTCC. Given the breadth and scope of technical issues to be dealt with in the process of implementing the RPTOA during the initial stages of power trading, it was deemed necessary to have the FG decide on key technical and work plan issues, without taking too much of the time of the more senior RPTCC members. Since the FG and PWG were created in 2006, they have met twice a year, whereas the RPTCC now meets only once a year, instead of twice a year as was the case prior to 2006. Each meeting is typically held over a 3-day period, with the subgroup meetings held on first and second days and the RPTCC meeting on the third day. Several in-country and development partner observers have suggested a more streamlined structure, with perhaps shorter meetings lasting only 2 days, especially in instances when the RPTCC is not organized back-to-back with the FG and PWG.

### 3. Resource Mobilization

62. Resource mobilization in the energy sector is rated “high” mainly due to ADB’s proactive initiative in catalyzing large sums of capital from the private sector through the use of the PPP modality for two hydropower projects in the Lao PDR (para. 34). As an example, the NT2 Hydroelectric Project was able to mobilize over \$1 billion of private sector money with only a relatively small amount of public sector money. In recent years, the Lao PDR has received about \$20 million per annum based on ADB’s performance-based allocation formula, with public sector-financed transmission lines being funded using ADF resources and hydropower projects that are revenue generating being funded from OCR (as was the case with the NT2 Project). Taking into account ADB’s limits on concessional funding, it could be increasingly difficult to finance regional energy projects unless they are revenue generating or ADB provides the relatively more expensive OCR funding. In the first case, ADB should continue to explore innovative financing approaches, including opening a new line of lending through the private

sector window, utilization of clean energy and climate change funds,<sup>36</sup> and possibly standalone guarantees. In the second case, especially for low-income countries such as the Lao PDR which are eligible for ADF funding,<sup>37</sup> the fiscal capacity of such countries needs to be ascertained.

63. Resource mobilization for TA projects has also been very impressive. Table 6 shows that ADB has been able to mobilize over \$10 million of cofinancing for the 16 GMS RETA out of the \$20 million in TA financing operations.

**Table 6: Technical Assistance Financing for GMS Energy Sector, by Source**

<b>Fund Source</b>	<b>Amount (\$'000)</b>	<b>% of Total</b>
ADB	7,506	37.4
Agence Française de Développement	1,200	6.0
France	2,000	10.0
Japan Special Fund	1,560	7.8
Sweden	5,000	24.9
Norway	820	4.1
GMS governments	1,975	9.8
<b>Total</b>	<b>20,061</b>	<b>100.0</b>

ADB = Asian Development Bank, GMS = Greater Mekong Subregion.

Source: ADB projects database.

### **C. Value Addition of the GMS Program to the Sector**

64. This is rated “substantial.” The GMS program’s role in energy development has undoubtedly been useful. It has brought about regional collective actions needed for greater connectivity and integration of energy plans, programs, and strategies among the GMS countries. The GMS has served as a platform, resulting in mutual benefits that would otherwise have not been available through national initiatives on energy or projects alone. Broadly, these include creation of external/extraboundary spillover effects or positive externalities through provision of public goods and services with transboundary implications, lowering of coordination or transaction costs, and capture of economies of scale. Another apparent benefit has been the demonstration effect of the GMS program, both within and outside the subregion.

65. The GMS program has been the main institutional mechanism to support the identification of common regional energy opportunities (e.g., potential energy trading) and the search for their collective solution since its inception. For example, the signing of the IGA by all GMS countries (para. 27), an important step in the development of a regional power market and of cooperation in power trade, was done through the GMS’ two main energy forums, the EPF and the EGP. The successful forging of this agreement indicates the GMS countries’ recognition that power trade can help secure a better balance in the subregion’s rich but uneven energy resources. The IGA was instrumental in the creation of the RPTCC, comprising representatives of the GMS countries, the body responsible for guiding the subregion’s power trading and market development. RPTCC activities include the conduct of priority studies (performance standards, transmission regulation); capacity building; power master planning; database development; and preparation of best practices for PPAs. Since 2004, the RPTCC has had six meetings, started implementing initial projects including the review of energy cooperation activities, and has thus far agreed to conduct a study on an integrated regional

<sup>36</sup> Depending on the project, ADB’s clean energy funds coupled with OCR funds might be able to provide some degree of concessionality.

<sup>37</sup> ADF funding for regional cooperation projects is current subject to a ceiling of 10% of the total ADF budget. There have been discussions about increasing this ceiling.

master plan for power development. With this, there is now a strong impetus toward developing the GMS power trade market.

66. Other GMS energy initiatives, including forums and policy dialogues as well as country reports, help in facilitating deliberation of issues of concern relating to regional power interconnection and trading, and how these could be addressed with a combination of country and regional initiatives. In particular, the EPF has conducted meetings and produced reports that have generated better understanding of energy plans and policies among the GMS countries and of the major concerns and issues that they are facing. It has also facilitated “open exchange between GMS countries not possible many years ago.”<sup>38</sup> These initiatives have also affirmed the important role of the private sector in energy development and the need for government to create the enabling environment for promoting private sector participation.

67. The GMS energy program has facilitated understanding of the nature, scale, and timing of costs and benefits to participating countries, including major players or stakeholders and reconciling different interests and priorities. For example, the China Southern Power Grid Company, Ltd. in the PRC indicated that the recently completed GMS Long-Run Power Master Plan gives a “clear concept on optimized distribution of GMS energy resources and guidance for further cooperation on specific power projects.” Moreover, the establishment of the GMS database and website has been acclaimed to be an effective platform for exchanging information among GMS countries.

68. The GMS program of hydropower development and construction of cross-border transmission lines has served to expand bilateral power trade between Lao PDR and Thailand and has produced significant economic benefits (see paras. 109–113 for a discussion of the economic benefits of bilateral power trading). The Lao PDR power exports to Thailand have generated substantial foreign exchange earnings, while providing Thailand with access to clean and low-cost power (typically \$0.04–0.05 per kWh). Thailand’s import of hydropower from the Lao PDR has also benefited its rural communities with electricity. The strong increase in the Lao PDR’s electricity generation over the past 10 years has led to an extension of its domestic market, contributed to the growth in GDP, and also strongly benefited rural and remote border communities. In recent years, demand growth in the Lao PDR due to grid expansion and power requirements for new mining operations has impinged on the exportable surplus. In some areas without grid-supplied power, the Lao PDR is buying electricity from Thailand at close to \$0.08 per kWh (vs. around \$0.20 per kWh or higher for diesel-fired generation and other off-grid power generation), which has eroded some of the net financial benefits to the Lao PDR.

69. An important apparent benefit of the GMS energy program has been the demonstration effect, both within the subregion and internationally, of implementing successful regional projects. The use of innovative project modalities, such as PPPs, in two of the GMS energy projects has also had a catalytic effect, both within the GMS program and externally. For example, within the GMS program, it may be surmised that the NT2 Hydroelectric Project may have proceeded without ADB support, but it is unlikely that the Project would have happened without the important precedent set by the Theun–Hinboun Project. Although it is difficult to gauge the exact breadth and extent of the demonstration effect externally, there is clear evidence that investor confidence in undertaking power export projects in the region has risen strongly in recent years. As an

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<sup>38</sup> TA 5643: Subregional Electric Power Forum Back-to-Office-Report, November 1997.

example, the latest power development plan for the Lao PDR includes 32 future power projects involving power export, most of which are joint ventures with foreign investors.<sup>39</sup>

70. One important energy challenge that will need to be addressed in the future relates to multilateral power trading. In terms of the RPTOA stages (Box 1), the GMS countries are just now moving into stage 1, wherein the aim is to use surplus or unutilized capacity in dedicated lines that are part of bilateral PPAs. Although the countries in the region have negotiated a large number of bilateral project-specific PPAs, as yet there is limited progress in negotiating a multilateral PPA, allowing for power trading among more than two countries. This seemingly slow progress in implementing the RPTOA is not surprising, as the GMS countries' power systems are at different stages of development.<sup>40</sup> The RPTOA envisages in its later phases the achievement of such multilateral trading, but a number of legal and technical issues are currently hindering progress and need to be resolved. Multicountry power pool trading could require an additional 10 years to develop the necessary infrastructure, legal framework, regulations, and human resource capacity.

#### **D. ADB Performance**

71. ADB's performance was assessed following five criteria: (i) adviser and honest broker support, (ii) institutional support, (iii) coordination with other development partners, (iv) capacity building, and (v) portfolio management.

##### **1. Adviser and Honest Broker Support**

72. This is rated "substantial." ADB has played an effective role as adviser and "honest broker" bringing together different stakeholders to achieve consensus in areas of shared concern in the GMS energy sector. Indeed, the Southern China Power Grid, an active member of the RPTCC, indicated that "ADB plays an irreplaceable role in the GMS power cooperation by its third party role demonstrating professional and fair working attitude." Also, the various forums, coordinating meetings, and subgroup meetings have undoubtedly served a useful role in facilitating discussion between the governments and providing continuity and coherence to the energy programs determined by the GMS member governments. While ultimate decisions to go ahead or not go ahead with various elements of the energy program have been made at various levels within the GMS member countries, there is no doubt that ADB's role as a mediator has been important in ensuring that the program moves ahead. That ADB in the past was often asked to prepare agendas or determine various program options through advisory and technical studies means that ADB has also exercised a significant and appropriate degree of advisory influence in determining program directions.

##### **2. Institutional Support**

73. This is rated "substantial." ADB's GMS Secretariat has been instrumental in providing backstopping and support to the GMS national coordinating committees in each of the GMS countries. The Secretariat's role as overall program coordinator has been crucial in ensuring continuous progress, coherence, and coordination among the nine GMS sector programs and 11 flagship projects. The Secretariat's energy-related work has been normally handled by ADB

<sup>39</sup> Maunsell Limited in association with Lahmeyer GmbH. 2004. *Power System Development Plan for Lao PDR: Final Report – Volume A: Main Report*. Auckland.

<sup>40</sup> By comparison, the Nordic Pool, which was established in the 1940s, took more than half a century to achieve its aim of becoming a major power pool with multicountry trading.

staff with the help of a local headquarters-based staff consultant, which appears to have been an appropriate arrangement.

74. Although the work accomplished by the Secretariat is generally highly valued, several GMS national coordinators indicated that they would appreciate receiving assistance from the GMS Secretariat to enhance the capacity of their respective GMS national coordinating committees to liaise with the various sector working groups, sector forums, and other stakeholders.

### **3. Coordination with Development Partners**

75. This is rated “substantial.” As discussed in paras. 39–42 and 53–54, ADB has coordinated with a broad range of multilateral development partners in the GMS energy sector; including the World Bank, the European Investment Bank, MRC, and ASEAN. ADB and the World Bank have worked particularly closely on the GMS regional energy program since its inception, and by all accounts this has been a good partnership. In addition, ADB has coordinated closely with several bilateral partners, including Japan, France, Norway, and Sweden. The World Bank and the Japanese, French, and Swedish aid agencies regularly attend RPTCC meetings.

76. The ADB resident missions in the GMS have been quite active in disseminating information about the GMS program. From 2000 to 2004, there were several meetings about developments in the GMS program. In Cambodia, for example, several presentations on planned infrastructure projects, including power transmission projects, were made to all ASEAN and European ambassadors in Cambodia, Lao PDR, and Viet Nam. Coordination with MRC has been relatively less active, due mainly to a lack of capacity on the part of MRC to implement its hydropower strategy and program. With the recent reactivation of the hydropower program (para. 41), there is good scope for future collaboration between ADB and MRC on issues related to hydropower development, and other energy resource development which may significantly impact water resources.

### **4. Capacity Building**

77. This is rated “substantial.” A range of TA activities have been carried out that have addressed the GMS countries’ and governments’ need to (i) identify optimal, sustainable, and environmentally sound hydropower projects; (ii) update and harmonize transmission plans/design and operational practices; and (iii) build institutional capacity to match the expansion of physical infrastructure for a competitive GMS regional power market. Capacity-building efforts have focused on assisting the subregional EPF, preparing a RIMPPI, formulating a RPTOA, developing a GMS ESS, and addressing issues related to environmentally sustainable development of electricity infrastructure in the GMS.

78. Meanwhile, several of the regional energy loans have included capacity-building elements that have sought to (i) analyze various financing options, and assist executing agencies and governments in negotiating suitable financing associated with projects; (ii) strengthen government capacity to implement and manage hydropower development projects effectively, including, in particular, mitigation of negative social and environmental impacts; and (iii) build government capacity for effective communication with all stakeholders. For example, a recently approved RETA,<sup>41</sup> with funding support from Sweden, is providing

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<sup>41</sup> ADB. 2007. *Regional Technical Assistance Report: Facilitating Regional Power Trading and Environmentally Sustainable Development of Electricity Infrastructure in the Greater Mekong Subregion* (financed by the Government of Sweden). Manila.

ongoing support for (i) establishing a competitive regional power market, and (ii) ensuring proper control of environmental impacts during development and implementation of regional power trading projects. One of the RETA's major components will build capacity for managing environmental impacts of projects, since it is crucial for both environmental authorities and power utilities to be able to properly prepare and implement environmental impact assessments and environmental management plans.

79. Future operations listed in the GMS development matrix include a number of TA activities that could enhance capacities in the energy sector such as (i) feasibility studies for gas pipeline distribution system, transmission systems, and hydropower projects; (ii) formulation of a subregional strategy to develop and promote renewable energy; and (iii) training of personnel for integrated GMS power system operation and management

## **5. Portfolio Management**

80. This is rated “substantial.” Lending to the GMS energy sector comprised two ADF loans to the Lao PDR; one ADF loan to Cambodia; and one OCR loan to the Lao PDR, with a total loan amount of \$176 million. The two ADF loans to the Lao PDR financed the Theun–Hinboun and Nam Leuk hydropower projects, both of which have been successfully completed and are exporting electricity to Thailand. Theun–Hinboun is considered successful and well designed owing to the thorough technical and economic evaluation of a suitable hydropower site, good and experienced developers, and a PPA advantageous to all parties involved. Nam Leuk was successful as well in providing domestic power supply and exporting surplus to Thailand. However, it was noted to have suffered implementation difficulties and achieved little capacity building, which could be attributed to insufficient funding to achieve multiple objectives including provision for environmental and social mitigation measures after plant operation.

81. There are also two ongoing loans. The Regional Power Transmission Project has suffered from implementation delays. Initial implementation of the loan was very slow because of delayed loan effectiveness due to the formation of a new government in Cambodia and slow fielding of consultants. In early 2008, the loan closing date was recommended to be extended by at least 1 year to end-2009 and administration of the project was delegated to the Cambodia Resident Mission. Physical progress for the loan is estimated at 35% against an average elapsed implementation period of 88%.

82. The NT2 Hydroelectric Project has remained largely on track and is expected to be physically completed in November 2009. Its physical progress is estimated at 54% against the elapsed implementation period of 61%.

## **IV. BOTTOM–UP ASSESSMENT OF THE SECTOR PROGRAM**

83. This bottom–up assessment of ADB assistance to the GMS energy sector employs the five evaluation criteria of relevance, effectiveness, efficiency, sustainability, and impact. The assessment covers four loans and 16 TA grants. Evaluation of ongoing projects is based on reports and recommendations of the President, back-to-office reports, and available project administration indicators, and is thus tentative. Performance assessment summaries are in section V.

### **A. Relevance**

84. ADB assistance to the energy sector in the GMS is assessed as “highly relevant.” The relevance of ADB’s loans and TA to the GMS energy sector is assessed on the basis of their

(i) compatibility and alignment with national development plans and programs of evolving GMS economies; (ii) consistency with ADB priorities, its country assistance programs, regional cooperation programs; and (iii) appropriateness of project design to achieve intended benefits.

85. At the time of formulation of the two completed regional energy projects, the Theun–Hinboun and the Nam Leuk hydropower projects, in 1995, Thailand’s economy was expanding rapidly with the growth of its GDP peaking at 9.2%, fuelled by the manufacturing sector. Maintaining this growth was getting to be difficult for Thailand, which had to depend on external sources for 60% of its commercial energy needs. Along with economic growth, per capita electricity consumption in Thailand increased from 706 gigawatt-hours (GWh) in 1990 to 1,524 GWh in 2000 to 2,105 GWh in 2006.

86. The Lao PDR’s economy, meanwhile, was growing by rates higher than 6%, and in 1995 and 1996 the manufacturing sector posted double digit growth rates. Yet economic growth was not balanced, as the country had to grapple with twin deficits—budgetary and current account. It had to look for sources of revenue both internally and externally. One potential source was electricity export. In 1971, Lao PDR and Thailand entered into a PPA for export of power from the Nam Ngum hydropower plant in Lao PDR to northeast Thailand.

87. The Lao PDR has vast hydropower potential, which at the time of project formulation and in the short term exceeds its electricity needs. In the Lao PDR, power serves two vital national priorities: (i) the promotion of economic and social advancement by providing a reliable and affordable domestic power supply, and (ii) earning much needed foreign exchange from electricity exports. On the domestic level, only 44% of households in the Lao PDR were electrified as of 2005; this was much less in the mid- and late 1990s. The development of hydropower for export also provided the government with a means to meet its goal of 90% electrification by 2020.

88. Both the Lao PDR’s Socioeconomic Development Plan, 2006–2010 and ADB’s second CSP for the Lao PDR covering 1996–2000 highlight the importance of improving infrastructure and regional cooperation to facilitate the country’s transition to a market economy and at the same time address the problem of high poverty incidence. ADB’s country program suggested eight sectors for intervention, of which energy was one. ADB’s primary objective in the Lao PDR’s energy sector was to assist the government in (i) policy analysis and administrative reforms to provide the policy and institutional framework necessary for development and for private sector participation; and (ii) direct capital investments that support private sector activities, particularly in the development of hydropower. The two hydropower projects, Theun–Hinboun and Nam Leuk, were in line with ADB’s country strategy at the time of their formulation. They continue to be consistent with existing strategy, which supports private sector development, and with the GMS strategy and program, especially initiatives aimed at fostering connectivity, promoting large-scale direct investment, and creating regional public goods.

89. The formulation of the Theun–Hinboun Project came shortly after the formalization of the GMS in 1992, which envisioned poverty reduction and sustainable development in the countries making up the subregion. The Theun–Hinboun Project was the first opportunity for ADB to play a significant role in bringing Lao PDR and Thailand together and to support a project with the potential to catalyze similar undertakings in the region in the energy sector. The Nam Leuk Project was approved in 1996, shortly after ADB issued its first policy on regional cooperation, identifying its role as an adviser. At that time, the opportunities for regional cooperation were identified and included agreements and complementary investments for

equitable exploitation of common hydropower potential and petroleum resources, as well as intercountry transmission of energy supplies.

90. The project performance audit report (PPAR) for Theun–Hinboun assessed it as “highly relevant” and that for Nam Leuk gave it a rating of “relevant” in the context of their consistency with ADB’s strategy for the country as well as with the country’s own development strategy. These two hydropower projects in the Lao PDR have helped boost its foreign exchange earnings for its development programs while helping to meet its projected power demand and expansion of rural electrification. The projects also enabled Thailand to have access to low-cost clean energy. Meanwhile, the CAPE for the Lao PDR<sup>42</sup> assessed both projects as “relevant,” but the CAPE felt that their designs “did not sufficiently take into account possible negative environmental impacts.”

91. ADB’s assistance to the energy sector in the context of regional cooperation in the GMS is assessed as “highly relevant.” ADB’s program in general, and the two completed hydropower projects in the Lao PDR in particular, supported ADB’s Energy Policy at the time of project formulation and continue to be consistent with current policy, which has regional cooperation as a continuing objective. A further aspect of relevance is that the Theun–Hinboun Project was a PPP that opened up new possibilities for private sector participation in the country in general and in the energy sector in particular.

## **B. Effectiveness**

92. The effectiveness of ADB assistance to the GMS energy sector involves the achievement of outcomes and outputs. In particular, effectiveness determines (i) the extent to which the results defined under the sector strategy and operations designs are actually achieved or likely to be achieved; and (ii) to what extent regional operations have contributed to building institutional, organizational, and/or human resource capacities at the regional and/or country level to support the GMS program objectives.

93. The two completed projects, the Theun–Hinboun (1994–1998) and Nam Leuk (1996–2002) hydropower projects, have achieved most if not all of their planned outputs/outcomes. Both aimed to export surplus power from Lao PDR to Thailand. Theun–Hinboun involved construction of a 210 MW hydropower plant and related power transmission line. Since the start of its commercial operations until the present, Theun–Hinboun has functioned without major problems; it has exported electricity to Thailand and contributed substantially to the foreign currency earnings of the Lao PDR. The second power project, Nam Leuk, was to provide domestic power supply and export surplus power to Thailand. In the first 3 years of its operation, Nam Leuk exceeded its expected average long-term generation capacity of 215 gigawatt-hours per year. It has thus achieved its objectives of producing targeted energy levels and supporting optimal development of the Lao PDR’s power subsector. Achievements of the Nam Leuk Project have been reportedly less for the other objectives of strengthening the management and protection of the Phou Khao Khouay National Park and increasing the capacity of Electricité du Laos (EdL) staff. Little was accomplished in capacity building, due mainly to lack of preparation at the design stage (e.g., no assessment of EdL’s needs, no specific task or budget), and lack of monitoring during implementation.<sup>43</sup> Nonetheless, both projects were generally rated “successful.”

94. The other two loan projects are ongoing—the GMS Transmission Project in Cambodia (2003–2008) and the NT2 Hydroelectric Project (2005–2011) in the Lao PDR—and reportedly

<sup>42</sup> ADB. 2006. *Country Assistance Program Evaluation: Lao People’s Democratic Republic*. Manila.

<sup>43</sup> ADB. 2004. *Project Performance Audit Report on the Nam Leuk Hydropower Project*. Manila.

progressing satisfactorily. The GMS Transmission Project involves construction of a 109 kilometer 230 kV transmission line, associated substations, and distribution facilities from the Vietnamese border to Phnom Penh, which will allow Electricité Du Cambodge to import up to 200 MW of capacity power from Viet Nam. Although this project experienced initial implementation delays due to installation of a new Cambodian government and slow fielding of consultants, its institutional, administrative, and organizational setup was found satisfactory and functioning well. The transmission line on the Vietnamese side is complete, while that on the Cambodian side is still under construction. Meanwhile, NT2 Hydroelectric Project includes the development, construction, and operation of a 1,070 MW transbasin diversion power plant on the Nam Theun River, a tributary of the Mekong in the central region of the Lao PDR. The objective of the project is reportedly within reach, as construction of infrastructure facilities has progressed satisfactorily. At Nakai dam, the spillway and all spillway piers have been completed. There has also been good progress on relocation of project-affected people, public health management in the project area, and the activities of the Watershed Management and Protection Authority.

95. Eleven of the 16 TA grants provided so far to the GMS energy sector have been completed, of which 7 were PPTA, 3 were ADTA, and 1 was a core TA. These completed TA operations were successful in accomplishing planned objectives that in general prepared the groundwork and ensured capacity building for the programs and projects that followed. Most of the PPTA activities led to loan projects particularly NT2, Nam Leuk, and the GMS Transmission Project in Cambodia.<sup>44</sup> The recently completed core TA 5643: Subregional Electric Power Forum accomplished its major outputs, which included (i) establishment of an EGP for promoting cross-border trade in electricity and developing a regional power grid; (ii) country reports, which have reportedly generated better understanding among the GMS countries of energy plans and policies and the issues they are facing through open exchange; (iii) efforts to continuously build on the understanding of environmental and social issues in energy projects and the need for instituting appropriate mitigation measures;<sup>45</sup> and (iv) a panel discussion, which highlighted the important role of the private sector in energy development and the need for governments to play a key role in creating the enabling environment for promoting private sector participation. The completed ADTA activities, meanwhile, helped GMS members (i) prepare the RPTOA; (ii) update the subregional masterplan and harmonize transmission planning, design, and operational practices to promote subregional power trade; and (iii) analyze various financing options and negotiate suitable financing. It is considered that the most important achievement thus far of the EPF and EGP has been the signing by all countries of the IGA in November 2002, which was adopted as the overall framework for development of the regional market structure (footnote 14).

96. Ongoing PPTA activities namely GMS Northern Power Transmission Project and Na Bong–Udon Thani Power Transmission (Lao PDR) are aimed at strengthening power trading in the subregion. There are also three ongoing ADTA operations, which are designed to facilitate

<sup>44</sup> Two PPTA operations (TA 2926: LAO Nam Ngum 500 kV Power Transmission and TA 3222: VIE Se San Hydropower Project) did not result in investment/loan projects. The former was not successful in identifying a private sector developer to undertake the transmission project, while the latter found significant social and environmental issues and risks.

<sup>45</sup> Under the Environment Policy which became effective in 2002, ADB has supported preparation of cumulative impact assessments and strategic environmental assessments for large hydropower and transmission projects. These types of assessments are intended to identify and mitigate direct and indirect impacts extending beyond the project sites, such as impacts on irrigation and fisheries downstream from large storage dams. ADB's capacity to conduct and direct such studies has evolved considerably, especially in the GMS, although with additional transaction costs (para. 104 and Box 4). Definition of "associated facilities" has been inconsistent and problematic, e.g., in instances where ADB funds a transmission line which evacuates power from generating plant(s) built without direct ADB support. In cases where ADB is unable to conduct due diligence on the associated facilities (as per the Environment Policy), ADB support for the proposed project may not be viable.

regional cooperation and power trading through (i) development and adoption of a regional strategy for 2006–2020, (ii) a holistic and integrated action plan on regional power trade development, (iii) capacity building and human resource development relating to regional power trade and cooperation, (iv) database for information exchange and a mechanism for communication, (v) establishing a competitive and efficient regional power market, and (vi) proper control of environmental impacts while developing power projects for regional power interconnection and trading. These ADTA operations to date are progressing satisfactorily and have been rated “successful.” In particular, the overall experience has been positive for the ESS preparation wherein a participatory process has been followed throughout its preparation involving governments and other stakeholders.

97. Overall, ADB assistance to the GMS energy sector projects is assessed as “effective.”

### C. Efficiency

98. The assessment of the efficiency of ADB’s assistance to the energy sector in the context of GMS cooperation looks at how the resources were converted to results using the reestimation of the economic internal rates of returns (EIRRs) of the projects. EIRRs were reestimated for the two completed hydropower projects in the Lao PDR, namely Theun–Hinboun and Nam Leuk (Table 7 and Appendix 6). The results for Theun–Hinboun confirm the economic benefits generated by the project. The reestimated EIRR for Nam Leuk is 10%, lower than the appraisal estimate of 14% and the PPAR estimate of 12%. This is due to the slightly lower generation and the higher transmission losses. A number of socioeconomic benefits generated from the project were not quantified such as electrification of isolated communities and the major source of revenues to fund accelerated economic and social development in the area. The Electricity Generating Authority of Thailand (EGAT) has also been providing TA for capacity building to staff of EdL.

**Table 7: Comparative EIRRs of Completed Energy Projects**

Item	RRP	PCR	PPAR	SAPE
Theun–Hinboun Hydropower	24	31	19	22
Nam Leuk Hydropower	14	10	12	10

EIRR = economic internal rate of return, PCR = project completion report, PPAR = project performance audit report, RRP = report and recommendation of the President, SAPE = sector assistance program evaluation.  
Sources: RRP, PCR, PPAR, and Operations Evaluation Mission.

99. The two hydropower projects in the Lao PDR were implemented to a high standard within the cost estimates. Theun–Hinboun was completed within schedule, while Nam Leuk experienced some delays in civil works that extended project completion by an additional 6 months. Execution of the two projects was highly satisfactory, and their designs are assessed as optimal. Based on the EIRR and implementation delays, the Nam Leuk Project is assessed as less efficient and the Theun–Hinboun Project is assessed as efficient.

100. The NT2 Hydroelectric Project was approved in April 2005, the largest hydropower project in the Lao PDR. It has both supporters and opponents, with the opponents claiming that the environmental damage from the project will be much greater than the socioeconomic benefits to the Lao PDR. Expected physical completion is November 2009, and expected financial closing is February 2011. To date, less than 50% of the civil works required have been completed and construction delays have been reported, but so far drawdowns have been made on schedule and no reported cost overruns have been made. At appraisal, the financial internal rate of return (FIRR) was estimated at 12%, while the EIRR was estimated at 16%. Sensitivity analysis shows that the estimates are robust.

101. Given the relative importance of the projects in the sector, overall, the GMS energy sector is assessed as “efficient.”

#### **D. Sustainability**

102. Sustainability assesses the outcomes from a longer term perspective and determines the likelihood of sustaining the planned outputs and whether the policies and sector interventions are likely to contribute to durable development gains.

103. The Lao PDR’s Theun–Hinboun Project (220 MW) started commercial operations in April 1998, soon after its completion. The current PPA between the Theun–Hinboun Power Company Limited and EGAT based on the take-or-pay principle has a term of 25 years (up to 2023) with the option for tariff negotiations. In early 2008, the PPA was renegotiated, and the new PPA will have a term of 27 years, starting in 2012 and ending in 2038. The start date of the new PPA is coordinated with the expected completion of the Theun–Hinboun Expansion Project, which will add an additional 280 MW, making for a combined 500 MW starting in 2012. The current and new PPAs ensure the project’s financial sustainability. The recalculated FIRR is 22% (Appendix 6), well above the weighted average cost of capital, which has been computed to be 4.8%. The high return to the project is due principally to a guaranteed long-run export price and access to relatively low-cost loans to cover EdL’s equity contribution. Theun–Hinboun is also physically sustainable, provided preventive maintenance is continued. The project is, therefore, rated “highly sustainable.”

104. The Nam Leuk Project (60 MW), which started its commercial operations in March 2000, was designed to have a long lifespan. Nam Leuk’s sustainability has depended largely on EdL’s effectiveness and stability in operating and maintaining large hydropower projects. EdL, particularly during the first 3 years of operation, has demonstrated that it can maintain and operate the project despite the pressures of rapid development in the energy sector in the Lao PDR. Although government owned, EdL operates as a private sector corporation and is subject to corporate tax laws. The recalculated FIRR for Nam Leuk is 4.3% (Appendix 6), which is sufficient to cover loan repayments but not sufficient to cover taxes. This raises concern about the project’s sustainability. The willingness-to-pay estimate implies that there is considerable consumer surplus in the Lao PDR that could be tapped through tariff increases should the financial viability of the project come into question. Tariff increases and more determined efforts to reduce transmission and distribution losses may be useful to enhance the sustainability of the project. On the other hand, Phou Khao Khouay Park—where the project is located and for which the project aimed to strengthen management and protection, is deemed not sustainable unless its management is improved (footnote 43). The Nam Leuk Project set aside 1% of revenues for the management of the Park’s protected area, which is considered to be environmental-cost compliant. However, as noted in the PPAR, these funds were not being efficiently used, and 70% of the park staff comprised retired military officers, which—in the absence of a worker retraining program—does not appear to be an optimum human resources strategy. The PPAR also states that better monitoring is required in the long-term operational period (post-loan closure) to determine long-term environmental impacts. Overall, this project is rated “likely sustainable.”

105. Under the GMS Transmission Project, which is still ongoing, a number of risks were identified by a review mission conducted by ADB’s Cambodia Resident Mission in early 2008. While citing that the main risk for regional cooperation is the Cambodian government’s lack of cooperation and commitment to PPAs, it was found during the review mission that Cambodia is committed to importing power from Viet Nam and that both countries have taken the necessary

actions to make the PPA effective.<sup>46</sup> It was also reported that the institutional, administrative, and organizational setup for the project has been functioning well. Meanwhile, the NT2 Hydroelectric Project has experienced some difficulties in implementing social and environmental mitigation measures, in spite of a mitigation budget of around 3% of total project costs (this budget is separate from the expenses incurred for safeguard analysis prior to financial closure).<sup>47</sup> To address this and to ensure that such project commitments are complied with, the NT2 Power Company Limited has entered into a legal contract with the government through the concession agreement for the compensation and rehabilitation of project-affected people. NT2 Power Company Limited is also to implement a project performance monitoring system to monitor the impacts and benefits, particularly with regard to consumers and rural electricity enterprises in the project area. Potential risks that may affect the successful implementation of NT2 are (i) less than expected revenues from customers; and (ii) inadequate water flows and/or flooding in the Xe Bang Fai, which may result in the loss of electricity output and revenues. With the existing measures in place to mitigate these potential risks, the sustainability of the outcomes and outputs of ongoing energy projects is also deemed “likely.”

106. As noted in the effectiveness section (paras. 95–96), energy sector TA has generally achieved the outcomes and outputs expected at the time of project design and has contributed to building institutional, organizational, and human resource capacities at the regional and country levels to support the GMS energy program’s objectives. Given the generally good institutional capacity in the executing agencies, the sustainability of outcomes and outputs of both completed and ongoing energy TA operations is deemed “likely.” Overall, the sustainability of both lending and nonlending operations is deemed “likely.”

## **E. Impact**

107. Impact refers to the contribution of ADB assistance to long-term changes in development conditions in the energy sector in the GMS. Impact assessment basically looks into the impact of ADB assistance to the energy sector on the regional economy and identifies not only the positive but also the unintended negative impacts that have been created due to the implementation of operations in the GMS energy sector. It also attempts to identify the demonstration effect and the value addition created by the operation that would benefit or distract from regional cooperation objectives.

108. Under GMS cooperation, a more integrated approach to energy development—through transmission grid interconnection, hydropower development, and cross-border power trade—is expected to bring important regional benefits such as enhanced connectivity, improved competitiveness, and a greater sense of community. Potential benefits in the power subsector are estimated at \$4 billion for 1995–2020, resulting from the complementarity of energy resources, load diversity, hydrological diversity, exchanges of base energy for peak energy, increased supply reliability, reduced reserve capacity requirements, and reduced system losses (footnote 6).

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<sup>46</sup> Back-to-office report of review mission conducted by Cambodia Resident Mission during 11–18 March 2008.

<sup>47</sup> The NT2 Hydroelectric Project has experienced implementation difficulties, including the head contractor’s refusal to implement basic water quality monitoring (biological oxygen demand, oil, and grease) and lack of domestic laboratory capabilities to analyze carbon dioxide and methane in the reservoir. In this instance, the head contractor holds ISO 14000 certification for environmental management systems. The hardware and software requirements for monitoring biological oxygen demand, oil and grease, carbon dioxide, and methane should not exceed \$1 million (vs. safeguards implementation budget of at least \$39 million). Quarterly progress reports also note problems with solid and hazardous waste management, and domestic wastewater management at construction camps (pointing back to the head contractor but also to other prime contractors and subcontractors).

109. Enhanced energy connectivity is steadily being achieved under the GMS program through construction of cross-border power transmission lines. At present, these lines serve to fulfill bilateral (between Lao PDR and Thailand) but one-way trade arrangements to the grid of the energy-deficient country (Thailand). This limited power trade currently taking place in the GMS has already generated substantial benefits to the parties. The Lao PDR's exports of hydropower to Thailand have increased its foreign exchange earnings and have already generated high FIRR (para. 104 and Appendix 6). However (as noted in para. 68), in some areas with no grid access, the Lao PDR is buying power from Thailand at an unfavorable tariff. Cambodia has also benefited by importing power via a 115 kV line from Thailand to Battambang and Siem Reap (power is purchased at \$0.08/kWh and ultimately sold to end-users at \$0.12/kWh, much lower than the typical generation cost of \$0.18/kWh in Cambodia). Additional hydropower capacity is being developed in the Lao PDR for export to Viet Nam (the Xe Xaman and Se Kong hydropower plants). Regional benefits and impacts from GMS power trading are discussed in Appendix 7.

110. The economic benefits of the bilateral power trade between Lao PDR and Thailand have been more evident on the part of the Lao PDR, although its exports of electricity to Thailand suffered a major slump during the Asian financial crisis. Exports of electricity as a percentage of GDP quadrupled from 1.63% in 1994, when construction of the Theun–Hinboun hydropower plant started, to 6.53% when exports from Nam Leuk started. This percentage tapered down to 3.48% in 2005 (Appendix 7).

111. On the other hand, the power trade between Lao PDR and Thailand provides Thailand access to a clean and low-cost energy source needed to support its growing economy. In 2007, imports of hydropower supplied 1.4% of EGAT's fuel requirements for power generation.<sup>48</sup> EGAT projects this to increase to 8.5% by 2021. The hydropower plants, which were built primarily for export of electricity to Thailand have also benefited rural communities with electrification. In 1995, only 45% of households nationwide had access to electricity; by 2007, access to electricity had gone up to 82%.<sup>49</sup>

112. The projects also had positive impacts on employment and infrastructure development. Although there are no statistics that would give the actual new employment generated by the projects, it is certain that some villagers have benefited directly or indirectly from the employment created, although dam construction created mostly short-term employment. New employment was created for the operation of the hydropower plants, but the amount of permanent employment is small. In 2005, the Theun–Hinboun plant had around 130 regular staff at the site and over 1,000 casual laborers. Nam Leuk had 59 staff,<sup>50</sup> but the project used more than 16,000 person-months of unskilled local workers to do pre-inundation work during the dry season, when there were few farm activities. The villages surrounding the hydropower plants have benefited from improved basic infrastructure such as roads, bridges, a community health center, and community water sources. Although not all of these benefits can be attributed to the regional hydropower projects, the PPAR<sup>51</sup> for the Theun–Hinboun Project reported that construction and improvement of roads leading to the project site had increased people's mobility and access to opportunities for commercial activities.

113. Part of the revenue from the Theun–Hinboun and Nam Leuk power plants is made available for the government's social programs. Both the Theun–Hinboun Power Company and

<sup>48</sup> EGAT. 2007. *Thailand Power Development Plan (PDP 2007)*. Bangkok.

<sup>49</sup> Praya Energy Group and World Resources Institute. 2007. *Empowering People: A Governance Analysis of Electricity*. Washington, DC.

<sup>50</sup> United Nations Development Programme. 2006. *Technical Background Paper for the Third National Human Development Report Lao PDR 2006*. Vientiane.

<sup>51</sup> ADB. 2002. *Project Performance Audit Report: on the Theun–Hinboun Hydropower Project*. Manila.

EdL have provided funds for mitigation of environmental and social impacts. One percent of the electricity export revenue from the Nam Leuk Project goes to the protection of the Phou Kao Khouay National Park and its resources. Despite these efforts, opponents of hydropower projects point to adverse impacts on the environment as a major reason not to pursue similar projects. They fear negative impacts of the Lao PDR dams not only in areas near the dam but also on the Mekong River. The PPAR for Theun–Hinboun reported negative environmental and social impacts, which were exacerbated by the lack of a resettlement plan and a weak environmental mitigation program. On the social side, the physical relocation of persons was not anticipated; and on the environment side, there was increased erosion and sediment and reduced downstream flows on the Nam Theun, which also had an impact on fisheries and transportation in the headpond area. The PPAR for the Nam Leuk Project (footnote 43) reported that the resettlement of Nam Leuk families was successfully carried out, but also noted that several villages were affected by insufficient water supply and that fishing activity had declined in several of the affected villages. Box 3 presents safeguard issues highlighted from the two completed regional energy projects.

### **Box 3: Safeguard Issues**

Evaluation of the Theun–Hinboun, Nam Leuk, and Nam Theun 2 (NT2) hydropower projects draws attention to safeguard issues that warrant careful consideration for future Asian Development Bank projects.

A common rule of thumb for environmental compliance costs on industrial projects is that 1–3% of capital and operation and maintenance costs is required to meet environmental regulatory compliance requirements. Since hydropower plants do not emit or generate large quantities of waste requiring intensive management, the compliance cost should be at the low end of the range. The Nam Leuk Project set aside 1% of revenues for the management of the Phou Kao Khouay Park protected area. However, the Nam Leuk project performance audit report (PPAR) noted that the funds for the Park were not efficiently used. The Nam Leuk Project was processed under the pre-2002 safeguards system, and such a legacy project should not be viewed through the lens of ADB's current system.

The Theun–Hinboun Power Company (THPC) did not provide for adequate environmental and social impact mitigation measures at the design stage since the extent of these impacts was not properly understood early on. During implementation and initial operation when it became apparent that the environmental and social impacts were more extensive than initially anticipated THPC allocated funds for mitigation measures, a mitigation and compensation program was drawn up and a new Environmental Management Division within THPC was created to implement the program.

The NT2 Hydroelectric Project was designed with the benefit of the good practice lessons gained from Nam Leuk and Theun–Hinboun in developing mitigation measures to address environmental and social impacts of hydropower projects. It also had the advantage of drawing from the experiences reflected in the report of the World Commission on Dams, the expertise of multiple aid agencies, and millions of dollars expended on consulting services for safeguard analysis and planning prior to loan approval.

Project proponents of NT2 Hydroelectric Project have allocated about \$90.5 million for environmental and social costs over the life of the project and a further \$10 million as a guarantee for dealing with unanticipated impacts stemming from project implementation. The environmental and social fund of \$90.5 million includes \$7.5 million environmental and social remediation fund for the benefit of resettlement villages during the post-commercial operation date period. An environment and social division was also established to implement NT2 Power Company's obligations under the concession agreements.

There is clearly a need for creativity and flexibility in addressing safeguard implementation on high-impact energy projects. The approach to safeguard implementation on NT2 has not yielded optimum results. The Nam Leuk PPAR noted that the Sector Development Program modality may be better suited to dealing with the “soft” elements of environmental and social impact management. The revenue set aside mechanism is a sensible and straightforward approach to ensure that a reasonable budget is available for safeguard implementation, which could be coupled with an adaptive environmental management program for effective results. A fundamental issue to be addressed is how to convert the “dead load” cost of compliance into productive opportunities.

Source: Operations Evaluation Mission.

114. Thus, while power trading in the GMS has so far been limited, significant positive impacts have already been created, mainly benefiting the trading countries, Lao PDR and Thailand, in terms of revenues, access to electricity, employment, and improved infrastructure. Revenues derived from these power plants have been partly used for the governments' social programs and in mitigating negative environmental and social impacts. Therefore, the overall impact of the Theun–Hinboun and Nam Leuk hydropower projects is rated as “substantial.”

115. An issue that has drawn increasing attention in recent years is the possible impacts of climate change on ADB projects. As part of an ADB-wide effort, the GMS projects have been subjected to preliminary screening for climate change risks. Hydropower projects are generally considered to have some incremental risk due to possible changes in rainfall, forest cover, and agricultural productivity, which could affect hydrology and negatively impact long-term power generation. ADB is preparing climate risk and adaptation guidance, which will be applicable to new projects and should be applicable to projects under implementation.

## V. OVERALL ASSESSMENT

116. **GMS Energy Sector Strategy.** Overall, the performance of the GMS energy sector strategy is rated “successful,” with some areas needing improvement. Table 8 summarizes the ratings.

**Table 8: Overall Top–Down Rating of GMS Energy Sector Strategy**

Criterion	Rating Scale	Overall Rating (scale of 0–8)	Description
Strategic assessment	0–8	6	Substantial
Institutional assessment	0–8	6	Substantial
Value addition	0–8	6	Substantial
ADB performance	0–8	6	Substantial
<b>Overall</b>	<b>32</b>	<b>24</b>	<b>Successful</b>

ADB = Asian Development Bank, GMS = Greater Mekong Subregion.

Note: Overall top–down rating (TR) is derived by adding up the scores accorded to the strategic assessment, institutional assessment, value addition, and ADB performance rating. Overall TR is assessed as highly successful if  $TR \geq 27$ ; successful if  $21 \leq TR \leq 26$ ; partly successful if  $15 \leq TR \leq 20$ ; and unsuccessful if  $TR \leq 14$ .

Source: Operations Evaluation Mission.

117. **GMS Energy Sector Program.** The bottom–up assessment of the energy sector program is rated based on separate assessments of relevance, effectiveness, efficiency, sustainability, and impact. The overall rating is derived from the average of all evaluated loans and RETA across these five criteria. Three of the four energy loans evaluated are rated as “successful” and one as “highly successful.” A review of 16 RETA operations shows that two are “highly successful” and the rest are “successful.” The overall score is 17 which means that ADB lending and nonlending assistance for GMS energy is “successful” (Table 9). A detailed evaluation is shown in Appendix 8.

**Table 9: Overall Bottom–Up Rating of GMS Energy Sector Program**

Criterion	Rating Scale	Overall Rating	Description
Relevance	0–3	3	Highly Relevant
Effectiveness	0–6	4	Effective
Efficiency	0–3	2	Efficient
Sustainability	0–6	4	Likely Sustainable
Impact	0–6	4	Substantial
<b>Overall</b>	<b>24</b>	<b>17</b>	<b>Successful</b>

ADB = Asian Development Bank, GMS = Greater Mekong Subregion.

Note: Aggregate bottom–up rating (BR) is assessed as highly successful if the  $BR \geq 20$ , successful if  $16 \leq BR \leq 19$ , partly successful if  $11 \leq BR \leq 15$ , and unsuccessful if  $BR \leq 10$ .

Source: Operations Evaluation Mission.

118. **Overall Assessment.** Combining the strategy and program assessments, the overall performance of the GMS energy sector is rated as “successful.” A summary of the overall assessment is shown in Table 10.

**Table 10: Overall Rating of Performance Assessment at the Sector Level**

<b>Item</b>	<b>Rating Scale</b>	<b>Score</b>	<b>Rating</b>
GMS energy strategy	0–32	24	Successful
GMS energy program	0–24	17	Successful
<b>Total Score</b>	<b>0–56</b>	<b>41</b>	<b>Successful</b>

ADB = Asian Development Bank, GMS = Greater Mekong Subregion.

Note: An overall sector assistance program evaluation performance assessment is derived as a combination of the bottom–up and top–down assessment of performance. The overall sector assistance program evaluation performance score is derived by adding up the bottom–up and top–down ratings. This is highly successful if the  $R \geq 47$ ; successful if  $35 \leq R \leq 46$ ; partly successful if  $23 \leq R \leq 34$ ; and unsuccessful if  $TR \leq 22$ .

Source: Operations Evaluation Mission.

## **VI. CONCLUSIONS AND WAY FORWARD**

### **A. Conclusions and Key Issue**

119. The GMS program has grown over the years to become a major regional cooperation initiative of ADB as well as of the GMS countries. Energy sector initiatives have been an important element of the GMS program. The bottom–up assessment rates the relevance of the energy program most highly, with effectiveness, sustainability, and impact also rated very well. The efficiency of ADB’s assistance is confirmed by the reassessment, despite the EIRR of one of the completed project being slightly lower than at the post-completion stage.

120. As discussed in para. 68, the GMS energy program has resulted in significant economic benefits to the participating countries. The strong increase in the Lao PDR’s electricity generation and exports to Thailand over the past 10 years has led to an extension of the domestic market in the former, contributed to the growth in its GDP, generated substantial foreign exchange earnings, and also strongly benefited rural and remote border communities. In a complementary manner, the power trade has provided Thailand with access to cleaner and lower cost energy and has also benefited its rural communities with electricity.

121. As mentioned in para. 69, an important apparent benefit of the GMS energy program has been the demonstration effect, both within the subregion and internationally, of implementing successful regional projects. Although it is difficult to gauge the exact breadth and extent of the demonstration effect, there is clear evidence that investor confidence in undertaking power export projects in the region has risen strongly in recent years. This is evidenced by the large number of private sector hydropower projects under construction or being planned in the Lao PDR.

122. A key issue facing the GMS power subsector is the long lead time that is required to achieve multilateral power trading. As mentioned in para. 70, although the countries in the region have negotiated a large number of bilateral, project-specific PPAs, there is still relatively little progress in negotiating multilateral PPAs allowing for power trading among more than two countries. The RPTOA envisages in its latter phases the achievement of such multilateral trading, but a number of legal and technical issues are currently hindering progress and need to be resolved. Based on similar experience in other regions, multicountry power pool trading could require an additional 10 years to be put in place.

## B. Lessons Identified

123. Although progress was at times slower than anticipated, the GMS program has been successful in promoting and enhancing cooperation on cross-border power trade and interconnections among its member countries. The key to this progress was the setting up of effective institutional arrangements with strong government ownership (e.g., the EPF, RPTCC) and the establishment of an appropriate policy framework for power trading in the GMS via multiparty agreements (e.g., IGA, RPTOA).

124. Notwithstanding generally effective institutional arrangements in the GMS energy sector, both the GMS energy program's internal coordination, as well as interprogram coordination with other sectors, could still be improved. As mentioned in paras. 60–61, within the GMS energy program, coordination between the RPTCC and its two subgroups, the FG and the PWG, appears to be suboptimal. A more streamlined structure, with working group meetings lasting only 2 days when not followed by the RPTCC meeting, should be considered. In terms of interprogram coordination, reports in the past have indicated that there is little interaction between sectors and their working groups. The GMS Secretariat has been addressing this problem through initiatives such as the GMS newsletter, cross-representation on sectoral working groups, and more recently the introduction of the “economic corridors” approach, whereby various sectoral working groups will be represented in a proposed Economic Corridors Forum.

125. The GMS is still comprised of predominantly agricultural economies, with almost 70% of its population dependent on local resources. The region's high economic growth is putting increasing stress on important natural land and water systems in the region. Evidence from the one ongoing and two completed ADB hydropower projects indicates that there have been difficulties in implementing social and environmental mitigation measures (paras. 104–105). There is a need to enhance the institutional and policy frameworks of member countries to ensure that environmental and social costs in energy systems remain reasonable.

126. As discussed in paras. 75–76, ADB has coordinated well with the World Bank and bilateral aid agencies in the energy sector. ADB's coordination with the other major regional agency, MRC, has been less active, due mainly to a lack of capacity on the part of MRC to implement its hydropower strategy and program. Following the appointment of MRC's new Chief Executive Officer in March 2008, ADB and MRC have resumed coordinating closely on water-related energy sector issues.

## C. Recommendations and Options

127. **More attention should be given to supporting other energy investments besides power trading, consistent with ADB's initiatives for energy efficiency and climate change.** Major project-level activities have so far been limited to just two GMS countries, Lao PDR and Cambodia. Additional project finance modalities and approaches should be investigated that would allow other GMS countries with good energy experience to be involved in these activities. In line with the draft GMS ESS, the GMS Energy Sector Forum should give attention to supporting other energy investments besides power trading, consistent with ADB's initiatives for energy efficiency and climate change. Technology and experience within the GMS can be effectively transferred, e.g., from Thailand (on energy efficiency funds and biofuel programs) and PRC (renewable energy, including biomass/biogas technology and carbon trading).

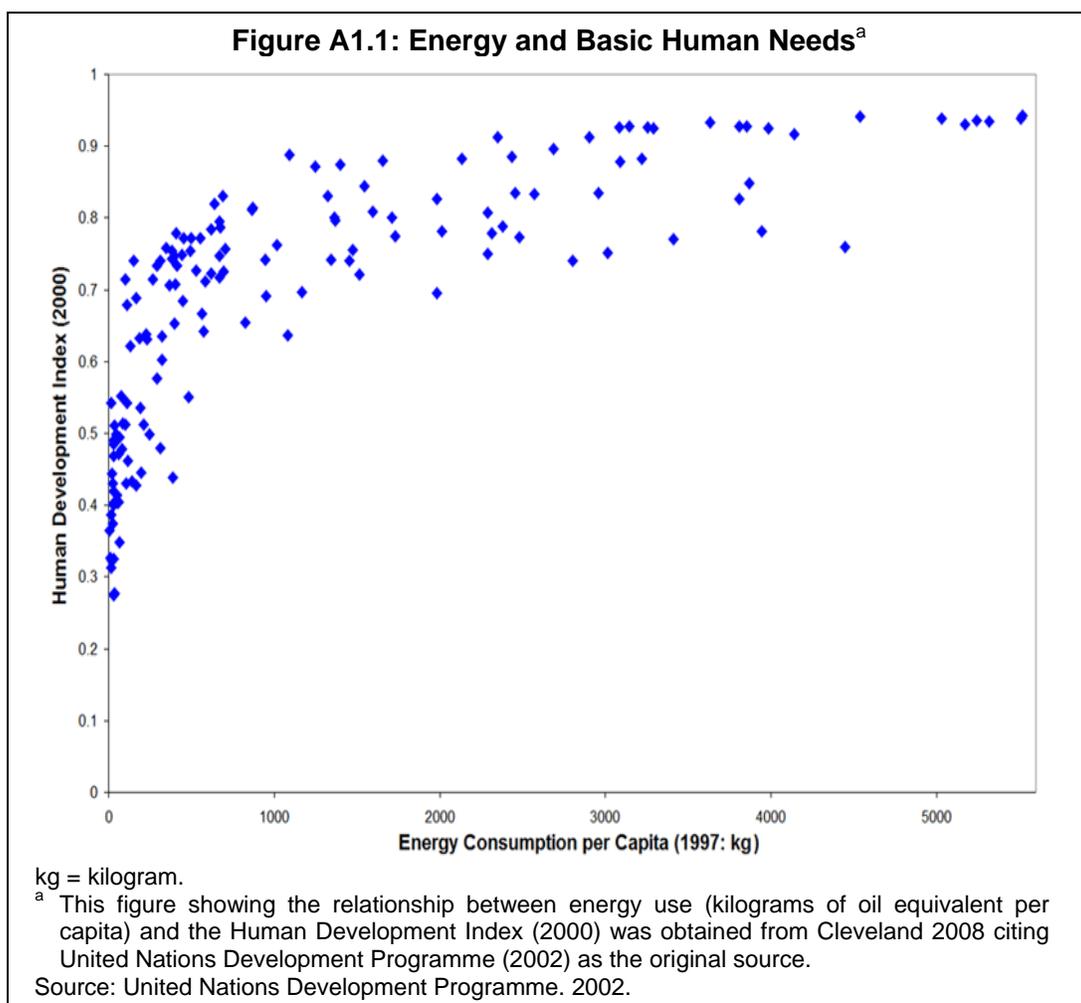
128. **ADB should be more strategic in providing assistance by leveraging its concessional resources to mobilize financing from the private sector and other development partners.** With the growth in the GMS energy sector, the funding needs of the countries will inevitably increase. ADB should be more strategic in providing assistance to GMS energy projects, e.g., by leveraging its concessionary resources to mobilize financing from private and other development partners. Additional financial resources may be available for clean energy projects from climate investment funds. Carbon-trading opportunities should be explored, e.g., for run-of-river hydropower and high voltage direct current projects, which may be considered “additional” or “transformational.”

129. **More creativity and flexibility are needed in addressing safeguard implementation on high-impact energy projects.** The NT2 Hydroelectric Project included lessons learned from previous hydropower projects in the Lao PDR to address mitigation measures associated with such projects. However, even the approach to safeguard implementation on NT2 has not yet yielded optimum results. The Nam Leuk PPAR noted that the sector development program modality may be better suited to dealing with the “soft” elements of environmental and social impact management. The revenue set-aside mechanism is a sensible and straightforward approach to ensure that a reasonable budget is available for safeguard implementation, which could be coupled with an adaptive environmental management program for effective results. A fundamental issue to be addressed is how to convert the “dead load” cost of compliance into productive opportunities.

## ENERGY SECTOR DEVELOPMENTS

### A. Role and Importance of Energy in the Greater Mekong Subregion

1. Access to modern energy services is critical for economic development and for improving the quality of life of the poor. This is because energy is an important input in industrial development and in the expansion of transportation and communication. Energy use has also been shown to be strongly correlated with gross national output<sup>1</sup> as well as with people's health and education status. In fact, it was found that most countries with high electricity consumption have a high human development index (Figure A1.1).<sup>2</sup> Access to modern forms of energy is, therefore, a necessary condition for poverty reduction and human development.



2. In the Greater Mekong Subregion (GMS), although economic growth since the 1990s has been impressive, many remain poor and lack access to high quality forms of energy.

<sup>1</sup> Cleveland, Cutler J., Robert Costanza, Charles A.S. Hall, and Robert Kaufmann.1984. *Energy and the U.S. Economy: A Biophysical Perspective*. Science, New Series, Vol. 225, No. 4665 (31 August), 890–897. Available: <http://www.oilcrisis.com>

<sup>2</sup> Cleveland, Cutler (Lead Author); Peter Saundry (Topic Editor). 2008. "Energy Transitions Past and Future." In: *Encyclopedia of Earth*. Eds. Cutler J. Cleveland (Washington, DC: Environmental Information Coalition, National Council for Science and the Environment). Available: <http://www.eoearth.org>

Energy poverty<sup>3</sup> is still prevalent in the region. Nearly one fourth (24%) of the population or 74 million people have no access to electricity. A significant proportion of the population, particularly in the rural areas, relies on traditional biomass—wood, agricultural residues, and dung—for cooking and heating. Of the total number of households, 80% in Lao People's Democratic Republic (Lao PDR), 83% in Cambodia, and over 50% in Viet Nam use fuel wood. In Yunnan Province of the People's Republic of China (PRC), almost 41% of rural households are totally dependent on firewood for cooking.<sup>4</sup> Overall in the GMS, the share of biomass in the total primary energy supply remains quite high at 26% in 2005 (31% in 2000). Continued significant use of biomass adds pressure on the environment, and the combustion of traditional fuels has profound human health impacts, especially for women and children. Thus, access to liquid and gaseous fuels and electricity is necessary for poverty reduction and improvements in human health.

## B. Energy Resources

3. The GMS has vast energy resources including crude oil, natural gas, coal, and some of Asia's best potential for hydropower projects. These resources are distributed among member countries (Table A1.1), with Lao PDR, Myanmar, and Yunnan Province having large hydropower potential; Thailand and Myanmar having gas resources; and Viet Nam and Yunnan Province having large coal deposits. The Mekong River basin has a catchment area of over 795,000 square kilometers with an estimated potential of 285 terawatt-hours with exploitable capacity mostly in Lao PDR, Myanmar, and Yunnan Province.

**Table A1.1: Energy Resources/Potential of GMS Countries**

GMS Country/Province	Energy Resources
GMS (overall)	Coal (81,421 mtce), crude oil (1,198 mtoe), hydropower, lignite (11,475 mtce), natural gas (1,645 bcm)
Cambodia	Crude oil and natural gas (at early exploration and development stages)
Guangxi Zhuang Autonomous Region, PRC	Coal, hydropower
Yunnan, PRC	Coal deposits (anthracite – 4,000 t, lignite – 9,000 t, and coking coal), hydropower
Lao PDR	Coal, hydropower
Myanmar	Coal (200–230 t), crude oil (2.7 billion barrels), hydropower, natural gas (450–560 bcm)
Thailand	Coal, natural gas
Viet Nam	Coal deposits (anthracite – 2,250 t, brown coal – 30,000 t), crude oil, natural gas

bcm = billion cubic meters, GMS = Greater Mekong Subregion, Lao PDR = Lao People's Democratic Republic, mtce = million tons of coal equivalent, mtoe = million tons of oil equivalent, PRC = People's Republic of China, t = metric ton.

Sources: Asian Development Bank. 2008. *Building a Sustainable Energy Future. The Greater Mekong Subregion*. Manila; Guangxi Zhuang Autonomous Region Planning and Construction Administration Committee Office. 2008. *Guangxi Beibu Gulf Economic Zone Development Scheme (2006–2020)*. Abridged Edition. Nanning.

4. **Hydropower Potential.** In the GMS, the total exploitable hydropower potential is about 248,000 megawatts (MW), with Myanmar and Yunnan Province having the greatest potential (Table A1.2). Less than one quarter of the potential is shared among the other

<sup>3</sup> Energy poverty has been defined as the absence of sufficient choice in accessing adequate, affordable, reliable, high quality, safe, and environmentally benign energy services to support economic and human development (footnote 2).

<sup>4</sup> As cited in the Energy Sector Strategy (draft report).

countries/provinces. Thailand has the least amount of exploitable hydropower resources. The total installed capacity from hydropower generation in the GMS is estimated at about 21,035 MW, representing 8% of the exploitable potential resources.

**Table A1.2: Total Exploitable Hydropower Potential and Installed Capacity in the GMS**  
(megawatt)

Item	Cambodia	PRC			Lao PDR	Myanmar	Thailand	Viet Nam	Total
		Yunnan Province	GZAR						
Potential	15,000	90,000	na	18,000	100,000	10,000	15,000	248,000	
Installed	13	11,980	na	663	802	3,422	4,155	21,035	

GMS = Greater Mekong Subregion, GZAR = Guangxi Zhuang Autonomous Region, Lao PDR = Lao People's Democratic Republic, na = not available, PRC = People's Republic of China.

Sources: World Bank. 2007. *World Bank Strategy in the Greater Mekong Subregion for Supporting Development of Power Trade*. Washington, DC (August). Draft; Viet Nam Electricity. 2007. *Viet Nam Electricity Corporate Profile 2006–2007*. Hanoi; Department of Electricity, Ministry of Energy and Mines. 2006. *Electricity Statistics of Lao PDR: 2005*. Vientiane; Electricité du Cambodge. 2007. *Statistical Handbook: 1995–2005*. Phnom Penh; and Xiaojiang Yu. 2003. *Regional Cooperation and Energy Development in the Greater Mekong Subregion*. Oxford (Energy Policy 31, 1221–1234).

5. **Coal.** Significant coal reserves exist in Yunnan Province, while lesser quantities are found in Lao PDR, Thailand, and Viet Nam. Coal resources in Yunnan Province are expected to generate 125,000 MW for 30 years. Outside the PRC, the largest coal-fired thermal generation source is the Mae Moh lignite mine site in northern Thailand. Viet Nam's coal resources (high-quality anthracite reserves and brown coal) used for thermal generation are found mainly in the northern part of the country. In the Lao PDR, coal resources are relatively abundant, and the Hongsa coal deposit (lignite with high ash content) is being considered for development to supply a 1,400 MW power plant for export to Thailand.

6. **Petroleum and Natural Gas.** Petroleum, in the form of crude oil and refined products, and natural gas will continue to provide the bulk of transport fuels and a significant share of power generation for the foreseeable future. Cambodia and Lao PDR have no significant oil and gas production, and are 100% reliant on imported gasoline and diesel for transport fuels. Diesel is commonly used for rural and off-grid power generation throughout the GMS. Thailand is the only country with commercial biofuels production, with ethanol currently meeting about 10% of gasoline demand. Viet Nam currently exports crude oil and imports refined products; this situation will change significantly when the Dung Quat refinery comes on-line in 2011 or 2012 and begins using domestically produced crude oil. This first oil refinery in Viet Nam is expected to achieve its design capacity output of 6.5 million tons by the end of the second quarter of 2009.

7. The GMS will continue to rely on crude oil imports for the foreseeable future, unless new field discoveries add to the reserve base. At first glance, the natural gas reserves scenario appears more secure, if current production and trading trends continue. However, Myanmar and PRC are currently conducting a feasibility study for a gas pipeline from Rakhine Province (southwestern Myanmar) to Yunnan Province. India and Myanmar are also considering a gas pipeline from Rakhine Province through the Indian states of Assam and West Bengal to Calcutta. Myanmar exports natural gas to Thailand via pipeline; exports have increased from 30 billion standard cubic feet (bscf) per year in 1998 to 450 bscf in 2007. Thailand is also considering additional import options including liquefied natural gas. The petroleum and natural gas fuel utilization picture could change quickly if alternative technologies, such as microliquefaction and gas to liquids, are employed instead of building conventional pipeline systems. Biofuel production could probably offset 5% of fuel demand in the foreseeable future.

### C. Electricity Production

8. Between 1990 and 2006, electricity production in the GMS increased at an average annual rate of 8.2% (Table A1.3 and Figure A1.2). During this period, growth was fastest in Viet Nam (12.6%), followed by Cambodia (11.1%) and Lao PDR (9.5%). This overall strong growth masks some important trends: for example, from 1995 to 2000, electricity production expanded at a much slower rate (by only 4.1%) in the wake of the economic slowdown caused by the Asian financial crisis. Between 2000 and 2006, electricity production increased at a high rate of 9.5% per annum in the GMS: this was roughly twice the rate of growth of electricity production in the Association of Southeast Asian Nations region and three times that of the world.

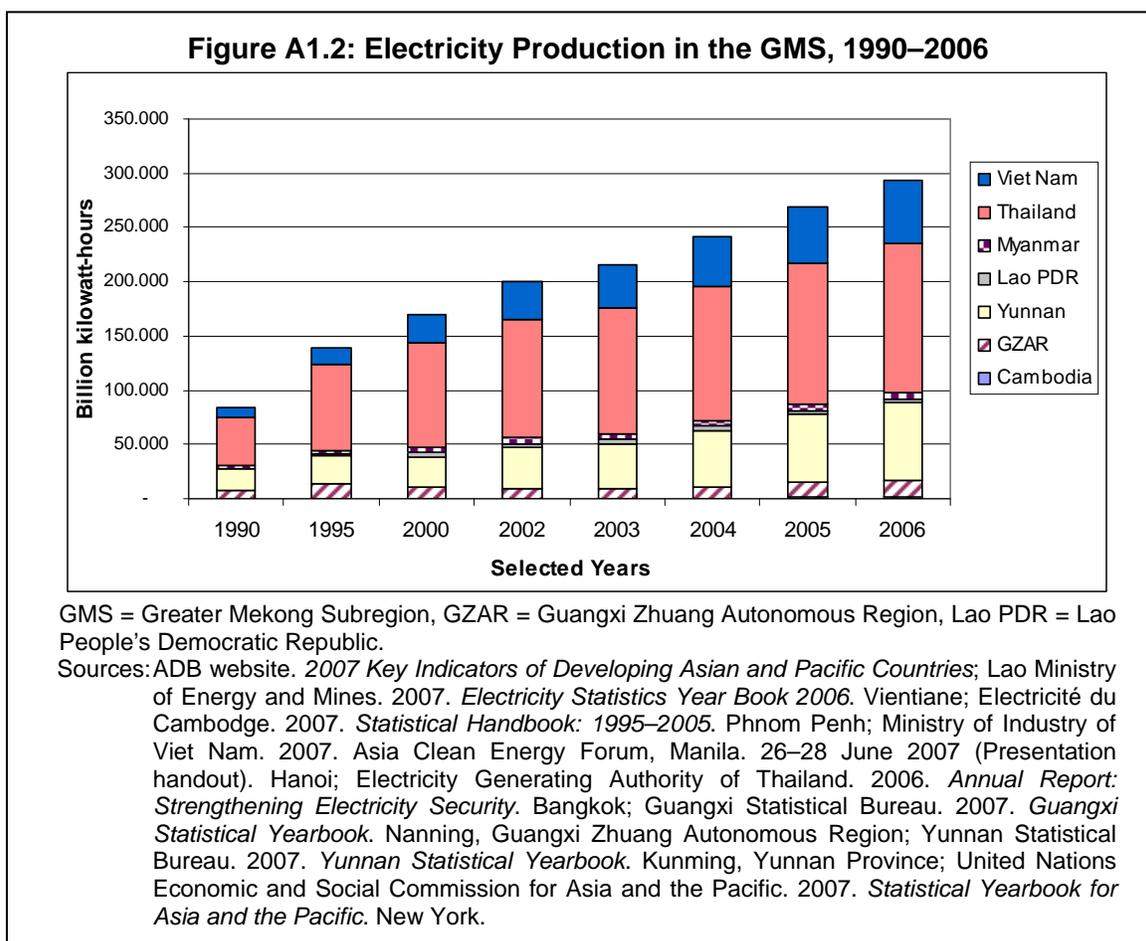
**Table A1.3: Electricity Production in GMS Countries, 1990–2006**  
(gigawatt-hour)

Year/Item	PRC						Viet Nam	Total GMS
	Cambodia	GZAR	Yunnan Province	Lao PDR	Myanmar	Thailand		
1990	199	8,195	18,544	844	2,622	44,175	8,790	83,369
1995	198	12,832	26,908	1,044	3,762	79,734	14,665	139,143
2000	435	9,691	28,747	3,678	5,522	95,531	26,682	170,286
2002	548	8,958	37,913	3,602	5,068	108,418	35,888	200,395
2003	632	8,486	41,966	3,179	5,426	115,852	40,500	216,041
2004	760	10,565	51,820	3,347	5,608	124,129	45,123	241,352
2005	906	14,342	62,260	3,430	6,015	130,426	52,072	269,451
2006	1,071	16,098	70,886	3,596	6,398 <sup>a</sup>	136,767	59,050	293,866
<b>Average Annual Growth Rate (%)</b>								
1990–2006	11.1	4.3	8.7	9.5	5.7	7.3	12.6	8.2
<b>Subperiod</b>								
1990–1995	(0.1)	9.4	7.7	4.3	7.5	12.5	10.8	10.8
1995–2000	17.0	(5.5)	1.3	28.6	8.0	3.7	12.7	4.1
2000–2006	16.2	8.8	16.2	(0.4)	2.5	6.2	14.2	9.5

GMS = Greater Mekong Subregion, GZAR = Guangxi Zhuang Autonomous Region, Lao PDR = Lao People's Democratic Republic, na = not available, PRC = People's Republic of China.

<sup>a</sup> 2008 figure.

Sources: ADB website. *2007 Key Indicators of Developing Asian and Pacific Countries*; Department of Electricity, Ministry of Energy and Mines. *Electricity Statistics Year Book, 2006 Lao PDR*; Electricité du Cambodge (Electric Utility in Cambodia). February 2007. *Statistical Handbook: 1995–2005*. Phnom Penh; Dinh Trung, Ministry of Industry of Viet Nam. 2007. Asia Clean Energy Forum, Manila. 26–28 June 2007 (Presentation handout); Electricity Generating Authority of Thailand. 2006. Annual Report. *Strengthening Electricity Security*. Thailand; Guangxi Statistical Bureau. 2007. *Guangxi Statistical Yearbook*; 2007. Yunnan Statistical Yearbook; United Nations ESCAP 2007. *Statistical Yearbook for Asia and the Pacific*. New York.



9. Electricity production and installed capacity of countries comprising the GMS are extremely uneven. In 2006, the GMS region generated nearly 300,000 gigawatt-hours (GWh) of electricity from combined installed capacity of nearly 62,000 MW. Yunnan Province produced nearly one fourth of the subregion's total production (Table A1.4). Guangxi Zhuang Autonomous Region, Thailand, and Viet Nam were also able to produce a significant proportion of electricity. On the other hand, Cambodia and Lao PDR had the lowest electricity generation capacity and production in the region.

10. The quality of power transmission infrastructure differs considerably among GMS countries. On the one hand, PRC, Thailand, and Viet Nam have well-developed power grid systems, with 500 kilovolt (kV) integrated backbone grids. On the other hand, Cambodia, Lao PDR, and Myanmar have only low and medium voltage power systems of limited extent, quality, and reliability. Existing cross-border transmission lines within the GMS include only the Nam Theun 2 (Lao PDR)–Thailand link and several medium-voltage connections. Also currently in progress are cross-border power transmission lines between some member countries—PRC to Viet Nam, Viet Nam to Cambodia, and Lao PDR to Thailand. Private power projects are also being developed for bilateral trading of electricity such as the Nam Theun 2, Nam Ngum 2, Nam Ngum 3, and Nam Ngiep 1 hydropower projects in the Lao PDR, for export to Thailand; Xe Kaman 3 Hydropower Project in the Lao PDR for export to Viet Nam; 115 kV transmission line to export power from Thailand to Cambodia; 115 kV transmission line to export power from Lao

PDR to Cambodia; and 115 kV and 230 kV transmission lines from Viet Nam to export power to Cambodia.<sup>5</sup>

**Table A1.4: Installed Capacity and Electricity Generated in the GMS**

Country/Province (Year)	Installed Capacity for Electricity Generation (MW)	Electricity Generated (GWh)
Cambodia (2006)	370	1,071
Yunnan, PRC (2006)	18,260	70,886
Guangxi Zhuang Autonomous Region, PRC (2006)	4,024 <sup>a</sup>	16,098
Lao PDR (2006)	684	3,596
Myanmar (2008)	1,718	6,398
Thailand (2006)	26,343	136,767
Viet Nam (2006)	11,300	59,050
<b>Total GMS (2006)</b>	<b>61,923<sup>b</sup></b>	<b>293,866</b>

GMS = Greater Mekong Subregion, GWh = gigawatt-hour, Lao PDR = Lao People's Democratic Republic, MW = megawatt, PRC = People's Republic of China.

<sup>a</sup> In the absence of firm data for installed capacity in Guangxi Zhuang Autonomous Region, PRC, we have calculated installed capacity as approximately 4,024 MW using similar load factors as in Yunnan Province (i.e., 4,000 hours per year, equivalent to 46%).

<sup>b</sup> We have assumed installed capacity of 4,024 MW for Guangxi Zhuang Autonomous Region and 1,718 MW for Myanmar in 2006.

Sources: Electricity Generating Authority Thailand. 2007. *Annual Report*. Bangkok; Viet Nam Electricity. 2007. *Corporate Profile 2006–2007*. Hanoi; Cambodian Ministry of Energy and Mines. 2006. *Electricity Statistics Year Book*; United States Department of Energy, 2006. *Country Energy Profiles*. Washington, DC; Yunnan Provincial Power Grid Corporation data.

11. As in other regions worldwide, energy efficiency has generally improved in the GMS countries since 1990 (Table A1.5). The greatest improvements have occurred in Myanmar and PRC, whereas energy efficiency has declined somewhat in Thailand.

**Table A1.5: Energy Efficiency in GMS Countries, 1990 and 2005**  
(in tons of oil equivalent per \$1,000)

Item	TPES/GDP		TPES/GDP (purchasing power parity)	
	1990	2005	1990	2005
Cambodia	1.32	0.86	0.22	0.14
PRC	1.94	0.91	0.47	0.22
Lao PDR	na	na	na	na
Myanmar	2.17	0.97	0.44	0.20
Thailand	0.55	0.64	0.17	0.20
Viet Nam	1.62	1.15	0.32	0.23
World	0.36	0.32	0.26	0.21
Asia	0.79	0.65	0.21	0.18
Non-OECD	1.00	0.72	0.22	0.18
OECD	0.23	0.20	0.22	0.18

GDP= gross domestic product, GMS = Greater Mekong Subregion, Lao PDR = Lao People's Democratic Republic, na = not available, OECD = Organisation for Economic Co-operation and Development, PPP = purchasing power parity, PRC = People's Republic of China, toe = ton of oil equivalent, TPES = total primary energy supply.

Source: Nangia, R. 2008. *Building a Sustainable Energy Future: The Greater Mekong Subregion*. Bangkok. Manila: ADB. Final regional workshop document.

<sup>5</sup> ADB. 2007. *Facilitating Regional Power Trading and Environmentally Sustainable Development of Electricity Infrastructure in the Greater Mekong Subregion*. Manila, RETA Report dated November 2007.

## D. Electricity Consumption

12. The average annual growth in electricity consumption in the GMS region during 1990–2006 was 9.8%, slightly faster than the growth rate in electricity production. Among countries in the subregion, Yunnan Province and Viet Nam's electricity consumption grew the fastest. On the other hand, electricity consumption in Myanmar had the slowest growth over the past two decades (Table A1.6).

**Table A1.6: Electricity Consumption in GMS Countries, 1990–2006 (gigawatt-hour)**

Year/Item	PRC							Total GMS
	Cambodia	GZAR	Yunnan Province	Lao PDR	Myanmar	Thailand	Viet Nam	
1990	199	11,666	6,157	263	2,622	38,342	6,200	65,448
1995	194	22,808	11,638	382	2,262	74,318	11,795	123,397
2000	331	32,202	21,951	640	4,087	92,467	8,675	160,353
2002	402	35,827	25,994	1,005	3,484	105,182	11,354	183,249
2003	462	41,624	28,355	1,080	3,850	112,142	12,490	200,003
2004	538	45,686	33,131	1,202	3,909	120,299	17,816	222,581
2005	641	51,015	42,594	1,011	3,663	126,521	48,722	274,167
2006	787	57,946	50,691	1,114	na	133,572	47,590	291,701
<b>Average Annual Growth Rate (%)</b>								
1990–2006	9.0	10.5	14.1	9.4	2.3	8.1	13.6	9.8
<b>Subperiod</b>								
1990–1995	(0.5)	14.4	13.6	7.8	(2.9)	14.2	13.7	13.5
1995–2000	11.3	7.1	13.5	10.9	12.6	4.5	(6.0)	5.4
2000–2006	15.5	10.3	15.0	9.7	(1.8)	6.3	32.8	10.5

GMS = Greater Mekong Subregion, GZAR = Guangxi Zhuang Autonomous Region, Lao PDR = Lao People's Democratic Republic, na = not available, PRC = People's Republic of China.

Sources: ADB website. 2007 *Key Indicators of Developing Asian and Pacific Countries*; Department of Electricity, Ministry of Energy and Mines. *Electricity Statistics Yearbook 2006 Lao PDR*; Electricité du Cambodge (Electric Utility in Cambodia). February 2007. *Statistical Handbook: 1995–2005*. Phnom Penh; Dinh Trung, Ministry of Industry of Viet Nam. 2007. Asia Clean Energy Forum, Manila. 26–28 June 2007 (Presentation handout); Electricity Generating Authority of Thailand. *Guangxi Statistical Yearbook*. Nanning, Guangxi Zhuang Autonomous Region, PRC; Yunnan Statistical Bureau. 2007. *Yunnan Statistical Yearbook*. Kunming, Yunnan Province; United Nations Economic and Social Commission for Asia and the Pacific. 2007. *Statistical Yearbook for Asia and the Pacific*. New York.

13. Growth in electricity consumption in the GMS was fastest during 1990–1995, slowing down during 1995–2000 in tandem with the Asian financial crisis, and recovering after 2000. From 2000 to 2006, average annual growth in energy consumption growth in the GMS was 10.5%, slightly above the average growth rate of gross domestic product (GDP) growth during this period, indicating a small increase in energy intensity (Table A1.7). However, Viet Nam had a relatively large increase in energy intensity during the period, as energy consumption grew at 32.8%, while its economy expanded at 7.3% per annum.

**Table A1.7: Electricity Consumption and GDP Growth in the GMS, 2000–2006**  
Growth Rates (%)

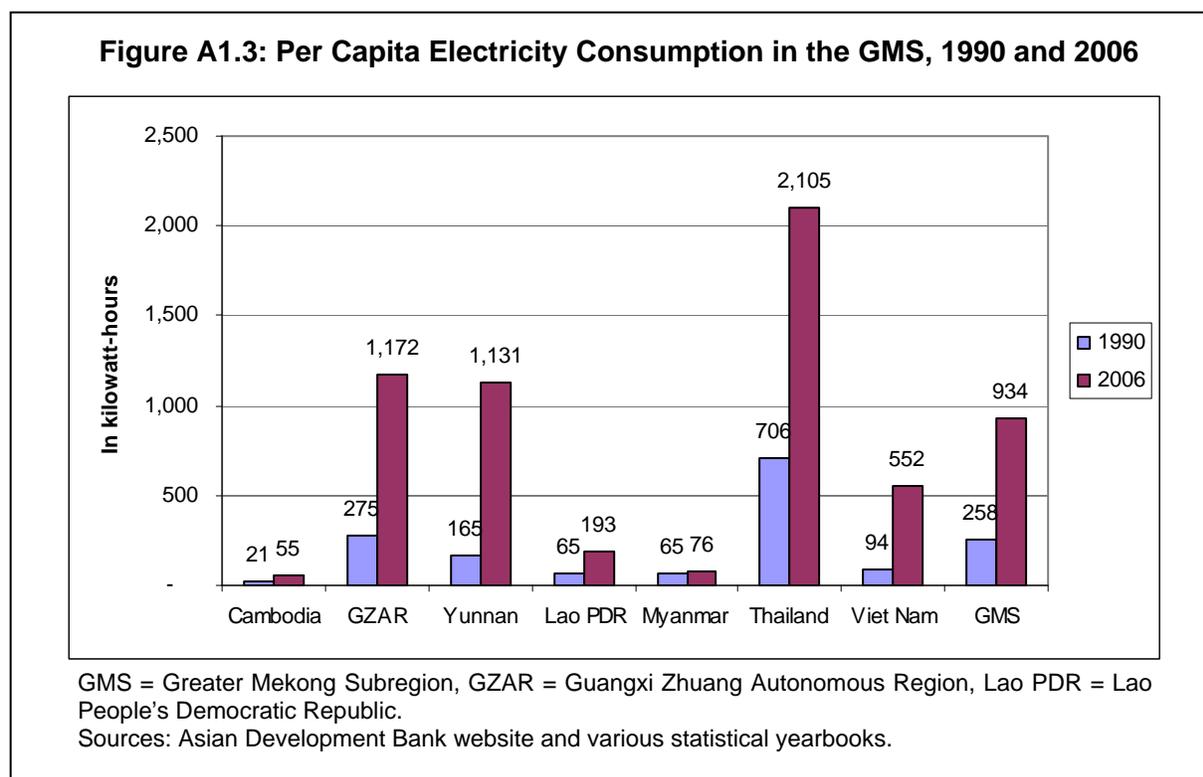
GMS Country/Province	GDP	Energy Consumption
Cambodia	7.2	15.5
Guangxi Zhuang Autonomous Region, PRC	10.1 <sup>a</sup>	10.3
Yunnan, PRC	8.5 <sup>a</sup>	15.0
Lao PDR	6.1	9.7
Myanmar	12.1	(1.8)
Thailand	5.0	6.3
Viet Nam	7.3	32.8
GMS	7.4	10.5

GDP = gross domestic product, GMS = Greater Mekong Subregion, Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.

<sup>a</sup> 2000–2005.

Sources: Asian Development Bank website and various statistical yearbooks.

14. Per capita consumption of electricity in the GMS was 934 kilowatt-hours (kWh) in 2006, with Thailand posting the highest per capita consumption of 2,105 kWh, and Cambodia, the lowest at 55 kWh (Table A1.8). Between 1990 and 2006, per capita electricity consumption in the GMS almost tripled, mainly due to significant increases in per capita electric consumption in Yunnan Province (seven-fold), Viet Nam (six-fold) and Guangxi Zhuang Autonomous Region (quadruple). In Cambodia, Lao PDR, and Thailand, electricity consumption per capita tripled (Figure A1.3). In spite of the high level of energy consumption growth during the past two decades, the average per capita use in the GMS region remains two thirds of the world average for all developing countries and is less than 10% of the average per capita consumption for the Organisation for Economic Co-operation and Development.<sup>6</sup>



## E. Power Trading

15. Power trading in the GMS started in 1971 with the Lao PDR's power export from its Nam Ngum hydropower plant to the northeastern portion of Thailand. Trading between the two countries continued uninterrupted despite border conflicts in the 1970s up to the 1980s, and expanded in 1991. Aside from this power trade between Lao PDR and Thailand, modest cross-border exchanges have been engaged in by the GMS countries, which has resulted in the electrification of remote areas of one country from the nearby system of another. It was from 1990 onward that bilateral power trade arrangements intensified, as memoranda of understanding were signed between governments across the subregion.<sup>7</sup>

<sup>6</sup> As cited in Nangia, R. 2008. *Building a Sustainable Energy Future: The Greater Mekong Subregion*. Bangkok. Final regional workshop document. Manila: ADB.

<sup>7</sup> World Bank, Transport, Energy and Mining Sector Unit, East Asia and Pacific Region. 2007. *World Bank Strategy in the Greater Mekong Subregion for Supporting the Development of Power Trade*. Washington, DC (August). Draft.

**Table A1.8: Per Capita Electricity Consumption in GMS Countries, 1990–2006** (gigawatt-hour)

Year/Item	GMS							
	Cambodia	GZAR	PRC Yunnan Province	Lao PDR	Myanmar	Thailand	Viet Nam	GMS
1990	21	275	165	65	65	706	94	258
1995	17	502	292	81	52	1,292	161	448
2000	26	678	518	123	89	1,524	139	579
2002	30	743	603	182	67	1,675	179	635
2003	35	857	648	192	73	1,778	194	687
2004	40	938	750	207	72	1,941	217	716
2005	46	1,100	957	178	76	2,008	573	886
2006	55	1,172	1,131	193	na	2,105	552	934
<b>Average Annual Growth rate (%)</b>								
1990–2006	6.4	9.5	12.8	7.1	1.0	7.1	11.7	8.4
<b>Subperiod</b>								
1990–1995	(3.7)	12.8	12.1	4.8	(4.3)	12.8	11.4	11.7
1995–2000	8.8	6.2	12.2	8.5	11.2	3.4	(2.9)	5.3
2000–2006	13.5	9.6	13.9	7.9	(2.5)	5.5	25.8	7.3

GMS = Greater Mekong Subregion, GZAR = Guangxi Zhuang Autonomous Region, Lao PDR = Lao People's Democratic Republic, na = not available, PRC = People's Republic of China.

Sources: Asian Development Bank website. *2007 Key Indicators of Developing Asian and Pacific Countries*; Department of Electricity, Ministry of Energy and Mines. *Electricity Statistics Year Book, 2006 Lao PDR*; Electricité du Cambodge (Electric Utility in Cambodia). February 2007. *Statistical Handbook: 1995–2005*. Phnom Penh; Dinh Trung, Ministry of Industry of Viet Nam. 2007. Asia Clean Energy Forum, Manila. 26–28 June 2007 (Presentation handout); Electricity Generating Authority of Thailand. 2006. Annual Report. *Strengthening Electricity Security*. Thailand; Guangxi Statistical Bureau. 2007. *Guangxi Statistical Yearbook*; 2007. Yunnan Statistical Yearbook; United Nations Economic and Social Commission for Asia and the Pacific. 2007. *Statistical Yearbook for Asia and the Pacific*. New York.

## E. Power Trading

16. Power trading in the GMS started in 1971 with the Lao PDR's power export from its Nam Ngum hydropower plant to the northeastern portion of Thailand. Trading between the two countries continued uninterrupted despite border conflicts in the 1970s up to the 1980s, and expanded in 1991. Aside from this power trade between Lao PDR and Thailand, modest cross-border exchanges have been engaged in by the GMS countries, which has resulted in the electrification of remote areas of one country from the nearby system of another. It was from 1990 onward that bilateral power trade arrangements intensified, as memoranda of understanding were signed between governments across the subregion.<sup>8</sup>

17. Power trade in the GMS took a regional dimension in 1992 with the formation of the GMS Electric Power Forum (herein referred to as the Forum), participated in by all six countries. In 1993, the GMS Experts Group on Power Interconnection and Trade was formed as the central coordinating body for the subregion. The ADB's GMS program for the energy sector took off in 1995 when the Forum had its inaugural meeting in Myanmar. Since then, significant events have taken place that have included agreements in hydropower potential and trade and intercountry transmission of energy supplies.

18. Notwithstanding this progress in power transmission and trade agreements, intraregional energy trade remains low, except for Lao PDR power and Myanmar natural gas. The overall share of Lao PDR power exports has been declining and is now between 60% and 70% from 88% in 1979 (footnote 6). Myanmar's export of natural gas meets about 25% of Thailand's

<sup>8</sup> World Bank, Transport, Energy and Mining Sector Unit, East Asia and Pacific Region. 2007. *World Bank Strategy in the Greater Mekong Subregion for Supporting the Development of Power Trade*. Washington, DC (August). Draft.

demand for gas. Bilateral exchange of electricity is taking place across borders, although power flows are mostly one way. Existing electricity trade flows in the GMS are from Lao PDR to Thailand, from Lao PDR to Viet Nam, and small amounts from Lao PDR to Cambodia.

19. Overall, the GMS is a net importer of energy (Table A1.9). In particular, the region is a net importer of crude oil and petroleum products, importing nearly 60% of its primary consumption needs. In 2005, nearly 25% of the total primary energy consumption of the region was imported. Thailand is the largest importer of energy, importing nearly 60% of its energy in the form of electricity, natural gas, and oil products at a cost of approximately \$5 billion annually. Cambodia, Lao PDR, and Viet Nam import 100% of their transport and other petroleum-based fuels. Guangxi Zhuang Autonomous Region and Yunnan Province also have to import refined products from other areas of the PRC. Myanmar and Viet Nam are net exporters of energy at present, but, given the rapid demand growth, the region is likely to remain heavily dependent on imported fossil fuels in the medium term (footnote 6).

**Table A1.9: Energy Balances for GMS, 2004/2005**

In petajoules (PJ) =  $10^{15}$  joules

<b>GMS 2004/2005<sup>a</sup></b>	<b>Coal</b>	<b>Crude Oil and Oil Products</b>	<b>Natural Gas</b>	<b>Hydro</b>	<b>Electricity</b>	<b>Biomass</b>	<b>Total</b>
Production	1,448.79	1,209.66	1,416.62	457.62		2,450.10	6,982.79
Net imports	578.10	1,671.33	65.44	(26.28)	32.10	0.89	2,321.58
Stock changes and other	(40.88)	29.73	0.38				(10.77)
<b>Primary Consumption</b>	<b>1,986.01</b>	<b>2,910.72</b>	<b>1,482.44</b>	<b>431.34</b>	<b>32.10</b>	<b>2,450.99</b>	<b>9,293.59</b>
Petroleum refineries		(283.23)	(22.98)				(306.21)
Power plants	(596.52)	(131.49)	(1,108.24)	(431.34)	937.00	(38.79)	(1,369.38)
Others	(211.19)	(3.88)	(5.34)		(38.51)	(221.99)	(480.91)
<b>Final Consumption</b>	<b>1,178.30</b>	<b>2,492.12</b>	<b>345.88</b>	<b>0.00</b>	<b>930.59</b>	<b>2,190.21</b>	<b>7,137.09</b>

GMS = Greater Mekong Subregion.

<sup>a</sup> Latest available data were used. For Thailand and Viet Nam, this was 2005 data, whereas for the other GMS countries, this was 2004 data. Since Thailand and Viet Nam together consume approximately 60% of GMS's total final energy, the total gives a picture that corresponds to 2005 more than 2004.

Source: Integriertes Ressourcen Management (IRM-AG). 2007. *Developing the Greater Mekong Subregion Energy Strategy* (Interim Report - Discussion draft prepared for the Second Regional Consultation Workshop 28–29 May 2007 in Bangkok).

## F. Future Energy Demand

20. The GMS economies' rapid economic growth since the 1990s (averaging 7%) has stimulated a significant rise in energy demand. Along with this high rate of growth was increased motorization and vehicle boom in the region, resulting in the overall consumption of diesel and gasoline by 177% and 149%, respectively, in 1990–2005. In the next decade, the demand for energy at the national level is expected to continue to rise between 7% and 16% per annum or at rates much faster than the projected growth of economic activities. A major challenge facing the GMS countries, therefore, is keeping up with the expected demand growth.

## REGIONAL AND COUNTRY-SPECIFIC STRATEGIES AND PLANS FOR THE ENERGY SECTOR

Item	Policies	Plans/Programs
<b>REGIONAL</b>		
<b>GMS Program</b>	<ul style="list-style-type: none"> <li>• In order to promote extended power cooperation in the Greater Mekong Subregion (GMS), the Electric Power Forum (EPF), right after it was established in 1995, adopted a two-pronged approach to develop a regional power market. The first prong involved providing the policy and institutional framework for promoting power trade opportunities, while the second involved a building block approach to develop the essential grid interconnection infrastructure to physically facilitate the cross-border dispatch of power. Commitment of GMS countries to power trading moved up another notch with the signing of the Policy Statement on Regional Power Trade in the GMS in October 1999 (during the Sixth EPF meeting in Phnom Penh). This policy statement expressed the need for a regional protocol on power trade and the creation of regional bodies to deal with technical and nontechnical power trade matters.</li> <li>• The <i>Intergovernmental Agreement on Regional Power Trade</i> in the GMS, signed by six GMS countries in 2002, fulfilled the regional protocol requirement and provided a framework for cooperation in and development of power trade in the subregion. The requirement for a regional body was fulfilled with the establishment of the Regional Power Trade Coordination Committee (RPTCC) in 2004. The RPTCC coordinates with and represents countries involved in the regional power trade, and agrees on operating rules and guidelines for the creation of a regional power market, as embodied in the <i>Regional Power Trade Operating Agreement</i>.<sup>a</sup> Linked with this agreement is the planning for the construction of various cross-border power interconnection projects.</li> <li>• <b>Four Strategic Thrusts:</b> <ul style="list-style-type: none"> <li>(i) <b>Broadening GMS energy cooperation</b> through enhanced efficiency and security, and sustainable development of energy resources</li> </ul> </li> <li>• <b>Regional power trade development:</b> <ul style="list-style-type: none"> <li>(ii) Building capacity for power trade operation, coordination, and grid interconnection</li> <li>(iii) Implementing key GMS interconnection projects for stage 1 power trading</li> <li>(iv) Developing generation projects for power exports under stage 1</li> </ul> </li> <li>• A <i>Regional Energy Sector Strategy for 2006-2020</i> is currently being developed by the Asian Development Bank (ADB) in partnership with the GMS countries.<sup>b</sup> The strategy aims to expand cooperation among GMS economies to ensure efficient and affordable access to modern energy services for all. It will provide analysis of cross-border energy supply options in order to (i) realize larger markets and efficiencies of scale, (ii) provide diversification and energy security, and (iii)</li> </ul>	<ul style="list-style-type: none"> <li>• The <i>Regional Indicative Master Plan on Power Interconnection</i><sup>c</sup> has recommendations on least-cost grid interconnection scenarios and identified activities to link national transmission systems. It has identified cross-border power interconnection projects such as the GMS Power Transmission Line and the GMS Power Interconnection Project Phase I and Phase II. Progress on this, however, is reportedly delayed due to a number of technical and financial issues.<sup>d</sup></li> <li>• Additional proposed and ongoing projects (up to 2012) include a rural electrification project along the East–West Economic Corridor; gas pipelines associated with the southern and East–West Economic Corridor; transmission systems upgrades and a series of transmission and interconnection projects around the region; a renewable energy and cooperation strategy; and oil- and gas-fired power plants and hydropower projects in Cambodia, People’s Republic of China (PRC), and Viet Nam.</li> <li>• New directions agreed upon during the Fourth Planning Working Group and the Fifth Focal Group meetings in Viet Nam on 20–21 November 2007 are as follows: (i) review of the future scope of studies on performance standards and transmission regulation to ensure that these adequately address the GMS countries’ requirements; (ii) additional training on power trading operations, which could utilize technical assistance resources provided by various development partners; (iii) the PRC to host the power database and act as its regional coordinator; and (iv) finalizing of a memorandum of understanding on the power trade road map for possible signing at the Third Summit in Vientiane in March 2008.</li> </ul>

Item	Policies	Plans/Programs
	incorporate environmental considerations into energy sector planning.	
<b>NATIONAL/GOVERNMENT STRATEGIES</b>		
<b>Cambodia</b>	<ul style="list-style-type: none"> <li>• <b>Energy Policy:</b> (i) To provide an adequate supply of energy throughout Cambodia at reasonable and affordable price, (ii) to ensure a reliable and secured electricity supply at reasonable prices, which facilitates investments in Cambodia and development of the national economy, (iii) to encourage exploration and environmentally and socially acceptable development of energy resources needed for supply to all sectors of the Cambodia economy,(iv) to encourage the efficient use of energy and to minimize the detrimental environmental effects resulting from energy supply and consumption (Cambodian Ministry of Industry, Mines and Energy [MIME], 2008).</li> <li>• <b>Energy Targets:</b> (i) 100% of villages have access to electricity services by 2020; and (ii) 70% of rural households have access to quality electricity services by 2030 (MIME, 2008).</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Power Sector Strategy Components:</b> (i) Development of generation; (ii) development of transmission; and (iii) power trade with neighboring countries (MIME, 2008).</li> <li>• (i) Development of Generation. Eight power plants with total capacity of 2,124 megawatts (MW) are targeted to be developed from 2010 to 2019, as follows: (a) 193 MW Kamchay Hydro-project (2010); (b) 200 MW Coal Power Plant (2011); (c) 120 MW Atay Hydropower Plant (2012); (d) 235 MW Lower Russei Chhrum Hydropower Plant (2013); (e) 246 MW Tatay Hydropower plant (2015); (f) 420 MW Lower Sesan II and Lower Srepok II Hydropower plant (2016); (g) 260 MW Stung Chay Areng Hydropower plant (2017); and (h) 450 MW Sambor Hydropower plant (2019).</li> <li>• <b>(ii) Development of Transmission.</b> Eighteen transmission lines with combined length of 1,803 kilometers (km) and power of 3,550 kilovolt (kV) are targeted to be operational from 2009 to 2019.</li> <li>• <b>(iii) Development of Power Trade.</b> For 2008–2010, plans include importation of 260 MW fuel from Viet Nam (220 MW), Lao PDR (20 MW), and Thailand (20 MW) to serve Banteaymeanchey–Siem Reap–Battambang, Phnom Penh, Stung Treng, and Pongnarkreak–Soung–Kampong Cham.</li> </ul>
<b>People's Republic of China</b>	<ul style="list-style-type: none"> <li>• Under the <b>11th Five-Year Plan (FYP)</b>, the Government is adopting a new focus for development, one that includes growth but takes a broader view of development. This FYP describes Government strategies from 2006 to 2010.</li> <li>• The 11th FYP highlights 22 social and economic indicators of progress toward the long-term goal, with targets for each indicator to reach by 2010. Targets include, for example, cutting pollution by 10% and energy intensity by 20%. The FYP aims to reach its targets through a combination of public investment, government initiatives, and policy reforms. Sectors targeted for investment include rural public services, urban environmental services, transport, and energy.</li> <li>• The <b>Renewable Energy Law</b> which was enacted in 2005 and took effect on 1 January 2006, was driven by a surging demand for energy as well as the desire for energy security, pollution reduction, and poverty alleviation. Specifically, the law aims to boost the PRC's renewable energy capacity to 15% by 2020 and has outlined a commitment to invest \$180 billion in renewable energy over this period. This sets the stage for the widespread</li> </ul>	<ul style="list-style-type: none"> <li>• One of the key targets of the 11th FYP is to cut energy intensity by 20%. The Government has identified 10 areas and is targeting 1,000 high energy-consuming enterprises to achieve this goal. Dependence on coal is targeted to be cut to 66%, and sulfur dioxide emissions by 10%. ADB will help cut energy intensity and dependence on coal through assistance in six areas: (i) energy efficiency and energy conservation; (ii) alternative energy, including wind, biomass, and hydropower; (iii) clean coal technologies; (iv) urban environmental improvement; (v) coal mine methane and coal bed methane; and (vi) regional cooperation in energy. The work will feature new initiatives and innovative financing tools to plan, design, and implement projects.</li> <li>• The <b>Renewable Energy Law</b>, which mandates grid companies to buy renewable energy, triggered the industry's rapid recent expansion. Installed wind power capacity in 2005 was about 1.3 gigawatts (GW). New installed capacity increased exponentially in the next 2 years, leaving the PRC with 3.3 GW of total installed capacity at the end of 2007. The National Development and Reform</li> </ul>

Item	Policies	Plans/Programs
	<p>development of renewable energy in the PRC, particularly for commercial-scale electricity generation facilities.</p> <ul style="list-style-type: none"> <li>Reforms in rural electricity supply hope to achieve three objectives: (i) developing rural electricity enterprises that are separated from the local governments, (ii) developing the rural power market, and (iii) rationalizing rural tariffs.</li> </ul>	<p>Commission, the agency effectively responsible for national energy policy, recently doubled China's installed wind capacity target to 10 GW by 2010. Chinese wind turbine manufacturers are reporting booming business, and wind farms are mushrooming across the country.</p> <ul style="list-style-type: none"> <li>The April 2002 power sector restructuring plan was a major reform that resulted in the unbundling of the State Power Corporation, separating policy and regulatory functions from the production functions, and separating generation from transmission and distribution. The power restructuring plan was complemented by the 2002 Clean Production Law, and various initiatives for the United Nation Kyoto Protocol Clean Development Mechanism, which has facilitated over 250 projects, mostly for renewable energy and energy efficiency.</li> </ul>
<b>Lao People's Democratic Republic</b>	<ul style="list-style-type: none"> <li>Recognizing both the economic and social advantages of electrification and the low rate of domestic consumption, the Government's power development strategy<sup>e</sup> states that energy resources "represent a major opportunity for economic development that assist in the alleviation of poverty and development of the country". It has four medium-term priorities: (i) maintain and expand affordable, reliable and sustainable electricity supply in the Lao PDR to promote economic and social development; (ii) promote power generation for export to provide revenues to meet development objectives; (iii) develop and enhance the legal and regulatory framework to direct and facilitate power sector development effectively; and (iv) reform institutions and institutional structures to clarify responsibilities, strengthen commercial functions, and streamline administration. In 2003, the Government prepared a Strategy for Implementing Sector Strengthening in the power sector.</li> </ul>	<ul style="list-style-type: none"> <li>The Government's plan until 2020 for the power sector involves rapid and simultaneous development on several fronts by (i) expanding generation, transmission, distribution, and off-grid development to increase the electrification rate for the country from the current level of about 41% to 90% by 2020; (ii) increasing government revenues from independent power producer (IPP) investments and honoring power export commitments with Thailand (3,000 MW) and Viet Nam (1,500–2,000 MW) by promoting IPP generation development; and (iii) promoting the development of a 500 kV transmission grid with neighboring GMS countries to integrate the Lao PDR power system with their power systems.</li> </ul>
<b>Myanmar</b>	<ul style="list-style-type: none"> <li>Myanmar's Fourth Short-Term Five-Year Plan (FY2006/2007–FY2010/2011) is targeting a growth rate of 12% per year through (i) retaining the growth momentum of the economy, (ii) solidifying the value of the kyat, (iii) reducing the budget deficit to have a surplus by the third year, (iv) curbing inflation, and (v) continuing the surplus of the current account position in the balance of payments.</li> <li>Myanmar has good potential for economic growth, considering its vast natural resources. However, the economy underperforms because of macroeconomic imbalances and structural problems that include a wide fiscal deficit due to high public expenditures, losses by state-owned enterprises (SOEs), and a dual exchange rate system. Accordingly, economic growth will depend on reforms to reduce structural rigidities, improving the investment climate for private sector development, progressing toward exchange rate unification, reducing subsidies to SOEs, enhancing social sector spending, and putting in place prudential reforms in the banking sector.</li> <li><i>There is no government strategy specific for the energy sector.</i></li> </ul>	
<b>Thailand</b>	<ul style="list-style-type: none"> <li>Thailand's strategic framework from 2007 to 2011, the 10th National Economic and Social Development Plan, consists of five strategies: (i) human and social development; (ii) strengthening the economic foundation of local communities; (iii) restructuring the national economy to achieve</li> </ul>	<ul style="list-style-type: none"> <li>Thailand's Medium-Term Investment Program (approved in mid-2005) showed investment of more than \$40 billion (roughly 5% of GDP) in large-scale infrastructure projects including the expansion of Bangkok's mass rapid transit system, highways, water supply, energy,</li> </ul>

Item	Policies	Plans/Programs
	<p>productivity gains, promote domestic and foreign investment and increase competitiveness; (iv) sustainable development through protection and sound management of the environment and natural resources; and (v) good governance for sustainable, long-term economic growth and development. Infrastructure development, capital market development, and energy efficiency improvements are core elements of the third strategy.</p> <ul style="list-style-type: none"> <li>• New investments and efficiency improvements are needed to strengthen Thailand's energy security and sustain growth. Although there has been a delay in implementation due to political transition, there is general consensus that (i) Thailand's infrastructure investment requirements are substantial, (ii) the targeted sectors constitute the priority areas for new investments, and (iii) private sector participation needs to be maximized.</li> </ul>	<p>housing, education, and public health projects. The Government is carefully reviewing its investment program and preparing an implementation plan that prioritizes projects based on, among others, financial viability, scope for private investment, and strategic contribution to development.</p>
Viet Nam	<ul style="list-style-type: none"> <li>• The Government's power sector policy as enunciated in the 2005 Electricity Law is to develop a power market on the principles of transparency and competition to achieve economic efficiency, to attract investments from both the state and nonstate sectors. The Government's aim is also to limit state monopoly in the sector to power transmission, national load dispatch and strategically important large power plants, leaving power distribution and nonstrategic power generation to potential private sector investors. The Law encourages investments from foreign private sector investors and joint ventures between foreign investors and domestic enterprises. To support these objectives, the Ministry of Industry is entrusted with establishing a competitive power market (including competitive bidding of IPPs) in the medium term (2009–2012) and procuring new generation capacity on flexible terms to facilitate the transition to a competitive power market.</li> <li>• The goals of the sector up to 2010 are to: (i) push up development of energy production industries; (ii) ensure supply-demand balance of the economy in terms of essential industrial products including electricity, coal, gasoline, and oil satisfying domestic demands; (iii) increase the production value of the electricity-water- gas industry by 3.8%; and (iv) expand exploitation of the electricity-water-gas industry by 5.1%. (Viet Nam, The Five-Year Socio-Economic Development Plan, 2006-2010)</li> </ul>	<ul style="list-style-type: none"> <li>• Since the enactment of the Electricity Law, the Government has demonstrated its strong commitment to creating a transparent power market and broadening ownership of the sector by taking several key initial steps in 2005 such as (i) establishing the Electricity Regulatory Authority, and (ii) commencing the equitization process of key subsidiaries of Viet Nam Electricity (i.e., power plants and provincial power distribution units). The latter is expected to be completed by 2008. Regional power trading forms an integral part of the Government's power sector strategy, especially importing power from neighboring countries to meet short-term power shortages (2007–2010) as well as for meeting long-term power needs once the hydropower potential of the country is fully exploited (after 2015).</li> </ul> <p><b>Development orientation of some industries for 2006–2010</b></p> <ul style="list-style-type: none"> <li>• <b>Electricity.</b> Activities to ensure stable power supply to production and daily life in 2006–2010: (i) synchronous investment and construction of power sources and grids; (ii) continue to establish a competitive electricity market; (iii) be proactive in regional and international cooperation for power exchange with other countries through grid connections with PRC, Lao PDR, Cambodia, and Thailand; and (iv) cooperative with Lao PDR and other countries in investment in power sources. Priority is given to the Son La Hydropower project and to coal and gas thermal power projects.</li> <li>• <b>Coal.</b> The principle is rational organization of coal production to ensure satisfaction of the current supply–demand balance and long-term supplies for later development stages, giving priority to coal provision for huge consumers such as power generation, cement, fertilizers,</li> </ul>

Item	Policies	Plans/Programs
		construction material producers, and cooking fuel users in rural and mountainous areas. <ul style="list-style-type: none"> <li>• <b>Oil and gas.</b> Intensify foreign investment attraction in exploration and search to increase identified reserves. Complete investment in Dung Quat oil refinery project in 2009; implement the Nghi Son petrochemical and oil refinery project and the oil refinery project in the south; and invest in oil and gas extraction overseas.</li> </ul>

ADB = Asian Development Bank; EPF = Electric Power Forum; GDP = gross domestic product; GMS = Greater Mekong Subregion; GW = gigawatt; IPP = independent power producer; km = kilometer; kV = kilovolt; Lao PDR = Lao People's Democratic Republic; MIME = Ministry of Industry, Mines and Energy; Cambodia MOU = memorandum of understanding; MW = megawatt; PRC = People's Republic of China; RPTCC = Regional Power Trade Coordination Committee; SOE = state-owned enterprise.

<sup>a</sup> ADB assistance for the conduct of the study – ADB. 2003. *Technical Assistance for a Study for a Regional Power Trade Operating Agreement in the Greater Mekong Subregion*. Manila (TA 6100-REG, for \$850,000, approved on 21 April).

<sup>b</sup> ADB. 2006. *Technical Assistance for Developing the Greater Mekong Subregion Energy Sector Strategy*. Manila (TA 6301-REG, for \$900,000, approved on 3 January), and supplementary assistance in November 2007.

<sup>c</sup> ADB. 2000. *Technical Assistance for Regional Indicative Master Plan on Power Interconnection in the Greater Mekong Subregion*. Manila (TA 5920-REG, for \$742,000, approved on 10 July).

<sup>d</sup> ADB. 2007. *Unraveling the Greater Mekong Subregion Program: An Overview and Update on Key Structures, Programs, and Developments*. Manila.

<sup>e</sup> Available: <http://www.lao-energy.com/intro.htm> as stated in <http://www.adb.org/Documents/CSPs/LAO/2006/CSP-LAO-2006.pdf>

Sources: GMS Energy Sector Strategy ([www.adb.org/projects/gms-energy-strategy/](http://www.adb.org/projects/gms-energy-strategy/)); GMS Vientiane Plan of Action 2008–2012 ([www.adb.org/GMS/Sector-activities/energy.asp#ener-17](http://www.adb.org/GMS/Sector-activities/energy.asp#ener-17)); annual reports and country strategy and programs for Cambodia, PRC, Lao PDR, Thailand, and Viet Nam; ADB and Myanmar 2007: A Fact Sheet ([www.adb.org/myanmar](http://www.adb.org/myanmar)); Cambodian Ministry of Industry, Mines and Energy. 2008. *Energy Situation in Cambodia* (Handout/Copy of presentation slides); ADB PRC Country Partnership Strategy 2008–2010 (<http://www.renewableenergyworld.com>; <http://www.chinaeconomicreview.com>).

## GREATER MEKONG SUBREGION INSTITUTIONAL STRUCTURES WITH RESPECT TO THE ENERGY SECTOR

1. **Electric Power Forum Meetings.** The regional power sector work has been guided by the Electric Power Forum (EPF), comprised of one senior representative from the government organization dealing with policy and planning in the power sector and one representative from the key power utility in each of the Greater Mekong Subregion (GMS) countries. The EPF was established in 1995 to identify and pursue opportunities for subregional cooperation in the field of electrical energy among the GMS countries.<sup>1</sup> The EPF met 11 times between 1995 and 2004 and had its last meeting in December 2004 in Bangkok, Thailand.
2. **Experts Group on Power Interconnection and Trade Meetings.** The Experts Group on Power (EGP) was created in June 1998 to develop detailed work programs and recommend its findings to the EPF to promote the development of the regional transmission network and facilitate the expansion of cross-border power trade. The EGP, which was comprised of representatives from government organizations dealing with policy and planning in the power sector and key power utilities in GMS countries, met nine times between 1995 and 2003 and had its last meeting in December 2003 in Guangzhou, People's Republic of China.
3. **Regional Power Trade Coordination Committee Meetings.** The Regional Power Trade Coordination Committee (RPTCC) took over from the EGP its tasks concerning the development of regional power trade. The RPTCC's mandate includes a number of tasks related to the establishment and implementation of regional trade arrangements.<sup>2</sup> The RPTCC has met six times since its inception in June 2004.
4. **Focal Group Meetings.** The RPTCC is assisted by two subgroups: the Focal Group (FG) and the Planning Working Group (PWG). The FG comprises middle management representatives from GMS government agencies associated with the planning and operation of regional power interconnections and has as its function implementation of the decisions of the RPTCC on a day-to-day basis in their respective countries and acting as the coordinating body of the RPTCC work program in each GMS member country. The FG has met six times since its inception in January 2006.
5. **Planning Working Group Meetings.** The second working group under the RPTCC is the PWG. The PWG comprises senior level representatives responsible for national transmission planning from the transmission system operators in each of the GMS countries and has as its function the coordination of the planning of GMS cross-border transmission lines. The PWG, in turn, is expected to have two divisions: (i) the regional PWG, which will make plans for upgrading facilities to increase cross-border transmission capacity or improve the reliability/security; and (ii) the operational PWG, which will undertake studies to improve reliability and security of regional network operation, and ensure that power market participants comply with the standards set. Given that as yet no multicountry GMS power market operation is taking place, only the regional planning work under the regional PWG is needed at present. This includes the conduct of technical studies that would comprise the Regional Power Trade Operating Agreement, such as performance standards, transmission regulation, standard metering, and grid code. The present PWG's work plan focuses on fulfilling the tasks of the regional PWG. The PWG has met five times since its inception in June 2006.

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<sup>1</sup> Electric Power Forum. 1995. *Terms of Reference of the Electric Power Forum*.

<sup>2</sup> Regional Power Trade Coordination Committee. 2004. *Terms of Reference of the Regional Power Trade Coordination Committee*.

6. **Energy Sector Forum Meetings.** The Energy Sector Forum is a new forum focusing on energy, including oil, gas, coal and other energy sources, as well as electricity. The Energy Sector Forum had its first meeting in December 2004 and had its second meeting in November 2008 in Bangkok, Thailand to discuss the draft energy sector strategy.

7. **Senior Officials Meetings.** Senior Officials Meetings have the role of reviewing progress in the GMS program's sectoral activities, determining issues that may require ministerial attention and reporting to GMS ministerial conferences. Representatives at the Senior Officials Meeting include the GMS national coordinator of each GMS government plus representatives from relevant line ministries. Since 2004, Senior Officials Meetings have assessed proposals and developments in the sectors, in part aided by the Plan of Action and its status reports.

8. **Ministerial Meetings.** The GMS Ministerial Conference serves as the policy-level body of the GMS program and is attended by ministers from a range of GMS country ministries, depending on the countries. The meeting discusses and reviews proposals and program progress as well as next steps in the program. Development partners also participate in these meetings.

9. **GMS Summits.** The first GMS Summit was held in Phnom Penh, Cambodia in 2002, and it has since become a regular feature of the GMS landscape, with the second Summit being hosted in Kunming, People's Republic of China in 2005 and a third being hosted in Vientiane, Lao People's Democratic Republic in 2008. Summits provide an opportunity for endorsement of frameworks, programs, and agendas to be endorsed at the highest level within GMS governments. Prior to 2002, the GMS program was run through sectoral initiatives and at the ministerial level.

10. **GMS Government National Coordinating Committee and National Coordinators.** The GMS national coordinators are responsible for overseeing all GMS-related activities in each of the countries and work in coordination with the GMS Secretariat at the Asian Development Bank and with members of each working group within their own countries.

**ADB ASSISTANCE TO THE ENERGY SECTOR**  
**Summary of Project Profiles, Assessment/Status and Lessons/Issues**

**A. Loans**

Project Identification	Project Description	Assessment/Status	Lessons/Issues
<p>1. Loan 1329-LAO (SF): Theun–Hinboun Hydropower Project</p> <p>ADB-Approved Financing: \$60M</p> <p>Period: 8 November 1994–14 October 1998</p> <p>Executing Agency (EA): Theun–Hinboun Power Company Limited</p>	<p>The Project was the Lao PDR's first joint-venture hydropower project with the private sector and foreign investors. It was aimed at supporting the country's economic growth by increasing foreign exchange earnings through export of electricity to Thailand. It entailed construction of a 210 megawatt (MW) hydropower plant and related power transmission line to Thailand.</p>	<p>Rated <i>successful, bordering on highly successful</i> (PPAR, December 2002): (i) well designed, and revenue contributed substantially to the Lao PDR's foreign exchange earnings; (ii) very low cost of generation (at \$0.02 per kilowatt-hour); (iii) FIRR–17% and EIRR–18.5%; (iv) strengthened financial health of EdL and increased social expenditures by Government; (v) power purchase agreement (PPA) with Electricity Generating Authority of Thailand (EGAT) has ensured financial sustainability; and (vi) with preventive maintenance, the Project was deemed physically sustainable.</p>	<ul style="list-style-type: none"> <li>• Key ingredients of success: (i) thorough technical and economic evaluation of a suitable hydropower site, (ii) choice of a group of developers with relevant experience, (iii) negotiation of a PPA advantageous to all parties involved, and (iv) willingness to learn from mistakes made and take responsibility to mitigate them (PPAR, December 2002).</li> <li>• The Project could serve as a model for effectively combining multilateral and bilateral aid and establishing a successful public–private partnership that benefits the country (PPAR, December 2002).</li> </ul>
<p>2. Loan 1456-LAO(SF): Nam Leuk Hydropower Project</p> <p>ADB-Approved Financing: \$52M</p> <p>Period: 10 September 1996–13 March 2003</p> <p>EA: Electricité du Laos (EdL)</p>	<p>The Nam Leuk Hydropower Plant Project was to provide domestic power supply and export surplus power to Thailand. Its objectives were to (i) support optimal development of the Lao PDR's power subsector; (ii) provide generating capacity to meet domestic demand and increase electricity exports to Thailand; (iii) strengthen the capabilities of EdL to prepare, design and implement environmentally sustainable projects; and (iv) strengthen the management and protection of the Phou Khao Khouay National Biodiversity Conservation Area (PKK Park) by providing technical and financial support.</p>	<p>Rated <i>successful</i> (PPAR, December 2004). The Project was relevant, efficacious, efficient, and with likely sustainability; it had moderate institutional development and other impacts: (i) EdL demonstrated that it can maintain and operate the Project; (ii) despite difficulties in implementation, project completion was not substantially delayed; (iii) the Project operated efficiently; costs incurred were within the budget; (iv) FIRR–7.6% and EIRR–11.8%; (v) the Project supported optimal development of the power sector but achieved little capacity building; and (vi) PKK Park was not sustainable as a national park and will not be unless project funds for the Park are used more productively.</p>	<p>Lessons include the need (i) to provide funds for environmental and social mitigation after plant operation, (ii) support the achievement of all objectives with a budget, and (iii) specify clear and measurable performance indicators to evaluate achievement of all objectives (PPAR, December 2004).</p>
<p>3. Loan 2052-CAM(SF): GMS Transmission Project</p> <p>ADB-Approved Financing: \$44.3M</p>	<p>The Project will construct a 109 kilometer (km) 230 kilovolt (kV) transmission line, associated substations, and distribution facilities from</p>	<p>Project is ongoing. Historical PPR ratings on impact and outcome (IO) – mostly <i>satisfactory</i>; implementation progress (IP) – mostly <i>satisfactory</i>, but there were</p>	<p>Based on BTOR of October 2007, environmental issues and health and related risks including requirements on campaigns against risks of sexually transmitted diseases,</p>

Project Identification	Project Description	Assessment/Status	Lessons/Issues
<p>Period: 15 December 2003–31 December 2010</p> <p>EA: Electricité du Cambodge (EdC)</p>	<p>the Vietnamese border to Phnom Penh, which will allow EdC to import up to 200 MW capacity power from Viet Nam.</p> <p>The Project aims to (i) stimulate trade and economic growth in the subregion by promoting the provision of sustainable and reliable electricity at affordable prices to consumers in Cambodia, and (ii) promote socioeconomic development and poverty reduction in Cambodia by enhancing accessibility to electricity of the poor (RRP, November 2003).</p>	<p>months (2004–2005) when IP was rated <i>partly satisfactory</i> due to initial implementation delays.</p> <p>Overall assessment based on midterm review mission findings (BTOR, October 2007): The institutional, administrative, and organizational set up for the Project was found satisfactory and functioning well. The transmission line on the Vietnamese border side is complete, while that on the Cambodian side is under construction.</p> <p>IP is back on track from early 2008 and the actual disbursement during the first quarter of 2008 overachieved the projection for the same period. With the recent delivery of major electrical materials to the project sites and notable progress of transmission works, it is expected that the disbursement in 2008 would achieve the yearly target of \$12 million. Due to initial implementation delays, loan closing has been extended to December 2010. ADB, EdC, and Inter-Ministerial Resettlement Committee need to continue to closely coordinate and monitor the work progress and timely address the implementation issues, especially the issue of compensation payments to the affected persons which may cause further delays in implementing the civil works contracts (BTOR, April 2008).</p>	<p>trafficking of women and children, and health and sanitation provisions are covered by the Construction Environmental Management Plan dated May 2007. EdC is to monitor CEMP implementation and prepare quarterly reports that will include a section on the status of implementation of said requirements.</p> <p>Mitigation measures should be undertaken to prevent erosion, ensure safety of local people and animals and transform the pit into productive use (BTOR, April 2008).</p> <p>While resettlement is reportedly working well and issues are resolved as they arise in the field, reporting needs to be improved. EdC's Social and Environment Office still needs strengthening, and all implementing agencies need resettlement training (BTOR, October 2007).</p>
<p>4. Loan 2162-LAO: Nam Theun 2 (NT2) Hydroelectric Project</p> <p>ADB Financing: \$20M</p> <p>Period: 4 April 2005–2 February 2011</p> <p>EA: Ministry of Industry and Handicrafts and Nam Theun 2 Power Company Limited (NTPC)</p>	<p>The objective of the NT2 Hydroelectric Project is to generate revenues through environmentally and socially sustainable development of NT2's hydropower potential to finance poverty reduction and environmental programs in the Lao PDR.</p> <p>The Project includes the development, construction, and operation of a 1,070 MW transbasin diversion</p>	<p>Project is ongoing. Construction of the power and road infrastructure facilities has progressed satisfactorily. Overall progress stands at 70.6% at an elapsed time of 56%. At Nakai dam, the spillway and all spillway piers have been completed. There has also been good progress on relocation of project-affected people, public health management in the project area, and the activities of the Watershed Management and Protection Authority (BTOR, November 2007).</p>	<p>The semiannual review (BTOR, November 2007) of NT2 implementation conducted in November 2007 by an ADB Mission and other international financial institution (IFI) missions identified implementation issues related to the reservoir impoundment planned to commence between March and June 2008. The main issues identified were (i) reservoir area needs to be cleared of biomass; (ii) uncertainty on the viability of plateau livelihood program for</p>

Project Identification	Project Description	Assessment/Status	Lessons/Issues
	power plant on the Nam Theun River, a tributary of the Mekong in the central region of the Lao PDR.	The objective of the Project is reportedly within reach, provided that risks—particularly relating to social and environmental safeguards—continue to be effectively managed as the project enters a decisive stage in its implementation (Project update, December 2007).	resettlement and ability to contribute to income targets; (iii) long delay in the downstream program implementation plan; the following need immediate attention: (a) coordination between teams implementing the infrastructure, livelihood development, and microcredit components; (b) clarity of options for compensation of loss of riverbank gardens and fish catch; (c) sustainability and transparency of the village microcredit funds; and (d) serious understaffing of the program in relation to its needed scale up.

ADB = Asian Development Bank, BTOR = back-to-office report, EIRR = economic internal rate of return, FIRR = financial internal rate of return, GMS = Greater Mekong Subregion, Lao PDR = Lao People's Democratic Republic, PPAR = project performance audit report, PPR = project performance report, RRP = report and recommendation of the President.

Source: Asian Development Bank database.

## B. Technical Assistance

TA Identification	TA Description	Accomplishments/Status and Issues
<p>1. TA 5643-REG: Subregional Electric Power Forum – GMS</p> <p>TA Type: Core</p> <p>Financing: Norway \$78,000</p> <p>Period: 20 September 1995–31 August 1998</p> <p>Executing Agency: ADB</p>	<p>The RETA aimed to help meet the financial requirements involved in preparing and conducting the forum/meeting. It consisted of (i) preparation of terms of reference for two of three river basin studies, (ii) preparation and organization of the meeting, (iii) conduct of the meeting, and (iv) publication and circulation of the meeting report.</p>	<p>(Financially closed, no TCR found in the database)</p> <p><b>Third Meeting of the Subregional Electric Power Forum:</b> Highlighted the need to address environmental and social issues such as land acquisition and resettlement concerns, concerns of indigenous and ethnic groups, and participation and gender concerns (BTOR, December 1996).</p> <p><b>Fourth Meeting of the Subregional Electric Power Forum:</b> Accomplished (i) establishment of an Experts Group that would focus on promoting cross-border trade in electricity and the attendant requirement of developing a regional power grid; (ii) country reports which have generated better understanding of energy plans and policies among the GMS countries and the major concerns and issues that they are facing (open exchange not possible many years ago); (iii) effort to continuously build on the understanding of environmental and social issues in energy projects and the need for instituting appropriate mitigation measures; and (iv) panel discussion with private sector representatives highlighting the important role of the private sector in energy development and underscoring the need for governments to play a key role in creating the enabling environment for promoting private sector participation (BTOR, November 1997).</p>
<p>2. TA 5697-REG: Se Kong–Se San and Nam</p>	<p>The long-term goal of the RETA is to facilitate economic cooperation among</p>	<p>The TA was regarded as <i>generally successful</i> since the objective was fully met (TCR,</p>

TA Identification	TA Description	Accomplishments/Status and Issues
<p>Theun River Basins Hydropower Development Study</p> <p>TA Type: FS/PP</p> <p>Financing: France \$2.0M; ADB \$500,000</p> <p>Period: 22 August 1996–31 March 2001</p> <p>EA: ADB</p>	<p>the GMS countries by establishing cross-border trade in electricity. The immediate objective was to prepare a regionally optimized, sustainable and environmentally acceptable hydropower development plan for the Se Kong–Se San and Nam Theun rivers in Lao PDR, Viet Nam, and Cambodia. The RETA comprised a review and comparison of potential hydropower projects on these three rivers which are tributaries of the Mekong River.</p>	<p>September 2000).</p> <ul style="list-style-type: none"> <li>• Shortcomings in the TA paper were remedied by including minor changes in the scope related mainly to approval of additional inputs to achieve the various tasks. The revised assignments included a revised load-forecast and implementation plan to take account of the downturn in the growth of regional electricity demand due to the Asian financial crisis.</li> <li>• An anthropologist who spoke many of the native languages was engaged to assist with soliciting the opinions of indigenous peoples.</li> <li>• The change in emphasis by ADB since 1996 on social impacts, participatory processes, indigenous peoples, and cumulative environmental impacts required more resources than allocated.</li> <li>• Major studies like this should have prior small-scale TA or staff consultant time allocated to adequately define the scope and budget.</li> </ul>
<p>3. TA 2926-LAO: Nam Ngum 500 kV Power Transmission</p> <p>TA Type: FS/PP</p> <p>Financing: ADB 580,000; Government \$25,000</p> <p>Period: 28 November 1997–31 December 2002</p> <p>EA: Ministry of Industry and Handicrafts (MIH)</p>	<p>The objectives of the TA were to (i) carry out a feasibility study of developing a 500 kV transmission interconnection between Lao PDR and Thailand to export power from Nam Ngum basin hydropower projects, and (ii) assist the Government of the Lao PDR to select a suitable private sector developer to develop and operate the transmission facilities.</p>	<p><i>Rated successful</i> (TCR, November 2001):</p> <ul style="list-style-type: none"> <li>• TA was successful in identifying the least-cost option for evacuating power output from the Nam Ngum basin.</li> <li>• TA was not successful in identifying a private sector developer to undertake the transmission project. No lessons learned were put forward, since the success or failure of the TA depended on factors outside the control of any of the stakeholders and could have not been foreseen.</li> <li>• The TA design and the terms of reference for consulting services were satisfactory.</li> </ul>
<p>4. TA 3222-VIE: Se San 3 Hydropower Project</p> <p>TA Type: FS/PP</p> <p>Financing: ADB \$998,000 (Japan Special Fund); Government \$250,000</p> <p>Period: 14 July 1999–31 October 2002</p> <p>EA: Electricity of Viet Nam (EVN)</p>	<p>The objective of the TA was to verify that Se San 3 (SS3) was the least-cost development alternative and to prepare the Project as a model hydropower project managed commercially and adopting internationally recommended operational, financial, environmental and social practices. Building on lessons learned from past hydropower development in Viet Nam and the region, best practices were to be incorporated into all aspects of project design to serve as a precedent for future hydropower development in Viet Nam.</p> <p>The TA was implemented in two phases. The first was to analyze various financial and ownership options and, based on analysis, recommend the most suitable structure. The second was to complete technical, environmental, and social analysis of SS3.</p>	<p><i>Rated as generally successful</i>, though not resulting in an investment project (TCR, December 2001):</p> <ul style="list-style-type: none"> <li>• Significant social and environmental issues and risks were identified during the TA, and forward action plans were prepared to provide guidance to the Government for further hydropower development in the Se San River basin. The TA was implemented following a variation of the new business processes, with extensive staff involvement throughout the TA implementation period. Several review missions were conducted and the final review mission was timed to coincide with the loan fact-finding mission. While this approach is preferable from the perspective of project quality, it requires a high level of involvement and commitment of human and financial capital resources by ADB. It also requires significant commitment on the part of the borrower (which this TA had). The TA was also designed under the assumption that previous environmental impact assessment work had been to ADB standards.</li> </ul>

TA Identification	TA Description	Accomplishments/Status and Issues
<p>5. TA 3225-LAO: Analyzing and Negotiating Financing Options for the Nam Leuk Hydropower Project Cost Overruns</p> <p>TA Type: Advisory and Operational</p> <p>ADB Financing: \$140,000</p> <p>Period: 16 July 1999–31 December 2000</p> <p>EA: EdL</p>	<p>This TA intended to cover the costs of analyzing various financing options and assist EdL and the Government of the Lao PDR in negotiating suitable financing to cover cost overruns associated with the Nam Leuk Hydropower Project (Loan 1456).</p>	<p>TPR Rating 29 February 2004: TA objective – satisfactory; implementation progress – partly satisfactory.</p> <p>(Financially closed, no TCR found in the database)</p>
<p>6. TA 5920-REG: Regional Indicative Master Plan on Power Interconnection in the GMS</p> <p>TA Type: Advisory</p> <p>Financing: ADB \$158,000; Norway \$742,000; GMS Governments \$50,000</p> <p>Period: 10 July 2000–30 April 2004</p> <p>EA: ADB</p>	<p>The main objectives of the TA were to (i) update the subregional transmission master plan proposed as part of the 1996 power transmission study, taking into account recent economic changes, ongoing power sector reform in Thailand, and increased viability of the use of natural gas in the subregion; and (ii) harmonize transmission planning, design, and operational practices to promote subregional power trade.</p> <p>The scope included (i) assessing electric power demand and reviewing generation and transmission expansion plans in the GMS and neighboring countries, (ii) updating plans for power grid interconnections on the basis of revised demand and supply projections, (iii) formulating an indicative transmission master plan to promote subregional power trade, and (iv) identifying the institutional and regulatory issues that needed to be addressed to properly implement the plan.</p>	<p>TPR Rating 31 March 2004: TA objective – satisfactory; implementation progress – satisfactory.</p> <p>The TA was completed in May 2002 (a total of five GMS meetings were held during RETA implementation). RETA savings were utilized to duplicate the Final Report as a CD-ROM, which was completed in May 2003, and to support a final GMS meeting held in the PRC in November 2003.</p>
<p>7. TA 4078-CAM: Preparing the Power Distribution and GMS Transmission Project</p> <p>TA Type: FS/PP</p> <p>Financing: ADB \$730,000; Government \$180,000</p> <p>Period: 10 January 2003–31 December 2007</p> <p>EA: EdC/MIME</p>	<p>The TA was to prepare/update feasibility studies designed to facilitate international power transfers and stimulate equitable economic growth across the country to promote sustainable poverty reduction.</p>	<p>TPR Rating August 2007: TA objective – satisfactory; implementation progress – satisfactory</p> <p>Completed. Major outputs include (i) updated feasibility study of a 220 kV transmission line from the Vietnamese border to Phnom Penh, (ii) assessment of the feasibility of providing the villages along the route with low-voltage electricity supply, and (iii) assessment of the feasibility of rehabilitating and expanding the generation and distribution systems in selected provincial towns.</p>

TA Identification	TA Description	Accomplishments/Status and Issues
<p>8. TA 4213-LAO: Preparing the GMS Nam Theun 2 (NT2) Hydropower Development Project</p> <p>TA Type: FS/PP</p> <p>Financing: ADB \$700,000; Government \$60,000</p> <p>Period: 9 November 2003–28 February 2006</p> <p>EA: MIH</p>	<p>The TA was the first phase of the preparatory work for the project. It aimed to (i) prepare the cumulative impact assessment study; (ii) strengthen government institutional capacity to implement hydropower development projects effectively, particularly social and environmental impact mitigations and project management; (iii) build government capacity for effective communication with all stakeholders; (iv) identify a compensatory component for the NT2 Project submergence area; and (v) facilitate coordination with civil society through domestic and international nongovernment organizations.</p>	<p>Completed.</p>
<p>9. TA 4323-LAO: GMS NT2 Hydropower Development Project, Phase II</p> <p>TA Type: FS/PP</p> <p>Financing: ADB \$1 million; Government \$180,000</p> <p>Period: 29 March 2004–30 April 2007</p> <p>EA: MIH</p>	<p>This TA was to assess the macroeconomic impact of the NT2 Project and examine possible effects on sectoral allocations and other funds particularly essential for poverty reduction in the Lao PDR.</p> <p>Objectives: (i) confirm specific aspects of the technical, economic, and financial viability of the proposed project not covered by the World Bank; (ii) ensure that social and environmental impacts were properly identified; (iii) ensure that the mitigation measures were developed in a consultative manner in accordance with good practices and relevant ADB policies and guidelines; and (iv) enable the Government of the Lao PDR to manage complex hydropower development projects in an environmentally and socially sustainable manner in the future.</p>	<p>TPR Rating 31 December 2007: TA objective–satisfactory; implementation progress – satisfactory</p> <p>(Financially closed, no TCR found in the database)</p>
<p>10. TA 6100-REG: Study for a Regional Power Trade Operating Agreement in the GMS</p> <p>TA Type: Advisory</p> <p>Financing: ADB \$850,000; Governments \$70,000</p> <p>Period: 21 April 2003–30 November 2007</p> <p>EA: ADB</p>	<p>The objective of the study was to help GMS members prepare a regional power trade operating agreement, taking into account the IGA and desirable forms of power trade so as to provide reliable and economical supply of electricity to consumers, develop sustainable energy resources, and extend economic cooperation.</p>	<p>The TCR was rated “highly successful” (TCR, December 2007). With the support of the TA, the Focal Group (FG) and the Planning Working Group, which serves as an ad-hoc technical group of the FG, were established to undertake priority activities identified by the GMS countries to develop power trade.</p> <p>The TA final report served as a basis for the Memorandum of Understanding signed by GMS countries in July 2005.</p>
<p>11. TA 6147-REG: Preparing the GMS Power Interconnection Project, Phase I</p> <p>TA Type: FS/PP</p>	<p>The purpose of the RETA was to support the GMS strategy for promoting regional power exchange among members and to extend economic cooperation among Lao PDR, Thailand, and Viet Nam. It was to assist in the preparation of a feasibility</p>	<p>TPR Rating December 2007:TA objective – satisfactory; implementation progress – satisfactory</p> <p>Completed. Final report submitted on 22 June 2007.</p>

TA Identification	TA Description	Accomplishments/Status and Issues
Financing: ADB \$800,000; Governments \$160,000  Period: 12 December 2003–29 February 2008  EA: ADB	study for the proposed 190 km of the 500 kV power transmission line and ancillary facilities between Lao PDR and Viet Nam.	
12. TA 6301-REG: Developing the GMS Energy Sector Strategy (ESS)  TA Type: Advisory  Financing: AFD \$1.2M; Governments \$100,000  Period: 3 January 2006–28 February 2009 (expected)  EA: ADB	The RETA is to develop a regional ESS for 2006–2020 to enhance cooperation among GMS countries to meet rising energy needs and develop a robust regional energy market. Expected outcome of the RETA is the adoption by GMS countries of the strategy.  (Formerly the GMS Energy Sector Strategy Study)	TPR Rating 30 November 2006, 30 April 2008: TA objective – satisfactory; implementation progress – satisfactory  RETA is ongoing. As of 31 October 2008, interim report has been revised based on country-specific information and comments from GMS governments and ADB. RETA completion date was extended up to 28 February 2009. A final workshop was conducted in Bangkok on 5–6 June 2008 and a road map based on the report suggesting actions up until 2012 was presented to the GMS governments for consideration in late November 2008 (TPR, 31 October 2008).
TA 6301-REG: Developing the GMS ESS (Supplementary)  TA Type: Advisory  ADB Financing: \$150,000  Period: 13 November 2007–13 February 2009 (expected)  EA: ADB	This supplementary RETA will be used to engage the services of international and domestic consultants to meet the required inputs needed for the preparation of the final GMS Energy Strategy Report.	Implementation of the GMS ESS is ongoing. The core of the strategy is an energy planning optimization model that examines options and their cost. The modeling work required a lot more resources compared with original estimates, because the strategy-making exercise was carried out in an open and participatory way. The work has also taken much longer to complete, given the need for consultations with governments, civil society, and other development partners at every stage (IN.31-08, 8 February 2008).
13. TA 6304-REG: GMS: Regional Power Trade Coordination and Development  TA Type: Advisory  Financing: ADB \$900,000; Governments \$100,000  Period: 16 January 2006–30 June 2009 (expected)  EA: ADB	RETA objectives: (i) develop a holistic and integrated action plan on regional power trade development; (ii) create adequate institutions to undertake the tasks associated with the implementation of regional power trade in the initial stages; (iii) assist GMS member countries in capacity building and human resource development relating to regional power trade and cooperation; and (iv) develop a database for information exchange and a mechanism for communication among GMS power agencies to facilitate regional power trade.  The TA target outputs were intended to help GMS countries strengthen their capacity to promote regional power trade development market.	TPR Rating 30 Nov 2006: TA objective – highly satisfactory; implementation progress – satisfactory  Project is ongoing.  The Fifth Focal Group Meeting and Fourth Planning Working Group (PWG) Meeting of the Regional Power Trade Coordination Committee were held on 21 November 2007 in Viet Nam and discussed the following (BTOR, November 2007): <ul style="list-style-type: none"> <li>• <b>Priority PWG studies</b> (performance standards, transmission regulation, training, and programs). These studies are to assist the GMS countries in ensuring system stability and quality of transmission when interconnecting with another GMS country networks. (i) Consultants were asked to prepare a work and financial plan on PWG members' suggestion to draft preliminary performance standards for each of the GMS countries and have these standards validated at a workshop. (ii) Transmission regulation study</li> </ul>

TA Identification	TA Description	Accomplishments/Status and Issues
		<p>has to be deferred as PWG members wanted to prioritize the preparation of performance standards. (iii) Training was conducted for PWG members in generation and transmission planning, electricity markets and cross-border trading, and electricity regulations.</p> <ul style="list-style-type: none"> <li>• <b>Regional Power Database/Website.</b> This has been completed, and a demonstration on how information can be accessed was conducted. The GMS countries have undergone the necessary training and the database was formally launched in the website prior to the GMS Summit in 2008.</li> <li>• <b>Indicative Regional Power Master Plan.</b> The current draft indicative regional power master plan looks at potential generation and transmission interconnections until 2035 and includes comments of members on the draft.</li> <li>• <b>MOU on Roadmap for Cross-Border Power Trade.</b> The MOU was circulated to all GMS countries and development partners for comment, and a final review meeting will be held on 14 December 2007. The MOU was signed at the GMS Summit in March 2008.</li> </ul>
<p>14. TA 4816-LAO: GMS: Northern Power Transmission Project</p> <p>TA Type: FS/PP</p> <p>Financing: ADB \$800,000; Government \$150,000</p> <p>Period: 19 July 2006–31 July 2009 (expected)</p> <p>EA: EdL</p>	<p>The TA's objective was to come up with a feasibility study and project design agreed to by ADB and the Government of the Lao PDR. The study was to formulate a project that is economically, financially, and technically feasible as well as socially and environmentally acceptable to (i) extend the transmission and distribution facilities in northern Lao PDR, and (ii) strengthen power interconnections with Thailand.</p>	<p>Work on the RETA commenced on 23 October 2006, and the consultants submitted an advance copy of the draft final report (ADFR) on 23 May 2007. ADB, EdL, and the Ministry of Energy and Mines (MEM) commented on the report and discussed the financial and economic analysis and the project concept in a tripartite meeting held in July 2007. The consultants were expected to complete the financial and economic analysis of the Project and provide ADB with the revised ADFR in September 2007. However, the consultants found that EdL's draft power development plan (PDP) was being revised and could not be used for the study. Therefore, the consultants, ADB, EdL, and MEM agreed that the consultants would develop the study based on the newly approved PDP. EdL's Board approved the PDP in principle on 8 February 2008. EdL agreed to submit the PDP's English translation by 29 February 2008 to the consultants and ADB. The consultants would then revise the study's financial and economic analysis and power flow studies (power flow analysis, short-circuit calculation, fault current analysis, and stability analysis), and provide ADB with the revised ADFR by 21 April 2008.</p> <p>The draft final report was submitted on 23 July 2008. A workshop and tripartite meeting was held in Vientiane in September 2008 to discuss the draft final report.</p>

TA Identification	TA Description	Accomplishments/Status and Issues
<p>15. TA 7026-LAO: Na Bong–Udon Thani Power Transmission (Lao PDR)</p> <p>TA Type: Advisory Financing: ADB \$760,000; Governments \$150,000</p> <p>Period: 12 December 2007–30 March 2009 (expected)</p> <p>EA: MEM</p>	<p>TA objectives: To promote economic growth of the country and the region by helping the Lao PDR develop its hydroelectric resource in an environmentally and socially sustainable manner. It is also expected to promote power trade in the GMS.</p>	<p>TPR Rating 31 May 2008: TA objective – satisfactory; implementation progress –satisfactory</p> <p>Project is ongoing.</p> <p>Notice to proceed was issued on 13 February 2008, and the consultants were mobilized after. By mid-March 2008, office facilities were established and a list of required equipment canvassed for procurement. The draft inception report was circulated on 20 March 2008 in preparation for the 27 March 2008 Tripartite Meeting.</p>
<p>16. TA 6440-REG: Facilitating Regional Power Trading and Environmentally Sustainable Development of Electricity Infrastructure in the GMS</p> <p>TA Type: Advisory</p> <p>Financed by the Government of Sweden: \$5 million, GMS Governments \$500,000</p> <p>Period: 19 December 2007–31 August 2010 (expected)</p> <p>EA: ADB</p>	<p>RETA objectives: (i) to establish a competitive and efficient regional power market, and (ii) to ensure proper control of environmental impacts while developing power projects for regional power interconnection and trading. The RETA focuses on developing institutions and building capacity to match the expansion of physical infrastructure for a competitive GMS regional power market. It has two components: (i) facilitating the development of regional power trade, and (ii) capacity development for managing environmental impacts of power projects. Training and workshops will be organized for capacity development under both components, to be hosted by the GMS countries.</p>	<p>TPR Rating 31 December 2007: TA objective – satisfactory; implementation progress –satisfactory</p> <p>Project is ongoing.</p>

ADB = Asian Development Bank; BTOR = back-to-office report; EA = executing agency; EdC = Electricité du Cambodge; EdL = Electricité du Laos; FS = feasibility study, GMS = Greater Mekong Subregion; IGA = Intergovernmental Agreement, km = kilometer; kV – kilovolt; Lao PDR = Lao People's Democratic Republic; MIME = Ministry of Industry, Mines and Energy, Cambodia; MOU – memorandum of understanding; PP = project preparatory; PRC = People's Republic of China; RETA = regional technical assistance; TA = technical assistance; TCR = technical assistance completion report; TPR = technical assistance performance report.

Source: Asian Development Bank database.

## OTHER AGENCIES' STRATEGIES AND PLANS

Item	World Bank Group	Bilateral Agencies
<b>Regional/GMS</b>	<p>The World Bank (WB) has supported the Greater Mekong Subregion (GMS) Power Forum and its associated Experts Group through economic and power sector work since 1997. This resulted in the Intergovernmental Agreement (IGA) on Regional Power Trade signed by GMS countries in 2002. The IGA has the following objectives: (i) cost minimization in planning and operation of power systems while maintaining adequate reliability, (ii) full cost recovery and equitable sharing of benefits of investments, and (iii) provision of reliable and economic electricity to all.</p> <p>Currently, WB along with the Asian Development Bank (ADB) and other bilateral agencies support the Regional Power Trade Coordinating Committee (RPTCC) established in 2002 to guide GMS power trading and market development. Since then, the RPTCC has had five meetings and has so far (i) reviewed the GMS energy cooperation activities, (ii) started implementing its work plan, and (iii) agreed to conduct a study on an integrated regional master plan for power development in the GMS.</p> <p>WB adopts a two-pronged approach in supporting the GMS power trade: (A) policy/institutional support, and (B) investment support.</p> <ul style="list-style-type: none"> <li>• Under (A), WB is currently providing independent advice and relevant technical assistance (TA) to the RPTCC on (a) developing good practice guidelines for regional bilateral arrangements power purchase agreements (PPAs), (b) developing principles regarding ownership, benefits estimation, and benefits sharing of transboundary transmission lines, (c) supporting the power sector in individual countries—in power sector reforms, regulatory arrangements and operation of electricity companies on commercial principles, and in preparing national power development plans; and (d) providing key technical inputs toward fostering a culture of regional planning and subsequently developing the terms of reference for a master plan study, feasibility study of interconnection for bulk power transfers from People's Republic of China (PRC) to Thailand, and grid-to-grid interconnection of the China Southern Power Grid (CSG) and Viet Nam, and (e) development along with ADB of a GMS market road map.</li> <li>• Under (B), WB is exploring possibilities for cofinancing with other international and regional financial institutions, bilateral agencies, and commercial banks. WB investments in GMS countries have potential for the following areas: (i) in-country high-voltage (HV) and extra high-voltage (EHV) transmission infrastructure, particularly that devoted to enhancing power exports/imports,</li> </ul>	<p>The Japan International Cooperation Agency (JICA) is engaged in cooperation with countries, particularly in the Association of Southeast Asian Nations (ASEAN) region, in accordance with the degree of development of individual countries. The four pillars of JICA's assistance for regional issues common to all ASEAN countries are (i) promotion of growth led by the private sector and for strengthening international competitiveness, (ii) correction of intraregional disparities, (iii) poverty reduction, and (iv) measures against terrorism and piracy. JICA's technical cooperation program for the energy sector in ASEAN countries including GMS (particularly Cambodia and Viet Nam) includes "software components"/studies leading to the preparation of energy master plans (see related entries below).</p> <p>The Japan Bank for International Cooperation assists with clean energy and energy efficiency; infrastructure projects.</p> <p>The French and Swedish development agencies—Agence Française de Développement and Swedish International Development Cooperation Agency (SIDA), respectively—support the RPTCC and have committed/provided funds for RPTCC activities.</p> <p>The SIDA assists with environmentally sustainable development of electricity infrastructure, power trade, and TA for the RPTCC.</p> <p>The German Technical Cooperation Agency (GTZ) operates in the following GMS countries Cambodia, PRC, Thailand, and Viet Nam. In these countries, GTZ is mainly into the provision of technical and funding assistance in the areas of rural development, economic reform and development of the market system, health, family planning and HIV/AIDS. GTZ has an energy-related project in Thailand (see below).</p> <p>The Norway/Norwegian Agency for International Cooperation provides assistance to the gas and oil sector.</p> <p>Netherlands Development Organization (SNV) is into projects that explicitly link access to renewable energy to basic services. SNV's focus is on domestic biogas, and it has experience in watermills and biofuels. It has biogas projects in four Asian countries including Cambodia and Viet Nam.</p>

Item	World Bank Group	Bilateral Agencies
	<p>respectively, (ii) regional bulk power transmission systems (e.g., PRC-Thailand and Thailand-Viet Nam), (iii) cross-border power trades for serving remote border areas, (iv) economically, environmentally and socially sustainable hydropower including feasibility studies and subsequent financing, and (v) loan dispatch centers.</p>	
<b>Cambodia</b>	<p>WB has (i) assisted Cambodia in preparing its energy strategy and power development plan, (ii) explored possibilities of cofinancing and investment in in-country transmission infrastructure and hydropower, and (iii) played a lead role in the design and implementation of load dispatch centers.</p> <p>WB supports the country's Rural Electrification and Transmission Project, which aims to (i) improve power sector efficiency and reliability; (ii) improve standards of living and foster economic growth in rural areas; and (iii) strengthen electricity institutions, the regulatory framework, and the enabling environment for sector commercialization and privatization. The transmission line component comprises the construction of a double-circuit 220 kilovolt (kV) line from the border with Viet Nam to Phnom Penh, and two associated substations; reinforcement of the grid around Phnom Penh, which involves lines and modifications to three substations and 22 kV extension; establishment of a National Control Center to optimize load dispatch operations and increase system security; and, building the capacity of the Electricité du Cambodge (EdC) in project management, land acquisition, resettlement, and environmental monitoring and mitigation. The rural electrification component supports EdC's grid extension program, covering medium- and low-voltage lines and electrification for rural households. The pilot Rural Electrification Fund (REF) component aims at implementing an innovative mini, and off-grid electrification program, as a transparent institutional mechanism for promoting rural electrification. The REF will assist private sector developers in providing new connections, make electricity available to households using solar home systems, and add mini-hydro, and micro-hydro capacity.</p>	<p>JICA funded the Master Plan Study on Hydropower Development in Cambodia. The Study aims at thorough investigation and prioritization of potential hydropower sites in Cambodia, and preparation of the Hydropower Development Master Plan, which will articulate development plans of selected hydropower projects within the framework of the Energy Sector Development Strategy for the period of 20 years.</p> <p>The National Biodigester Program is a joint program between the Cambodia Ministry of Agriculture, Forestry, and Fisheries (MAFF) and SNV. The current pilot phase runs from 2005 until December 2009, covering provinces with a very good biodigester potential. The overall objective of the first phase of the program is the dissemination of domestic biodigesters as an indigenous, sustainable energy source through the development of a commercial, market-oriented biodigester sector in selected provinces of Cambodia. MAFF's Department of Animal Health and Production is the advisory and coordinating agency for the program, SNV provides TA to the program; and the Directorate General for International Cooperation of the Dutch Ministry of Foreign Affairs provides financial assistance in the framework of the Asia Biogas Program. If the results are satisfactory, the program can be extended to all provinces in a second phase.</p> <p>The Electricity Generating Authority of Thailand (EGAT) has assisted Cambodia with its power development plans.</p>
<b>People's Republic of China (PRC) (Yunnan Province and Guangxi Zhuang Autonomous Region)</b>	<p>WB is providing technical inputs for a feasibility study for grid-to-grid interconnection of China Southern Power Grid, Ltd. (CSG) with Viet Nam.</p> <p>The China Energy Efficiency Financing Project was approved in May 2008 financed through on International Bank for Reconstruction and Development loan (\$200 million) and a Global Environment Facility grant (\$13.5 million). The Project aims to improve the energy efficiency of medium- and large-sized industrial enterprises in the PRC, and thereby reduce their adverse environmental impacts on climate. The Project has four components: (i) promotion of energy efficiency financing which supports the preparation and</p>	

Item	World Bank Group	Bilateral Agencies
	<p>implementation of two or three industrial energy conservation projects; (ii) energy conservation investment lending; (iii) national policy support and capacity building to strengthen the government's capabilities to implement industrial energy efficiency policies and programs; and (iv) project implementation support, monitoring, and reporting.</p>	
<p><b>Lao People's Democratic Republic (Lao PDR)</b></p>	<p>WB is (i) providing assistance to the Lao PDR in preparing a power import-export strategy, (ii) exploring possibilities of cofinancing and investment in in-country transmission infrastructure and hydropower (past WB support has resulted in the creation of a master plan for power development in the Lao PDR); and (iii) soon to play a lead role in the design and implementation of load dispatch centers.</p> <p>WB has three active loan projects in the Lao PDR: (i) GMS-Power Trade Project, (ii) Rural Electrification Project, and (iii) Nam Theun 2 Hydroelectric (NT2) Project.</p> <ul style="list-style-type: none"> <li>• The GMS Power Trade Project has three immediate development objectives: (i) to bring affordable grid-based electricity to Cambodia's provinces of Kampong Cham and Stung Treng, through import of power from Lao PDR and Viet Nam; (ii) to supply affordable grid-based electricity to the province of Saravan in the Lao PDR in the near term while establishing a portion of a transmission link that would in the medium term help interconnect Cambodia and Thailand through southern Lao PDR to increase power trade among them; and (iii) to help establish load dispatching facilities and capabilities in Lao PDR, that would enable it to optimize its system operation and facilitate its participation in regional trade.</li> <li>• The Rural Electrification Project aims to (i) increase access to electricity of rural households in villages of targeted provinces, and (ii) improve financial performance of the power sector. There are two components: the first component will extend electrification to about 42,000 rural households through connection to the grid of Electricité du Laos, and the second component provide electrification to about 10,000 households through off-grid technologies.</li> <li>• The NT2 Project seeks to generate revenues through the environmentally and socially sustainable development of NT2's hydropower potential. The project includes (i) installation of a hydropower facility that will provide 995 megawatts (MW) of power for export to Thailand, and an additional 75 MW for domestic use; (ii) management of environmental and social impacts on the Nakai Plateau, in the NT2 watershed, and in the downstream areas of the Nam Theun and Xe Bang Fai rivers; and (iii) monitoring and evaluation arrangements designed to meet sound engineering practices, fiduciary responsibilities, and the respective oversight requirements of the various financial institutions.</li> </ul>	<p>The CSG has assisted the Lao PDR in preparing power development plans.</p>

Item	World Bank Group	Bilateral Agencies
<b>Myanmar</b>	<i>No WB operations</i>	<p>The CSG has assisted Myanmar in preparing power development plans.</p> <p>EGAT has assisted Myanmar in developing a hydropower master plan for the Salween River (20,000 MW).</p>
<b>Thailand</b>	<p>WB provides assistance to EGAT under the <i>EGAT - Investment Program Support Project</i> which aims to (i) help EGAT meet its essential investment commitments on generation and transmission projects whose implementation has already been under way; (ii) help EGAT not lose ground in accomplishing its organizational restructuring and corporatization, and implementing its privatization strategy; and (iii) help improve the regulatory framework for the energy sector. The overall project includes four generation projects and four transmission systems as follows: (i) Krabi Thermal Power Plant Unit 1; (ii) Ratchaburi Power Plant Project; (iii) Wang Noi Combined Cycle Power Station, Stage II; (iv) 500kV Transmission System for Independent Power Producers and Hong Sa Project in Laos; (v) bulk power supply for greater Bangkok; (vi) EGAT–TNB Stage II interconnection; (vii) Transmission System Expansion Project no. 9; and (viii) restructuring, corporatization, and privatization of EGAT. The project will also reform the regulatory system for the energy sector including formulation of corporate policy for environmental and social management; and strengthening EGAT's environmental management function.</p>	<p>The Thai-German Program for Enterprise Competitiveness: Eco-Efficiency Component. This program, supported by GTZ, is aimed at enhancing the competitiveness of Thai small and medium enterprises (SMEs) in a number of selected sectors. It has two components: (i) Improving the Access of SMEs to Business and Financial Services, and (ii) stimulating the Eco-Efficiency of Industry. A subcomponent of the program is the Energy and Eco-Efficiency in Agro-Industry (E3Agro) Project, which aims to strengthen the competitiveness of Thai agroindustry through the implementation of cost-effective production process technologies and professional management techniques. It promotes the efficient use of energy and the improvement of biomass utilization for energy production.</p>
<b>Viet Nam</b>	<p>WB is (i) providing technical inputs for a feasibility study for grid-to-grid interconnection of Viet Nam with CSG, (ii) exploring possibilities of cofinancing and investment in in-country transmission infrastructure in the country, and (iii) playing a lead role in the design and implementation of load dispatch centers.</p> <p>WB energy projects currently in operation in Viet Nam are:</p> <ul style="list-style-type: none"> <li>• Rural Distribution Project - aims to improve the reliability and quality of medium-voltage service to targeted retail electricity distribution systems. It entails rehabilitating and strengthening rural distribution networks in 15 provinces in northern Viet Nam; 20 provinces in the Southern Region, the Central Region, including Hai Phong City, and Hai Duong; and Dong Nai Province in the Southern Region. There is also a component that supports the corporate development of selected participating power companies.</li> <li>• Second Rural Energy Project - aims to improve access to good quality, affordable electricity services in rural communities in an efficient and sustainable manner to support Viet Nam's efforts toward socioeconomic development through (i) upgrading and/or expanding of the low voltage system in the rural power network in 1,200 communes,</li> </ul>	<p>The JICA-assisted Study on National Energy Master Plan in Viet Nam covers (i) establishment of a national Energy Master Plan up to 2025 including energy security, energy diversity, power import-export, rural electrification, promotion of renewable energy utilization, carbon dioxide emission, energy conservation, investment plan, socio environmental impacts, and international cooperation; and (ii) establishment of the national energy database of Viet Nam including socioeconomic data and energy data covering electric power, coal, oil and gas, renewable energy, etc. JICA also has technical cooperation projects with the Viet Nam Development Plan Training Center for Electric Power (Hanoi and North Viet Nam) Sector (September 2007–August 2009).</p> <p>SNV supports the Biogas Program for the Animal Husbandry Sector in Viet Nam. This program aims to (i) exploit effectively biogas technology and develop a commercial viable biogas sector in Viet Nam; and (ii) contribute to rural development and environmental protection via provision of clean and affordable energy to rural households, improvement of community sanitation and rural people's health, creation of</p>

Item	World Bank Group	Bilateral Agencies
	<p>(ii) rehabilitating the medium voltage systems in the same project communes, (iii) developing and implementation of a framework for regulation of companies and cooperatives and building the capacity of national and provincial authorities in planning and regulation of rural electrification, (iv) transforming local distribution utilities (LDUs) into legal entities, (v) strengthening the abilities of the LDUs; and (vi) replicating of the best practices developed in other LDUs.</p> <ul style="list-style-type: none"> <li>• Second Transmission and Distribution Project - is the efficient development of Viet Nam's transmission distribution system. The project consists of (i) building new, or reinforcing existing, 500, 220, and 110kV transmission and distribution lines and substations; (ii) supply and installation of a supervisory control and data acquisition and energy management system for the national load dispatch center; (iii) support to Electricity of Vietnam (EVN) to develop its transmission business as a separate entity, and establishment of an internal power market.</li> <li>• Demand-Side Management and Energy Efficiency Project - aims to (i) develop and expand demand-side management business programs and test new market transformation efforts within EVN, and (ii) develop sustainable business models and mechanisms to support energy efficiency retrofit investments in commercial and industrial facilities.</li> <li>• System Efficiency Improvement, Equitization, and Renewables Project - The objective of the Project is to improve the overall efficiency of power system services, particularly to the poor in rural areas, by optimizing the transmission systems, and upgrading subtransmissions, and medium voltage distribution lines for rural electrification. Power system efficiency will be improved by upgrading the 500 kV and 200 kV transmission networks and associated substations. Rural electricity access will be improved by upgrading, and strengthening the 110 kV subtransmission line and substations, restoring five existing hydropower plants, constructing a small-scale hybrid wind-diesel power plant at Phu Quoc Island, and piloting 20 community-based hybrid renewable-energy grids. Sector reform and institutional development will be pursued through improvements in the management information system, the creation of one District, and several commune-level joint-stock distribution companies; and by strengthening the regulation, planning, and implementation capacity for renewable electricity.</li> </ul>	<p>jobs for rural labor, and reduction of greenhouse gas emission. Project period: 2003–2010.</p>

ASEAN = Association of Southeast Asian Nation, CSG = China Southern Power Grid, EHV = extra high-voltage, GMS = greater Mekong subregion, GTZ = German Technical Cooperation, HV = in-country high-voltage, IGA = Intergovernmental Agreement, JICA = Japan International Cooperation Agency, PPA = power purchase agreement, PRC = People's Republic of China, RPTCC = Regional Power Trade Coordinating Committee, TA = technical assistance, SNV = Netherlands Development Organization. WB = World Bank.

Sources: World Bank. 2007. *World Bank Strategy in the Greater Mekong Subregion for Supporting Development of Power Trade* (Draft August 2007). East Asia and Pacific Region. World Bank Group website <http://web.worldbank.org/WBSITE/EXTERNAL/PROJECTS/>; JICA: <http://www.jica.go.jp/>; GTZ <http://www.gtz.de/>; SNV: <http://www.snvworld.org/en/ourwork/Pages/energy.aspx>; and SNV: program websites <http://www.biogas.org.vn/Web/Default.aspx>; <http://www.nbp.org.kh/>; also searched JBIC, AusAid, FDC, ASEAN Cooperation, GVEP, EC, USAID websites.

## REASSESSMENT OF FINANCIAL AND ECONOMIC INTERNAL RATES OF RETURN AND ASSESSMENT OF BENEFIT DISTRIBUTION FOR COMPLETED GMS ENERGY PROJECTS

1. The financial and economic analyses of the Theun–Hinboun and Nam Leuk hydropower projects in the Lao People’s Democratic Republic (Lao PDR) follow the model adopted in their respective project performance audit reports (PPARs). The reestimation of the financial internal rates of return (FIRRs) and the economic internal rates of return (EIRRs) was carried out on an incremental basis. All prices and costs are expressed in first quarter 2008 constant values and expressed in US dollars. The World Bank unit value manufacturing index was used as a proxy for world price movements and was used to convert all prices to a 2008 base. The FIRRs were evaluated by comparing revenues and costs during the assumed economic life of the projects. For power sales in the domestic market, actual average domestic tariffs were used until 2008. Domestic tariffs were held constant at 2008 levels from 2009 onward. The exchange rate for the first quarter of 2008 was 8,900 Lao kip per US\$. The main parameters used in the analysis for the two reports are discussed below.

### A. Theun–Hinboun Hydropower Project

2. The project’s investment cost (total project costs without interest during construction and loan service charges) was established at \$240 million in current prices. The economic cost is \$271 million at constant 2008 prices. The project was assumed to have an economic life of 25 years from 1998, the time it started operations, and depreciation was applied on a straight-line basis. This is the same assumption that was made in the PPAR and the project completion report (PCR), although, based on the actual state of the facilities during the Operations Evaluation Mission, this estimate appears to be very conservative. All data used until the first quarter of 2008 are actual data.

3. Royalty payments to the Government are assumed at 5% of revenue, while taxes are assumed at 15% of revenue from 2009. Actual tax payments were used from 2005 to 2008. The energy generated is assumed to remain at the 2008 level until 2010, when Nam Theun 2 (NT2) Hydroelectric Project is expected to become operational.

4. The current power purchase agreement (PPA) between the Theun–Hinboun Power Company Limited, the state-private joint venture that is responsible for operating the power plant, and the Electricity Generating Authority of Thailand (EGAT) is based on the take-or-pay principle and has a term of 25 years (up to 2023) with an option for tariff negotiations. Actual tariffs are used until 2008. The PPA stipulates that the tariff determined in US dollars can escalate by only 1% per annum during the first 10 years of operation, and in the 11th year, if the parties cannot agree on any modification, the tariff will continue to escalate at 1% per annum. On this basis, the US dollar tariff was escalated by 1% in this estimation. In 2008, the PPA was renegotiated, and a new PPA was agreed upon that will have a term of 27 years, starting in 2012 and ending in 2038. The start date of the new PPA is coordinated with the expected completion of the Theun–Hinboun expansion project.<sup>1</sup> The tariff projections and underlying assumptions do not reflect the renegotiated PPA due to unavailability of relevant data.

### 1. Financial Analysis

5. The project’s original financing structure is shown in Table A6.1. Equity of \$110.0 million came from investments by Electricité du Laos (EdL), Nordic Hydropower, and MDX Lao Public Co. Ltd. (MDX). Part of EdL’s equity (\$51.1 million) was sourced from the Asian Development

<sup>1</sup> THPC plans to invest an additional \$500 million to increase its electric power generating capacity. The expansion will include a dam and reservoir on the Nam Gneuang River, installing a 60-megawatt (MW) powerhouse near the upstream dam, and adding a 220-MW generator at the current powerhouse site. The expansion of the facilities will increase power generation capacity up to 500 MW from the current level of 210 MW. The construction is expected to be completed before 2012. In undertaking the reassessment, we have not taken into account either the costs associated with the extension project, nor any of the expected benefits from the increased power generation.

Bank (ADB) by the government and onlent to EdL at 6.21% with a grace period of 5 years and a repayment period of 25 years. The government loan from ADB of \$6.6 million was onlent to the Theun–Hinboun Power Company Limited at an interest rate of 10% and a repayment period of 16 years, including a grace period of 4 years. All funds sourced from ADB were from the Asian Development Fund.

**Table A6.1: Sources of Financing for Theun–Hinboun Hydropower Project**

Source	Amount (\$ million)
<b>Equity</b>	
Electricité du Laos	66.0
Nordic Hydropower <sup>a</sup>	22.0
MDX Lao Public Co. Ltd. <sup>b</sup>	22.0
<b>Subtotal</b>	<b>110.0</b>
<b>Debt</b>	
Government <sup>c</sup>	6.6
Commercial Loan	56.2
Export Credit	67.4
<b>Subtotal</b>	<b>130.2</b>

<sup>a</sup> Owned by Statkraft SF, Norway and Vattenfall AB, Sweden, which operates the Theun–Hinboun Power Plant.

<sup>b</sup> Foreign company based in Thailand.

<sup>c</sup> Loan from Asian Development Bank.

Source: Asian Development Bank. 2000. *Project Completion Report on the Theun–Hinboun Hydropower Project*. Manila.

6. The FIRR for the project is recalculated to be 21.7% (Table A6.2) and compares very well with the weighted average cost of capital computed at 4.8%. The higher return to the project is due principally to a guaranteed long-run export price and access to relatively low-cost loans to cover EdL's equity contribution. The FIRR appears better than at appraisal and in the PPAR, largely because of the impact of adjusting to 2008 prices, since the long-run contract price rises faster than the unit value manufacturing index and, hence, dollar revenues rise in real terms in the calculation. Table A6.3 presents the FIRR in detail.

**Table A6.2: Theun–Hinboun Hydropower Project  
Financial Internal Rates of Return, %**

RRP	PCR	PPAR	SAPE
18.7	19.5	17.0	21.7

PCR = project completion report, PPAR = project performance audit report, RRP = report and recommendation of the President, SAPE = sector assistance program evaluation.

Sources: Theun–Hinboun Hydropower RRP, PCR, PPAR, and Operations Evaluation Mission estimates.

7. To determine the distribution of financial benefits to the different investors in the project, the return to total capital is disaggregated into returns to the different groups with equity in the project and computed as the difference between the discounted value of their equity investments and the discounted value of dividends they receive. For purposes of the base case scenario in the distribution analysis, it was assumed that gains to MDX will be repatriated to Thailand, where the firm is based. The benefits remain in the Greater Mekong Subregion (GMS) but leave the Lao PDR. It is further assumed that the other foreign shareholder, Nordic Hydropower, repatriates 100% of its return to capital back to home country which is outside the GMS. Of the total financial net present value (NPV) at 12% of \$143.75 million, the bulk goes to EdL and Nordic Hydropower, which are both recipients of government loans and hence gain proportionately more than MDX. The project lenders are shown to have close to zero net gains, as their loans are at a 12% interest rate and returns net out when a 12% discount rate is used to compare the present value of the loan and that of loan repayments. The estimated returns to the different groups are presented in Table A6.4. Gains that accrue to the Government of the Lao PDR come from royalties and taxes net of the difference between the present value of the ADB loan and the present value of loan payments or what would be tantamount to a loan subsidy.

**Table A6.3: Financial Internal Rate of Return**  
**Theun–Hinboun Hydropower Project** (\$ million; 2008 constant prices)

Year	Electricity Sales (GWh)			Costs			Sales Revenue	Net Cash Flow
	Export	Domestic	Total	Capital	O&M	Total		
1994				16.5		16.5	0.0	(16.5)
1995				27.2		27.2	0.0	(27.2)
1996				84.9		84.9	0.0	(84.9)
1997				91.7		91.7	0.0	(91.7)
1998	1,048	1	1,048	50.6	2.5	53.1	52.3	(0.8)
1999	1,444	1	1,445		3.6	3.6	75.3	71.7
2000	1,488	1	1,489		3.2	3.2	77.8	74.6
2001	1,532	1	1,533		3.4	3.4	79.7	76.3
2002	1,456	1	1,457		0.2	0.2	78.3	78.1
2003	1,431	5	1,436		0.2	0.2	73.5	73.3
2004	1,527	6	1,533		2.7	2.7	75.0	72.3
2005	1,360	8	1,368		2.7	2.7	67.2	64.4
2006	1,495	10	1,505		2.6	2.6	74.6	72.0
2007	1,564	11	1,576		2.2	2.2	78.6	76.3
2008	1,364	12	1,376		2.6	2.6	66.7	64.1
2009	1,364	12	1,376		2.6	2.6	66.9	64.3
2010	1,166	14	1,180		2.6	2.6	57.2	54.6
2011	1,086	15	1,101		2.6	2.6	53.7	51.1
2012	1,086	15	1,101		2.6	2.6	54.0	51.4
2013	1,086	15	1,101		2.6	2.6	54.2	51.6
2014	1,086	15	1,101		2.6	2.6	54.4	51.8
2015	1,086	15	1,101		2.6	2.6	54.7	52.0
2016	1,086	15	1,101		2.6	2.6	54.9	52.3
2017	1,086	15	1,101		2.6	2.6	55.2	52.6
2018	1,086	15	1,101		2.6	2.6	55.5	52.8
2019	1,086	15	1,101		2.6	2.6	55.7	53.1
2020	1,086	15	1,101		2.6	2.6	56.0	53.4
2021	1,086	15	1,101		2.6	2.6	56.5	53.9
2022	1,086	15	1,101		2.6	2.6	57.0	54.4
							<b>FIRR =</b>	<b>21.7%</b>
							<b>WACC =</b>	<b>4.8%</b>

FIRR = financial internal rate of return, GWh = gigawatt-hour, O&M = operation and maintenance, WACC = weighted average cost of capital.

Source: Operations Evaluation Mission estimates.

**Table A6.4: Returns to Different Groups in the Theun–Hinboun Hydropower Project**  
(net present value in \$ million at 12% discount rate)

Group	Financial Returns	Distribution of Returns to		
		GMS	Lao PDR	Thailand
Electricité du Laos <sup>a</sup>	90.66	90.66	90.66	
Nordic Hydropower <sup>b</sup>	32.03			
MDX Lao Public Co Ltd <sup>c</sup>	9.62	9.62		9.62
Government <sup>d</sup> of which:	10.18	10.18	10.18	
ADB Loan	(26.36)	(26.36)	(26.36)	
Taxes and Royalties	36.54	36.54	36.54	
Export Credit	0.62			
Commercial Lenders <sup>e</sup>	0.62			
<b>Total</b>	<b>143.75</b>	<b>110.46</b>	<b>100.84</b>	<b>9.62</b>
FIRR (%)	21.70	24.60	28.00	16.30

ADB = Asian Development Bank, GMS = Greater Mekong Subregion, FIRR = financial internal rate of return, Lao PDR = People's Democratic Republic, NPV = net present value.

<sup>a</sup> Electricité du Laos gains 60% of dividends plus the subsidy from the ADB loan, which is onlent from the Government to cover its equity.

<sup>b</sup> Nordic Hydropower gains the difference between the present value of its equity and the present value of dividends. These are treated as extraregional benefits.

<sup>c</sup> MDX Lao Public Co. Ltd. (MDX) gains the difference between the present value of its equity and the present value of dividends. MDX is a Thai-owned company, and its income is treated as a regional benefit.

<sup>d</sup> The Government gains the present value of taxes and royalties and loses the difference between the present value of the ADB loan and the present value of loan repayments (that is, the loan subsidy).

<sup>e</sup> Lenders gain the difference between the present value of the loan and the present value of repayments. These are treated as extraregional benefits. However as the interest rate applied is 12%, the discounted value is close to zero.

Source: Operations Evaluation Mission estimates.

## 2. Economic Analysis

8. **Project-Level Estimation.** The reestimated project-specific EIRR for Theun–Hinboun is 21.8%, confirming earlier estimates at postevaluation, project completion, and appraisal that the EIRR estimate is above the economic discount rate of 12% (Table A6.5) and is considered efficient. This estimate looked at the results from the perspective of the Lao PDR alone. Details are in Table A6.6.

**Table A6.5: Comparative EIRRs of Completed Energy Projects, Theun–Hinboun Hydropower Project, %**

RRP	PCR	PPAR	SAPE
23.6	30.8	18.5	21.8

EIRR = economic internal rate of return, PCR = project completion report, PPAR = project performance audit report, SAPE = sector assistance program evaluation, RRP = report and recommendation of the President.

Sources: Theun–Hinboun Hydropower Project RRP, PCR, PPAR, and Operations Evaluation Mission estimates.

**Table A6.6: Project-Specific Economic Internal Rate of Return Theun–Hinboun Hydropower Project (\$ million; 2008 constant prices)**

Year	Electricity Sales (GWh)			Costs			Sales Revenue	Economic Benefits	Net Benefits
	Export	Domestic	Total	Capital	O&M	Total			
1994				16.5		16.5	0.0	0.0	(16.5)
1995				27.2		27.2	0.0	0.0	(27.2)
1996				84.7		84.7	0.0	0.0	(84.7)
1997				91.5		91.5	0.0	0.0	(91.5)
1998	1,048	1	1,048	50.6	2.5	53.1	52.3	0.1	(0.7)
1999	1,444	1	1,445		3.6	3.6	75.3	0.1	71.8
2000	1,488	1	1,489		3.2	3.2	77.8	0.1	74.7
2001	1,532	1	1,533		3.4	3.4	79.7	0.1	76.4
2002	1,456	1	1,457		0.2	0.2	78.3	0.1	78.2
2003	1,431	5	1,436		0.2	0.2	73.5	0.4	73.7
2004	1,527	6	1,533		2.7	2.7	75.0	0.5	72.7
2005	1,360	8	1,368		2.7	2.7	67.2	0.6	65.0
2006	1,495	10	1,505		2.6	2.6	74.6	0.7	72.8
2007	1,564	11	1,576		2.2	2.2	78.6	0.8	77.1
2008	1,364	12	1,376		2.6	2.6	66.7	0.8	64.9
2009	1,364	12	1,376		2.6	2.6	66.9	0.9	65.2
2010	1,166	14	1,180		2.6	2.6	57.2	1.0	55.5
2011	1,086	15	1,101		2.6	2.6	53.7	1.0	52.1
2012	1,086	15	1,101		2.6	2.6	54.0	1.0	52.4
2013	1,086	15	1,101		2.6	2.6	54.2	1.0	52.6
2014	1,086	15	1,101		2.6	2.6	54.4	1.0	52.8
2015	1,086	15	1,101		2.6	2.6	54.7	1.0	53.1
2016	1,086	15	1,101		2.6	2.6	54.9	1.0	53.4
2017	1,086	15	1,101		2.6	2.6	55.2	1.0	53.6
2018	1,086	15	1,101		2.6	2.6	55.5	1.0	53.9
2019	1,086	15	1,101		2.6	2.6	55.7	1.0	54.2
2020	1,086	15	1,101		2.6	2.6	56.0	1.0	54.4
2021	1,086	15	1,101		2.6	2.6	56.5	1.0	54.9
2022	1,086	15	1,101		2.6	2.6	57.0	1.0	55.4
							<b>NPV</b>	<b>\$2.3</b>	<b>\$146.3</b>
							<b>EIRR</b>	<b>=</b>	<b>21.8%</b>

EIRR = economic internal rate of return, GWh = gigawatt-hour, NPV = net present value, O&M = operation and maintenance.

Source: Operations Evaluation Mission estimates.

9. **Subregional-Level Estimation.** The subregional EIRR is calculated to be 32%. In the estimation of the subregional EIRR, the impact of the project on the power market in Thailand is considered. Sales are treated as nonincremental consumption in Thailand and are taken to replace higher cost and environmentally less-friendly thermal sources. In the estimation of the benefits to Thai consumers, the difference between the cost of the thermal source and the export price from the project is taken as a form of consumer surplus benefit. An approximate thermal cost of \$0.05/ kilowatt-hour (kWh) taken from the report and recommendation of the

President on the NT2 Hydroelectric Project<sup>2</sup> is converted to 2008 prices and used as the cost of alternative supply. Over the life of the project, some of this surplus may be captured by power producers through higher electricity tariffs in Thailand, but the net gain is shown as a benefit to consumers.

10. Approximately two thirds of the subregional gains accrue to the Lao PDR, and most of these will go the public sector, as the Government collects taxes and royalties and owns EdL. In principle, therefore, it is available for reinvestment in the economy. It is assumed that the ADB loan to the project would have gone to the country anyway and thus has a domestic opportunity cost, which is approximated by the 12% discount rate. The foreign investment and foreign loans are treated as project specific. One third of the benefits accrue to Thailand, which has access to a cheaper energy supply source and thus demonstrates a genuine regional cooperation project with gains to both participating countries (Table A6.7). Details of the subregional EIRR are in Table A6.8.

**Table A6.7: Economic Benefit Distribution of Theun–Hinboun Hydropower Project**

Item	Gain to GMS	Gain to Lao PDR	Gain to Thailand
Net Present Value (\$ million, at 12%)	163.0	103.1	59.9
Economic Internal Rate of Return (%)	32.0	28.2	39.4

GMS = Greater Mekong Subregion, Lao PDR = Lao People's Democratic Republic.  
Source: Operations Evaluation Mission estimates.

## **B. Nam Leuk Hydropower Project**

11. The project was assumed to have a life of 40 years, the same assumption used in previous evaluations. It is wholly owned by the Government of the Lao PDR through EdL. Aside from adjusting price data and using actual capital costs, the recalculation adjusts for higher than planned transmission and distribution losses. The project's investment cost, excluding interest during construction and loan service charges, was established at \$100.3 million in current prices. The economic cost is \$120.5 at constant 2008 prices. Actual data from EdL were used until the first quarter of 2008 and showed that actual generation was lower and transmission and distribution losses were higher than assumed at appraisal at the PPAR stage. These data were incorporated in the recalculation assuming a long-term capacity of 227 gigawatt-hours per year, with 1.35% transmission losses and distribution losses of 14.8% decreasing to 12.1% from 2020. The key difference with the PPAR assumption is that it assumed a capacity of 246 gigawatt-hours and transmission losses of 1%.

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

**Table A6.8: Subregional Economic Internal Rate of Return  
Theun–Hinboun Hydropower Project (\$ million; 2008 constant prices)**

Year	Electricity Sales (GWh)			Costs			Sales Revenue	Net Financial Benefits			Consumer Benefits			Total Net Benefits			
	Export	Domestic	Total	Capital	O&M	Total		Lao PDR	Thailand	Region	Lao PDR	Thailand	Region	Lao PDR	Thailand	Region	
1994				16.5		16.5	0.0	0.0	(8.2)	(8.2)				0.0	(8.2)	(8.2)	
1995				27.2		27.2	0.0	0.0	(4.6)	(4.6)				0.0	(4.6)	(4.6)	
1996				84.7		84.7	0.0	(23.3)	(2.9)	(26.2)				(23.3)	(2.9)	(26.2)	
1997				91.5		91.5	0.0	(49.0)	(8.6)	(57.5)				(49.0)	(8.6)	(57.5)	
1998	1,048	1	1,048	50.6	2.5	53.1	52.3	(7.8)	(3.5)	(11.3)	0.1	12.1	12.2	(7.7)	8.7	0.9	
1999	1,444	1	1,445		3.6	3.6	75.3	19.1	5.1	24.3	0.1	13.8	13.9	19.2	18.9	38.2	
2000	1,488	1	1,489		3.2	3.2	77.8	22.5	6.2	28.7	0.1	16.0	16.0	22.6	22.2	44.8	
2001	1,532	1	1,533		3.4	3.4	79.7	26.6	6.4	33.0	0.1	19.8	19.8	26.6	26.2	52.8	
2002	1,456	1	1,457		0.2	0.2	78.3	32.0	5.9	37.9	0.1	17.4	17.5	32.1	23.3	55.4	
2003	1,431	5	1,436		0.2	0.2	73.5	36.7	4.9	41.6	0.4	14.3	14.7	37.1	19.2	56.2	
2004	1,527	6	1,533		2.7	2.7	75.0	46.0	8.0	54.0	0.5	12.7	13.2	46.4	20.8	67.2	
2005	1,360	8	1,368		2.7	2.7	67.2	41.0	7.0	48.0	0.6	11.1	11.6	41.6	18.1	59.6	
2006	1,495	10	1,505		2.6	2.6	74.6	46.6	8.4	55.0	0.7	10.2	10.9	47.3	18.5	65.8	
2007	1,564	11	1,576		2.2	2.2	78.6	49.9	9.3	59.1	0.8	6.9	7.6	50.6	16.1	66.8	
2008	1,364	12	1,376		2.6	2.6	66.7	42.1	7.5	49.6	0.8	3.2	4.0	42.9	10.7	53.6	
2009	1,364	12	1,376		2.6	2.6	66.9	44.1	8.3	52.4	0.9	2.5	3.4	45.0	10.8	55.8	
2010	1,166	14	1,180		2.6	2.6	57.2	39.6	7.5	47.1	1.0	1.6	2.6	40.6	9.1	49.6	
2011	1,086	15	1,101		2.6	2.6	53.7	37.1	7.0	44.1	1.0	0.9	2.0	38.2	7.9	46.1	
2012	1,086	15	1,101		2.6	2.6	54.0	37.2	7.1	44.3	1.0	0.4	1.5	38.3	7.5	45.7	
2013	1,086	15	1,101		2.6	2.6	54.2	37.3	7.2	44.4	1.0	(0.1)	0.9	38.3	7.0	45.3	
2014	1,086	15	1,101		2.6	2.6	54.4	37.3	7.2	44.5	1.0	(0.6)	0.4	38.4	6.6	44.9	
2015	1,086	15	1,101		2.6	2.6	54.7	37.4	7.3	44.7	1.0	(1.2)	(0.1)	38.4	6.1	44.6	
2016	1,086	15	1,101		2.6	2.6	54.9	37.5	7.4	44.9	1.0	(1.7)	(0.7)	38.5	5.7	44.2	
2017	1,086	15	1,101		2.6	2.6	55.2	37.6	7.5	45.1	1.0	(2.2)	(1.2)	38.6	5.3	43.9	
2018	1,086	15	1,101		2.6	2.6	55.5	37.3	7.8	45.1	1.0	(2.8)	(1.7)	38.4	5.0	43.4	
2019	1,086	15	1,101		2.6	2.6	55.7	37.5	7.8	45.3	1.0	(3.3)	(2.2)	38.5	4.5	43.0	
2020	1,086	15	1,101		2.6	2.6	56.0	37.6	7.9	45.5	1.0	(3.8)	(2.8)	38.6	4.1	42.7	
2021	1,086	15	1,101		2.6	2.6	56.5	37.9	8.0	45.9	1.0	(4.4)	(3.3)	39.0	3.6	42.6	
2022	1,086	15	1,101		2.6	2.6	57.0	38.2	8.1	46.3	1.0	(4.9)	(3.9)	39.2	3.2	42.4	
														<b>NPV</b>	<b>= \$103.12</b>	<b>\$59.89</b>	<b>\$163.01</b>
														<b>EIRR</b>	<b>= 28.2%</b>	<b>39.4%</b>	<b>32.0%</b>

EIRR = economic internal rate of return, GWh = gigawatt-hour, Lao PDR = Lao People's Democratic Republic, NPV = net present value, O&M = operation and maintenance.

Source: Operations Evaluation Mission estimates.

## 1. Financial Analysis

12. For the initial financial recalculations, domestic and export tariffs are projected over the life of the project by assuming they are constant in real terms. The reestimated FIRR before tax is 4.3% (Table A6.9) approximating the weighted average cost of capital of 4.4%. Details are presented in Table A6.10. The power exports from NT2 are expected to continue until 2012, when NT2 becomes operational. This indicates an adequate margin for loan repayments, but not for tax. The willingness-to-pay-estimate implies there is considerable consumer surplus in the Lao PDR that could be tapped through tariff increases should the financial viability of the project come into question. Tariff increases and more determined efforts to reduce transmission and distribution losses may be necessary to ensure the sustainability of the project.

**Table A6.9: Financial Internal Rates of Return, Nam Leuk Hydropower Project, %**

RRP	PCR	PPAR	SAPE
9.8	4.9	7.6	4.3

PCR = project completion report, PPAR = project performance audit report, RRP = report and recommendation of the President, SAPE = sector assistance program evaluation.

Sources: Nam Leuk Hydropower Project RRP, PCR, PPAR, and Operations Evaluation Mission estimates.

**Table A6.10: Financial Internal Rate of Return  
Nam Leuk Hydropower Project (\$ million; 2008 constant prices)**

Year	Electricity Sales (GWh)			Costs				Sales Revenue	Net Cash Flow
	Export	Domestic	Total	Capital	O&M	Distribution	Total		
1997				16.6			16.6	0.0	(16.6)
1998				33.8			33.8	0.0	(33.8)
1999				43.9			43.9	0.0	(43.9)
2000	276		276	21.6	2.1		23.7	9.3	(14.3)
2001	242		242	6.0	2.0		8.0	8.1	0.0
2002	144	87	231		1.7	1.3	3.0	8.7	5.7
2003	66	153	219		1.3	2.2	3.5	8.7	5.2
2004	85	137	222		1.3	1.9	3.1	9.3	6.2
2005	101	142	244		1.3	2.0	3.3	10.3	7.0
2006	87	141	228		1.3	1.9	3.2	10.5	7.3
2007	39	152	191		1.1	2.0	3.1	9.8	6.7
2008	40	153	194		1.0	1.9	2.9	9.5	6.6
2009	45	153	197		1.0	1.9	2.9	9.7	6.8
2010	45	153	198		1.0	1.9	2.9	9.8	6.9
2011	40	157	197		1.0	1.9	2.9	9.8	6.9
2012	34	164	197		1.0	2.0	3.0	9.9	6.9
2013		193	193		1.0	2.3	3.3	10.1	6.8
2014		193	193		1.0	2.3	3.3	10.1	6.8
2015		194	194		1.0	2.4	3.3	10.2	6.8
2016		195	195		1.0	2.4	3.4	10.2	6.9
2017		195	195		1.0	2.4	3.4	10.2	6.9
2018		196	196		1.0	2.4	3.4	10.3	6.9
2019		196	196		1.0	2.4	3.4	10.3	6.9
2020		197	197		1.0	2.4	3.4	10.3	7.0
2021		197	197		1.0	2.4	3.4	10.3	7.0
2022		197	197		1.0	2.4	3.4	10.3	7.0
2023		197	197		1.0	2.4	3.4	10.3	7.0
2024		197	197		1.0	2.4	3.4	10.3	7.0
2025		197	197		1.0	2.4	3.4	10.3	7.0
2026		197	197		1.0	2.4	3.4	10.3	7.0
2027		197	197		1.0	2.4	3.4	10.3	7.0
2028		197	197		1.0	2.4	3.4	10.3	7.0
2029		197	197		1.0	2.4	3.4	10.3	7.0
2030		197	197		1.0	2.4	3.4	10.3	7.0
2031		197	197		1.0	2.4	3.4	10.3	7.0
2032		197	197		1.0	2.4	3.4	10.3	7.0
2033		197	197		1.0	2.4	3.4	10.3	7.0
2034		197	197		1.0	2.4	3.4	10.3	7.0
2035		197	197		1.0	2.4	3.4	10.3	7.0
2036		197	197		1.0	2.4	3.4	10.3	7.0
								<b>FIRR</b>	<b>4.3%</b>
								<b>WACC =</b>	<b>4.4%</b>

FIRR = financial internal rate of return, GWh = gigawatt-hour, O&M = operation and maintenance, WACC = weighted average cost of capital.

Source: Operations Evaluation Mission estimates.

## 2. Economic Analysis

13. Economic benefits to the Lao PDR were computed using the same assumptions used in the PCR and PPAR in deriving diverted and generated market benefits. Domestic sales of electricity, which comprise the bulk of output, are divided between incremental and non-incremental output. Incremental sales are by far the larger and are valued at an estimated willingness-to-pay price. This is taken as the simple average of the replacement cost of electric power from the grid of \$0.12/kWh (through kerosene lighting and private diesel generators, for example) and the actual tariff. This average willingness-to-pay price is approximately \$0.87/kWh. The non-incremental electricity use is assumed to have occurred without the project, with the marginal supply source being imports from Thailand. The unit cost of electricity imports in 2005 is \$0.063/kWh from the NT2 report and recommendation of the President (footnote 2), converted to 2008 prices. Taking only economic benefits that accrue to the Lao PDR, the EIRR is estimated to be 8.6% (Table A6.11).

**Table A6.11: Economic Internal Rates of Return, Nam Leuk Hydropower Project (%)**

RRP	PCR	PPAR	SAPE	
			Lao PDR	Subregion
13.5	10.4	11.8	8.6	9.7

Lao PDR = Lao People's Democratic Republic, PCR = project completion report, PPAR = project performance audit report, report and recommendation of the President, SAPE = sector assistance program evaluation.

Sources: Nam Leuk Hydropower Project RRP, PCR, PPAR, and Operations Evaluation Mission estimates.

14. The economic benefits that accrue to Thailand were estimated as before using the difference between the negotiated export price and the cost of alternative thermal source to Thailand. When benefits to Thailand are accounted for, the EIRR rises to 9.7%. The distribution of the gains among participating countries is presented in Table A6.12. Details are in Table A6.13.

**Table A6.12: Returns to Different Groups in the Nam Leuk Hydropower Project with Project-Specific Concessional Financing (%)**

Item	Financial Returns	Distribution of Returns to		
		GMS	Lao PDR	Thailand
Electricité du Laos	(51.8)	(51.8)	(51.8)	
Consumer Benefits		34.8	25.2	9.6
<b>Total</b>	<b>(51.8)</b>	<b>(17.0)</b>	<b>26.6</b>	<b>9.6</b>
EIRR (%)	4.3	9.7	8.6	

EIRR = economic internal rate of return, Lao PDR = Lao People's Democratic Republic.

Source: Operations Evaluation Mission estimates.

15. The EIRR estimate for the GMS is a conservative estimate, since it is based on the assumption that the real value of energy and willingness to pay for it will remain constant in real terms in the Lao PDR over the next 25 years. Any real rise in the scarcity value of energy will improve both the EIRR and the FIRR above these given here. Furthermore, any improvement in project efficiency in terms of reducing generation, transmission, and distribution losses will also improve the returns to the project.

**Table A6.13: Economic Internal Rate of Return  
Nam Leuk Hydropower Project  
(\$ million; 2008 constant prices)**

Year	Total Cost (\$ million)	Total Generation (GWh)	Export (GWh)	Export Revenues (\$ million)	Domestic Revenues (\$ million)	Economic Benefits to Lao PDR		Net Benefits to Lao PDR (\$ million)	Economic Benefits to Thailand	Net Benefits to Subregion (\$ million)
						Diverted Market Benefits (\$ million)	Generated Market Benefits (\$ million)			
1997	16.6	0.0	0.0		0.0	0.0	0.0	(16.6)	0.0	(16.6)
1998	33.7	0.0	0.0		0.0	0.0	0.0	(33.7)	0.0	(33.7)
1999	43.8	0.0	0.0		0.0	0.0	0.0	(43.8)	0.0	(43.8)
2000	24.4	286.5	276.2	9.3	0.0	0.0	0.0	(15.1)	4.7	(10.4)
2001	8.0	250.8	242.1	8.1	0.0	0.0	0.0	0.0	4.2	4.3
2002	3.0	256.6	143.9	5.0	3.7	0.3	6.8	9.1	2.3	11.5
2003	3.5	251.0	66.1	2.2	6.5	0.5	12.0	11.2	1.2	12.4
2004	3.1	257.6	85.1	2.6	6.7	0.5	11.2	11.1	1.7	12.8
2005	3.3	286.4	101.5	3.2	7.1	0.5	11.6	12.0	2.0	14.0
2006	3.2	265.9	87.3	3.1	7.4	0.5	11.7	12.1	1.4	13.4
2007	3.1	242.4	39.4	1.5	8.3	0.5	12.8	11.7	0.5	12.2
2008	2.9	227.0	40.3	1.5	8.0	0.5	12.7	11.8	0.6	12.4
2009	2.9	227.0	44.8	1.7	8.0	0.5	12.7	12.0	0.5	12.6
2010	2.9	227.0	44.8	1.8	8.0	0.5	12.7	12.1	0.5	12.6
2011	2.9	227.0	40.3	1.6	8.2	0.5	13.0	12.3	0.5	12.7
2012	3.0	227.0	33.6	1.3	8.6	0.6	13.6	12.5	0.4	12.9
2013	3.3	227.0			10.1	0.7	16.0	13.3	0.0	13.3
2014	3.3	227.0			10.1	0.7	16.1	13.4	0.0	13.4
2015	3.3	227.0			10.2	0.7	16.1	13.4	0.0	13.4
2016	3.4	227.0			10.2	0.7	16.2	13.5	0.0	13.5
2017	3.4	227.0			10.2	0.7	16.2	13.5	0.0	13.5
2018	3.4	227.0			10.3	0.7	16.2	13.6	0.0	13.6
2019	3.4	227.0			10.3	0.7	16.3	13.6	0.0	13.6
2020	3.4	227.0			10.3	0.7	16.3	13.7	0.0	13.7
2021	3.4	227.0			10.3	0.7	16.3	13.7	0.0	13.7
2022	3.4	227.0			10.3	0.7	16.3	13.7	0.0	13.7
2023	3.4	227.0			10.3	0.7	16.3	13.7	0.0	13.7
2024	3.4	227.0			10.3	0.7	16.3	13.7	0.0	13.7
2025	3.4	227.0			10.3	0.7	16.3	16.1	0.0	16.1
2026	3.4	227.0			10.3	0.7	16.3	13.7	0.0	13.7
2027	3.4	227.0			10.3	0.7	16.3	13.7	0.0	13.7
2028	3.4	227.0			10.3	0.7	16.3	13.7	0.0	13.7
2029	3.4	227.0			10.3	0.7	16.3	13.7	0.0	13.7
2030	3.4	227.0			10.3	0.7	16.3	13.7	0.0	13.7
2031	3.4	227.0			10.3	0.7	16.3	13.7	0.0	13.7
2032	3.4	227.0			10.3	0.7	16.3	13.7	0.0	13.7
2033	3.4	227.0			10.3	0.7	16.3	13.7	0.0	13.7
2034	3.4	227.0			10.3	0.7	16.3	13.7	0.0	13.7
2035	3.4	227.0			10.3	0.7	16.3	13.7	0.0	13.7
2036	3.4	227.0			10.3	0.7	16.3	13.7	0.0	13.7
					<b>36.4</b>	<b>2.5</b>	<b>NPV =</b>	<b>(26.8)</b>	<b>9.6</b>	<b>(17.2)</b>
						\$59.00	<b>EIRR =</b>	<b>8.6%</b>		<b>9.7%</b>

EIRR = economic internal rate of return, GWh = gigawatt-hour, Lao PDR = Lao People's Democratic Republic, NPV = net present value.

Source: Operations Evaluation Mission estimates.

## REGIONAL BENEFITS AND IMPACTS FROM GREATER MEKONG SUBREGION POWER TRADING

### A. Background

1. One way to accelerate economic growth and development is to have countries in the same region or contiguous regions accumulate and share resources to achieve balance and effect a more efficient movement of goods, people, and capital. Regional cooperation can assist countries accomplish one or more development objectives and allow them to take advantage of economies of scale and competitive efficiencies that otherwise might not occur. It can also safeguard the different economies from external shocks and their adverse impacts and provide a competitive model to attract investment and technology. The sharing and the cooperation build a sense of security among neighbors and provide some stability, especially in the energy sector. Cooperation in the energy sector may also contribute to the promotion of a reliable and competitive commercially-based energy system that minimizes environmental and social costs. It may also enhance rural electrification, especially in isolated towns and villages.

2. Regional cooperation, however, is not without its challenges. Institutions promoting regional cooperation and countries involved in the partnerships have to grapple with factors that may be impediments to the success of the programs. Resource constraints such as limited time, energy, and staffing are often identified as significant obstacles. Countries may have conflicting goals, values, and missions; and national policies may favor self-sufficiency and substitution rather than a more open trade environment. There may be insufficient public understanding or awareness so that the program may be received with opposition, fear, and/or general skepticism. A successful program should be able to overcome these obstacles and be able to work through and address economic disparities among participating countries.

3. In March 1994, the Asian Development Bank (ADB) issued its first regional cooperation policy.<sup>1</sup> It identified ADB's role as a catalyst in regional cooperation by (i) providing information to developing member countries (DMCs), (ii) facilitating dialogue and participation, and (iii) assisting in the mobilization of public and private sector resources to finance regional cooperation activities. ADB initially adopted a phased approach to supporting regional cooperation wherein ADB was to ultimately finance or help mobilize financing for regional projects that would have a strong economic rationale. National projects with regional implications or projects that called for complementary investment by neighboring DMCs were to be pursued. Among the opportunities identified for regional cooperation were agreements and complementary investments for equitable exploitation of common hydropower potential and petroleum resources, as well as intercountry transmission of energy supplies.

4. In July 2006, the Regional Cooperation and Integration Strategy<sup>2</sup> was adopted. It broadened the scope of regional economic cooperation with the inclusion of trade and investment cooperation and economic integration as one of the four pillars of regional cooperation that would help reduce poverty in the DMCs. The first pillar, the Regional and Subregional Economic Cooperation Program, includes the promotion of connectivity through cross-border hard infrastructure such as energy, water, transport, and tourism.

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<sup>1</sup> ADB. 1994. *Bank Support for Regional Cooperation*. Manila.

<sup>2</sup> ADB. 2006. *Regional Cooperation and Integration Strategy*. Manila.

5. The Regional Cooperation Strategy and Program<sup>3</sup> for the Greater Mekong Subregion (GMS) adopted in March 2004, shared ADB's overarching objective of poverty reduction. Poverty reduction was to be achieved by (i) strengthening connectivity and facilitating cross-border movement and tourism; (ii) integrating national markets to promote economic efficiency and private-sector development; (iii) addressing health and other social, economic, and capacity-building issues associated with subregional linkages; and (iv) managing the environment and shared natural resources.

## B. GMS Program in the Energy Sector

6. Under the GMS program, cooperation in energy focuses on the development of the regional power market and power trade arrangements. This involves a two-pronged approach consisting of (i) providing the policy and institutional framework for promoting opportunities for extended cooperation in regional power trade, and (ii) using a building block approach to realize essential grid connection infrastructure that will physically allow the cross-border dispatch of power. The rationale for promoting regional power trade arises from the fact that, while the GMS is well endowed with diverse energy resources to feed the growing demand for electricity, the geographic distribution of these resources is uneven. Power trade can help secure a better balance in the subregion's energy supplies.

7. To date, there have been four regional power projects in the GMS (Table A7.1). Three have involved hydropower development in the Lao People's Democratic Republic (Lao PDR) for export, primarily to Thailand and the fourth, in Cambodia, involves the installation of a transmission line from the Viet Nam border to Phnom Penh. The inaugural meeting of the Electric Power Forum within the framework of the GMS program was held in Myanmar in 1995. There have been nine regional technical assistance grants to support studies, conferences, institution building and development of master plans. An advisory technical assistance to analyze various financing options to cover the cost overruns associated with the Nam Leuk Hydropower Project was approved in 1999.

**Table A7.1: Energy Projects Promoting Regional Cooperation in the Greater Mekong Subregion**

Loan No.	Country	Project Name	Year of Approval	Approved Amount (\$ million)
1329	LAO	Theun–Hinboun Hydropower Project	1994	270.0
1456	LAO	Nam Leuk Hydropower Development Project	1996	112.6
2052	CAM	Cambodia: GMS Transmission Project	2003	95.0
2162	LAO	Nam Theun 2 Hydroelectric Project	2005	1,250.0

CAM = Cambodia, GMS = Greater Mekong Subregion, LAO = Lao People's Democratic Republic.  
Source: Asian Development Bank database.

8. To facilitate the subregional market evolution, the GMS program continuously works to strengthen the policy and institutional framework for power trade. A major step was taken when the GMS countries signed the Intergovernmental Agreement on Regional Power Trade in 2002. This provided for the Regional Power Trade Coordination Committee (RPTCC), comprising representatives of senior government officials from the six<sup>4</sup> GMS countries, to coordinate regional power trade in the GMS and to oversee the formulation and adoption of the Regional

<sup>3</sup> ADB. 2004. *The GMS Beyond Borders: Regional Cooperation Strategy and Program 2004–2008*. Manila.

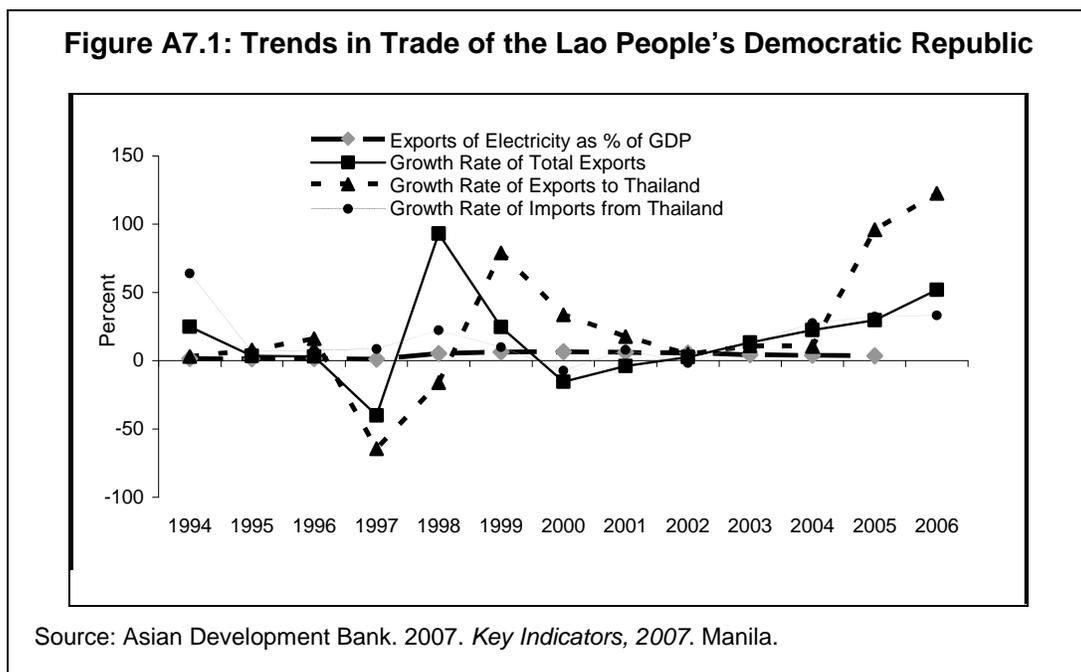
<sup>4</sup> The countries that comprise the GMS are Cambodia, People's Republic of China, Lao PDR, Myanmar, Thailand, and Viet Nam.

Power Trade Operating Agreement (RPTOA). The RPTOA, an integral component of the GMS flagship program on power interconnection, was to constitute the operating guidelines for technical coordination, cross-border pricing, and institutional framework for power trade in the GMS and would contain harmonized rules for technical coordination among members. In July 2005, the GMS countries signed a memorandum of understanding on the Guidelines for the Implementation of the Regional Power Trade Operating Agreement Stage 1, which sets rules for initial trade at stage 1, to involve country-to-country trading and development of institutions. Other RPTCC activities cover the conduct of priority studies (performance standards, transmission regulation); capacity building; power master planning; database development; and preparation of best practices for power purchase agreements.

### C. Assessment of Benefits and Impacts of the GMS Energy Program

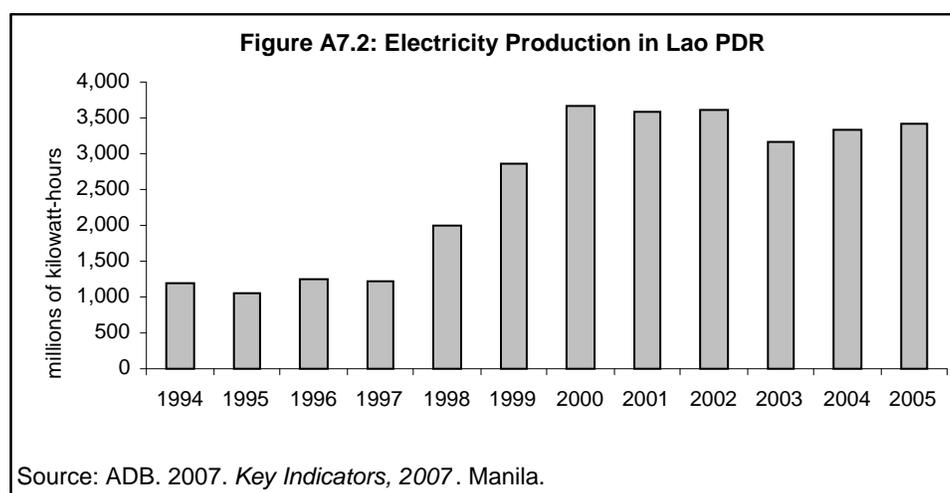
9. Enhanced energy connectivity is being steadily achieved under the GMS program through construction of cross-border power transmission lines. At present, these lines serve to fulfill bilateral (trade between Lao PDR and Thailand) but one-way trade arrangements to the grid of the energy-deficient country (Thailand). Even this limited power trade currently taking place in the GMS has generated substantial benefits to the parties. The Lao PDR's exports of hydropower to Thailand have increased its foreign exchange earnings, and the multilateral development community is working with the Lao PDR Government to strengthen governance issues to ensure that these funds are used to finance development programs in education, health, and social welfare.

10. The economic benefits of the bilateral power trade between Lao PDR and Thailand have been more evident on the part of the Lao PDR, although its exports of electricity to Thailand suffered a major slump during the Asian financial crisis (AFC) (Figure A7.1). Exports of electricity as a percentage of gross domestic product quadrupled from 1.63% in 1994, when construction of the Theun–Hinboun hydropower plant started, to 6.53%, when exports from Nam Leuk started in 2000. This percentage tapered down to 3.48% in 2005.



11. Theun–Hinboun was brought into commission in 1998 shortly after the start of the start of the AFC, while Thailand was just starting to take stock of its impact. That same year, the Lao PDR's electricity exports to Thailand suffered a 16% decline, already an improvement over the 64% contraction in 1997. Electricity exports to Thailand expanded by 79% in 1999, the same year that Theun–Hinboun became fully operational and as Thailand started recovering from the AFC. Since then, the growth of electricity exports to Thailand has been in double digits except for 2002.

12. The Lao PDR's electricity production has been steadily increasing, with output in 2005 growing by three times over the 1994 level. The fastest expansion in production came in 1998, when output grew by 63%. Rapid growth continued, although at a slower rate, in 1999 and 2000. Electricity production has been a major contributor to the Lao PDR's gross domestic product.



13. The hydropower plants, which were built primarily for export of electricity to Thailand, have also benefited rural communities in the Lao PDR with electrification. In 1995, only 45% of households nationwide had access to electricity. The government plans to have 90% of households electrified by 2020. The development of power sources supports this goal.

14. The projects have also had positive impacts on employment and infrastructure development. Although there are no statistics that give the actual new employment generated by the projects, it is certain that some villagers benefit directly or indirectly from the employment created, although dam construction created mostly short-term employment. There was new employment for the operation of the hydropower plants, but the number of permanent employees is small. In 2005, the Theun–Hinboun Power Corporation (THPC) had around 130 regular staff at the site and 1,000 casual laborers. Nam Leuk had 59 staff,<sup>5</sup> but the project employed more than 16,000 person-months of unskilled local workers to do pre-inundation work during the dry season, when there were few farm activities. The villages surrounding the hydropower plants benefit from improved basic infrastructure such as roads, bridges, a community health center, and community water sources. The project performance audit report<sup>6</sup> (PPAR) for the Theun–Hinboun Project reported that construction and improvement of roads

<sup>5</sup> United Nations Development Programme. 2006. *Technical Background Paper for the Third National Human Development Report Lao PDR 2006*. Vientiane.

<sup>6</sup> ADB. 2002. *Project Performance Audit Report: on the Theun–Hinboun Hydropower Project*. Manila.

leading to the project site had increased people's mobility and access to opportunities for commercial activities.

15. Electricity exports generate two kinds of revenues. Revenues from THPC are in the form of royalties, taxes, and dividends to Electricité du Laos as a shareholder. Revenues generated from Nam Leuk are from power exports. Part of the revenues from these power plants is made available for the Government's social programs.

16. Both THPC and Electricité du Laos have provided funds for mitigation of the environmental and social impacts of the projects, thus mitigating any adverse impact of the projects. One percent of the electricity export revenue from the Nam Leuk Project goes to the protection of the Phou Kao Khouay National Park and its resources. THPC is the first private company in the Lao PDR to implement an environmental management action plan.

17. Opponents of hydropower projects point to adverse impacts on the environment as a major reason not to pursue similar projects. They fear negative impacts of the Lao PDR dams not only in areas near the dam but also on the Mekong River. The PPAR for Theun–Hinboun reported negative environmental and social impacts, which were exacerbated by the lack of a resettlement plan and a weak environmental mitigation program. On the social side, the physical relocation of persons was not anticipated, and on the environment side there occurred increased erosion and sediment loads, which reduced downstream flows on the Nam Theun, having an impact on fisheries and transportation in the headpond area.

18. The PPAR for the Nam Leuk Project<sup>7</sup> reported that the resettlement of Nam Leuk families was successfully carried out, but also quotes a report on fish monitoring data that southern villages fisheries declined from December 1996 to December 2001.

19. The power trade between Lao PDR and Thailand provides Thailand with access to a clean and low-cost energy source needed to support its growing economy. In 2007, imports of hydropower supplied 1.4% of the Electricity Generating Authority of Thailand's (EGAT's) fuel requirements for power generation.<sup>8</sup> EGAT projects this to increase to 8.5 by 2021.

20. Power trading in the GMS has so far been limited to bilateral but one-way trade arrangements, e.g., export of power from specific hydropower projects in a surplus country to the grid system of a power-deficient country. This limited trade arrangement has already generated substantial benefits to the parties involved. Eventually, the aim is for grid-to-grid interconnection (stage 4 of the GMS program) involving two or more countries that will require multiparty trading of power and therefore more efficient power markets in the long run. The expansion of power trading in the GMS will (i) provide energy security and regional stability; (ii) help to efficiently utilize the subregion's energy potential by reducing investments in power reserves to meet peak demand, reduce operational costs, achieve more reliable supply, and reduce system losses; (iii) achieve environment benefits by substituting hydropower for coal and other fossil fuels; and (iv) allow countries with energy surplus to also benefit by servicing their deficit areas more efficiently with power imports from other grids.

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<sup>7</sup> ADB. 2004. *Project Performance Audit Report on the Nam Leuk Hydropower Project*. Manila.

<sup>8</sup> EGAT. 2007. *Thailand Power Development Plan (PDP 2007)*. Bangkok.

## EVALUATION MATRIXES FOR PROGRAM ASSESSMENT

Table A8.1: Overall Performance Rating of Asian Development Bank Assistance to the GMS Energy Sector

Item	Aggregate Amount (\$ million)	Weight (%)	Relevance (0–3)	Effectiveness (0–6)	Efficiency (0–3)	Sustainability (0–6)	Impact (0–6)	Overall Rating (0–24)	Overall Rating Description
Loans	176.3	70	3	4	2	4	4	17	Successful
RETA	9.066	30	3	5	2	4	4	18	Successful
<b>Overall Bottom-up Sector Rating</b>			<b>3</b>	<b>4</b>	<b>2</b>	<b>4</b>	<b>4</b>	<b>17</b>	<b>Successful</b>

GMS = Greater Mekong Subregion, RETA = regional technical assistance.  
Source: Operations Evaluation Mission.

Table A8.2: Loan Project Evaluation

Loan No.	Project Name	Country	Year of Approval	Amount (\$ million)	Status	Relevance (0–3)	Effectiveness (0–6)	Efficiency (0–3)	Sustainability (0–6)	Impact (0–6)	Overall Rating (0–24)
1329	Theun–Hinboun Hydropower	Lao PDR	1994	60.0	Completed	3	5	3	5	5	21
1456	Nam Leuk Hydropower Development	Lao PDR	1996	52.0	Completed	3	4	2	4	4	17
2052	GMS Transmission Project	Cambodia	2003	44.3	Ongoing	3	4	1	4	4	16
2162	Nam Theun 2 Hydroelectric Project	Lao PDR	2005	20.0	Ongoing	3	5	2	4	4	18
				<b>176.3</b>		<b>3</b>	<b>4</b>	<b>2</b>	<b>4</b>	<b>4</b>	<b>17</b>

GMS = Greater Mekong Subregion, Lao PDR = Lao People's Democratic Republic.  
Source: Operations Evaluation Mission.

Table A8.3: Loan Project Rating Comparison

Loan No.	Project Name	PCR Rating	PPER Rating	SAPE Rating
1329	Theun–Hinboun Hydropower	Successful	Successful <sup>a</sup>	Highly successful
1456	Nam Leuk Hydropower Development	Successful	Successful	Successful
2052	GMS Transmission Project	Not available <sup>2</sup>	Not available <sup>b</sup>	Successful
2162	Nam Theun 2 Hydroelectric Project	Not available <sup>2</sup>	Not available <sup>b</sup>	Successful

GMS = Greater Mekong Subregion, PCR = project completion report, PPAR = project performance audit report, SAPE = sector assistance performance evaluation.

<sup>a</sup> Bordering on highly successful.

<sup>b</sup> Ongoing project.

Source: Operations Evaluation Mission.

**Table A8.4: Technical Assistance Evaluation**

TA No.	TA Name	Year of Approval	Status	Relevance (0–3)	Effectiveness (0–6)	Efficiency (0–3)	Sustainability (0–6)	Impact (0–6)	Overall Rating (0–24)
5643	Subregional Electric Power Forum – GMS	1995	Completed	3	5	2	4	5	19
5697	Se Kong-Se San and Nam Theun River Basins Hydropower Development Study	1996	Completed	3	5	2	4	4	18
2926	Nam Ngum 500 kV Transmission – Lao PDR	1997	Completed	3	4	2	4	4	17
3222	Se San 3 Hydropower – Viet Nam	1999	Completed	3	4	2	4	4	17
3225	Analyzing and Negotiating Financing Options for the Nam Leuk Hydropower Project Cost Overruns – Lao PDR	1999	Completed	3	3	2	4	4	16
5920	Regional Indicative Master Plan on Power Interconnection in the GMS	2000	Completed	3	5	2	4	4	18
4078	GMS: Cambodia: Preparing the Power Distribution and GMS Transmission Project	2003	Completed	3	5	2	5	5	20
6100	Study for a Regional Power Trade Operating Agreement in the GMS	2003	Completed	3	5	2	5	5	20
6147	Preparing the GMS Power Interconnection Project, Phase I	2003	Completed	3	5	2	4	4	18
4213	Preparing the GMS: Nam Theun 2 Hydropower Development Project	2003	Completed	3	5	1	4	5	18
4323	GMS Nam Theun 2 Hydropower Dev't Project Phase II	2004	Completed	3	5	2	4	4	18
6301	Developing the GMS Energy Sector Strategy (formerly GMS Energy Sector Strategy Study) – including supplementary TA	2006	Ongoing	3	5	2	4	4	18
6304	GMS: Regional Power Trade Coordination and Dev't.	2006	Ongoing	3	4	2	4	4	17
4816	GMS: Northern Power Transmission Project	2006	Ongoing	3	4	2	4	4	17
7026	Na Bong–Udon Thani Power Transmission (Lao PDR)	2007	Ongoing	3	4	2	4	4	17

TA No.	TA Name	Year of Approval	Status	Relevance (0–3)	Effectiveness (0–6)	Efficiency (0–3)	Sustainability (0–6)	Impact (0–6)	Overall Rating (0–24)
6440	Facilitating Regional Power Trading and Environmentally Sustainable Development of Electricity Infrastructure in the GMS	2007	Ongoing	3	4	2	4	4	17
<b>Total</b>				<b>3</b>	<b>5</b>	<b>2</b>	<b>4</b>	<b>4</b>	<b>18</b>

GMS = Greater Mekong Subregion, kV = kilovolt, Lao PDR = Lao People's Democratic Republic, TA = technical assistance.  
Source: Operations Evaluation Mission.

**Table A8.5: RETA Rating Comparison**

RETA No.	RETA Name	TCR Rating	SAPE Rating
5643	Subregional Electric Power Forum – GMS	Not available <sup>1</sup>	Successful
5697	Se Kong-Se San and Nam Theun River Basins Hydropower Development Study	(Generally) Successful	Successful
2926	Nam Ngum 500 kV Transmission – Lao PDR	Successful	Successful
3222	Se San 3 Hydropower – Viet Nam	(Generally) Successful	Successful
3225	Analyzing and Negotiating Financing Options for the Nam Leuk Hydropower Project Cost Overruns – Lao PDR	Not available <sup>a</sup>	Successful
5920	Regional Indicative Master Plan on Power Interconnection in the Greater Mekong Subregion	Not available <sup>a</sup>	Successful
4078	GMS: Cambodia: Preparing the Power Distribution and Greater Mekong Subregion Transmission Project	Not available <sup>a</sup>	Highly successful
6100	Study for a Regional Power Trade Operating Agreement in the Greater Mekong Subregion	Not available <sup>a</sup>	Highly successful
6147	Preparing the GMS Power Interconnection Project, Phase I	Not available <sup>a</sup>	Successful
4213	Preparing the GMS: Nam Theun 2 Hydropower Development Project	Not available <sup>a</sup>	Successful
4323	GMS Nam Theun 2 Hydropower Development Project Phase II	Not available <sup>a</sup>	Successful
6301	Developing the GMS Energy Sector Strategy (formerly GMS Energy Sector Strategy Study)	Not available <sup>b</sup>	Successful
6304	GMS: Regional Power Trade Coordination and Dev't.	Not available <sup>b</sup>	Successful
4816	GMS: Northern Power Transmission Project	Not available <sup>b</sup>	Successful
7026	Na Bong-Udon Thani Power Transmission (Lao PDR)	Not available <sup>b</sup>	Successful
6440	Facilitating Regional Power Trading and Environmentally Sustainable Development of Electricity Infrastructure in the Greater Mekong Subregion	Not available <sup>b</sup>	Successful

GMS = Greater Mekong Subregion, kV = kilovolt, Lao PDR = Lao People's Democratic Republic, RETA = regional technical assistance, SAPE = sector assistance performance evaluation, TCR = technical assistance completion report.

<sup>a</sup> No TCR found in database.

<sup>b</sup> Ongoing project.

Source: Operations Evaluation Mission.