



INTEGRATING STRATEGIC ENVIRONMENTAL ASSESSMENT INTO POWER PLANNING

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Executive Summary

This book is the first in a three-volume series arising from a project of the Asian Development Bank (ADB) on ***Ensuring Sustainability of the Greater Mekong Subregion Regional Power Development***. This study shows how the strategic environmental assessment (SEA) process can be used for power planning. The study is the first in the world to incorporate SEA, which focuses on sustainability and policy making, into power development plans (PDPs). Specifically, the study incorporates SEA into the PDPs in the Greater Mekong Subregion (GMS) to arrive at an optimal power development trajectory for the GMS as a whole.

This volume highlights the role of SEA in assessing the sustainability of policies and plans at a regional or national level, emphasizing how SEA can contribute toward good governance in the power sector, create greater stakeholder involvement in consultation processes, and develop capacity in GMS countries to undertake SEA of their PDPs. The second volume demonstrates how a set of indicators can be used to analyze PDPs in the GMS to achieve greater sustainability. It also explains why particular indicators were selected for this study, why they are important, how they can be measured, and what the indicators reveal. The third volume shows how SEA may be applied to compare different scenarios and how, by incorporating the wider impacts considered during the SEA process, a more sustainable power plan can be developed. It also shows how sustainability may be assessed in power planning.

Over the next 15 years, the power sector is expected to expand significantly throughout the GMS, with demand projections in the Lower Mekong countries alone showing an increase from 317 terawatt-hours in 2012, to 815 terawatt-hours in 2025. In terms of power planning, the current PDPs project a doubling of coal and lignite power plants in the GMS countries to 83 plants with an installed capacity of over 50,000 megawatts (MW). Gas-fired plants are expected to increase by about 87% to 54 plants with 24,000 MW; and large hydropower plants would increase from a current 116 plants with 50,000 MW to 254 plants with over 111,000 MW. Four nuclear plants are expected to be built in the period in the GMS in both Guangxi Zhuang Autonomous Region in the People's Republic of China and in Viet Nam. Renewable sources such as solar, wind, and biomass would also increase by more than three times but from a very low 3,500 MW (ADB 2014b).

This major expansion in the power sector will bring added environmental and social pressures, resulting from the impacts of individual plants, as well as the cumulative impacts of a number of power plants around major cities or along river systems. While many impacts can be mitigated, e.g., reducing air pollutants, there will be residual impacts that cannot be managed so easily, such as losses to biodiversity. The scale of impacts and the management of the mitigation measures demand that greater attention should be paid to incorporating greater sustainability into the power planning process. SEA is a tool that can inform more sustainable power planning.

Power plans are usually developed at a national level and provide the country's decision makers with an economic response to meeting the projected demand for electricity. They estimate the demand, usually based upon gross domestic product multipliers, and then propose a rolling plan for the implementation of a mix of power plants—thermal, hydropower, nuclear with a limited contribution from renewable sources and energy efficiency measures—and fuels; and including importing or exporting power from neighboring countries. Power plans may have a 20-year vision with 10- and 5- year planning horizons. There are differences in the approach between the GMS countries, with some countries such as Thailand and Viet Nam having well-developed PDPs, while Cambodia, the Lao People's Democratic Republic, and Myanmar have less developed plans, if any. The PDPs from Thailand and Viet Nam have been criticized for projecting unrealistic demands and for not emphasizing renewable energy sources and energy efficiency measures. They thus project the need to build progressively more power plants with all the environmental and social consequences that are associated with power generation and transmission.

Conventionally, power planning in the GMS has followed a multi-objective, least-cost approach. National policies such as the promotion of renewable energy, energy efficiency and conservation, power import and export, and environment concerns may be reflected in the process, but only to a limited extent. Environmental and social impacts and their costs have rarely been factored into decision making about the plans, choice of technology, and locations of power plants. In essence, the sustainability of the power plans has never been considered, with the result that the installed power plants and interconnecting transmission lines between the countries of the GMS may not be as environmentally sound, socially acceptable, and economically viable as they could have been. SEAs lead to better integration of sustainability issues in PDPs compared to the impacts-based approach (i.e., managing the impacts of individual power plants). The latter tends to endorse the least-cost approach and assumes that environmental and social impacts can be mitigated.

Good governance in the power sector is considered one of the major issues influencing sustainability in power development. ADB's long-term strategic framework for 2008–2020, otherwise known as Strategy 2020, notes that improved governance in fragile situations would facilitate regional stability and enable a wider range of intra- and interregional engagement, both private and public. SEA offers the possibility of incorporating sustainability issues into national PDPs, especially if the SEA is set up with sound sustainability objectives, rather than just being focused on addressing the impacts after the plan has been finalized.

The SEA approach, which is essentially a consultative and participative process, provides both the experience and techniques for improving policy making in power planning. SEA can provide the platform through which power planning processes can include greater stakeholder consultation. While the legal requirements and procedures for SEAs of policies, plans, and programs are progressively in place in several GMS countries, the application of SEA has been relatively rare, and generally supported only as demonstration studies by ADB and other international agencies.

In power projects, SEA can either be impact-based, providing information after the major decisions regarding energy policy have already been made; or sustainability-led, being actually instrumental in shaping the overall PDP, i.e., influencing the entire generation mix

and approach to energy supply and provision. This volume presents as a case study the SEA of the Viet Nam Power Development Plan VII to illustrate the difference between impact-based SEA and sustainability-led SEA. The SEA process has limitations as to data availability and broad generalizations, and cannot provide the “decision,” but it contributes to the decision-making process by providing assessments of different power development scenarios and options. In addition, due to the variability of data and shortage of information about critical aspects, it is difficult for SEA practitioners to develop scientifically sound assessments. In order to strengthen the capacity for carrying out such SEA, databases need to be developed on subjects as air and water emissions and their control techniques, and the impacts on biodiversity and their management.

In the future, the capacity of both the power planning agencies and the agencies responsible for environmental and social management of power projects needs strengthening in order to apply SEA effectively. A program of capacity building in SEA is needed, including technical support for actual SEA of power plans. Greater regional coordination and support for sustainability assessments using SEA would also help strengthen capacity at both national and regional levels.

In the GMS, the consultation process in SEA needs to be strengthened by preparing protocols for consultation in power planning. These should be tested for application in GMS countries, drawing upon the experience gained from other GMS projects.

Abbreviations

ADB	–	Asian Development Bank
CIA	–	cumulative impact assessment
CSG	–	China Southern Power Grid Company
EIA	–	environmental impact assessment
EOC	–	Environmental Operations Centre
GIS	–	geographic information system
GMS	–	Greater Mekong Subregion
km	–	kilometer
Lao PDR	–	Lao People’s Democratic Republic
LMB	–	Lower Mekong Basin
LOLP	–	loss-of-load probability
MW	–	megawatt
PDP	–	power development plan
PRC	–	People’s Republic of China
SEA	–	strategic environmental assessment
TA	–	technical assistance



Dam wall with water intake tower of the
100 MW Nam Lik 1-2 Hydropower Plant,
Lao People's Democratic Republic

Introduction

The Asian Development Bank's (ADB) project on ***Ensuring Sustainability of the Greater Mekong Subregion Regional Power Development*** is a \$1.35 million technical assistance project (ADB 2010a). It has the following objectives:

- (i) assess the impacts of alternative directions for the development of the power sector in the Greater Mekong Subregion (GMS) through a strategic environmental assessment (SEA);¹
- (ii) develop recommendations on how to minimize and mitigate harmful impacts in the power sector; and
- (iii) provide capacity building for GMS countries in the conduct of SEA, and support its integration into the power planning process.

This project commenced in March 2012 with a series of three regional consultations. National consultations were also held in four countries of the Lower Mekong to contribute toward the development of sustainability indicators for use in assessing the impacts.² A baseline report was produced in January 2013, including a report setting out the alternative

¹ The Greater Mekong Subregion includes Cambodia, the Lao People's Democratic Republic (Lao PDR), Myanmar, Thailand, Viet Nam, and Yunnan Province and Guangxi Zhuang Autonomous Region in the People's Republic of China (PRC).

² This strategic environmental assessment (SEA) study was "sustainability-led." Sustainability issues were defined in terms of national and regional "security aspects"—the degree of protection against danger, damage, or loss. Eight security aspects that capture the essence of sustainability for power planning were identified, namely: (i) ecological security (pollution, land and biodiversity, rivers); (ii) climate security; (iii) food security; (iv) social security; (v) health and safety security; (vi) good governance and state security; (vii) energy security; and (viii) economic security. Associated with each security aspect is a series of indicators and sustainability statements that were developed through stakeholder consultation and literature review, and against which the contribution of the existing regional power plan was assessed.

scenarios (ADB 2013).³ The impact assessment report and summary report, complete with recommendations were finalized in December 2013.

A three-volume series of knowledge products prepared from the study captures significant aspects of the SEA process. These volumes are as follows.

- (i) Integrating Strategic Environmental Assessment into Power Planning
- (ii) Identifying Sustainability Indicators of Strategic Environmental Assessment for Power Planning
- (iii) How Strategic Environmental Assessment can Influence Power Development Plans—Comparing Alternative Scenarios for Power Planning in the Greater Mekong Subregion

This volume aims to show how the SEA process can be used for power planning and how capacity for conducting SEAs and the consultation process can be strengthened. It highlights the role of SEA in assessing the sustainability of policies and plans at a regional or national level. This volume complements the second and third volumes in this series.

The second volume describes the application of the SEA methodology to the GMS regional PDP. It shows how a set of indicators may be defined and used to capture the wider impacts of power planning, and to analyze PDPs in the GMS to achieve greater sustainability.⁴ The volume explains why the particular indicators were selected for the study, why they are important, how they can be measured, and what the indicators reveal. Using the indicators established by the study, the volume shows how SEA may be applied to qualitatively and quantitatively compare different scenarios. The second volume also presents monetization as a means of comparison across scenarios, and explains how selected indicators were monetized.

The third volume applies SEA to compare different scenarios, and shows how a more sustainable power plan can be developed by incorporating the wider impacts considered during the SEA process. It also demonstrates how sustainability may be assessed in power planning, and how incorporating wider impacts might change decisions on the optimal power plan. The process of developing these scenarios starts from an updated

³ The study had three power planning scenarios: (i) current power development plan (PDP), (ii) renewable energy, and (iii) energy efficiency. The current PDP scenario is an updated version (as of 2012) of the existing GMS Power Transmission Master Plan developed under the Asian Development Bank's (ADB) TA 6440-REG. The current PDP scenario incorporates the national PDPs of Cambodia, the Lao PDR, Thailand, and Viet Nam to 2025. The PDP for Myanmar as well as for Yunnan Province and Guangxi Zhuang Autonomous Region in the PRC were not available for this study. The current PDP is compared to the baseline situation of all power plants and regional interconnectors operational in 2012. Two displacement options are considered for the renewable energy and energy efficiency scenarios—a global impacts option in which some coal-fired power plants are displaced to reduce carbon emissions; and a regional and local impacts option in which some large hydropower, nuclear, and coal-fired power stations are displaced to reduce regional and local impacts. In the context of this SEA, the term “displacement” is used to indicate the option of removing a planned thermal, large hydropower, or nuclear plant from the PDP scenario and replacing it with greater contributions from renewable energy and energy efficiency.

⁴ The World Commission on Environment and Development (the Brundtland Commission) in 1987 defined sustainability as development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

version (as of 2012) of the existing GMS Power Transmission Master Plan under TA 6440-REG, henceforth referred to as “current PDP.” The current PDP scenario incorporates the national PDPs of Cambodia, the Lao People’s Democratic Republic, Thailand, and Viet Nam to 2025 (the PDPs for Myanmar and Yunnan Province and Quangxi Autonomous Region of the People’s Republic of China were not available for this study). The current PDP is compared to the baseline situation of all power plants and regional interconnectors operational in 2012.

In addition, a series of SEA briefing papers produced earlier present the different stages of the SEA process in the format of case studies. An updated database of power plants in the GMS developed from a database provided by an earlier ADB project (TA 6440-REG) titled *Facilitating Regional Power Trading and Environmentally Sustainable Development of Electricity Infrastructure in the Greater Mekong Subregion. Component 2: Analysis of SEA in GMS Countries, and Identification of Gaps, Needs and Areas for Capacity Development* (ADB 2010b) is also available, together with an explanatory manual (ADB 2014a).

The SEA process is usually conducted at a relatively high level and complements the more detailed environmental impact assessments (EIAs) necessary for specific developments. The SEA process has its own limitations and assumptions because of the scale at which it is conducted. Such assumptions must be made clear and transparent.

The development of more sustainable power plans must be underpinned by good governance.⁵ Poor governance throughout the power planning process and operation of power plants in the GMS, along with the associated environmental and social impact assessment and monitoring, were major concerns of stakeholders consulted throughout this study. This volume shows how the SEA process can contribute to good governance in the power planning process, and how the capacity of national governments and stakeholders in the power planning process can be strengthened.

This study constitutes an attempt to introduce and incorporate a methodology for SEA in PDPs. The findings and recommendations are by no means exhaustive and final, but are meant to serve as a springboard for more in-depth SEA on individual national PDPs. The monetization of more indicators, in particular, is an area for future research.

⁵ In this study, good governance covers policy making including laws and regulations, enforcement of environmental conditions and social safeguards, as well as issues of corruption and capacity of institutions to manage the process. It refers to oversight of policy making, planning, operations and management by government, state-owned enterprises, and private entities, and involves consultation with public, private, and civil society organizations. Good governance and capacity development is one of the five drivers of change that the Asian Development Bank (ADB), in its long-term strategic framework Strategy 2020 (ADB 2008), focuses on to better mobilize and maximize resources, the others being (i) private sector development and private sector operations, (ii) gender equity, (iii) knowledge solutions, and (iv) partnerships.



Lower weir, 193 MW
Kamchay Hydropower Plant,
Cambodia

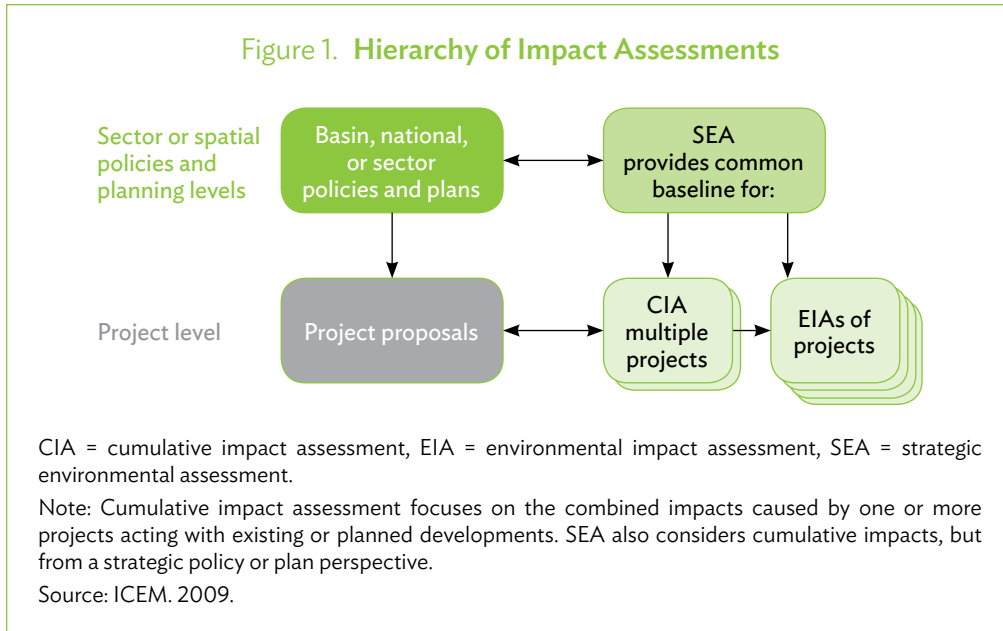
How Strategic Environmental Assessment Contributes to the Power Planning Process

What Is Strategic Environmental Assessment?

Strategic environmental assessment is generally aimed at assessing the impacts of policies, plans, and programs. SEA is a tool to help policy makers integrate the environmental, social, and economic dimensions of sustainability into decision making. SEA is different from EIA, which assesses the impacts of projects. SEA follows steps similar to that of EIA but often has wider boundaries in terms of time, space, and subject coverage. SEA may include cumulative impacts and address broader strategic issues. SEA also serves as an umbrella level of analysis that informs more specific project-focused EIAs and improves their quality (Figure 1).

Power Planning Processes in the Greater Mekong Subregion

Power system planning in GMS countries generally follows the conventional approach of multi-objective, least-cost planning with different constraints depending on country-specific objectives and resources. National policies such as promotion of renewable energy, energy efficiency and conservation, power import and export, and environmental concerns may also be reflected in the process. In GMS countries (except Guangxi Zhuang Autonomous Region and Yunnan provinces in the People's Republic of China), all power generation planning is performed in the context of modifications to the existing system over a long period. Usually the PDP is developed for a 5–10-year period, with an outlook for the next 10 years. The process begins with (i) electricity load demand forecasting; which is followed by (ii) reliability evaluation to determine if and when additional generation is needed; and finally, (iii) optimal capacity



expansions selection based on economic considerations. These processes are reviewed briefly below.

Load Forecasting

Total system load generally is well known and a wealth of historical data is available. Load forecasting for the purpose of generation planning, however, requires a substantially longer time horizon, because system expansion projects require long lead times, often between 2 and 10 years. The outputs from a load forecast include annual energy sales (in kilowatt-hours), and the annual peak demand (in kilowatts). There are two widely used methods in energy sales forecasting in GMS, econometric regression analysis at national level and by sector, and end-use electricity models.

The level of complexity and update on load forecasting varies from country to country. Thailand has a load forecasting subcommittee under the Energy Policy and Planning Office, which updates on an annual basis the load forecast for the country. Viet Nam’s load forecast is updated less frequently and is carried out by the Institute of Energy under the Ministry of Industry and Trade. In Cambodia and the Lao People’s Democratic Republic (Lao PDR), load demand forecasting is led by Electricite du Lao and Electricite du Cambodge, respectively, with participation from various departments and ministries, and based on a simple econometric model in Excel using international assistance. In Myanmar, forecasts of long-term energy demand and supply by energy source are not available (ADB 2012f); however, the Ministry of Planning has some basic projection for long-term electricity demand, based on a fixed growth rate for each period of 5 years.

Forecasting the peak demand is based on projected energy sales calculated by multiplying forecasted energy with an empirically determined load factor coefficient.

Relationship Between Capacity Reserves and Reliability

Assuming that maintenance requirements are known, and that forced outages can be characterized by probability, the question of the appropriate capacity of generation for a given load forecast needs to be addressed. “Appropriate” in this context means reliability of service. It then follows that PDPs need to map between the capacity and service reliability or, more precisely, between capacity margins and service reliability.

Capacity margin is a better measure of reliability because it represents the difference between capacity and peak load. Required capacity reserves commonly are determined using a probabilistic approach that examines the probabilities of simultaneous outages of generating units and compares the resulting remaining capacity with the peak system load.

A number of days per year with capacity shortages can be determined and this measure, termed loss-of-load-probability (LOLP) index, provides a consistent and sensitive measure of generation system reliability. Therefore, given a system and the outage characteristics of the units, planners can determine whether it satisfies the desired LOLP index.⁶

Capacity Resource Planning

The question of what type of generating station (hydropower, nuclear, coal, gas turbine, or other) would be the most economical addition to the system is answered by combining a production cost analysis with an investment cost analysis. This process is illustrated in Figure 2.

The process presented above is based on least-cost analysis without environmental or social impact costs and benefits. It is best suited for use by vertically integrated utilities in GMS countries. If these environmental and social impacts are taken into consideration, the SEA process can be used alongside power planning. However, the SEA process is not well integrated into the PDP process in GMS countries, except in the case of the Viet Nam PDP VII, which was the first application of SEA to the PDP formulation process (see Figure 3 and Box). The Viet Nam PDP VII was also the first time that an SEA for a sectoral development plan was conducted in Viet Nam.

⁶ For power planning process, the loss-of-load-probability (LOLP) of Thailand is LOLP <24 hours per year, while Viet Nam uses LOLP = 1–3 days per year, compared to 1 day per 10 years in developed countries. It is not clear what LOLP Cambodia and the Lao PDR use, but from discussions, it seems that these power systems, including the Thailand power planning process, emphasize reserve margins criteria, which vary from 15% to 25% of peak demand.

Figure 2. Power Planning Process

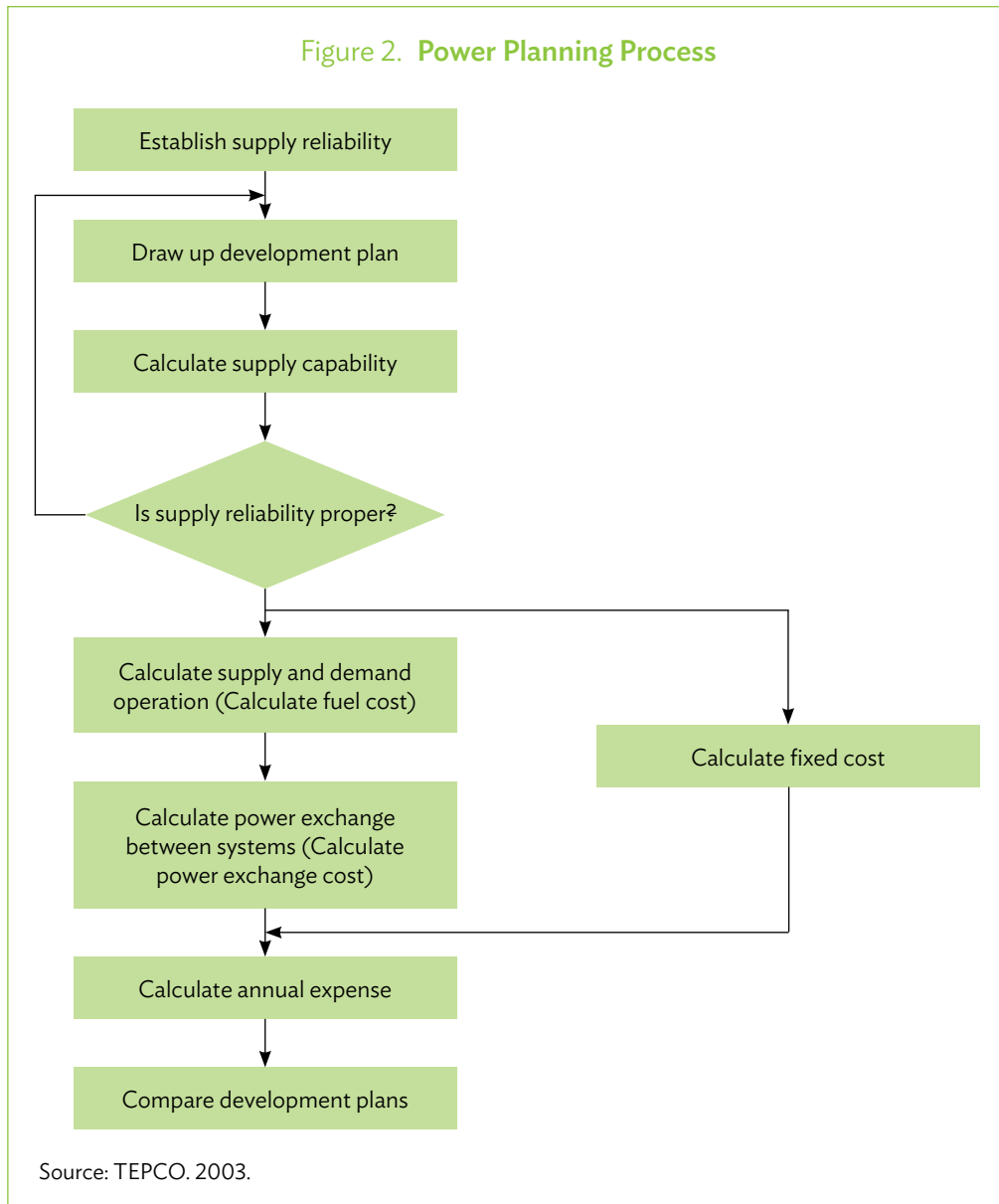
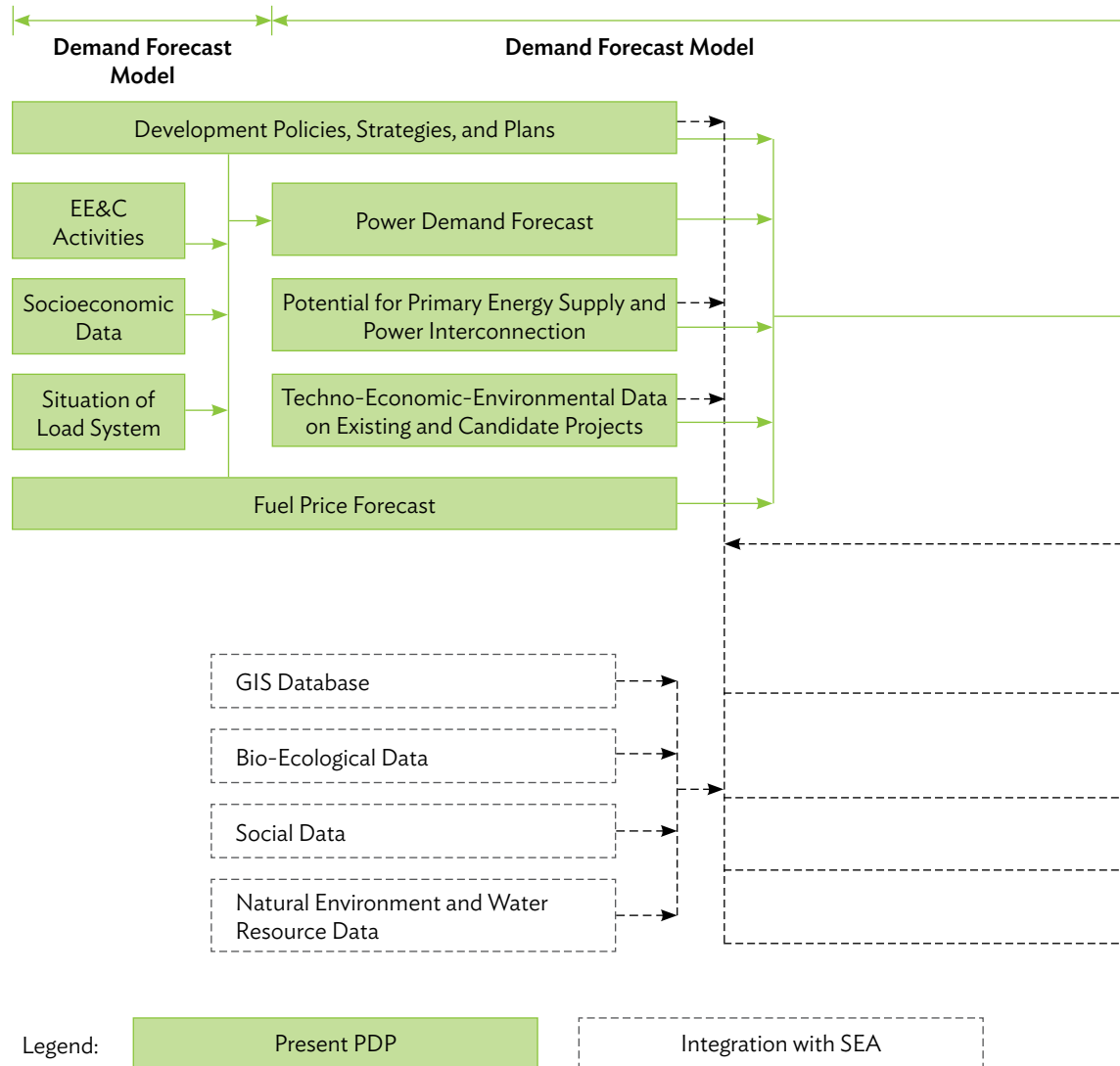
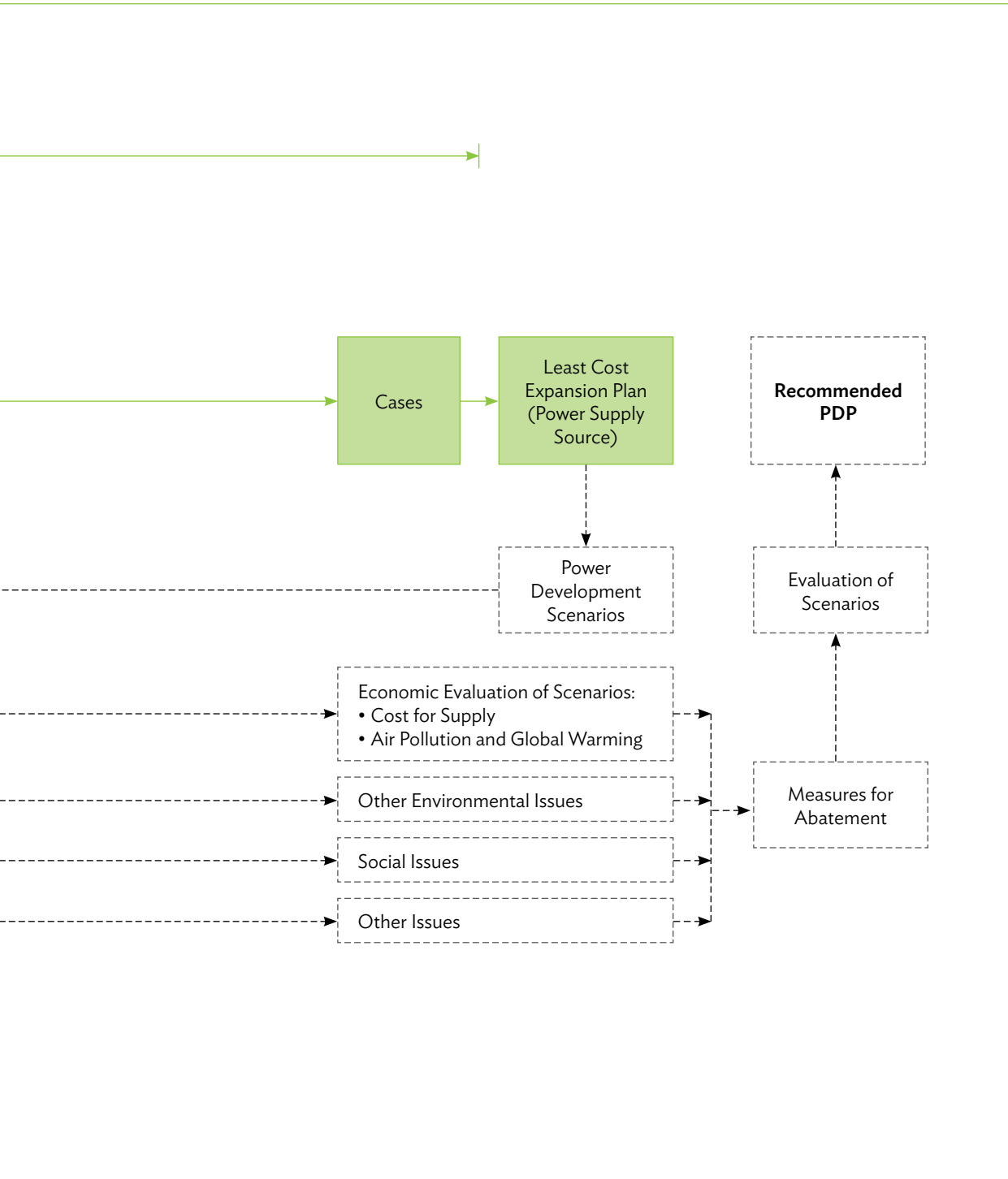


Figure 3. Strategic Environmental Assessment Integration into the Power Planning Process in Viet Nam



EE&C = energy efficiency and conservation, GIS = geographic information system, PDP = power development plan, SEA = strategic environmental assessment.

Source: Ministry of Industry and Trade. 2011.



Box. Case Study on Strategic Environmental Assessment Integration into the Viet Nam Power Development Plan VII

The Viet Nam Power Development Plan (PDP) VII is the first application of strategic environmental assessment (SEA) to the PDP formulation process. Although the SEA for the Viet Nam PDP VII set out clear objectives for assessment, the overall objectives of PDP VII were biased toward accepting the economic growth rate as first priority. The SEA was used in a *reactive* way to mitigate the environmental and social impacts of this default first priority, instead of making environmental management and sustainability objectives the starting point of the SEA. SEA integration in the Viet Nam PDP therefore was more of an *impact-based SEA* than an *objective-led SEA*. Specifically, for the strategic issues assessed, no sustainability objectives were set for each of the objectives. Because of this, the final conclusion of the SEA stated that “*the study in the SEA shows that the PDP VII is necessary to meet economic development needs. During the implementation of the PDP VII, impacts upon people and the environment and other social impacts are inevitable.*” “Inevitable” here can imply that they must be accepted in the name of economic growth.

The SEA was timely, as it was conducted concurrently with the formulation of the PDP VII. However, the SEA could not provide guidance to the subsequent SEA on the hydropower component, as most of the hydropower projects under PDP VII either were already under construction or committed.

The SEA claimed that it assessed the most effective, least costly (taking into account full economic costs) methods for meeting likely future demand. However, the SEA was overconfident in many of the recommended mitigation measures. The final selection of the preferred option was based on the assumption that most of the impacts could be mitigated while many of the recommended mitigation measures were only theoretical ideas that have not been verified.

Despite the weakness of the SEA in Viet Nam, it set a good example in proving that SEA is a useful tool for early integration of sustainability into decision making, emphasizing its role as a tool for other policies, plans, and programs. The close integration between planning and the SEA process needs to be maintained, since it is very important that SEA and policy making and/or planning processes share several activities, such as fact-finding, information dissemination, and stakeholder engagement or public participation.

During the course of the SEA of PDP VII, two national workshops were conducted with the participation of about 70 experts from the ministries and agencies with relevant state management mandates, power investors, Electricity Vietnam National, consultancy firms, and provincial environmental management agencies including Departments of Natural Resources and Environment (DONREs) and Departments of Industry and Trade (DOITs).

The SEA started with a stakeholder consultation workshop on SEA scope and methodology held July 2010 in Qui Nhon city. The purpose of that workshop was to define key socioeconomic and environmental issues related to the sustainable and strategic environmental aspects of PDP. Twenty socioeconomic and environmental issues of PDP were discussed, resulting in a set of the most important strategic issues to be used as the analytical framework of the SEA. From this first round of consultations and consultations with specialized agencies and local management authorities, using the scoring method, the working group selected 12 strategic environmental issues and developed assessment indicators for each of these issues.

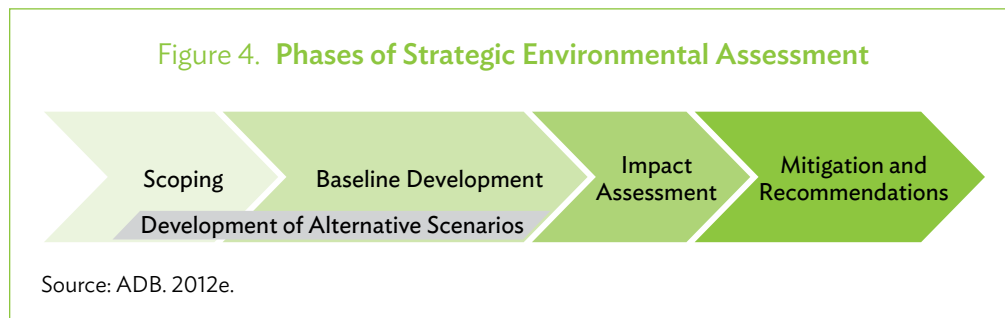
Impact matrices were distributed to relevant provincial authorities (DONREs and DOITs) in provinces where PDP VII power development projects are located to gather their key concerns regarding potential environment impacts.

In the final phase of the project, another workshop was organized to present the results and receive feedback on the assessment and recommendations in the SEA. The workshop included a discussion about government agencies responsible for relevant policy areas in revision of possible recommendations for the SEA.

The Strategic Environmental Assessment Process

The SEA process is most effective when there is a well-defined plan, such as national PDPs, or in the case of this ADB project, the regional power plan, which is made up of the national power plans of six GMS countries and the regional interconnections among them. In order to test the sustainability of the PDP using SEA, the impacts of the plan are compared to several alternatives or variations on the plan, often called scenarios. In this ADB project, the scenarios included alternatives that had increased contributions from renewable energy sources, and decreased demand due to greater investment in energy efficiency measures. These scenarios allowed different generation mixes to be considered, i.e., with fewer coal-fired power stations or with fewer large hydropower and nuclear power stations within the region, and with different requirements for regional interconnectors. These scenarios are not alternative plans. They are used as planning tools to highlight the differences in environmental, social, and economic impacts.

The SEA process usually has five phases: (i) scoping, (ii) baseline description, (iii) development of alternative scenarios, (iv) impact assessment, and (v) mitigation and recommendations (Figure 4). A SEA cannot cover all the environmental and social issues, as the data and the analysis would become unmanageable and the focus would be lost.



Scoping

This process refines the issues so that only the key strategic issues are considered. The scope may be refined by considering technical and other constraints, and through a stakeholder consultation process to identify key strategic environmental, social, and economic issues emerging from “sustainability principles” found in various policy documents. Not all of the issues will be equally relevant to all of the different power generation and transmission technologies. By carefully selecting the key strategic issues there can be a balance across technologies.

Baseline Development

The baseline describes the current status and trends in the selected strategic issues as measured by their indicators. The baseline should include historic trends (e.g., observed changes in air pollution, deforestation, poverty or health over the last decade), and also develop future trends to enable an assessment of how the issue is expected to develop over time. A baseline year or starting point is usually chosen. In this study, the baseline was existing situation of power plants operating in 2010. Plans usually have a definite time horizon, e.g., 2025, so that the environmental and social impacts of the different scenarios can be compared. The trends in the environmental and social indicators can also be described over three 5-year time periods to 2025. The implementation of the plan during these periods will draw upon the proposed dates of commissioning and retiring plants.

Environmental Assessment

This is the phase that requires the power plan and its scenarios to be clearly defined, with the numbers, sizes, and locations of the power plants. The spatial and cumulative dimensions of the impacts of these power plants can then be described. Typical environmental and social impact profiles or footprints of each type of power plant would be developed, especially for thermal plants and renewables. Hydropower plants tend to be very different and are more difficult to assess using typical profiles; specific information about the locations and inundation areas may be required so that cumulative impacts of the plan may be assessed. Transmission lines will also require an approach considering the impacts of specific route alignments, especially when passing through protected areas. Some indicators can use specific measurements, e.g., air pollution indicator. Others such as biodiversity are more difficult to quantify and may only be described qualitatively, i.e., by developing matrices that show the direction (positive or negative) and strength of the change (high, medium, or low), so that all the impacts on all the indicators can be shown together.

Social Assessment

This may include an analysis of relevant socioeconomic data to establish trends, timelines, and spatial distributions of social variables that contribute to the distribution of power demand and benefits, and to socioenvironmental pressures. Data on socioeconomic development, poverty, equity, urbanization, local communities and peoples, employment, resettlement, health, gender, and natural resource dependent livelihood impacts may be used.

Economic Assessment

This may include cost–benefit analysis and monetization of the impacts of the scenarios. The energy security implications of the scenarios and the change in scarcity rents at different rates of depletion of fossil fuels may be assessed as well the wider structural and macroeconomic implications. The economic analysis would draw together valuation exercises carried out by the social and environmental teams. Valuation tends to be data-intensive with a high degree of uncertainty related to the estimates. To address this and to test critical assumptions, sensitivity analysis can be conducted in the cost–benefit analysis

for different externality costs (e.g., carbon costs) and social discount rates. Valuation can help to capture the costs of so-called environmental and social “externalities” and therefore provide a more comprehensive understanding of the economic costs of power plans; for example, by integrating health impacts into the total cost of the plan.

However, the conclusions drawn from the valuation should be tempered by an acknowledgment that in some cases, only a portion of the cost is captured (for example, with resettlement, this SEA did not monetize the multi-generational costs to communities). Some impacts are very difficult to value monetarily, including cultural impacts, and impacts on ecosystems and biodiversity (i.e., species extinction).

Mitigation

This involves identification of measures to address the impacts identified in the preceding phases. These may be classified in terms of avoidance, reduction, enhancement of benefits, compensation, trade-offs, and offsets. For an SEA of a power plan, avoidance or reduction in the impacts may be achieved by changing the mix of power generation. Avoidance may also mean changing the location of a specific major power plant or re-routing a transmission line to avoid especially vulnerable areas, e.g., protected areas. The assessment of energy security of the scenarios may also lead to recommendations for changes to national PDPs and the regional transmission links. Benefit sharing from hydropower projects is an example of enhancement, ensuring that communities most affected share in the economic benefits on a long-term basis. Compensation, trade-offs, and offsets are really the last resort in the mitigation toolbox. They recognize that some environmental and social assets will be lost irretrievably if a particular option is pursued.

Strategic Environmental Assessment as a Means to Improve Planning

A well-defined SEA can clearly indicate the sustainability “pros” and “cons” of different policy options and broad directions for choice of technology and location of power plants. It can highlight the trade-offs that have to be made when making these choices. The effectiveness of SEA will depend upon the design and key questions that policy makers need to answer, examples of which are presented below.

- (i) Can improvements in sustainability be achieved by increasing renewable energy contribution to power generation and the power trade?
- (ii) Will greater energy efficiency lead to greater sustainability?
- (iii) What are the environmental and social trade-offs that will be necessary if carbon emissions are to be limited by reducing coal-fired power generation?

As with all tools, SEA has its limitations. The experience of this study has shown that an SEA can only highlight the differences and the trade-offs, it cannot “make the decision.” SEA is a tool among several others that can inform the decisions. Some limitations of SEA are as follows.

Availability of Information

There is considerable variation in the availability and quality of information about power plants, and environmental and social data between the different countries in the GMS. Within one country, the quality of the data may be more uniform.

Uncertainty

Power development plans change frequently. This results from changes in policies and external factors, delays in project development, and vagaries of negotiations. Power plants themselves are subject to significant changes as they progress from identification through to construction. The timing of when power projects will be commissioned is never exact.

Broad-Brush Approach

Unlike an EIA where more information that is precise is available, SEAs often take a broad-brush approach to cover different power plants and transmission lines. For some plants, generic assumptions about plant footprints can be applied, e.g., analysis of impacts of thermal power plants and renewables assumes a standard area occupied per megawatt capacity. However, for hydropower plants, it is necessary to identify the characteristics of individual power plants in more detail. The reservoir area is a critical piece of information for determining the land take and changes in land use, fishery production, and numbers of people to be resettled, but often this is uncertain until detailed designs are available; as a result, only approximate sizes can be estimated based on power density.

Location

Identifying the locations of power plants and interconnections is fundamental to carrying out an adequate impact assessment. However, this is a difficult exercise for new power plants, because the exact location of a power plant to be built in 10 years' time is not known, and it may be unwise to release the location before the necessary analysis and public consultation.

Zone of influence

One impact assessment approach is to define zones of influence around the different types of power plants. Typically, circles with radius of 1 kilometer (km), 5 km, and 10 km centered on the power plant location have been assessed for indicators such as land use, biodiversity, populations, etc. This is an approximate generalization, and the actual significant zone of influence would be affected by factors such as prevailing wind direction and topography.

Population Density

Exact estimates of population affected cannot be provided, and assessment has to rely upon population density in and around the location of the power plants. This data helps to define the scale of the populations affected, for example, by air pollution or for resettlement, by multiplication with the area of the relevant zones of influence.



National Stakeholder
Consultation Workshop,
Lao People's Democratic Republic

Applying Strategic Environmental Assessment in Power Planning in the Greater Mekong Subregion

Strategic Environmental Assessment as a Means for Good Governance and Consultation on Impacts

Power planning processes across the GMS are currently largely driven and overseen by energy ministries and utilities. While most countries provide some mechanisms for stakeholder consultation, these are often limited in scope. It can also be difficult for civil society representatives to obtain access to the full assumptions and data used in planning that otherwise could enable them to effectively review and evaluate these.

Good governance in the power sector emerged as one of the major concerns of stakeholders consulted in the SEA process. Some of the governance issues raised include:

- (i) lack of transparency regarding power plans, in the power planning process, and in its implementation. For instance, compiling the list of existing and planned power plants and their locations was a major and time-intensive undertaking for this SEA;
- (ii) corruption in the implementation of large construction projects such as power plants, such that choices are made for less sustainable plants and designs at the possible expense of the wider public benefit;
- (iii) inadequate environmental and social impact management policies and compensation procedures;
- (iv) gaps between the policies and practices required for management of the environmental and social impacts;
- (v) inadequate preparation and appraisal of EIAs leading to approval of power projects with defective environmental and social management plans;

- (vi) lack of capacity for monitoring of environmental and social impacts;
- (vii) inadequate enforcement of regulations and environmental and social clauses in concession agreements;
- (viii) not enough meaningful public consultations and real public input into the decision-making process; and
- (ix) unclear, ineffective, or missing grievance mechanisms.

Good governance was one of the most difficult aspects to identify suitable indicators for in this SEA. It is however, one of the most important aspects of sustainability. Good governance can assure public confidence and acceptance of the plans and projects being developed. Poor governance and the unnecessary environmental and social impacts that result undermine public confidence and may lead to dissent and even unrest about power developments in the future.

The SEA process, as described earlier, is above all a consultative process. It seeks wider views on what are the critical social and environmental impacts of power development and, from these, develops a set of indicators and measures to be used in capturing these impacts and comparing PDPs. The SEA is not expected to give a definitive answer. Rather, it should inform and enrich the consideration of these wider impacts in the power development process and, in particular, direct attention to alternative approaches such as reducing the use of the most damaging power generation technologies.

A commitment to apply SEA and its accompanying consultative processes is not enough in itself. “Even in the most democratic systems, public participation in SEA faces many constraints because of political sensitivity and confidentiality of strategic level issues” (Shi 2011). In particular, SEA should support good governance by (i) setting out the tasks of public participation in subsequent environmental and social assessments as needed; (ii) investigating the records of public consultation that were previously taken; and (iii) summarizing key messages from these records that are useful for the decision makers for the formulation of a certain policy and/or strategy.

The process undertaken for this study represents what might be considered a “minimal” model for an SEA consultation. The World Resources Institute comprehensive assessment framework (World Resources Institute et al. 2007) can be applied to build a governance power sector monitoring system, and thereby determine what would represent best practice processes.

How to Include Strategic Environmental Assessment

Environmental and social considerations in the strategic power planning process are often limited as to the inclusion of renewable energy and energy efficiency targets set through separate processes. These are taken as constraints rather than variables to be considered as alternatives to other conventional generating technologies. The importance of environmental and social impacts is generally recognized, but is dealt with through EIAs and social impact assessment conducted at the project level once these have been selected in the overall master plan. Questions of whether alternative power plans could minimize overall environmental and social impacts and thereby reduce the total costs to society of power development are rarely considered in depth.

Ideally, the SEA should be an integral part of the power planning process, with the findings feeding back into the PDP that is finally approved, to ensure that it is more sustainable. However, as illustrated by the SEA of the Viet Nam PDP VII, it is clear that an impact-based SEA will tend to endorse the current least-cost approach and assume that the environmental and social impacts can be mitigated. If the SEA continues to be applied in this way to the PDP process in Viet Nam, then it is likely that the SEA of PDP VII will have its greatest influence upon the design and analysis of the future PDP VIII.

A sustainability-led SEA uses the wider sustainability objectives that should be used in developing the PDP, rather than least cost. It should be applied early on in the PDP process before the plan is finalized. It should compare the different scenarios or alternatives to the plan, and the results on the most sustainable options should then be used in finalizing the PDP.

Cross-Border Analysis

The GMS has a decade-long history of energy cooperation. In 2007, ADB supported the formulation of a GMS Power Transmission Master Plan, which proposes building new power generation and transmission infrastructure facilities to satisfy the growing demand for energy in the GMS from 2010 to 2025 (ADB 2010a). However, the master plan, which employs a traditional least-cost approach, does not incorporate environmental and social impact assessments of the planned infrastructure facilities. SEA of energy development is relatively new so it was not originally incorporated in the GMS Master Plan. The traditional least-cost approach takes into account only the financial costs of electricity generation and transmission. It neglects to fully account for local environmental and social costs (e.g., local pollution and impacts on public health, livelihood disruptions); global environmental costs (greenhouse gas emissions, global warming); opportunity costs of indigenous resources; scarcity rent of fossil fuels; and increased vulnerability of GMS countries to high and/or volatile energy prices (ADB 2010a).

This SEA study recommends how to incorporate environmental and social considerations in the GMS master plan to ensure its sustainability. It makes recommendations on how to build the capacity of key GMS agencies and utilities to manage and mitigate the social and environmental impacts of these facilities. SEA is not meant to reduce national control of power planning processes or of energy policy in general. Countries would continue to develop their own development plans to meet their own policy objectives. However, those plans would also recognize their wider social and environmental impacts in the region, as well as ensure consistency of key assumptions with other national plans in the region. Impacts of PDPs, after all, are felt beyond national borders. For example, a new dam in the Lao PDR may have downstream impacts in Cambodia and Viet Nam. SEAs in the GMS need to continue to be applied at a regional as well as national level, and to be supported by a comprehensive database of existing and proposed power projects developed in coordination with all GMS member countries.

The SEA study illustrated the importance of cross-border analysis of PDPs. It also noted the wide divergence in power planning across the region that makes analysis of impacts significantly harder. For example, the timing of hydropower projects identified for export purposes is different in the national PDPs of the Lao PDR, Thailand, and Viet Nam. To be manageable, a cascaded planning structure may be required, starting with a high-level SEA similar to this study. This would represent a “first pass,” which identifies major impacts, assesses the significance of cross-border impacts, and highlights and resolves the most important inconsistencies across the national plan. National SEAs supporting the development of national power plans would then follow. These would represent national concerns as identified through the national consultation process. However, they would also take into account cross-border impacts identified through the regional SEA, while the national power plans would be developed based on common assumptions on the timing and locations of possible cross-border projects.

Capacity Building and Training Needs for Strategic Environmental Assessment Implementation

Legal Status of Strategic Environmental Assessment in the Greater Mekong Subregion Countries

An earlier GMS power planning project (ADB 2006 and 2010b) carried out a review of the legal status and application of SEA throughout the GMS countries by identifying the capacity needs for enhancing SEA use. This study concluded that GMS countries are at various stages of SEA development.

The People’s Republic of China and Viet Nam are the only two countries in the subregion that have formally adopted SEA in their legal structure. Both countries have created the necessary legal, administrative and procedural frameworks, and technical guidelines for

SEA implementation. The legal framework in each country focuses on EIA and/or SEA of government plans and programs. The legal frameworks do not extend to environmental assessment of government policies. The legal frameworks and implementation guidance in each country are generally consistent with the guidance on SEA of the Organisation for Economic Co-operation and Development.

Intensive capacity building efforts have been undertaken in both countries by international development agencies, and several pilot studies have been completed. Thus far, SEA has only been conducted on a demonstrative basis, and routine application of SEA in government plans and programs is yet to materialize.

According to the EIA law in the People's Republic of China, strategic environmental assessments are required for some sector plans as well as plans concerned with natural resource exploration. However, the SEA is still at an initial stage in the country and some plans have not gone through the SEA process before their launch. Instead, post-environmental impact assessment or monitoring and evaluation during the implementation of a plan is carried out (ADB 2012d).

In Viet Nam, the Law on Environmental Protection was approved by the National Assembly on 29 November 2005 and provides the legal framework for environmental protection in Viet Nam. With 15 chapters and 55 articles, this law comprehensively covers the field of environmental protection, including SEA. The integration of environmental issues into strategies and development plans is a mandatory requirement through the SEA. The Law on Environmental Protection, 2005 specifies the type of strategies, planning, and implementation plan for SEA. From 2006, the government and MONRE have had detailed instructions for this activity (ADB 2012c).

The SEA process has been discussed in Thailand over the past decade, and Thailand is currently in the process of legalizing the process. Draft regulations and guidelines have already been formulated, and submitted to the National Environment Board for approval. Two pilot SEAs have been completed thus far, and several are planned to be undertaken. Strategic environmental assessment is the latest policy option that the National Environment Board has approved (ADB 2012b).

In the Lao PDR, SEA has been incorporated into Environmental Protection Law No: 29/NA 2012. The law defines SEA and states that while developing the policies, strategic plans, and programs, particularly of the energy and mining, agriculture and forestry, industry and commerce, public works and transportation, post-telecommunication and communication, and information culture and tourism sectors, a SEA shall be conducted, except for plans of small-scale areas and subject to the integrated spatial plans. Integrated spatial planning is a regulatory instrument to integrate and balance competing or conflicting interests, thereby guiding public and private investments and government policies from all sectors and interests toward one shared, desired direction. Two pilot projects have been carried out by ADB's GMS Environmental Operations Centre (EOC) on a SEA at the provincial

level, in Oudomxay and Champassak (ADB 2012a). SEA also emphasizes the participation by organizations, local concerned authorities, and people, who are directly or indirectly affected by the sectoral policies, strategic plans, and programs. An SEA decree is currently under preparation, which specifies that the Ministry of Energy and Mines shall carry out SEA on policies or strategies on promotion and development of hydropower, coal, thermal, and others, to achieve sustainable development goals.

Cambodia and Myanmar have not expressed any policy commitment to SEA to date. A pilot SEA with a primary capacity building component was completed for the Cambodian Tourism Sector by the ADB Core Environment Program in 2008. However, the understanding of the SEA concept, and human and institutional capacity to implement SEA are limited. In Myanmar, the national legislation for environmental protection was only drafted recently, and at present, there are no legal procedures for environmental assessment. Project-level EIA is practiced on an ad hoc basis by international organizations operating in the country, while the capacity within national institutions is limited.

Disparities in GMS countries extend beyond SEA development into the overall enforcement of environmental regulations and execution of resources available for environmental protection. These factors already play a significant role in the status of SEA implementation in the GMS, and will become more important in the management of regional environmental issues in the future.

Previous Experience in Strategic Environmental Assessment within the Greater Mekong Subregion

Most of the previous applications of SEA have been undertaken as demonstrations with financial and technical support from ADB, the World Bank, and other donor agencies. Some of the most significant SEAs in the region include the following.

- (i) **Cambodia:** ADB. 2009. *Strengthening Sustainable Tourism—SEA of the Tourism Sector in Cambodia*. Consultant's report. Manila.
- (ii) **Lao PDR:** World Bank and Norplan. 2004. *Lao PDR Hydropower—Strategic Impact Assessment*. Washington, DC.
- (iii) **Lower Mekong (Cambodia, the Lao PDR, Thailand, Viet Nam):** Mekong River Commission. 2010. *Strategic Environmental Assessment of Mekong Mainstream Dams*. Vientiane, Lao PDR.
- (iv) **Thailand, the Lao PDR, and Yunnan:** ADB. 2009. *Strategic Environmental Assessment of the North South Economic Corridor Strategy and Action Plan*. Manila.
- (v) **Thailand, the Lao PDR, Myanmar, and Yunnan:** ADB. 2012. *Strategic Environmental Assessment of Tourism in the Golden Quadrangle, 2011–2012*. Manila.

- (vi) **Viet Nam:** ADB, MONRE, Ministry of Industry and Trade, and Viet Nam Electricity. 2008. *Strategic Environmental Assessment of the Quang Nam Province Hydropower Plan for the Vu Gia-Thu Bon River Basin*. Consultant's Report. Ha Noi, Viet Nam.
- (vii) **Viet Nam:** ADB and SEI. 2011. *Harnessing Hydropower for Development—A Strategic Environmental Assessment for Sustainable Hydropower Development in Viet Nam*. GMS Environmental Operations Centre, Bangkok, Thailand
- (viii) **Viet Nam:** ADB. 2012. *Strategic Environmental Assessment of the National Plan for Power Development for the Period 2011–2020 with Perspective to 2030 (PDP VII) for Viet Nam*. Manila.
- (ix) **GMS:** ADB. 2013. *Environmental Analysis of the Greater Mekong Subregion Regional Investment Framework—Applying a Spatial Multicriteria Assessment Approach*. Manila.

Various training exercises have been provided to participants from GMS countries by ADB, the World Bank, and others, for example, a SEA training sponsored by the Swedish International Development Agency in March 2013 in Sweden.

Results of Capacity Building Questionnaire

During the course of the SEA study, participants at national stakeholder consultations were asked a series of questions about capacity building needs for further SEA application in the region. For all countries, SEA training was considered very useful to the participant's work. All considered a 1-month training with practical work, tools, case studies, and exercises to be the most useful. There is no substitute for actually doing an SEA for power development in order to build capacity, with outside technical assistance to guide and mentor the process. The table that follows consolidates some of the responses.

Principles for Capacity Building for Wider Application of Strategic Environmental Assessment in Power Planning

Following the application of this SEA project in the GMS region as a whole, the following conclusions or principles can be derived for the design of future SEA capacity building.

- (i) Enough SEA demonstrations, formal training, and awareness courses have been done; what remains now is real-life application.
- (ii) Real-life application for power planning is most effectively done at the national level, rather than at the regional level.
- (iii) Real-life application is best for encouraging ownership of the SEA and its findings, which can feed directly into decisions concerning the national power development plan.

Table. Responses to Strategic Environmental Assessment Capacity Building Questionnaire

Questions	Cambodia	Lao PDR	Thailand	Viet Nam
Previous SEA training and experience	Almost 10% of respondents have some SEA training, and 10% have SEA experience	29% of respondents have some SEA training, and 25% have SEA experience	65% of respondents have SEA training, while 25% have some SEA experience	35% of respondents have SEA training, 50% have some SEA experience
Importance of SEA	60% find SEA influential to decision making	62% find SEA influential to decision making	80% believe that SEA is influential to decision making	85% still find SEA influential to decision making
Comments	“SEA can help balance benefits and losses”	SEA can “support decision making” and “help mitigate impacts,” but the use of SEA is limited by a “lack of understanding,” and “a lack legal status”	“Telling the whole picture” “Building the participation of the people” “Decrease conflict” “Build understanding between industry, government and people”	SEA can help incorporate stakeholders and external costs; however, there is a lack of guidelines and a lack of legal status
Length of training preferences	1 day—25%, 1 week—75%, 1 month—54% Master’s—25%	1 day—12.5% 1 week—20.8% 1 month—54% Master’s—17%	1 day—25% 1 week—30% 1 month—45% Master’s—16%	1 day—5% 1 week—55% 1 month—35% Master’s—10%
Most important aspects and tools for training (scores on a scale of 1 to 3) (low to high)	Biodiversity and social assessments (2.6 out of 3)	Sustainability assessment (2.7 out of 3)	Sustainability, social, and aggregate impact assessment (2.7–2.8) More technical training (geographic information sensing, statistical analysis) ranked slightly lower	Sustainability, social and economic assessments (approximately 2.7 out of 3)

Lao PDR = Lao People’s Democratic Republic, SEA = strategic environmental assessment.

Note: National meetings were not held in Myanmar or Yunnan, and no capacity building questionnaire was administered in these areas.

Source: ADB. 2012g.

- (iv) SEA tends to differ in content and methods of analysis depending upon the topic and the objectives of the policy or plan to be studied. Effective preparation, i.e., development of study objectives, for real-life application may be carried out through training and/or consultation exercises.
- (v) Consultation is a critical component of SEA and increases transparency and direction of power plans. Capacity building for effective consultation is also required.
- (vi) “Ownership” in carrying out SEAs of national PDPs should be with the ministries or agencies responsible for the plans. Other agencies such as environment and social development ministries should also be involved.
- (vii) Tools such as power planning databases and models, e.g., OptGen, should be used in conjunction with SEA in order to develop the required scenarios. Training for both OptGen and SEA can be run side by side, so that they complement each other.



Power generation controls being demonstrated to the SEA team at an oil-fired power station, Phnom Penh, Cambodia

Conclusions and Recommendations

The legal and policy requirements in many countries of the GMS have accepted the relevance and importance of SEA application to policies, plans, and programs. Wider application of SEA in different sectors is now required, and the power sector can lead the way by showing how useful SEA can be in power planning at the national level. This SEA has illustrated this application at the regional level.

In order to undertake SEAs of PDPs at the national level, the capacity of both the power planning agencies and agencies responsible for managing environmental and social impacts needs to be strengthened through training and practical applications.

In order to make these applications of SEA scientifically sound, databases of information need to be prepared and made available for SEA practitioners on some of the most difficult aspects. These include information on emissions, water pollution, and biodiversity.

This study conducted the most comprehensive stakeholder consultation on perspectives on power planning to date, comparing perspectives in different countries and highlighting both concerns and benefits. This has revealed a great desire for more knowledge on power development, and a real desire by all stakeholders, including power planners, to make power development more sustainable, and to integrate social and environmental concerns in planning. However, it has also revealed weaknesses in current consultation processes, a lack of transparency and access to information, as well as a lack of tools for energy planners to incorporate these concerns.

The effectiveness of public consultation on PDPs is mixed, and generally appears to ignore wider environmental and social concerns. There is a need to increase public participation and access to information in power planning. Grievance mechanisms, compensation procedures, and measures for sharing of benefits still receive criticism and should be developed and refined further.

The implementation of SEA needs to focus on improvements in the following areas: (i) improving the consultation process in power planning, (ii) building SEA capacity, (iii) strengthening the knowledge base of environmental and social impacts, and (iv) strengthening regional power planning coordination.

Improving the Consultation Process in Power Planning

The consultation process in any development planning is an extremely important aspect for sustainability. In the GMS countries there is significant room for improvement in the consultation process in all sectors, especially power planning. The following suggestions will strengthen the consultation process in this sector.

1. Put in place minimum protocols for public consultation on regional power development plans

- (i) *Develop a set of common minimum protocols governing public participation in power planning*

Public consultation in power planning has not been effectively practiced in the GMS countries. Just as the EIAs of individual power plants require and benefit from public consultation, so would the national and regional power plans. This SEA attempted some elements of wider consultation, but this could be improved. Protocols should be developed and agreed upon for use in power planning in GMS countries.

- (ii) *Develop standards for the public release of information at different stages of the power planning process*

Effective public consultation relies upon the release of adequate information about the power plans. Alongside protocols for public participation in power planning processes, standards can be developed for the release and access to information, e.g., access to databases and plant information, and standards, cost norms, and assumptions used. This SEA developed a database (the “GMS Energy-SEA Database”) that could be made available with caveats stating that locations are approximate and that planned projects may change.

- (iii) *Pilot these processes by using them to agree on a common set of indicators and valuation methodologies for incorporation in future power planning*

These public participation processes can be tried through the “field testing” of the indicators and valuations that need to be selected and refined, as well as through priority weighting, as described above.

2. Make more effective use of existing consultative processes

The potential for integrating power planning consultation with consultations conducted by ADB's GMS-EOC and for individual GMS projects should be reviewed. A considerable body of knowledge about consultation processes has been used by other ADB projects. The GMS-EOC has also used other SEA consultation approaches. These should be drawn upon in developing these protocols and standards.

3. Encourage cooperation and coordination in regional power planning

This SEA has illustrated the potential for greater coordination in power planning at a regional level. This will bring benefits to both national plans and greater coherence to the plans for the power trade and interconnections. Greater regional coordination can also strengthen the capacity for sustainability assessment using SEA methods throughout the region.

Power planning is undertaken on a national, not a regional basis. Consequently, inconsistencies emerge and cross-border impacts are not fully considered. The SEA database of power plants in the region is an important tool for regional planning and should be updated and revised by the GMS countries, and maintained by the new Regional Power Coordination Center.⁷ For ease of comparison and coordination between national and regional PDPs, standards, norms, and assessment processes may be agreed on for power planning across the region. It was also found that the hydrological data and modelling for hydropower development was often inadequate and inconsistent.

- (i) *Establish a power planning subcommittee under the Regional Power Coordination Center with a remit to review and comment on national plans and prepare regional plans*

Regional power planning would be strengthened with established institutional arrangements, such as through a subcommittee of the Regional Power Coordination Center, rather than with relying upon a series of projects to do this.

- (ii) *Encourage exchanges of personnel involved in power planning*

Understanding the requirements for power planning in different national situations throughout the GMS may be strengthened through exchanges of personnel. This could also be extended to include specialists of environmental and social issues associated with power planning.

- (iii) *Provide capacity building to weaker national power planning agencies to bring these up to a common standard*

Power planning capacity is not evenly matched among the GMS countries. Regional coordination would be improved by focusing capacity building on those weaker countries, e.g., Cambodia, the Lao PDR, and Myanmar. Training should include application of the OptGen software, and use of SEA and associated tools.

- (iv) *Establish and maintain a common database for power planning purposes, with particular reference to common assumptions on export projects*

⁷ The location of the Regional Power Coordination Center is not yet agreed on.

The database from TA 6440-REG that was adapted, refined, and used for this SEA is now developing into a valuable tool that may be used for regional power planning. It can be improved further and will require regular updates and improvements in the quality of the data. The SEA database includes some of the data about power plants in Myanmar, and Yunnan Province and Guangxi Zhuang Autonomous Region in the People's Republic of China, but these have not yet been incorporated into the modelling analyses. The power plants in these countries will need further data before they can be used in the modelling.

It is suggested that this database be hosted by the proposed Regional Power Trade Centre, to maintain and provide access for member countries, and be available upon request to other interested organizations such as power planning and environmental researchers.

(v) *Use a common software package for power planning purposes*

The OptGen software package was used in TA 6440-REG, and proved to be a versatile tool for this SEA. It is also being regularly updated and improved. It is suggested that this software be consolidated and agreed for use in future regional power planning studies. Further database improvements include the following:

- (a) improved data for inflows to hydropower projects, which would result in significantly more reliable analysis;
- (b) load shapes should be updated both for each year and on a monthly basis ;
- (c) increase the data available for reservoir storage capacities and inflows for new projects in Viet Nam and revise as needed;
- (d) provide further information on hydro project operational constraints such as minimum downstream flows, which typically severely constrain operational flexibility;
- (e) use the stochastic dynamic dual programming dispatch model within OptGen, to enable representation of important constraints on hydropower and thermal plant operations and better modelling of nondispatchable alternative energy; and
- (f) create a new flexible thermal capacity plan for the region. Modelling of this aspect may have significant impacts on the needs for interconnection and on emissions, but would require more detailed modelling using the SDDP model within OptGen.

(vii) *Strengthen the hydrological information used for power planning and incorporate this into the database*

Hydrological information on the rivers on which hydropower plants are proposed was identified as one of the big gaps in the quality of the data used in the SEA database. The power planning analysis would be strengthened considerably if a concerted study were to be undertaken to identify the plants where the hydrological information and the design assumptions for the project are weak, and to correct the database with updated information.

Building Strategic Environmental Assessment Capacity

1. Build the capacity of power planning agencies to understand and undertake SEAs through further national pilot studies

National pilot SEAs should be directly linked to the power planning process and should consist of the following steps:

- (i) preliminary training and/or consultation workshop for the main agencies to be involved and other key stakeholders, including relevant academic and nongovernment institutions. The purpose of this workshop would be to define the scope and objectives of the study and the terms of reference. This SEA may be used as a case study, highlighting issues covered, methodologies used, and assumptions;
- (ii) training on the application of the OptGen model and power plant database, and development of appropriate scenarios for the SEA of the proposed PDP;
- (iii) briefing of senior decision makers in the energy and environment ministries on the scope and terms of reference for the proposed SEA, including technical support from the financing agency (ADB);
- (iv) identification and contracting of the SEA team and technical assistance required;
- (v) team meetings to build the capacity to carry out the study, develop scenarios, and identify indicators and assessment methods;
- (vi) develop a consultation strategy and plan for the SEA and identify stakeholders to be invited to the consultation meetings. Usually three such events would be held during the issues scoping phase, after the baseline, and after the impacts assessment and mitigation phases, and preferably involving the same participants;
- (vii) during and upon completion of the pilot SEA, guidance and support would be provided to decision makers in the interpretation and use of the findings of SEAs of national PDPs, so that these can be incorporated into decisions on power development; and
- (viii) based upon the experience of the SEAs of national PDPs, decisions and guidelines for the regular practice of SEA for power planning may be agreed on.

2. Provide training and support for environment regulatory agencies in the management of impacts specific to the power sector

There is a need to strengthen the capacity of agencies responsible for regulation and enforcement of environmental and social impact management measures to keep pace with power sector development. This would also increase the involvement of environmental management and social development agencies in the power planning process. Training for these agencies would relate specifically to addressing the issues raised in both the power planning and site selection process for power plants, as well as in the EIAs and environmental management and monitoring required for specific power plants. It would include strengthening capacity in terms of conducting SEAs and providing support for power planning agencies during the SEA process.

Strengthening the Knowledge Base of Environmental and Social Impacts

With the strengthened capacity of the agencies involved in carrying out SEAs and EIAs for the power sector, there will be a greater need for accurate scientific data to use in the assessments, and hence in the better management of environmental and social impacts. As the power sector expands rapidly, this will become increasingly important. To do this, the SEA also recommended the need to strengthen the technical knowledge base for environmental and social impacts management in the power sector through the following methods.

1. Develop an accessible database and case studies for best practice in emissions control and management for the GMS countries

An important step in ensuring adequate pollution control in the power sector is a good understanding of the type and quantity of pollutants generated by the sector. This forms the basis of monitoring systems. It is also an essential prerequisite for policy formation and targeting of resources on problem areas. In the case of the power sector in the GMS, the evidence base relating to heavy metals and persistent organic pollutants emissions is lacking. There is an urgent need for better understanding on these emissions as they have particularly important impacts on the environment and human health. As yet, there is limited information on these emissions in the region.

Greater control of emissions of air and water pollutants emerged as a key issue for environmental management in the power sector. It is important that the steadily improving best practice technology be brought to the attention of power sector planners and power plant managers and designers, so that these technologies can be included in new plants and retrofitted into existing ones where necessary. An accessible database or sourcebook that would be regularly updated will help to promote solutions to reducing emissions.

2. Strengthen avoidance, management, and mitigation measures for addressing biodiversity impacts caused by the power sector

This SEA has highlighted biodiversity loss as one of the critical issues that is likely to be increased by the rapid development of the power sector in the GMS. This includes threats to protected areas, damage or fragmentation of critical habitats, and loss of aquatic and terrestrial biodiversity. In planning power sector development including regional interconnectors, the principles of avoidance of protected areas and identified biodiversity corridors should be adopted wherever possible, with options considered to minimize the impacts on or control access to such biodiversity-rich areas. The concept of enhancing biodiversity protection and management through compensation and biodiversity offsets associated with both power plants and transmission lines needs to be actively developed for application in the GMS.

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Integrating Strategic Environmental Assessment into Power Planning

This book is the first in a three-volume series of studies arising from the project Ensuring Sustainability of the Greater Mekong Subregion Regional Power Development. The study aimed to assess the impacts of alternative directions for development of the power sector in the Greater Mekong Subregion (GMS) through a strategic environmental assessment (SEA); develop recommendations on how to minimize and mitigate harmful impacts in the power sector; and provide capacity building for GMS member institutions in the conduct of SEAs, and support their integration into the power planning process. This volume highlights the role of SEA in assessing the sustainability of policies and plans at a regional or national level, emphasizing how SEA can contribute toward better policy making in the power sector, create greater stakeholder involvement in consultation processes, and develop capacity in countries of the GMS to undertake SEA of their power development plans.

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